BOOK REVIEWS

A Scientific Venturer

Arrhenius. From Ionic Theory to the Greenhouse Effect. ELISABETH CRAWFORD. Science History Publications/USA (Watson), Nantucket, MA, 1996. xiv, 320 pp., illus. $49.95. Uppsala Studies in History of Science, vol. 23.

Most of us know at least one or two happy warriors—persons who see themselves as champions in a struggle between good and evil, truth and falsehood. Win or lose, they take delight in a test of energy and ingenuity and find joy in the camaraderie of the shared contest. Svante Arrhenius was such a happy warrior, and this fine biography, the first in English, is a rewarding account both of the man and of the various causes to which he devoted his formidable talents.

Svante Arrhenius "doing experiments at the Danish State Serum Institute." [From *Arrhenius*; reprinted from T. Madsen, *Statens Seruminstitut: Institutets udvkiling 1902–1940* (Copenhagen, 1940)]

Born near Uppsala, Sweden, in 1859, Arrhenius attained notoriety at a relatively early age for his theory of electrolytic dissociation. The outcome of several years of study of the electrical conductivity of dilute aqueous solutions and the immediate stimulus of J. H. Van't Hoff's paper on osmotic pressure, Arrhenius's central idea—that salts, acids, and bases dissociate into electrically charged ions in solution—was published in 1887, in the inaugural volume of Wilhelm Ostwald's *Zeitschrift für physikalische Chemie*. For most of the next decade Arrhenius explored the implications of his idea and proselytized on its behalf—a crusade that linked him closely with his fellow ionists, Ostwald and van't Hoff. Although, as Crawford points out, resistance to the new physical chemistry of ions was rather stronger in Arrhenius's imagination than in reality, there was plenty of opportunity for polemic, and skirmishes with both critics outside and heretics within the new circle of ionists honed Arrhenius's combative style.

By the mid-1890s ionic dissociation was widely accepted among chemists, even though questions remained regarding the extent of dissociation (especially in strong electrolytes), the condition of ions in solution, and the physical significance of dissociation for atomic and molecular structure. Arrhenius lacked the facilities, students, and patience to compete with other research groups that had by then entered the field, most especially those of Ostwald and his students. Perhaps more important, he had, since his youth, harbored the ambition to make his mark in physics. More and more, ionic dissociation was enmeshing investigators in the myriad complexities of particular solutions. Arrhenius's own efforts to extend the ionic theory to the study of conductivity in gases proved abortive, and he soon looked elsewhere to satisfy his ambition and his taste for ideas both novel and big.

Cosmic physics would be the vehicle—a subject-in-the-making that in Scandinavia and some parts of central Europe was bringing together investigators interested in meteorology, historical climatology, volcanism, sunspots, and ocean currents among other topics. The field was, well, cosmic, and its devotees shared little more than a common interest in cyclic or circulatory processes in nature. Many scientists found the whole venture a bit suspect, but the very inchoateness of the subject appealed to Arrhenius, who had won his earlier success in a field, physical chemistry, that had hardly been more coherent. Arrhenius had a knack for discerning meaningful patterns in seemingly random data and seems to have understood that this was his special strength; fields that were just opening up offered him ample grist for his mill. Through numerous lectures, a massive textbook, and a highly successful foray into popular science writing (*Worlds in the Making*) Arrhenius labored to bring order and attention to the subject. He was rather more successful in engaging the interest of amateurs than of professional scientists; cosmic physics was soon supplanted by fields like geophysics that covered parts of its domain. But even if it did not produce a new discipline, the venture yielded new ideas, including two that Arrhenius played a central role in developing: the idea that carbon dioxide in the atmosphere, like the glass of a hothouse, traps heat and plays a causal role in periodic episodes of global warming and refrigeration, and the far less fully developed notion that life on Earth may have arisen through a colonization of our planet by spores driven through space by the pressure of light. Both, it hardly need be said, have had a subsequent history.

Even while continuing to lecture on cosmic physics and to prosecute the occasional investigation in physical chemistry, Arrhenius, shortly after the turn of the century, embarked on what would become a third major line of inquiry, into the chemistry of immune response. By now a "great man," Arrhenius attracted immediate publicity for the idea that reactions between toxins and antitoxins in the body are essentially simple neutralizations that obey the law of mass action—an idea that he developed in a long and close collaboration with the Danish bacteriologist Thorvald Madsen. Just as in his earlier work, Arrhenius here saw opportunity to bring order to a field in which scientists seemed overwhelmed by the complexity of their data. Not all lost souls were ready to be saved, however, and Arrhenius soon was embroiled in one of the great controversies of the era—a long-running battle with Paul Ehrlich, who was as com-

"At [Paul] Ehrlich's Institute für Serumtherapie in Frankfurt, 1904. Seated at the table, Paul Ehrlich (with dog) and Svante Arrhenius." [From *Arrhenius*; Royal Swedish Academy of Sciences]

mitted to the complexity of immune response as Arrhenius was to its simplicity.

Crawford organizes her biography around these three natural divisions in Arrhenius's scientific life with a sure hand. Her analysis of Arrhenius's science does not break new ground, but she expertly synthesizes the results of more specialized historical inquiries. There are ample signs of the polish that comes from careful reflection about sources. Crawford's signal contribution, however, is her vivid descriptions of Swedish society and institutions. A Swedish-born sociologist, Crawford knows Arrhenius's origins and working environment intimately and uses that knowledge to explain aspects of her subject's personality and career that otherwise remain opaque. We have here, then, a book that accomplishes the difficult task of combining a lucid treatment of scientific ideas and a sensitive reconstruction of their historical circumstances. Crawford is a sociologist whom historians would gladly claim as one of their own.

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Emergent Maladies

Occupation and Disease. How Social Factors Affect the Conception of Work-Related Disorders. ALLARD E. DEMBE. Yale University Press, New Haven, CT, 1996. xiv, 344 pp., illus. $37.50 or £25.

Early in this century, industrial hygiene involved putting guards on machinery in the hope of preventing dismembering accidents. Although this strategy worked, it far from eliminated industrial safety hazards. Nearly everyone knows a cashier or computer operator who suffers from carpal tunnel syndrome. In some occupations, such as meat cutting, in which 15 percent of the workers may have acquired this syndrome, the problem has reached near-epidemic proportions. Other disorders, such as job-related lower back pain, which costs on the order of $11 billion a year in compensation, and noise-induced hearing loss, continue to perplex insurers, employers, and employees.

Few historians have considered the changing nature of industrial disability or examined how particular disorders have come to be regarded as work-related problems. Allard Dembe's case studies of cumulative trauma disorders of the hands and wrists, back pain, and noise-induced hearing loss address these issues. Using a sophisticated blend of sources from such fields as medical, labor, and social welfare history, Dembe describes the eclectic mix of forces that have created professional and public awareness of occupational illnesses. He emphasizes both the social nature and the complexity of the problem. No fewer than nine major variables, such as labor activism, medical politics, and the efforts of the mass media, figure into his explanations. Nor do the variables that explain the emergence of one illness necessarily explain that of another.

The social element of Dembe's analysis comes through most clearly in his discussion of the role of doctors. The field of industrial medicine has its share of undeconstructed saints, such as Hull House resident Alice Hamilton, but these sorts of physicians do not appear here. Dembe's doctors include George S. Phalen of the Cleveland Clinic, unable to conceive of a particular hand ailment as work-related because so many of the affected patients were women, who, by Phalen's culturally determined definition, do not engage in hard manual work. Other doctors have seen repetitive stress injuries as psychological in nature, owing to the hysterical nature of women and Jews. Dembe handles these ethnic and gender themes with skill, although he never tells us why Hamilton, unlike Phalen, was apparently able to surmount her class prejudices.

This book derives in part from Dembe's doctoral dissertation in work environmental policy, and it has some of the off-putting qualities of that genre, such as an earnest striving for social-science significance. Still, the sheer fascination of the stories more than compensates. We learn, for example, that workers carrying stones to build the pyramids were treated for lower back pain by the Egyptian physician Imhotel, but it was not until the advent of railroad travel, with the passengers and crew bouncing up and down in the seats, that the problem emerged in its modern context. Although railroad passengers were reimbursed for "railroad spine," railroad workers, not well organized in the 19th century and lacking political clout, received almost no reimbursement. Pliny the Elder noticed that people who lived near waterfalls suffered hearing loss, but not until the advent of gunpowder, the Industrial Revolution, and later the development of inexpensive audiometers did the link between working and hearing loss become firmly established.

Despite Dembe's elegant erudition, he has lived in the real world. Experience at the Liberty Mutual Insurance Company has sensitized him to the importance of the workers' compensation program in the history of occupational disease and illness. Some problems, such as telegraphist cramp, came to medical attention after the Industrial Revolution but before the creation of workers' compensation. More modern maladies have been shaped in part by the political battle over compensation costs. Workers' compensation pays the medical costs of job-related injuries and illnesses. Since this country lacks national health insurance, workers often need to establish the occupational relevance of a health expenditure if they expect to receive reimbursement. That puts tremendous pressure on distinguishing between work-related and non–work-related injuries even in cases, such as lower back pain, where the line is almost impossible to draw. It also forces doctors to act as gatekeepers of public benefits. Because of the importance of this gatekeeping role, illnesses in which doctors can use imaging equipment and other diagnostic tools to distinguish between signs and symptoms enjoy advantages in the compensation process.

If there is a flaw in Dembe's book, it may be in the fact that the stories have a certain random quality about them. We never know if we are getting the full story. A lack of focus exacerbates the problem. The book is in part about medical recognition, in part about societal recognition, and in part about recognition within workers' compensation systems of three significant industrial conditions. What we get is more than enough, however. Dembe nicely accomplishes his goal of showing how social factors affect the conception of work-related diseases.

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Books Received

Algae. An Introduction to Phycology. C. van den Hoek, D. G. Mann, and H. M Jahns. Cambridge University Press, New York, 1995. xiv, 623 pp., illus. $110; paper, $39.95.

Blood Substitutes. New Challenges. R. M. Winslow, K. D. Vandegriff, and M. Intaglietta, Eds. Birkhäuser Boston, Cambridge, MA, 1996. xii, 209 pp., illus. $69.50.

Children of the Ice Age. How a Global Catastrophe Allowed Humans to Evolve. Steven M. Stanley. Harmony, New York, 1996. viii, 279 pp. $25.

The Physics of Polymers. Concepts for Understanding their Structures and Behavior. Gert R. Strobl. Springer-Verlag, New York, 1996. xii, 439 pp., illus. Paper, $39.95.

Social Causes of Violence. Crafting a Science Agenda. Felice J. Levine and Katherine J. Rosich. American Sociological Association, Washington, DC, 1996. x, 114 pp. Paper. Spivak Program in Applied Social Research and Social Policy.

Speech. A Special Code. Alvin M. Liberman. MIT Press, Cambridge, MA, 1996. xiv, 458 pp., illus. $55. Learning, Development, and Conceptual Change.

The World's Writing Systems. Peter T. Daniels and William Bright, Eds. Oxford University Press, New York, 1996. xlvi, 920 pp., illus. $150.