the operation frequency, the season, the solar zenith angle and the radiation angle. We have to distinguish between permanent prediction, which is correct over a complete solar cycle, and monthly predictions, which are published several months in advance and mostly serve localized areas. The author then discusses the calculation procedures for one-hop distances over the F_2 layer (less than 4000 km) by using charts and nomographs. Later on larger transmission distances are considered.

In chapter 8 then the very important scatter-propagation problem is investigated. The author discusses D-region scattering at turbulent irregularities of the ionosphere, meteor scattering and reflections from a meteor trail, equatorial F scatter and auroral scatter. In the last section the author discusses the electron-density profiles of the atmosphere derived from radar scatter measurements. In the last chapter low- and very-low-frequency waves are considered. These waves, reflected from the lower boundary of the D-layer, can serve as an alternative to higher-frequency waves and they are less affected by ionospheric disturbances.

Extensive lists of references are added to each chapter and the book contains large indexes of subject, author and place. As a whole this book is well balanced between theoretical models and aspects and experimental data on ionospheric propagation. It will be extremely helpful to everybody who is engaged in propagation problems at high frequencies where the ionospheric layers of the earth play such an inportant role.

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The concern of an electronic engineer engaged in systems engineering includes propagation phenomena of transmission. H. J. Hagger is associated with Albiswerk/Zürich, in Switzerland.

Physics and philosophy: closer

MIND AND COSMOS: ESSAYS IN CONTEMPORARY SCIENCE AND PHILOSOPHY. Robert G. Colodny, ed. 362 pp. U. of Pittsburgh Press, Pittsburgh, 1966. $8.00

by R. Bruce Lindsay

With the ever increasing preoccupation of professional philosophers with the facts and theories of science, the relations between the two disciplines have been growing ever closer. One result has been the proliferation of symposia and lecture series with the mutual participation of both scientists and philosophers. The present book is the outgrowth of such a series given under the auspices of the Center for the Philosophy of Science at the University of Pittsburgh in 1963–64.

Prefaced by an introductory summary by editor Robert G. Colodny, the book consists of ten essays of which the first eight are devoted to consideration of various problems posed by human thinking on the nature of science, while the last two (corresponding to the *cosmos* of the title) by Thomas Gold and Henry Margenau discuss respectively "Cosmic Processes and the Nature of Time" and "The Philosophical Legacy of the Quantum Theory," and hence are concerned with more specific aspects of science.

By far the larger part of the volume may be fairly described in terms of the word *mind* in the title, though the various contributions cover a wide and rather disparate array of subjects. Thus Herbert A. Simon of the Carnegie Institute of Technology leads off with an article entitled "Thinking by Computers," which is a brief analysis of the psychology of human thinking in terms of the way in which man has taught the computer to "think" (that is, solve problems) by appropriate programing. This is followed by a somewhat more ambitious essay by the same author on "Scientific Discovery and the Psychology of Problem Solving," in which an attack is made on what is undoubtedly one of the most challenging problems in the philosophy of science: an understanding of the ways in which scientific geniuses make their discoveries and inventions. Simon seeks a clue to this elusive puzzle in terms of a theory of problem solving, which deserves more extensive development, though in its preliminary form scarcely offers a guaranteed recipe for success in science.

The University of Chicago philoso-

pher Dudley Shapere next examines "Meaning and Scientific Change." His essay is essentially a critique of what might be called the historical approach to the philosophy of science, which has in recent years grown up as a reaction to logical positivism and logical empiricism. Logical empiricists have tended to ignore the historical development of theories as having no relevance for the philosophy of science, and if they have considered the history of science at all have tended to interpret it in terms of what has been called by Thomas Kuhn "the concept of development-by-accumulation." On the other hand the views of the historically-minded researchers like Kuhn and Paul Feyerabend are criticized by Shapere because they involve too drastic an interpretation of the notion of scientific "revolution" as a complete break in the meaning of scientific concepts. In view of the increasing interest in the relation between the history and philosophy of science, it would appear that Shapere's contribution is an important one.

The contribution of Sylvain Bromberger of the Massachusetts Institute of Technology on "Why-Questions" is largely an exercise in logic, but contains some illustrations that will be of interest to physicists.

The two essays by Carl G. Hempel of Princeton ("Recent Problems of Induction") and Wesley C. Salmon of Indiana University ("The Foundations of Scientific Inference") both relate to the fundamental problem of induction, usually considered vital in the establishment of the validity of scientific activity. Salmon's very long article (140 pages) is almost a text on the various attempts made to solve the problem originally posed by David Hume: "How do we acquire knowledge of the unobserved?" From the standpoint of philosophy Salmon's presentation is a veritable *tour de force*. The average physicist, however, is likely to remain unmoved by it so far as it applies to him, since for better or worse, physicists have for some time ceased to feel concerned over the problem of induction. It would certainly do them no harm to read and ponder Salmon's masterly essay.

Two articles by Joseph T. Clark, S. J., of the Canisius College of Buffalo on "The Physiognomy of Physics" and "Science and Some other Components of Culture" complete the part of the volume related to more purely philosophical problems in the professional sense.

Gold's views on the nature of time as revealed in cosmic physics and Margenau's excellent review of the fundamental principles of quantum mechanics are well worth the attention of any physicist. The volume as a whole is commended to the attention of all interested in the philosophy of physics.

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R. Bruce Lindsay frequently reviews books on the history and philosophy of physics.

Starting with Landau's Fermi liquid

THE THEORY OF QUANTUM LIQUIDS: Vol. 1, Normal Fermi Liquids. By David Pines, Phillippe Nozières. 355 pp. W. A. Benjamin, New York, 1966. $15.00

by Howard H. C. Chang

A quantum liquid is a homogeneous system of strongly interacting particles at such a low temperature that quantum effects are important in determining its behavior. Lev Landau laid the foundations of the theory of quantum liquids over 25 years ago in his classic papers on He^4. During the last decade work in this field has been so fruitful that we now possess a unified point of view and the machinery suitable for the study of many-body systems. The authors are eminently qualified to write this advanced textbook, for they have made important contributions to our understanding of quantum liquids. David Pines and Phillippe Nozières are professors of physics at the University of Illinois and the University of Paris respectively and have previously written *The Many-Body Problem* (Pines) and *The Theory of Interacting Fermi Systems* (Nozières). Accordingly, there is considerable overlap between these books and the present volume.

The book begins with Landau's theory of a neutral Fermi liquid, which serves to illustrate in a physical and elementary way how quantum statistics and particle interactions de-