Roster of winners

NOBEL LECTURES IN PHYSICS, VOL. 1: 1901–1921. 498 pp. American Elsevier, New York, 1967. $85.00 for 3-volume set

by Morris E. Rose

This volume is one of a series in which are to appear the lectures of the Nobel laureates in each of the five disciplines for which the prize is awarded. In each category there are to be three volumes covering 1901–21, 1922–41 and 1942–61, respectively. From 1962 onwards the annual Nobel lectures will be collected in a yearbook. All lectures are translated into English, and each lecture is accompanied by a short presentation address and a brief biography of the prize recipient.

At various times in the past the attitude prevailed that physics had reached a state of perfection such that little remained for future generations but to fill in details in a noble edifice reared by their predecessors. This was very nearly the concensus when the first Nobel prize was awarded. At other times physicists have been only too aware of the incompleteness of our descriptions of nature but that the problems have been so difficult that little progress could be expected on a short time scale and that real progress must await another breakthrough such as occurred in the middle of the third decade of this century. A perusal of the work of the Nobel laureates, on the whole, serves to demonstrate the shortcomings of both points of view. To be sure, there may be some pressure to award a prize with few lapsed years. Indeed, in the history of this competition only six years were distinguished by the absence of a physics award, and of these four (1916, 1940–42) were war years. Presumably in 1931 and 1934 no great achievement was discernible either as a recent work or as one less recent but only newly recognized as important. Nevertheless, the achievements for which the prize in physics has been awarded are in every case of undoubted importance and in almost every case of extremely great importance.

This was certainly true in the first two decades covered in the present volume. Certain puzzling circumstances, well-known to all physicists, can be cited, of course. Notable among these was the omission of Rutherford from the roster of physics prize winners although as early as 1908 he appears as a chemistry award winner for his work in radioactivity. Yet what could be more worthy of a physics prize than his work on alpha-particle scattering leading directly to the discovery of the nucleus? Einstein's clarification of the photo-electric effect was worthy of a prize (1921), but one is puzzled by the apparent lack of appreciation of special relativity reported in the same year. Incidentally, Einstein's lecture, delivered two years after the award, was not meant to be associated with the award and is concerned entirely with the problem of relativity, both special and general. A unique insight into the mechanisms of selection is obtained in the book "Nobel–The Man and his Prizes," H. Schück et al (Elsevier), which is worth reading in conjunction with the present work.

As to the lectures presented here, little need be said other than the fact that they constitute a series of vignettes testifying to the fact that physics was as difficult in this bygone era as it is now. Each lecturer describes in a not overly technical manner the path by which he was led to his result. It was not always the original goal, but that is the way discoveries are made.

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History of kinetics

KINETIC THEORY. Vol. 1, The Nature of Gases and of Heat. Stephen G. Brush, ed. 249 pp. Pergamon Press, Oxford, 1965. Paper. $4.95

by George H. Weiss

The value of collections of famous, but dated, papers of historical interest has always struck me as being problematic. Without denying the possible utility of such collections to those with interest in the history of science, it is difficult to see that most of the papers will be read profitably by anyone else.

This collection begins with the monumental papers by James Clerk Maxwell and Ludwig Boltzmann that laid the foundations of kinetic theory. However, to modern eyes the papers seem long, tedious and no more enlightening than more recent expositions of the same subject matter. Other papers in this collection include one by Lord Kelvin showing that it is impossible for large temperature to arise spontaneously, two by Poincaré, of which one introduces the notion of the Poincaré cycle, and finally, the exchange of papers by Boltzmann and Zermelo on the possibility of irreversibility in a universe ostensibly described by differential equations that are second order in time. These papers *are* of considerable interest, if only because they show that Zermelos' objections were not as decisively refuted as current dogma would have it.

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New biophysics

THEORETICAL AND EXPERIMENTAL BIOPHYSICS: A SERIES OF ADVANCES, Vol. 1. Arthur Cole, ed. 397 pp. Marcel Dekker, New York, 1967. $17.50

by Joseph G. Hoffman

The preface asks why biophysics might not be called bio-mathematical-physical-chemistry, or by some other shuffling of the four terms. And well it might because the six review papers, of immediate interest to all bio-physicists, exemplify the subject's interdisciplinary complexity.

The first paper, "Water Structure," by Herman J. C. Berendsen discusses a problem first posed by Wilhelm C. Roentgen in 1892. Though he is not mentioned, Roentgen's concept of water structure is still valid. The problem still is: how to fit the numerous, though tenuous data, into a quantitative theory. Berendson gives a concise review of current major theories and their relation to the facts. The addendum shows that all theories are under continuous and close scrutiny and that they are subject to modification with the next data. There is as yet no theoretical formulation that can

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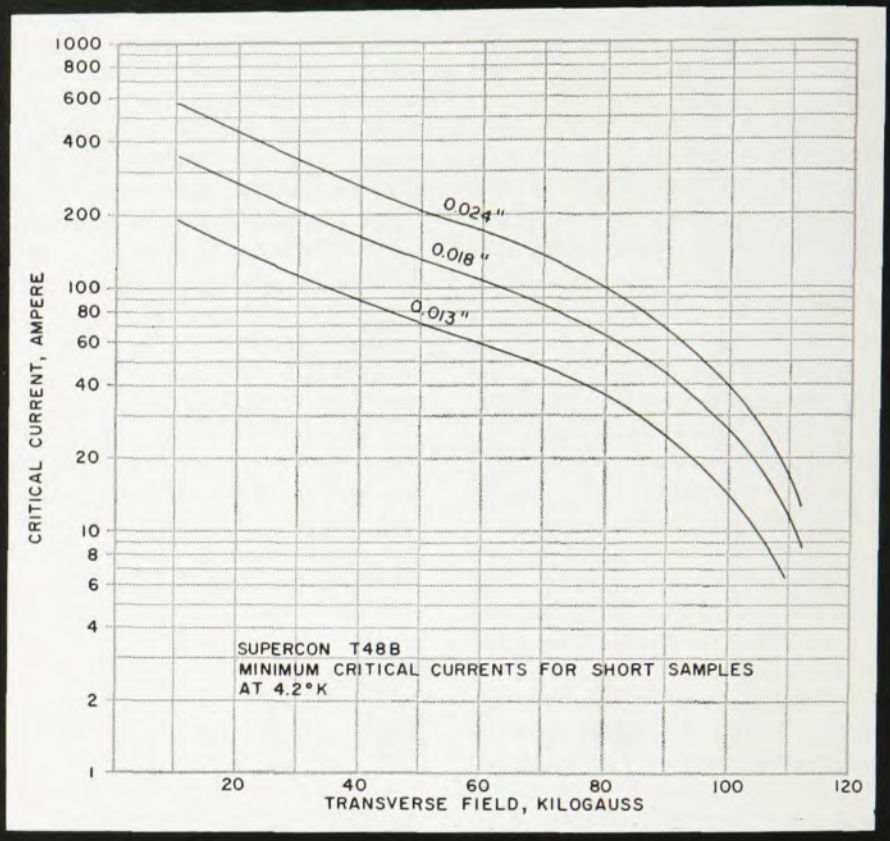

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The second paper, by Wayne Thornburg, on "Mechanisms of Motility," examines a possible common basis for the many kinds of automotion of living matter. Is the swimming of eels and snakes merely analogous to the swimming of spermatozoa? Can the small forces that make a chromosome move one micron per second, or two feet per year, have the same mechanochemical origins as those that contract a muscle cell in milliseconds? There are few data to answer these questions. In 50 pages the wide-open and difficult subject is examined impartially, and up to the most recent possible hypothetical mechanism, namely, the allosteric transition in proteins.

The third paper, on "Biologic Control Mechanisms," considers "Human Accommodation as an Example of a Neurological Servomechanism" and is by Lawrence Stark, Y. Takahashi, and G. Zames. It is clear that certain experimental subjects, such as this one, may eventually entail crews comprising several different specialists. The ramifications of a subject can create a need for Big Science. The enormity of biophysical topics is here demonstrated in the nonlinear servoanalysis of human lens accommodation, not so much by the intricacies but by the many unknowns that have to be guessed at.

The inevitable subject of radiobiology is represented in the fourth review, "Mechanism of Action of Different Ionizing Radiations on the Proliferative Capacity of Mammalian Cells," by G. W. Barendson. The carefully limited topic permits a quantitative estimate of the sensitive volume in the cell nucleus. Apparently lethal injury follows when 15 to 20 chemical changes are induced by ionizations within a volume having dimensions of about 10 nanometers. The cytoplasm is not as sensitive as the nucleus. All the details of the hazy picture that emerges cannot be listed here. The review is satisfying in the manner it neatly separates the interwoven factors determining cell sensitivity.

"The Genetic Code—1964" by Carl R. Woese, the fifth paper, is a summary useful to experts and to nonspecialists in code lore. There are almost three pages of definitions followed by 64 pages of cryptogrammetry, the art of unraveling the most exciting molecular puzzle in science. The story starts with the Gamow era: "This one communication (in 1954) of Gamow's did more than any other single event to fire scientific interest in the biological code." At the end, an appraisal of the evolution of the fantastic machinery that reads and translates the code conveys a sense that large molecules have special properties. These must be physical attributes that make it possible for life to withstand random motions and events at the molecular level.

The physical entity that contains the primary, encoded molecules is discussed in the last paper, "Chromosome Structure," by Arthur Cole, which summarizes the 20 different models of chromosomes that have been proposed since 1956. This is a valuable review because it pulls together the results of widely diverse experimental methods of analysis. There are fibrils; there are coiled structures, and there is evidence for the histones. But the problem remains: How is this central and self-replicating source of information put together? How is the 200-cm-long DNA molecule wrapped up to fit into the 15-micron-diameter tissue cell?

The editor has given biophysics a new, and much needed, point of view in a timely and stimulating volume 1. The copious and up-to-date references after each paper cover the subjects thoroughly. Illustrations and supporting tables are numerous and more than adequate. There is an author and a subject index in addition to the table of contents.

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Waves around the world and over the horizon

IONOSPHERIC RADIO PROPAGATION. (Reprint of 1965 ed.) By Kenneth Davies. 470 pp. Dover, New York, 1966. Paper $2.25

by H. J. Hagger

The knowledge of electromagnetic wave propagation in the ionosphere is not only important for long-distance communication at high frequencies, but also for scatter propagation in over-horizon links on very-high frequencies. For both, the behavior of the ionospheric medium to electromagnetic waves is of particular interest.

This book is a reprint of NBS Monograph No. 80 published in 1965 and an extension of an earlier publication by NBS (1948) due to special efforts made during the IGY(1964–65). In chapter 1 the author discusses the roots of the problem, for example the atmosphere of the earth, its magnetic field and the influence of the sun. In the next chapter the reader becomes familiar with the basic ideas of ionospheric radio-wave propagation. Starting with the principles of electromagnetism, the book considers motion of charged particles in electric and magnetic fields and Appleton's formula for the refractive index of the ionosphere, and some properties thereof are derived.

In chapter 3 the various methods for measuring the ionospheric parameters are discussed. In the next chapter high-frequency propagation (3 to 30 MHz), both for plane and curved earth and ionosphere, are investigated. The maximum frequency for reflection, experimental results and problems of long-distance (multihop) and multipath transmission are considered. In chapter 5, on signal strength, the author discusses the factors affecting the average power at the receiver (system loss) and the parameters that produce variations about the average (fading). In the first part of the chapter absorption and polarization effects are included in the discussion.

Chapter 6 is devoted to ionospheric disturbances and the author uses this term for numerous ionospheric conditions that show some departure from the usual state. Some of these are related to solar flares and to ionospheric storms associated with magnetic storms. In chapter 7 the reader is given an idea of how propagation in the ionosphere may be predicted, an analysis based on sun-spot number,