History of Science

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Centenary of the Award of a Nobel Prize to Eduard Buchner, the Father of Biochemistry in a Test Tube and Thus of Experimental Molecular Bioscience

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Origin and Purpose of the Nobel Prizes

Alfred Nobel was a pro-research preparative and industrial chemist who was sometimes hotheaded, but was always authoritative with a good head for business combined with marketing expertise at a time that was to witness economic booms in arms manufacture and tunnel construction. This melancholic loner 112 years ago dedicated his huge fortune, built up in times of both war and peace, to a set of annual prizes. These prizes were to be awarded for the most important achievements in the then-recognized natural sciences: physics, chemistry, and biology/medicine (mathematics was presumably not considered a concrete science and instead at that time occupied a niche as a special division of the highest level of philosophy). Prizes also were to be awarded for literature and the pursuit of world peace with the aim of exoneration and edification of both conscience and character. Aware that every beginning is difficult, he was nevertheless forced in the end to entrust the setup of the awards to the executors of his estate.

The Max Planck Effect is a label applied to the observation that, for general acceptance, significant paradigm shifts typically must await the advent of a new generation of scholars. Similarly, major cultural achievements tend not to be widely recognized in their first year, but only after an incubation period that can take longer than a lifetime. Time is required as well for a prize to reach the point of enjoying widespread public and media respect and resonance, considerations important even at the turn of the 20th century. This goal was achieved by awarding prizes mainly for already well-established and prestigious topics, which meant looking backwards, and thereby establishing a tradition not particularly conducive to paradigm shifts.

The managers, administrators, and curators of the Nobel Foundation recognized all these considerations. They devised an effective but very cumbersome selection procedure for the awards. This procedure involved first listening to suggestions, gathered in extremely crude fashion, and then secretly soliciting expert advice. There then followed endless meetings that resulted in multiple preliminary and tentative decisions—all in the hope of forestalling the corruption that so readily creeps into the web of tightly intertwined collections of interested parties. The unavoidable lack of transparency would of course become a useful tool in the hands of imaginative dignitaries and determined politicians, and from the very outset was watched closely.

The Nobel Prizes Gain Prestige through Tradition

At the start, the Nobel prizes generally were awarded to researchers and writers who were already widely recognized and of a respectable age. In a few cases, however, public enthusiasm built up remarkably quickly for some topic, and the fortunate party was awarded the prize shortly after. The selections usually met with widespread support, especially those that involved the types of medical or chemical advance relatively easy for people to understand or contemplate and that had not been long shielded by "ivory towers" or "ivy-covered walls".

After an especially short incubation period, the Nobel Prize for Chemistry was awarded 100 years ago, in December 1907, to Eduard Buchner (1860–1917; Figure 1). This really should not come as a surprise, since Buchner accomplished, from the point of view of reductionist research, what had been struggled toward by many in vain after since the investigation of life processes began. It had been assumed that study of the metabolism of foodstuffs would need to be conducted with living animals. This was either in terms of the balance sheets or else by devising some "flow-through" procedure, in which everything would occur behind closed doors to avoid provoking a public, which, although interested in health and cures, was so concerned about animal welfare that demonstrations were held in support of the cause. Suddenly the goal so long awaited was finally reached, but from an unexpected quarter: the tranquility of a perfectly ordinary chemistry laboratory bench.

An "accidental discovery"? As always, the apparent discontinuity of Buchner's work was no accident, but had come out of an atmosphere that

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Figure 1. Eduard Buchner (1860–1917), Nobel Laureate in Chemistry 1907.

encouraged the freedom of action and communication. From a more personal standpoint, it was not only an atmosphere characterized by fairness in the assignment of credit, but also of ambition. Buchner's accomplishment also did not come out of a world of hierarchical schools, but a peripatetic environment that rested firmly on reciprocity and exchange. Targeted and large research projects certainly have the possibility of attaining "excellence" in their limited areas of interest, but they rarely produce unique discoveries in which "pure chance" constitutes a significant component.

Eduard Buchner had quietly produced a sensation. The scientific community took notice and reacted.

The Prize Award Ceremony of 1907

In Stockholm, the year's anxious recipients-to-be stood before the young tennis ace Gustav V Adolf, who had just succeeded his father Oskar II on the Swedish throne. For the King, the process was already routine: a courtly ceremonial handing over of medals, checks, and citations, always in conjunction with a royal handshake, carried out in the palace. The King would have the privilege of carrying out the elegant tradition on forty more occasions. Those to be honored in 1907 included a 47-year-old Royal Bavarian Reserve officer with a brush cut, a carefully waxed mustache, and a goatee, who was at that time serving as director of the Berlin Institute for Commercial Fermentation. He was accompanied by the 55-year-old physicist Albert A. Michelson, an ordinary looking man, reminiscent of Mark Twain, born in Strelno, Posen (a Polish province, occupied since the third division of Poland in 1793 by Prussia), but then living in Chicago. In 1881 he had conducted a famous experiment that demonstrated that the speed of light is independent of the earth's rotation, which lay to rest the notion of omnipresent "ether" and in the process had set in motion what no less than Einstein declared to be a paradigm shift for physicists. Also in attendance, sporting a walrus mustache, was Charles L. A. Laveran, a 62-year-old French protistologist, who had initiated an experimental therapy with respect to malaria through his discovery in 1880 of *Plasmodium falciparum* in the blood of a patient from Morocco. These representatives of the factual side of what Charles Percy Snow (1906–1980) would later describe as the "Two Cultures" were joined on the fictional side by Louis Renault (64), former president of the Court of Justice at the Hague, and the pacifist Ernesto T. Moneta (74). These two distinguished international magnates and dignified old hands represented legal and economic peace in the world. Finally the author Rudyard Kipling, at 42 already a literary celebrity among imperialists bearing "the white man's burden" from all the colonizing nations.

The "Zymase" Ennobled—One Push, a Dozen Steps

The amusing part of this success story is that it came from an incorrect concept and a cooperation between chemistry and medicine that actually pointed toward the future, in this case a pair of brothers, in one of those coincidences that so often helps the fortunate and successful. Also important were a maternal culinary recipe and a paternal gift for observation and quick interpretation; in other words, the very components necessary for illustrating Pasteur's aphorism that "chance favors only the prepared mind". Anglo-American intellectuals will of course be reminded of the word "serendipity", coined by Horace Walpole (1717–1797) and derived from an old Persian fairy tale, "The Three Princes of Serendip". Serendipity might in a sense be described as a condition that results from the chance intersection of opportunity and action.

The biologist Jacques Monod (1910–1976), who also wrote on the philosophy of science, declared that the French word "hasard" (meaning chance in the sense of coincidence as opposed to a lucky accident) is the essential driving force for a particular development to take place in an appropriate setting. The fine linguistic distinction entailed here is unfortunately lacking in both German and English. The devout poet John Milton (1608–1674) almost exactly 300 years previously lived in fear of both chance and compulsion, preferred to rely on destiny. We mere mortals hope, like Pasteur, for an opportunity to recognize the cloak of fate, and then grasp it. Eduard Buchner was the right man in the right place when the wheel of fortune rolled by.

Cell Physiology and Cell Biochemistry of Unicellular Organisms: Insight, But No Outlook

Several lines of research crossed toward the end of the 19th century in the ongoing effort to shift the study of physiological/biochemical aspects of metabolism from the complexity of whole animal organisms to model systems, which would be both easier to handle and less costly. Developmental idiosyncrasies suggested that the sea-urchin egg may be a convenient and available cell type in a suitable setting, such as an oceanographic institute like Anton Dohrn's Stazione Zoologica in Naples, or in one of the American laboratories at Woods Hole or Cold Spring Harbor, where self-financed scientists could pursue independently devised research projects. The single-celled faunal organism in general was not useful for the study of metabolism as had been hoped, although, in specific areas such as the respiration studies of Otto Warburg (1883–1970), it did provide some guidance and a starting point for further research. Microorganisms would naturally have been much more accessible, especially the various types of easily propagated yeasts, cultures of which could be obtained from breweries and bakeries, and then multiplied in the laboratory as desired. Yeast suspensions clearly support at least a primitive version of metabolism, but the protective barrier presented by the cell wall proved to be an obstacle to anyone wishing to determine the chemical processes within. As early as the 1870s, Maria Manassaina (1841–1903) from St. Petersburg, searching for a challenge of her own while her husband worked on his dissertation in Vienna, seized upon a suggestion by the botanist Hans Molisch (1856–1937) that it might be possible to open up dry yeast cells with the aid of heat. She subsequently made persistent and obstinate, but unconvincing, claims to have succeeded in inducing a cell-free (cooked) yeast-broth preparation to ferment sugar into alcohol. However, attempts to reproduce her results consistently failed, from efforts by Felix Hoppe-Seyler (1825–1895) to those of the recent past.

The Breakthrough—Summer Vacation, 1896

Meanwhile, several determined researchers were trying to penetrate yeast cells with the aid of detergents or by "macerating" them by digestion, but without success. Later, *post Buchner*, once hope had been restored, and work was being undertaken systematically rather than based on whim, these "poor-man approaches" again came to the fore and ultimately contributed a great deal to the clarification of metabolic reactions and pathways beyond simple fermentation.

In the intervening phase, however, a short "preliminary communication" suddenly emerged from Tübingen in the January issue of the *Berichte der Deutschen Chemischen Gesellschaft* 30, 117–124 (1897).

Eduard Buchner: Alkoholische Gährung ohne Hefezellen (Alcohol Fermentation Without Yeast Cells)

(Submitted on January 11)

… note that this publication came from a time when editors had absolute authority and before digital instant communication—within two weeks a printed version of the handwritten manuscript was on the desks of the readers!

The article begins with a fanfare:

"Separation of fermentative action of living yeast cells has never previously been achieved; in what follows, a procedure is described that accomplishes this task".

Drum roll!

Then comes a sober description of how fresh and washed brewers' yeast was pressure-dried at 25 atmospheres and then triturated to a paste with quartz powder and celite. This was compressed at 300 atmospheres in a filter cloth using a hydraulic press. What flowed out was a clear highly perishable yellow juice rich in protein, which (based on a proven recipe) could ferment added sugar into alcohol and carbon dioxide, as with intact yeast cells, and according to the same one-to-one stoichiometry!

$$\text{cane sugar } (C_{12}) \rightarrow 4\,\text{ethanol } (C_2) + 4\,CO_2\ (C_1).$$

And so on.

This was the starting signal for "zymologists" (gr. *zyme* = yeast) to burst forth in a rush to earn the title "enzymologist", since they were now in a position to use their powerful chemical probes to examine yeast in intimate detail. These were the individuals who dominated, for a generation, the entire field of enzymes and fermentation (although idiosyncratic troublemakers like Otto Warburg continued to use the traditional terms); they began as pioneers but later became forefathers. The younger generation, with more modern concepts and refined chemical and (increasingly) physical methods, turned their attention to other metabolic routes and processes. This all culminated in our present understanding of metabolic biochemistry, and resulted in the study of regulatory and control mechanisms and metabolic energy-flux equilibria, both with and without electron acceptors, and furthermore, by electronic combination of many strands of data from flux algorithms, bioinformatics.

Profound and More Serious Effects

The concept of binary switching has had a powerful influence on all aspects of the way the molecular and biological sciences are perceived, similar to other topics in the past, such as pumping or leverage in the case of mechanical devices, or attractive and repulsive interactions in chemistry, which all involve a transformation in the form of energy. The naïve are easily led to overly hasty conclusions from such parallels, but from experimentation and theorization that is both inductive and sophisticated, and involves feedback, it has developed a high-level life of its own.

With imagination, patience, good fortune, and of course funding, even erroneous or rash investigations sometimes experience success, and Buchner's discovery comfortably illustrates this. The discovery marked the beginning of a multidimensional ascent out of the dull gray monotony of biotheory into the colorful world of biotechnology, and with it, the debt began to be repaid, with interest, to the sponsors of a "neutral" research tradition.

However, in the prompt box at the front of the stage through which everything transpires, there remained:

Eduard Buchner's In vitro Biochemistry

In vitro biochemistry became the key for the stepwise disassembly of a living aggregates, for a detailed analysis, and subsequent reassembly of the overlapping components to recreate a functioning complex. The door was thereby widely opened to targeted variation: combinatorial functional, and ultimately dynamic, biosynthesis.

Buchner's discovery ended once and for all the helpless nihilistic era of vitalism and firmly established today's molecular understanding of life processes and targeted intervention as desired.

It is no wonder that chemists and men of medicine were so enthusiastic when, 110 years ago, this pioneering achievement became public, and they conveyed their viewpoint to the Nobel Committee so effectively that a mere ten years later, Eduard Buchner became the sole recipient of a Nobel Prize, as a 47-year-old "nobody" appearing from offstage.

It would be interesting to know who first made and sponsored the audacious suggestion. The knowledgeable Adolf von Baeyer was somehow doubtless behind it, though he is credited only with the dry observation: "This will make him famous, even if he doesn't have any talent for chemistry".

The Origins of a (Thank Goodness!) Perfectly Ordinary Chemist

It is also interesting to know the sort of man Eduard Buchner was, the nature of his training, the origin of the prize-winning work, as well as what the winner subsequently made of the work and generally experienced.

The origins of the Buchner family in Bavaria, Franconia, and Swabia included both Catholic and ultra-Catholic branches, and in middle Germany, protestant, even Moravian, lines. Actual relationships are difficult to untangle, since Buchner is a common name in these regions. Those from Hesse were similar in their thinking, aspirations, and actions to an unrelated compatriot with a name that differed only by the inclusion of an umlaut: Georg Büchner (1809–1837), the great German dramatist.

Those from the south were pious churchmen, and included friars from fundamentalist orders together with worldly and patient-oriented practicing physicians. Other family members in the medical professions showed a chemical or pharmaceutical bent. Their genes can be traced back to Johann Andreas Buchner (1783–1852), professor of pharmaceutical studies in Munich, whose most lasting contribution was the isolation in 1828 from willow bark of the bitter and indigestible substance salicin, which was used during the Continental Blockade as a substitute for quinine. The "detoxification" of salicin by acetylation led later to the international top-selling drug aspirin from Bayer, the origin of which is a controversial industrial legend in itself, told in various ways depending on the viewpoint of the narrator.

Priority often is a sensitive issue. For example, Germans tend to put forward the wordy Justus Liebig from Darmstadt as the father of agricultural chemistry, whereas credit actually should go to a bustling Sir Humphry Davy (1778–1829) for his efforts in 1806 while Liebig was still a child. Similarly, the first fusion of the worlds of organic and inorganic chemistry is generally attributed to Friedrich Wöhler (1800–1882) for his synthesis of urea in 1828. Although we do not begrudge the sympathetic, peace-loving man from Frankfurt such a tribute, but in truth his cyanic acid came from an organic prussiate of potash. Thus, one should probably instead recognize the more narrow-minded Hermann Kolbe (1818–1884), who in 1853 prepared the natural product salicylic acid from phenol and CO_2. Admittedly phenol was usually isolated from tar, and thus strictly speaking was again not unambiguously an inorganic starting material, but the compound could equally well have been synthesized from benzene.

And so it goes with physiological and medicinal chemistry: chemistry is found simply everywhere, and the time was ripe for that to be recognized. Matters of nomenclature were attended to by tenacious and effective propagandists, among them Johann Andreas Buchner, a pharmacist whose mental powers were impressive, but so were his offspring.

His son and successor, thereby becoming a colleague of Max von Pettenkofer, was Ludwig Andreas Buchner (1813–1897), who studied under Justus Liebig and built his reputation on the analysis of plants and springs, but he is also noteworthy for being one of the very first physiological chemists.

His cousin Ernst (1812–1872), from a parallel line that introduced art into the clan, also demonstrated talent in both his work and his writings.

The Munich Buchners, Three Generations of Professors

Ernst Buchner, father of Eduard, was professor of forensic medicine in Munich, an organizer and man of letters who founded the profitable "Münchner Medizinische Wochenschrift" (Munich

Medicinal Weekly). He was blessed with many children from three marriages, and thought it important that all of them be well educated and endowed, in particular the sons.

For his son Hans (1850–1908), there were sufficient resources to finance the costly study of medicine. Hans dedicated himself to the developing field of bacteriology, and made such a good impression that he was named successor to the famous Munich hygienist Max von Pettenkofer (1818–1901). He championed Emil von Behring's "serum theory" of endogenous bacteriocidic activity through fever induction, favoring it above the (correct) cellular phagocytosis theory of Ilja I. Metschnikow (1845–1916). This hypothesis, in which everything had been in effect turned upside down, left the term "alexin" as its legacy, similar to Paul Ehrlich's (1854–1915) "complement" concept. On one totally unexpected level, the flawed idea actually led to positive results, in rather the same way as Pettenkofer's failed attempt at self-infection with the cholera bacillus provided the decisive impetus in a totally other, future-oriented direction: systematic communal sewage treatment.

In this case, Hans Buchner began searching for a more accessible protein substitute for the natural serum proteins that were known to destroy fever-causing bacteria, a subject he discussed at length with his brother Eduard, the chemist.

Even in 1880, One Worked to Pay Tuition Fees and Progressed by Networking

Eduard (1860–1917), after his high school diploma (Abitur) and a year with the "Blue Dragoons", had to go to work to cover the costs of his studies. During his military service he commuted between "Türken-Kaserne" (Turkish army barracks) and the nearby polytechnic, where he attended courses run by Emil Erlenmeyer (1835–1909). Thus initiated into the world of chemistry, he worked for the next four years at a canning and preserves factory, where he was responsible for sugaring fruits and fruit juices, rather like one might do in the kitchen. Both of these extracurricular activities later proved invaluable to him in terms of applied and practical chemistry.

With this background, Eduard commenced his studies at the institute of the famed Adolf von (Indigo) Baeyer (1835–1917), at the time a world-class center for organic chemistry. Among his student comrades and drinking buddies were the gregarious and sporty Theodor (hydrazine) Curtius (1857–1928) and Hans von (diazomethane) Pechmann (1850–1902), both from Munich and both of whom helped Buchner get his bearings. Fraternal submission to his conscientious dynamic, but at the same time judicious, older brother Hans, who had a post as assistant at the botanical institute (in those days that was where bacteriologists were trained), together with a readily aroused curiosity, led Eduard, in the course of his chemistry studies, also to acquire laboratory training in plant physiology under the botanist and Mendel-skeptic Carl Wilhelm Nägeli (1817–1891), another potentially valuable experience.

Buchner was an early example of a true mountaineer. He developed the habit of yodeling by daylight from various mountaintops to the astonishment of alpinists, but also from town-hall balconies at night to the dismay of town guards. One result was that he nearly spent the eve of his wedding in a drunk tank. Eduard was anticlerical, similar to much of the Bavarian intelligentsia, and, though loyal to the king, he was a Bismarck patriot as befitted a lieutenant in the imperial reserves. An outburst of patriotism, entirely in keeping with the times, ended up being his downfall, and when war broke out in 1914 and when Eduard was already 54, he declared his solidarity with the younger generation, submitted to reactivation, and ended up deployed as a major in a (non)rearguard position in Rumania (then an occupied country as a consequence of the Russian Revolution). Wounded in the course of a foraging expedition, Buchner died of sepsis in a hospital near Focşani, (on the south Carpathian slopes of Walachia on the Moldau, away from the flood swamps of the Seret River). Other similarly enthusiastic, medal-seeking professors returned safely to their institutes after only a brief tour of duty well behind the lines, or perhaps concluded it would suffice to issue manifestos from the safety of their desks. Some things never change.

The Pasteur Effects of Closed Systems

As a student, Eduard Buchner made only a modest impression on his doctoral advisor. This particular judge of human character may have considered him as "not having any talent for chemistry", but, as a gentleman scientist, von Baeyer, rather than treating chemistry as the navel of the world, stood by his protégé. He actually thought highly of Buchner as a person and appreciated Eduard's commitment and diligence, assigned a grade of "good" on his dissertation on pyrrole, and lent him support and encouragement.

Eduard's contact with his ten-year-older impulsive brother Hans remained close, even with respect to scientific questions and challenges. A topic for study suggested by his brother was the anaerobic sugar fermentation induced by brewer's yeast. Presumably Hans had in the back of his mind the concept of "Kontrastheilung" (contrast cure) brought about by fever-inducing proteins, present in abundance as allergens in yeast. Eduard initiated this study on his own while his dissertation research was still in progress. He had the express consent from his benevolent research adviser along with aid from his friends from the Munich bars, where he was a valued patron. As early as 1886 he published one finding that was particularly significant for the sponsoring fermentation industry. This finding challenged the authority of Louis Pasteur (1822–1895) by concluding that the absence of oxygen was not an absolute requirement for fermentation (the "Pasteur effect"), but rather there were other still unknown factors, related to the phosphate balance.

Adolf von Baeyer looked upon this extraterritorial excursion into the chemistry of brewing with some scorn, but he nevertheless took Buchner on in 1890 as a paid teaching assistant, made possible his Habilitation in 1891, and arranged for generous funding from the Munich brewers. By 1893, however, the latter were becoming impatient because they failed to see returns on their investment. In 1894 his fraternity brother Curtius, who in the meantime had become director of the Institute of Chemistry at the University of Kiel, jumped in and arranged for Buchner to receive an interim appointment there. This move truly stimulated Eduard, and he displayed creative panache for the reactions of Curtius' diazoethylacetate. In particular it was he who discovered the ring expansion of benzene to cycloheptatriene. Then his friend von Pechmann in Tübingen proceeded to offer him a well-funded position: an extraordinary professorship in "analytical pharmaceutical chemistry" that he had managed to squeeze out of his department. This move assisted both geographically and thematically to the maintenance of contact with his speculative brother in Munich, and during the semester break in 1896, the two resumed their work on fever-inducing yeast proteins.

The result was the study of the "zymases", which Eduard announced, in January 1897 in the pages of *Berichte*.

Following these years of teaching and roaming there came the period of eminence, during which he was courted by institutions in Berlin, Breslau, and Würzburg. The journey to Stockholm took place ten years later, and today we recognize how much Buchner's work has meant to the biosciences in general. Incidentally, in the long run the award proved expensive for the Nobel Foundation: scarcely a single one of the Nobel Prizes awarded for the sensational and brilliant accomplishments throughout the realm of quantitative, functional, structural, molecular, and genetic life sciences would have been possible without Buchner's in vitro biochemistry.

It is clear that in the course of good scientific practice (GSP), each new question builds logically upon a previous problem; all valid and legitimate results, whether spectacular or trivial, are interconnected, and every Nobel Prize inherently rests on a foundation of considerable drudgery. Anything quicker needs to be scrupulously labeled with a large question mark.

What Lies Waiting in Dame Fortune's Cornucopia

Eduard Buchner was actually a "perfectly ordinary chemist", but one blessed with vision and good luck. He was not easily distracted from his course of experimentation and notation, systematic variation, observation, and chronicling, along with internal comparison, interpolation, and extrapolation. He was interested not only in number of results, but also in their quality; he kept his target always clearly in his sights, like a good sportsman and chance found in him a prepared mind. He was adept recognizing connections and discarding the superfluous. Later, first in Breslau (1909) and then in Würzburg (1911), he pursued only a limited number of follow-up investigations into the "zymases", as befitted a solid chemist wearing chemical blinkers. These investigations consisted of more precise descriptions of the processes and characteristics, along with the variations in the nature of the sugar: fructose, glucose, saccharose (18% proved optimal), or maltose fermented stoichiometrically to two moles of ethanol for each of hexose, with no isoamyl alcohol formed, in contrast to non-fermentable lactose and mannitol. He also tried varying the medium (the pH must not be alkaline, and therefore powdered quartz rather than powdered glass was used for trituration, and salts were found to reduce the activity). All this work was conducted systematically and reliably, characteristic for the 19th century. The method for production of alcohol was extended into vinegar production with the aid of *Acetobacter xylinum*, and in 1903, with help from his brother (who was shortly to die) and the latter's assistant, Martin Hahn, Eduard prepared the essential summary on the subject of zymase fermentation. It was never reprinted. Further progress followed, in some respects too rapidly, in two basic dimensions: 1) depth, in terms of cofactors, the phosphate dependence of zymase fermentation (soon recognized as a multistep "anaerobic glycolysis" process), enzymology, and proteinology; and 2) breadth, that is applications to the physiology of cells generally, regardless of source organ or organism, from unicellular species to elephants. The methodology was in essence extremely simple, but also readily subject to ingenious improvement that continuously took place as more experience was gained.

Many scientists, the true elite of these early years, biochemical Hellenes and Trojans alike, have stamped their names in the course of establishing the individual steps in glucose metabolism. They have been honored in a way analogous to how society festooned boulevards with monuments in those days, that is, the perpetuation of their names in chemically appropriate contexts: Harden–Young, Robison, Neuberg, and Cori esters; Embden–Meyerhof, Cori, Szent–Görgyi, Krebs cycles, and so forth. It is like calling upon the gods: name the name and you are mine! In the meantime, facts are something one searches for with Google, names have been forgotten, and after eighty or so years this all becomes the stuff of myth. And now a full century has elapsed since the anointing of Eduard Buchner, the initiator.

Each To His Own, and a Dowry for the Descendants

With his discovery that "zymases"—he regarded them as a true entity—are components of yeast cells, Buchner had fulfilled his mission. Unlike today, he was almost completely spared the pressures and those seeking salvation in areas far outside his realm of competence imposed by a public swarming at the door of the Nobel Laureate, a phenomenon that can lead to a considerable waste of time and productive effort, where the trumpeter is seduced to blow the trumpet yet again, and more loudly. None of this is of course new. Only the pitch, the melody, and the public have changed. There was in those days no talk yet of the debt research owed to society. One did it, but also spoke about it.

Eduard Buchner was not really qualified to compete in a race with others who were better prepared and better compensated; he simply would not have been able to keep pace. He was of the old school: deliberate and hesitant rather than energetic and resolute. He probably sensed that he was only able to cut a good figure on horseback, and in uniform. Even the much younger Otto Warburg, a man of a completely different nature, had first to be ordered (by Albert Einstein) to dismount from his elite uhlan (lancer) steed to better ride the horse science—and through this noble act he became for biochemistry something akin to the legendary 12th-century Emperor Barbarossa, still napping in the Kyffhäuser Mountains, but poised to return in his country's hour of greatest need.

Eduard Buchner's genius was of a different caliber, if you will, more like that of a mortar, with effects distributed over a wide area, rather than a rocket with a sharply defined target. Both men are needed for all disciplines, not just (bio)chemistry.

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