Books

Atomic Physics and Human Knowledge. By Niels Bohr. 101 pp. John Wiley & Sons, Inc., New York, 1958. $3.95. *Reviewed by J. C. Polkinghorne, University of Edinburgh.*

The middle essay of the seven here reprinted is Professor Bohr's account of his discussions over the years with Einstein. A charming feature is the illustration of "apparatus" proposed by Einstein and reanalyzed by Bohr in their debate about the validity of the uncertainty principle. Never before were thought experiments performed with such robust and satisfying clocks and measuring rods! The essay is an exciting account of the interaction of two great men and great physicists.

The other six essays are accounts, mostly addressed to congresses of nonphysicists, of the epistemological revolution brought about by the quantum theory and its implications for other fields of human knowledge. In particular Professor Bohr believes that the idea of complementarity gives new insight into such problems as the relation between living and inanimate matter. An essential feature of living matter is its continual interaction with its environment and this places limits on the degree to which it or its parts can be isolated and subjected to experiment. He refers to "the obvious exclusiveness between such typical aspects of life as self-preservation and self-generation of individuals on the one hand, and the subdivision necessary for any physical analysis on the other hand. Owing to this essential feature of complementarity, the concept of purpose, which is foreign to mechanical analysis, finds a certain field of application in biology." However he decidedly rejects the point of view that supposes the uncertainty principle to provide scope for the will to tamper with the laws of physics. His position is a synthesis transcending the opposing attitudes of mechanism and vitalism.

Professor Bohr has maintained his position with such consistency that there is necessarily a good deal of overlap between these essays.

The Preparation of Programs for an Electronic Digital Computer (2nd Revised Edition). By Maurice V. Wilkes, David J. Wheeler, Stanley Gill. 238 pp. Addison-Wesley Publishing Co., Inc., Reading, Mass., 1957. $7.50. *Reviewed by F. J. Corbató, Massachusetts Institute of Technology.*

When the first edition of this book appeared in 1951 it represented a valuable documentation of how to use one of the early high-speed digital computers. As such the first edition was basically a handbook for the EDSAC computer; however, despite the attempt of the authors to generalize their coverage, the second edition is still such a handbook. The contents of the present edition arise from two sources. First, there has been a polishing and revision of the material of the first edition so as to keep pace with the evolvement of both EDSAC and present-day computer practice. Second, there has been the insertion of a few short chapters on more recent topics, in particular, Chapter 3, Programming for Other Machines (15 pp.) and Chapter 8, Automatic Programming (12 pp.); but in both instances the treatments given can only be considered sketches. As in the first edition there are numerous programming examples given in the awkward mnemonics of the EDSAC code. All told it is felt that the authors have done a good job of updating the first edition, but that in the subject of programming their book has been eclipsed by the more recent *Digital Computer Programming* by D. D. McCracken (Wiley).

Water Waves: The Mathematical Theory with Applications. By J. J. Stoker. 567 pp. Interscience Publishers, Inc., New York, 1957. $12.00. *Reviewed by R. Bruce Lindsay, Brown University.*

No one who has observed the breakers on an ocean beach can fail to be interested in water waves, and perhaps the same can be said in a somewhat different context for those who have experienced the effects of such waves aboard a ship at sea. The problems connected with them have fascinated generations of mathematicians and mathematical physicists beginning with Lagrange in the eighteenth century and extending through the nineteenth-century investigations of scientists like Kelvin, Stokes, Rayleigh, and Lamb to the present-day applied mathematicians and oceanographers. A vast literature and numerous books devoted to water waves exist and the natural question arises: why another book devoted to this field? The answer lies in the never-ending and ever-increasing curiosity of man about complicated natural phenomena coupled with his desire to accomplish more and more decisive control of the technological applications connected therewith. For this purpose the mathematicians are steadily providing more powerful techniques, notably in the field of nonlinear differential equations. The author of the present work has been in the forefront of the modern attack on the problems of waves in incompressible fluid media, and the present book, which provides a connected account of the contemporary treatment of wave motion in liquids with a free surface, will be cordially welcomed by mathematicians, physicists, and technologists alike.

The book consists of four main parts devoted respectively to the fundamental hydrodynamic theory of nonviscous incompressible fluids, the small amplitude theory of wave propagation, the approximate nonlinear theory for waves of larger amplitude in shallow water, and finally some considerations on the exact nonlinear

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theory, including a proof of the existence of periodic waves of finite amplitude. The principal structure of the treatment is mathematical and much emphasis indeed is laid on the mathematical techniques employed, which include among others complex function theory, the method of characteristics in the solution of partial differential equations, and the Fourier transform. The author does not hesitate to devote space to the proof of uniqueness theorems and is obviously very much interested in the mathematics. However, it would be quite wrong to give the impression that the book is solely mathematics. A great deal of attention is paid to physical examples and there are many excellent photographic illustrations of various types of water waves, bringing out clearly the results of the analytical treatment. The average physicist using the book would indeed have been aided by more numerous references to mathematical sources.

Among topics of special interest to physicists may be mentioned the tides, wave diffraction, waves produced by a ship as well as the effect of sea waves on the ship's motion, shock waves in water, gravity waves in the atmosphere, and flood waves in rivers. The reviewer would have wished a more thorough examination of the rather difficult but from the physical standpoint extremely important topic of group velocity in a dispersive medium. The author dismisses this as having primarily kinematic significance, deprecating the common association with energy flow. This is a controversial point about which more might well have been said.

The presentation is very clear and the typography excellent. There is also an adequate bibliography of both classical and recent literature.

Edward Williams Morley: His Influence on Science in America. By Howard R. Williams. 282 pp. Chemical Education Publishing Co., Easton, Pa., 1957. $6.50 in US; $7.00 elsewhere. *Reviewed by R. S. Shankland, Case Institute of Technology.*

This fine biography is the result of nearly twenty years of searching out letters and personal papers of Professor Edward Williams Morley (1838–1923), in studying this material, and in the preparation of an inspiring account of an outstanding personality and pioneer American scientist. Morley received all his formal education in New England at a time when nearly all students of science looked to Europe. However, both at Williams College and at the Andover Theological Seminary, Morley's great natural gifts enabled him to surge far beyond his formal educational opportunities. When he first undertook the development of courses in chemistry at Western Reserve University, in Hudson, Ohio, he had had practically no formal training in the subject. However, his exceptional intellectual abilities and habits of self-discipline and intense work enabled him to provide chemistry courses which were unique for his time, not only in the middle west, but throughout the country.

In addition to his teaching, Professor Morley also became a world-wide leader in the development of analytical chemistry, especially gas analyses, and his reputation soon led to his appointment as Professor of Medical Chemistry in the Cleveland Medical College.

The research activities which gradually developed during the Hudson years became his major concern when Western Reserve University moved to Cleveland in 1882. The most notable of Professor Morley's researches in chemistry was the measurement of the relative atomic weights of oxygen and hydrogen, a research for which he was awarded the Davy Medal of the Royal Society of London and other rewards for highest scientific distinction. A measure of the stature of Edward W. Morley in chemical research may be indicated by the fact that he was second in the balloting for the Nobel Prize in Chemistry in 1902, when the award went to Emil Fischer.

In addition to his distinguished position in chemistry, Professor Morley also held a very high place in both physics and mathematics, and it was most natural that he should collaborate with Professor Albert A. Michelson of Case School of Applied Science when in 1882 the two colleges moved to adjoining campuses in Cleveland. Michelson's first research work at Case had been a repetition of his measurements of the speed of light, which he conducted independently of Morley. However, during the year 1884 Michelson and Morley were thrown close together on two occasions, the first being at the meeting of the British Association for the Advancement of Science at Montreal in August, and they also both attended the "Baltimore Lectures" of Lord Kelvin delivered at the Johns Hopkins University in October of 1884. The late Professor Henry Crew once told the reviewer that Morley was the "shark" at the Baltimore Lectures, working all of Kelvin's problems and explaining them in detail to the others. Lord Rayleigh also was at Montreal and at Baltimore and both he and Kelvin urged Michelson to repeat the aether-drift experiment which had been given a preliminary and inconclusive trial at Potsdam in 1881. The prevalent theories relating to this subject as developed principally by Lorenz could have been salvaged if either the Potsdam experiment were wrong (as widely believed), or if an earlier experiment by Fizeau on the speed of light in moving water was in error. This accounts for the fact that the first research collaboration of Michelson and Morley was to repeat the Fizeau experiment in a form that gave definitive results confirming the earlier findings.

With this result established, Michelson and Morley then began their collaboration on the great experiment which is very properly known as the *Michelson-Morley Experiment*. Professor Morley's contributions to this work were of major importance. In addition to encouraging Michelson he provided the ample facilities of his research laboratory, and also made the key suggestion that the optical parts of the interferometer be mounted on a large slab of sandstone ($5' \times 5' \times 1'$) to reduce vibration and the effects of mechanical strain which had nullified the observations at Potsdam. Further-