Book Reviews

A Branch of Basic Science

Physics of Hot Plasmas. Scottish Universities' Summer School, Newbattle Abbey, 1968. B. J. RYE and J. C. TAYLOR, Eds. Oliver and Boyd, Edinburgh, and Plenum, New York, 1971. xvi, 456 pp. + plates. $32. Scottish Universities' Summer Schools in Physics, vol. 9.

Plasma physics should at least provide plentiful source material for future historians and sociologists of science. Passing its formative years in the classified shadow of the H-bomb, it may have been the first branch of basic science to come of age outside an academic environment. Soon after the Geneva conference of 1958, governments around the world declassified their controlled thermonuclear fusion programs, and the cooperation which quickly developed among the United States, the Soviet Union, western Europe, and Japan in this area was one of the few happy furloughs from the Cold War. Now, applications to weapons research, real or imagined, show dismal signs of driving the subject underground again. Academic plasma physicists in all but a handful of universities are still, intellectually, poor relations, scattered over half a dozen engineering departments in addition to departments of physics and astronomy. It is not likely that anyone outside the field now listens to a plasma seminar or reads a plasma paper with more than a very modest degree of comprehension.

This confused state of affairs is not easy to understand, especially in view of the fact that plasma physics concerns the state of upwards of 99 percent of the matter in the universe and has in it what are probably the greatest possibilities for both benefit and harm to mankind of any single branch of modern physics. One of the several subtly connected factors that may help to explain the muddle is a situation that has resulted from treating a branch of basic science as if it were a branch of technology. The fact that plasma physics was akin to kinetic theory, to fluid mechanics, and to electromagnetic theory, together with the fact that each of these was already worked out to a sophisticated level, led to the erroneous conclusion that all that remained to do was to join them up and make thermonuclear reactors. But life turned out to be more complicated, and the whole to be greater than the sum of its parts. Though it has been clear for some time that far more basic understanding of the collective behavior of charged-particle systems will be needed before one can control a plasma in economically interesting parameter regimes, this insight has yet to be integrated into either the way plasma research is funded or the way most of it is done. Programs have every incentive to justify themselves in terms of unlikely short-run goals and to ignore the long run, where the stakes are real, and far higher. For example, it is hard to think of any *other* energy source for the post-A.D.-2000 world than controlled fusion; but the day when that source becomes available may not be hastened much by scheduling reactor technology meetings when the first self-sustaining fusion reaction is still a few orders of magnitude away.

This book is a modest but admirably solid achievement in the neglected enterprise of distilling what has been learned about plasmas into a coherent enough form to be assimilated into the mainstream of physics. The proceedings of the 1968 Scottish Universities' Summer School, it consists of a dozen review articles on plasma kinetic theory, waves and stability, numerical methods, turbulence, "collisionless" shock waves, laser-produced plasmas and laser diagnostics, "high density" plasma devices (such as the theta pinches and Focus), and refractivity measurement techniques. A few of the articles, such as the workmanlike assembly of experimental material on shocks by J. W. M. Paul, contain substantial amounts of previously unpublished results. The careful survey of linear Vlasov stability theory by E. G. Harris is one of the best combinations of lucidity and accuracy available on that subject. There is little emphasis in most of the articles on the "relevance" of plasma physics to practical pursuits. The tone throughout is low-keyed, and there is little or none of the aggressive salesmanship that has been a bane of plasma physics. One can only envy the "forty-three students, eleven lecturers, and seven other participants" who were permitted to ponder the subject for two weeks in Newbattle Abbey under such conditions.

A mild irony of the situation is that during the summer school the International Atomic Energy Authority Conference on Controlled Fusion, a much fancier affair, was taking place in Novosibirsk. This was apparently thought by the organizers to be a handicap in arranging a program at the summer school. An interesting puzzle for the historian or sociologist of science looking at these documents a century hence may be to try to decide where the action really was.

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A Classical Physicist

The Life of Wilhelm Conrad Röntgen. Discoverer of the X Ray. W. ROBERT NITSKE. University of Arizona Press, Tucson, 1971. xii, 356 pp., illus. $8.50.

In this work Nitske presents an encyclopedic compilation of data on Röntgen's life which allows the reader to judge not only Röntgen the scientist but also Röntgen the man. Here is the struggling student, the aspiring professor, the loving husband, the faithful friend, and the energetic traveler in addition to the experimenting physicist. But most important, the overall presentation places into context the physical philosophy and procedures of this first winner of a Nobel Prize in Physics.

Röntgen, even though he lived well into the 20th century (he died in 1923), remained to the end a classical physicist in the 19th-century mold. He frequently worked alone, built much of his own equipment, and took grudging pride in his lack of funds. He was cautious in speculation. He repeated experiments over and over again to convince himself of the correctness of his observations and then wrote his reports in a modest, objective style emphasizing tested and proven results. One suspects that he would

have felt lost in a modern, bustling research institution with a large staff, pressing schedules, grant reports, and expensive equipment.

Reviewing this life of Wilhelm Conrad Röntgen reconvinces one of the old adage that accidental discovery favors the prepared mind. But more than that is involved. Many other contemporaries were experimenting with cathode-ray tubes and also had the opportunity to discover x-rays. Several even noted the same phenomenon that originally attracted Röntgen's attention, but they passed on to other concerns which were the immediate focus of their attention. Röntgen not only observed the phenomenon and understood that it could not be the direct result of cathode rays, he then concentrated his studies on the properties and effects of these strange new invisible rays and on establishing their penetrating powers with photographic evidence.

It is also worth noting the limitations of even so precise and resourceful an experimenter as Röntgen. He erroneously suggested that x-rays were longitudinal vibrations in the ether and not transverse vibrations as visible light. He was unable to note any significant reflection, refraction, or diffraction with x-rays. The establishment of the nature of x-rays within the present electromagnetic spectrum was left for others to make 17 years after his initial discovery in 1895.

The mass of detail included sometimes makes Nitske's style ponderous, but the overall effect is informative. Anyone interested in Röntgen or in the history of physics at the turn of the century will find this work worth the effort. Particularly useful are chapters 7 through 15, Röntgen's three original papers on x-rays which are included, and the extensive bibliography.

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Autobiography and Essays

Wanderings of a Biochemist. FRITZ LIPMANN. Wiley-Interscience, New York, 1971. x, 230 pp., illus. $8.95

In *Wanderings of a Biochemist* Fritz Lipmann presents first an autobiography, which deals mainly with his scientific genesis and his personal philosophy, and then a collection of his essays selected for their humanistic and general interest rather than for their technical value. Lipmann initially set out to publish a number of his papers and essays with a brief commentary for continuity, but the scope of the book was altered, as he relates in his preface, following discussions with several of his students at the Rockefeller University, in which he found that the students were surprisingly interested in biochemical history and wanted to know more of how his important contributions came about. It is indeed fortunate that the original aim was not followed, for the scientific community would have been denied the opportunity to gain insight into the thought and the warm personality of Lipmann that he provides as he recounts the evolution of his many discoveries in the era when biochemistry grew to maturity.

Lipmann defines the "wandering" of the title as having a meaning somewhere between the German and the English connotation; the word as he uses it denotes not only "just wandering" but also "scientifically, following one's instinct without knowing exactly where it will lead." Lipmann's career has been distinguished by a sense of intellectual wandering, and his wanderings have been fecund. His work on pyruvate oxidation in *Lactobacillus delbruckii* led not only to an understanding of pyruvate metabolism in animal tissues but to the discovery of coenzyme A. The finding of this coenzyme and the elucidation of its function became the basis for research into protein synthesis, with all its far-reaching implications.

Lipmann started his career in medicine and wandered into biochemistry. Those of us who have been associated with him are fully cognizant of the fact that his medical training has played a significant role in shaping his research orientation and thinking. He himself writes, "The biological education to which the observant student is exposed in medicine is a superior preparation for any career." It is of interest to note that his first major opportunity to utilize his scientific ability was in the department of surgery at the Massachusetts General Hospital and not in a biochemistry department.

Lipmann had to pursue a career under the most adverse circumstances. Having to find a job as a Jew in an emerging Nazi Germany, or in the United States as a refugee who had yet to distinguish himself, were not conditions most favorable to a scientific wanderer. Lipmann's reflections on these matters evoke compassion from the reader.

Another facet of this book that should have attraction for all readers is Lipmann's interaction with the chief architects of modern biochemistry. He speaks of the time he spent in Meyerhof's laboratory at the Kaiser-Wilhelm Institute in Dahlem as his "adolescence" in biochemistry and says that his future research was subconsciously mapped out for him during this period. Lipmann was influenced not only by Meyerhoff but also by the mysterious hero from the top floor, Otto Warburg. Lipmann's account of his meetings with Lundsgaard and Nilsson leads one to a better understanding of how the pathway of fermentation was elaborated. His characterizations of these figures are vivid and are provocative to those who are interested in the history of science.

The narrative is supplemented with relevant excerpts from Lipmann's technical publications; this approach is most helpful in giving the reader an understanding of the reasoning behind his research. It is in this manner that we are led through the work on aldolase (carried out in Meyerhof's laboratory with Lohmann), phosphoproteins, acetyl phosphate, ~P, coenzyme A, uncoupling of oxidative phosphorylation, carbamyl phosphate, sulfate activation, peptide bond formation, and chain elongation. This list reads like a primer in biochemistry and certainly elucidates the fundamental role Lipmann has played in determining the course of biochemistry.

The general essays Lipmann has included in the second part of the book are timely and easily read. They range in subject from the function of the B vitamins through the evolution of mechanisms of biosynthesis to "Disproportions created by the exponential growth of knowledge." These papers are exciting discourses in biological thought.

Lipmann has shown in this book that biochemistry, thought by many to be only an experimental field, actually is a discipline with deep philosophical ramifications.

Lipmann's research has not been goal-oriented, but no one can question that his work will be of profound benefit to mankind because of its currently recognized importance in such fields as medicine and agriculture. One must take pause and contemplate whether