ments. First the essay by Professor Bohr is worth the entire price of admission, with its delicacy and care of thought, and its wonderful evocation of the spirit in which the fierce but friendly war has for years been waged between the Princetonian and the Copenhageners. In the full earnestness of the presentation, Professor Bohr yet allows himself a few of his little jokes, always so illuminating. One is the tale of the two kinds of truth, and one is in the pictures, with their diagrammatic Gedankenversuchen, drawn no longer with mere lines for slits and detectors, but with the full pseudorealism of bolts and castings, springs and pointers. Second, the objections which Professor Einstein still raises, like that of the Geiger counter with printing recorder, or that of the moon's position, are indeed interesting ones. But they have not been analyzed in his usual penetrating way, by calculating what indeed are the final outcomes of such measurements. Perhaps he might still find a bridge between the two views, if he were to take really seriously the claims of the quantum theory for the subtlety of phase relations in measurement. And quantum-theorists are still, while confident in their general theory, not very good at making most plain the real nature of those relationships, the real meaning of the necessary cut between the system and its classical measurement. Last, it is to be hoped that the unfailing good humor of Professor Einstein will forgive one final shot on the darkening battlefield if the reader is asked to consider now the nature of Brownian movement and its extraordinary statistical interpretation, first pointed out by Einstein himself, and yet only in some world surely not our own to be replaced with purely causal law.

The third theme is the question of the meaning of general relativity, its magnificent effort and high if not final success in understanding that most difficult of large-scale physical forces, gravity. As but one example, the nature of non-Euclidean geometry is illumined by H. P. Robertson in an essay which begins with the tough question, "is space really curved?" Professor Robertson discusses this point in a way which is at once advanced and yet transparent to the most practical minded physicist or student. He makes great use of the elegant idea of Poincaré, in which the measuring rod takes a length depending upon the ambient temperature. The idea becomes much clarified by actual detailed examination of the experiment of measuring a flat plate of nonuniform temperature with a short metal rule brought to local thermal equilibrium before measuring. This calculation, done by E. W. Barankin, forms a fine framework for clarifying the whole question of the Riemannian geometry of Einstein's gravitating world. Gödel, Lemaître, Infeld, Menger, Milne, Dingle add special, sometimes quite technical accounts, extending the theory to the nature of geometry and to problems of general cosmology, and in the cases of Milne and Dingle, making new and for the reviewer not at all understandable fundamental approaches to the theory.

Other themes are discussed in some of the other essays: the history of the conservation laws is nicely set out by Professor von Laue; Einstein's social philosophy is the subject of an account by V. G. Hinshaw; Professor Bachelard of the Sorbonne presents a wonderfully spirited but not easy account of what he calls the "dialectical implications of relativity" in bringing a unity of the rational and the empirical, which seems in a way like Professor Einstein's own views, though far more sweepingly put. For the rest of the book, you will have to look for yourself. This review has by no means even mentioned all the valuable portions.

Perhaps it is best to close with the feeling that there is much left to be said. This sense of growth, of participation, of eager anticipation for the future, of the gradual accumulation of the good things of the mind, and of an uncompromising, courageous, perpetual fight against the bad—these are not far from the center of Professor Einstein's work, closer even than those magnificent tools of theory he has forged for all of us to use clumsily or well. If we have differences with him, he himself has assuaged them when he says: "One can only really quarrel with his brothers or close friends, others are too alien for that." If we feel that we have not lauded him enough, he has told us (speaking of course of another man): "A man to whom it has been given to bless the world with a great creative idea has no need for praise . . . His achievement has already conferred a higher boon . . ." If we despair of the times, he said once even on the brink of war: "(of our unimaginable sorrow) . . . Nothing of all that will remain but a few pitiful pages in the history books, briefly picturing to the youth of future generations the follies of its ancestors."

There are many pages here. In them there is something for everyone. Read what is to your taste, and join in wishing all men, all Americans, all members of the Physical Society, the high good luck to have still much more from the wise and articulate pen of Professor Einstein.

Philip Morrison
Cornell University

Ample Compensation

History of Physics. By Max von Laue. Translated by Ralph E. Oesper. 150 pp. Academic Press, Inc., New York, 1950.

The book consists of fourteen chapters, under the headings Measurement of Time, Mechanics, Gravitation and Action at a Distance, Optics, Electricity and Magnetism, The Reference System of Physics, The Bases of the Theory of Heat, The Law of Conservation of Energy, Thermodynamics, Atomistics, Nuclear Physics, Physics of Crystals, Heat Radiation, Quantum Physics. It is more than a mere history of physics: the fourteen chapters not only tell the story of the growth of the knowledge in the field with which they deal, they also relate what the author considers to be the most important, and probably the most lasting, results of the study of that field. In fact, throughout the book, the emphasis is on the subject, not on personalities and not even on the story of the development. The reader thus foregoes the amusement which we derive from hearing anecdotes from the lives of great people, or the often dramatic story of a spectacular growth. He is amply compensated, however, by the well balanced emphasis on the significant accomplishments in the fields which the author presents, and by the clarity of the presentation. The book reads very well and, once one is well started on it, one soon forgets the often obvious inadequacies of the translation and finds it difficult to lay the book aside. It is a short and useful book. It may not contain a "message" but it is of the kind which one expects to peruse again periodically and few of its readers will ever wish to part company with it.

Although the book is not chronologically arranged, its index makes it also a useful reference book. Nevertheless, the reviewer feels that its usefulness would be much increased by a chronological table. Naturally, all nonchronological history books group the events so that the aspect of the subject most important to the author appears most coherently. In the case of the present book, this aspect is a very important one for all readers. Nevertheless, physics now is a single entity more than it ever was before, perhaps more so than the casual reader will realize from von Laue's book. The reader who may wish to ponder on the interrelation of the various disciplines would derive much assistance from a chronological listing of the most important landmarks in the history of our science.

Eugene P. Wigner
Princeton University

Books Received

THE HUMAN USE OF HUMAN BEINGS. By Norbert Wiener. 241 pp. Houghton, Mifflin Company, Boston, Massachusetts, 1950. $3.00.

THE INELASTIC BEHAVIOR OF ENGINEERING MATERIALS AND STRUCTURES. By Alfred M. Freudenthal. 587 pp. John Wiley and Sons, Inc., New York, 1950. $7.50.

STELLAR EVOLUTION. By Otto Struve. 266 pp. Princeton University Press, Princeton, New Jersey, 1950. $4.00.

MECHANICS AND PROPERTIES OF MATTER. VOLUME I of A TEXTBOOK OF PHYSICS. By R. C. Brown. 285 pp. Longmans, Green and Company, New York, 1950. $2.25.

KLEINSTE DRUCKE IHRE MESSUNG UND ERZEUGUNG. By Rudolf Jaeckel. 302 pp. Springer-Verlag, Berlin, Germany, 1950. DM 39.60.

THERMODYNAMIK. By E. Schmidt. 520 pp. Springer-Verlag, Berlin, Germany, 1950. DM 30.00.

LEITFADEN DER TECHNISCHEN WÄRMELEHRE. By Hugo Richter. 617 pp. Springer-Verlag, Berlin, 1950. DM 34.50.

MATRIX ANALYSIS OF ELECTRIC NETWORKS. By P. Le Corbeiller. 112 pp. Harvard Monographs in Applied Science. Number 1. Harvard University Press, Cambridge, Massachusetts. John Wiley and Sons, Inc., New York, 1950. $3.00.

ACHEMA YEAR BOOK 1940/50. Deutsche Gessellschaft für Chemisches Apparatewesen, Frankfurt, Germany, 1950.

THE STRUCTURE OF MOLECULES AND THE CHEMICAL BOND. By Y. K. Syrkin and M. E. Dyatkina. Translated and Revised by M. A. Partridge and D. O. Jordon. 509 pp. Interscience Publishers, Inc., New York, 1950. $8.75.

PRIMARY BATTERIES. By George Wood Vinal. 336 pp. John Wiley and Sons, Inc., New York, 1950. $5.00.

THE EARLY DEVELOPMENT OF THE CONCEPTS OF TEMPERATURE AND HEAT. THE RISE AND DECLINE OF THE CALORIC THEORY. Prepared by Duane Roller. 106 pp. Harvard Case Histories in Experimental Science. Harvard University Press, Cambridge, Massachusetts, 1950. $1.25.

ELECTROMAGNETIC THEORY. By Oliver Heaviside. 386 pp. (Unabridged edition of Volumes I, II, and III of Heaviside's work) Dover Publications, New York, 1950. $7.50.

POCKET ENCYCLOPEDIA OF ATOMIC ENERGY. By Frank Gaynor. 204 pp. Philosophical Library, New York, 1950. $7.50.

ELECTROMAGNETIC FIELDS, THEORY AND APPLICATION. VOLUME I. MAPPING OF FIELDS. By Ernst Weber. 590 pp. John Wiley and Sons, Ltd., New York, 1950. $10.00.

ASTRONOMY. By Robert H. Baker. (5th Edition) 526 pp. D. Van Nostrand Company, Inc., New York, 1950. $4.75.

ELECTRON-TUBE CIRCUITS. By Samuel Seely. 529 pp. McGraw-Hill Book Company, New York, 1950. $6.00.

A MANUAL OF ELECTRICAL MEASUREMENTS. By Robert Quinly Gregg, Harry Emmons Hammond, and Robert Hartwig Frost. Addison-Wesley Press, Inc., Cambridge, Massachusetts, 1950. $2.50.

Journal notes

Polarization

The ionosphere is a region of charged particles above the earth which owes its existence to ionization of atmospheric gases by ultraviolet radiation from the sun. Knowledge of the structure and characteristics of the ionosphere is necessary for predicting its effect on radiowave propagation. Much information can be obtained by observing the echo reflected from the region when a strong pulse of radio frequency energy is directed toward it from the ground. Because the earth's magnetic field renders the medium doubly refracting to radio waves, the reflected wave usually is elliptically polarized. An instrument has been developed capable of measuring precisely the orientation and dimensions of the polarization ellipse.

The 1.5 megawatt transmitter with which the polarimeter is used emits a 150 microsecond pulse of radio frequency energy every 0.64 second on a carrier frequency of 150 kilocycles per second. The downcoming elliptical echo is resolved into two quadrature components by crossed loop antennas. The components are amplified with equal gains and phase shifts by two identical, broadband, superheterodyne receivers, and then connected to an oscilloscope which displays the original ellipse. The direction of rotation of the ellipse is determined by shifting the phase of one receiver output 90 degrees, and using this signal to turn off the oscilloscope intensity on every half cycle. The resulting Lissajous figure reveals the direction of rotation.

The observations are recorded photographically at a rate of one every 3 to 5 seconds, and the film is scaled for the ratio of axes, the angle of tilt, and the direction of rotation.

Measurements on the electric vector indicate that the polarization is, in general, elliptical with the major axis of the ellipse tilted east of magnetic north, and that only left-handed polarization is present which corresponds to the ordinary ray in the Northern Hemisphere. These results check well with simple ray theory. H.J.N.

A Polarimeter for the Study of Low Frequency Echoes. By A. H. Benner and H. J. Nearhoof. *Rev. Sci. Inst. 21: 830, October, 1950.*

Conductivity of an Electron-Proton Gas

Previous detailed analyses of conductivity in gases, developed by Enskog, Chapman, and others usually involve the tacit assumption that each collision between two molecules involves a large change in their velocities, either in magnitude or direction. In a gas consisting entirely of protons and electrons this assumption is not realistic. The velocity of a single electron changes frequently by relatively small amounts, with each change produced by a relatively distant encounter with another electron or with a proton. The cumulative effect of these small velocity changes gradually produces large changes in the velocity of an electron. Thus the position of an electron in velocity space changes in the same way that the physical position of a particle changes in Brownian motion, where the cumulative effect of many small displacements is also relevant. The differential equations developed to describe the effect of Brownian motion on the spatial distribution of a set of particles may be