persons and the destruction of an immense amount of property. Although dropping phosphorus bombs on civilians is not likely to occur again, he concludes that "no other substance can produce the dense smoke of phosphorus pentoxide… [and] phosphorus will continue to be part of the armoury of all armed forces in the foreseeable future."

Emsley depicts the development of some of the most deadly poisons known—nerve gases including sarin, soman, tabun, and "the ultimate nerve gas" VX as well as their antidotes. He also discusses organophosphate insecticides (OPs). He also describes a number of famous cases of poisoning, and he surveys the production of phosphorus from the 18th to 20th centuries. During the second half of the last century its peaceful use in making phosphates for detergents sent its production soaring to more than a million tons per year.

After detailing several disasters involving phosphorus, Emsley considers the phosphate cycle in nature that governs all life on earth. He surveys the development of phosphate fertilizers including "superphosphate" and "triple superphosphate", emphasizing the contributions of Justus Liebig, John Lawes, and Henry Gilbert. He quotes Isaac Asimov: "We may be able to substitute nuclear power for coal, and plastics for wood, and yeast for meat, and friendliness for isolation—but for phosphorus there is neither substitute nor replacement."

In the chapter "Oh, Shit!" (Emsley favors attention-getting titles) he deals with the problems that phosphorus causes when human and animal sewage as well as phosphate food additives and detergents enter our environment. Eutrophication refers to aquatic systems oversupplied with nutrients which results in perpetual algal blooms that make them green, smelly, devoid of fish, and unfit for drinking or recreation. Although phosphates were first thought to be responsible for such environmental disasters, they were later vindicated. When used as fuel, chicken manure (hence the chapter title) with its high phosphate and high energy content can generate electricity and yields an ash containing as much as 25% phosphate.

In a final, intriguing chapter Emsley discusses alleged cases of spontaneous human combustion, which he calls "probably a myth" that he attributes to external sources of ignition and the "wick effect." After reciting all the horrors that preceded it, his succinct four-page epilogue, "the Devil's Element," which summarizes the entire book, is optimistic. He attributes the damage and misery that elemental phosphorus has caused to its flammability and toxicity, but he concludes that the damage caused by the human exploitation of phosphates and other compounds is due to an entirely different set of properties. He claims that current regulations will ensure that only completely safe compounds will be allowed, and he predicts "a golden future" for the element.

A three-page appendix summarizes important numerical data on phosphorus and discusses its allotropes. A 10-page list of sources, arranged according to chapter and ranging from 1677 to 1998, serves as a list of references and suggestions for further reading. A detailed index (11 double-column pages) facilitates location of material.

Emsley occasionally uses formulas, but he writes equations in terms of words. He possesses a felicitous, almost poetic way with words, and he makes chemistry come alive with vivid images, for example, "when we strip away [phosphorus'] protective cage of four oxygen atoms and expose the element itself, we release a tiger." A lapse in grammar, "The average person has in *their* body about 3.5 kg of calcium phosphate" (p. 257), is an exception rather the rule.

Although Emsley often considers phosphorus as "nature's nefarious element," he generally presents a balanced blend of its positive and negative aspects, and he uses it to praise the benefits of chemistry in everyday life and to dispel any exaggerated fears about its environmental impact. I heartily recommend this modestly priced volume to both scientists and nonscientists.

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The Nitro Group in Organic Synthesis. By *Noboru Ono*. John Wiley & Sons Ltd., New York 2001. 372 pp., hardcover £92.95.—ISBN 0-471-31611-3

This book focuses on the preparation, reactivity, and transformation of organic nitro compounds. It summarizes the recent important advances in organic synthesis using nitro compounds up to the year 2000. A large number of equations, schemes, and tabulated data are presented, and the yields of the products in almost all reactions are shown. Plenty of references at the end of each chapter allow fast access to the relevant original publications. However, as a result of the limited size of the book only a few principles and mechanisms are discussed.

After a short introduction, the preparation of nitro compounds by nitration of hydrocarbons and by oxidation of amines and oximes is outlined in Chapter 2. Chapter 3 describes the nitro-aldol (Henry) reaction. In particular, recent progress on the catalytic asymmetric Henry reaction is included. Chapter 4 is devoted to the utilization of nitroalkenes and nitroalkanes as Michael acceptors and donors, respectively. Stereoselective Michael reactions are also summarized.

Chapter 5 deals with methods for regioselective C-alkylation, acylation, arylation, and heteroatom incorporation. In particular, the carbon–carbon bond forming reactions by radical substitution and by a transition-metal-catalyzed reaction are described. In Chapter 6 the transformation of nitro compounds into carbonyl compounds and nitrogen-containing compounds such as nitrile oxides, nitriles, and amines is discussed. Chapter 7 highlights the nucleophilic substitution of nitro compounds mediated by radical and ionic processes and elimination of NO_2 from $R-NO_2$ giving $R-H$ or alkenes. Chapter 8 begins by outlining the methodology and stereochemistry of cycloaddition using nitro compounds, then continues with a discussion of recent applications in the total synthesis of natural products.

The penultimate chapter deals with nucleophilic aromatic substitutions on nitro-arenes where the nitro group behaves as a leaving group, and also describes the NASH reaction (nucleo-

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philic aromatic substitution of hydrogen). The final chapter focuses on the synthesis of biologically important heterocycles such as pyrroles and indoles from nitro compounds.

In summary, this monograph provides an excellent overview of recent developments in nitro group chemistry. Since this book clearly presents a wide variety of synthetically useful reactions with organonitro compounds, it will be very attractive to the researchers in pharmaceutical, agrochemical, and fine chemical industries.

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Richard Willstätter im Briefwechsel mit Emil Fischer in den Jahren 1901 bis 1918. Edited by *Horst Remane* and *Wolfgang Schweitzer.* Verlag für Wissenschafts- und Regionalgeschichte Dr. Michael Engel, Berlin 2000. 125 pp. Softcover 19.68 €.—ISBN 3-929 134-27-6

The 47 letters from the correspondence between Willstätter and Fischer—they do not form an unbroken chain—come with one exception from the Bancroft library of UC Berkeley. The Emil Fischer Papers were acquired at Berkeley as a gift from Hermann O. L. Fischer on his death in 1960. The editors have prudently commented on the letters and provided a source index. Short biographies of the two great researchers precede the letters.

The relationship between the two pioneers was based on mutual respect, on the part of the 20-year younger Willstätter it was even reverence. The latter is shown by the polite address to the older man as "Excellency, highly esteemed Privy Councillor" as well as letter endings such as "I remain in deep reverence, respectfully yours". The reader who anticipates titanic dialogues from these letters will be disappointed. Exciting new ideas, visions, unpublished work, and future plans of the researchers are not addressed; the politeness even prohibited critical comments.

The first seven letters served to set the scene: the work areas were carefully demarcated. In connection with the synthesis of the atropine/cocaine series, Willstätter was interested in the carboxylic acids of piperidine and pyrrolidine. The worry of encroaching on Fischer's domain (amino acids) was legitimate, and, with all politeness, discrepancies in melting point and analyses of the betaine aurochlorate were even clarified.

The allocation of the spheres of interest was only slightly relaxed in the first half of the 20th century and finally fell in the 1950s. The young generation turned against the traditional mores, and the protest, especially from the other side of the atlantic, led to unlimited elbowroom.

The long letters No. 8 to 10 are concerned with the preparations for the 70th birthday party of Adolf von Baeyer (October 1905), their mutual academic teacher. Here the cost of the recommended subscription to a reprint of Baeyer's collected publications was calculated, and the question as to whether in addition to a bronze bust (A. von Hildebrand) a medal should also be coined, was even discussed with Baeyer himself.

In 1905 Willstätter moved from Munich to a position as professor at the Eidgenössische Polytechnikum (later ETH) at Zurich. His later nomination for the new Kaiser–Wilhelm Institut of Chemistry in Berlin–Dahlem led to a rise in the correspondence (13 letters from Nov 1910 to the end of 1911). At the inaugural meeting of the Kaiser–Wilhelm Gesellschaft in Nov 1911 (in the presence of the Imperial couple), Fischer presented an experimental lecture on recent advances and problems in chemistry and biology, for which he borrowed a sample of crystalline chlorophyll from Willstätter. Fischer succeeded in convincing his colleagues and the authorities that Willstätter was the outstanding personality to represent Organic Chemistry in the new KWI. The nomination proceedings faltered when in July 1911 Willstätter—here two letters are missing—abruptly withdrew his application. Skillfully the editors blend in letters (E1–E9) from Fischer to Beckmann, Haber, and Duisberg, as well as their replies. Fritz Haber recognized that Willstätter did not want to be appointed as subdirector under Ernst Beckmann, who had already been proposed as director of the KWI in 1910. In order that Willstätter could be given a state pension, he had been offered the position of professor extraordinarius at Berlin University. Habers diplomatic skill led to the solution to the puzzle: Free research activities at the KWI and an honorary full professorship without teaching obligations at the University. Willstätter agreed and moved at the end of 1912 to Berlin after completion of the Institute buildings.

In January 1915 Willstätter asked Fischer for permission to propose him for a second Nobel Prize honoring his work on amino acids, polypeptides, and proteins (letter nos. 34, 37, 38); Fischer had received his first in 1902 for his pioneering efforts on sugars and purines. Fischer put forward strong arguments against a second nomination. The 1915 Nobel Prize went to Willstätter for his investigation of plant pigments.

In 1916 Willstätter succeeded A. von Baeyer as professor at Munich; no letters were preserved from possible efforts to keep Willstätter in Berlin–Dahlem. In August 1917 A. von Baeyer died at the age of 82 years. Letters 41–44 concern the organization of a worthy Memorial Session, the writing of the obituary, as well as the erection of a statue and its financing. Note from the reviewer: the Baeyer statue created by H. Hahn was positioned in 1922 in front of Willstätter's refurbished building at the Chemische Laboratorium der Bayerischen Akademie der Wissenschaften, as it was called at the time, and survived the destruction of the laboratories in World War II. Today it is positioned in front of Haus F of the new buildings of the Department of Chemistry of the Ludwig–Maximilians University in Munich–Grosshadern.

The last exchange of letters (No. 46, 47) occurred in 1918 and concerned the maintaining of the level of Liebigs Annalen der Chemie as well as the founding of a Society for the Promotion of Chemistry Teaching.

The blossoming of academic research requires a solid institutional framework, so elastic that it would survive even in times of war. The fascinating reading matter in this exchange of letters conveys less on research results, but more on the characters of the two great scientists and the conditions of their work. Viewed

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