Book Reviews

Historical Studies in the Physical Sciences. By Russell McCormmach (Ed.). Second Annual Volume 1970. University of Pennsylvania Press (1970). xx + 356 pp.

In view of the apparent present overcrowding in the science professions, it may be a good time for both the employed and those not so fortunate to look into the history of physics and other sciences in order to understand how it all started and evolved and to know where we are at now. Such a study might well influence a person in deciding whether to stick to his chosen field or to divert his talents to, say, anthropology or capitalism.

To my casual observation, histories seem to fall into two general classes, namely, intensive and extensive histories. In the former the historian confines himself to a narrow corridor of events and never lets go. In the latter the author presents a wider and more interesting view of his subject. There have been a number of histories of chemistry and mathematics which seem quite accurate but usually make quite dull reading. An exception are the histories of mathematics by the late E. T. Bell. The present volume consists of eight more or less intensive historical studies of theoretical physics during the nineteenth and present centuries, all by different authors. On reading the book I found that my interest varied, but I do not question the accuracy of the eight articles. There are numerous references, but, alas, no index.

There have been at least three histories that have made a strong impression on scholars and laymen alike, and I hope I will not be excluded from good society if I mention them here briefly. First, I name the inquisitive, much traveled, and observant Herodotus (c, 484-425 B.C.). In his travels around the Aegean and Mediterranean Seas, he took careful notes on what he was told and what he himself saw or experienced. He didn't believe all he was told; in particular, he discounted the Helen of Troy account on the grounds that the Trojans wouldn't have fought a ten-year war over a fickle girl. He estimated the age of the Nile delta from some measurements on the silt in the sea. He describes in detail the silly and costly invasion of Greece by the Persian, Xerxes. Xerxes was soundly defeated and returned home to Lydia where he sought comfort in the bosom of his harem until done in by an advisor. Even if Xerxes had won the invasion, he wouldn't have been able to cope with the Greeks anyway. For a second history I take that of Fanny Hill by John Cleland (1709-1789). At the age of 15 Fanny embarked by chance on a career of kept woman in London; she exploited affluent men. After some ups and downs Fanny emerged quite affluent herself; she married her first lover and raised a nice family. Her history takes the form of two long letters written to a woman friend, but since there is no hint of what happened to the letters or to whom they were addressed, one is left with the possibility that Cleland fabricated the entire history. Being a man Cleland could hardly be depended on to describe Fanny's several experiences. As a third history I have chosen Dee Brown's recently published "Bury My Heart at Wounded Knee." It is an interesting and well documented account of how some of our early pioneers cheated the American Indians out of their lands, often with the consent and help of the prevailing government.

The above cited histories may be classed as extensive. It is important to note that the three are based on observations of people and emotions and things as they existed at the times and places covered. With the possible exception of Fanny Hill, there were no carefully repeated experiments involved. In the book under review we have an entirely different situation in that a considerable body of careful observations and difficult experimentation form the strong foundation for the theories of electrons, radiation, spectra, quanta, relativity, and thermodynamics whose early histories are the subject of the book.

It is said that the tools of a theoretical physicist consist of a pencil, paper, a waste basket, and a penetrating mind. He, or she, deals in abstractions; i.e., he abstracts from experimental results and observations what seems to be underlying causes and laws. I have often wondered how Planck, Einstein, Bohr, Lorentz, and others happened to get paid for work that few understood or cared about and that showed no promise at the time of having any practical applications. But it turned out that the results proved to be highly interesting and to have many practical applications, We could philosophize about all this, but let's get on with the book.

The book is divided into "articles", not chapters. Each article has a different author and all but one are Americans. One author is located in Kansas; the remaining Americans are in New England. The eight authors are historians of science, and as far as I know none has engaged in any physics research themselves. This may be a good thing, for outsiders sometimes see us in a clearer light than we see each other.

The first article is by Martin Klein and sets forth the Einstein-Bohr dialogue about quantum theory. Einstein disagreed with a number of aspects and concepts of the theory, and some of his arguments are still heard to this day in the laboratories. Bohr's earlier theory, a mechanical one, eventually gave way to the Born-Heisenberg-Schroedinger theories, but Einstein was never quite content with those either; he didn't dig the fact that only probabilities could be arrived at. But the quantum theory still lives and flourishes.

In the second article by McCormmach the long association of Einstein and Lorentz in connection with the latter's electron theory is brought out in some detail. More is due to Lorentz in both his electron theory and relativity than many realize. In effect he laid the groundwork for both. Since I attended seminars and lectures given by both Einstein and Lorentz, I can say that both men gave the definite impression of being friendly and kindly; neither was ever snooty in any respect in my own experience. With some variations, the Lorentz theory still survives.

In a third article Stanley Goldberg gives a remarkably clear picture of Einstein's special relativity theory and the response of the British, French, and Germans to the theory. Starting with two simple postulates, videlicet the constancy of the velocity of light and the impossibility of determining an absolute motion of any kind, Einstein was able to derive the Lorentz transformation with ease as well as many other relations of a kinematical nature. The "ether" was dismissed in a short sentence. The German physicists understood the theory, but not all agreed with it. The British stuck with the ether and didn't even try to understand special relativity. The French were not much interested in the theory either; even Poincaré failed to mention it in his writings on electrodynamics. Americans ridiculed the theory for the most part, but G. N. Lewis and R. C. Tolman at Berkeley took it seriously and made some interesting applications of the theory. Contrary to what Goldberg says, both theoretical and practical applications are essential for the health of any physical theory; otherwise, the theory merely becomes a nice exercise in algebra.

The fourth article by Romualdas Sviedrys gives a readable account of how James Clerk Maxwell managed to introduce physics into Cambridge University (England). It wasn't easy. It seems that Cambridge was established to teach students how to be gentlemen and spend money. I suppose they succeeded in this, though Sviedrys presents no evidence in this direction. It goes without saying that Maxwell changed the course of Cambridge, and to everyone's advantage.

The fifth and sixth articles by Paul Forman and Yehuda Elkana are on Landé and Helmholtz, respectively. These articles are too long for me to review effectively; suffice to say that Landé managed to unravel the anomalous Zeeman effect, and Helmholz was finally persuaded that his conservation of "Kraft" really meant conservation of energy.

Elizabeth Wolfe Garber, in the seventh article, writes on the kinetic theory of gases as developed by Clausius and Maxwell. The two approached the matter from different directions: they helped each other but they never managed to come together. In the end Maxwell prevailed, but it required the talents of Boltzmann (and Gibbs) to place the theory on a firm statistical basis. If one has studied the kinetic theory of gases and statistical mechanics, he or she will understand Elizabeth's article; otherwise it will be a dead loss. She doesn't define a number of words that really require a definition, such as distribution function, Ergodic hypothesis, Boltzmann's H theorem, and others. She does put her formulas in readable form. And she does seem to understand that scholarly, and sometimes withering, polemics have the purpose of clarifying concepts, theories, and facts which often initially are not completely clear to to the originators of same. The purpose of war, according to an old Spanish saw, is to serve God and get rich; polemics are meant to clarify ideas.

Finally we come to the eighth article by Edward Daub (of Kansas) on Entropy, or more properly, thermodynamics. The beginning student of thermodynamics should by all means read Daub's article. He will find, to his great relief, that some of the great minds of the last century didn't understand entropy either; these included Thomson, Maxwell, Tait, and others. Apparently only Clausius and Gibbs were clear on the matter at the time, but considerable fur flew before the controversial dust finally settled. I may say that I first learned that Peter Guthrie Tait was a Scottish physicist from Daub's article; I had only known of him as a writer on quaternions. On checking in my 1911 Britannica and Willard Gibbs' collected works, I found that he was both a good physicist and mathematician; he was also noteworthy for his heated polemics. He attacked Gibbs' vector analysis and dyadics; he quarreled with almost everybody about entropy. Eventually quaternions gave way to vector analysis, dyadics to matrices, and entropy is now a well defined and curvy matron. Daub's article would have been improved if he had included at the start the present statements of the laws of thermodynamics.

G. N. Lewis once compared the development of science to the building of a lovely cathedral; there is first a collection of stones, then scaffolds, the bandied jests and curses of the workmen, but finally all these are cleared away to reveal a beautiful structure dedicated to a noble prupose. The present book gives some indication of greater monuments while under construction. The laws of nature don't die or fade away.

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About the Reviewer: We again welcome Professor Yost's words to these columns. To our readers of long standing he needs no introduction; readers recently come aboard we remind of our reviewer's position as Professor Emeritus of Chemistry at California Institute of Technology and refer them to his writings in earlier issues of Nuclear Science and Engineering.

Professor Yost acknowledges discussion with Pancho P. Gomez, of Boise, Idaho, and assistance in preparation of the manuscript from Mrs. Yost and Ruth Hanson, Secretary to the Division of Chemistry and Chemical Engineering, California Institute of Technology.

Enrico Fermi, Physicist. By Emilio Segrè. University of Chicago Press (1970). $6.95.

This book will be of special interest to physicists and other scientists. In it is a systematic account of Fermi's family background, his early schooling, his doctoral studies at the University of Pisa, his appointment to a professorship at Rome at the age of 26, and subsequent professional growth to a preeminent position in physics.

Professor Segrè has presented a carefully documented and critical account of the career of an extremely gifted person, largely self taught, proud, ambitious, and personally cautious and reserved. Since Fermi possessed a remarkably retentive memory, the books that he studied early in his career made a lasting imprint upon him, and many of these are cited by title.

Fermi almost single handedly brought modern physics to Italy, and the methods whereby he attracted colleagues and students of physics to Rome are described. The high points of Fermi's professional achievements, his statistics, his contributions to beta-ray theory, and his work on slow neutron properties are set forth in an orderly way.

Fermi, through his work and personal contacts with colleagues and students, had an important influence upon the development of physics, worldwide. He played a major role in the successful conclusion of the chain reacting uranium pile experiments, and in the development of the