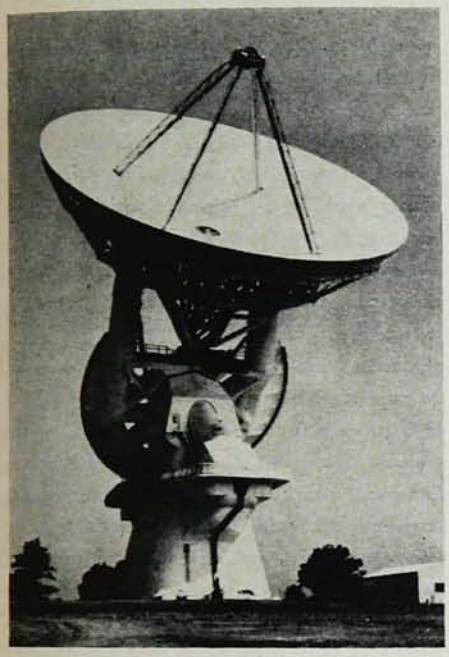
knowledge of the surfaces of the planets by reflection-coefficient measurements. But passive measurements at different wavelengths still disclose some mysteries of "surface temperature." It should be mentioned that during the period covered by this report measurements of Doppler frequency shifts due to rotation of a planet were undertaken. Two most interesting companions in the solar system, Jupiter and Saturn show surprising results both at microwave frequencies and at lower frequencies in the range of decameter wavelengths. In the last chapter observational techniques are dealt with and some newer radio telescopes and interferometers are briefly described. To each chapter a large number of references of the period (1960-1963) are attached, which are most helpful for further studies.



This small book does not only reproduce the papers given at the Tokyo General Assembly of URSI, but also acts as a survey of the state of the art, a survey of the interests radio astronomers have at present and an easy to follow report of the investigations in radio astronomy in the period 1960-1963.

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Deciphering x-ray diffraction patterns

COMPUTING METHODS IN CRYSTALLOGRAPHY. J. S. Rollet, ed. 256 pp. Pergamon Press, New York, 1965. $12.00.

by J. Gillis

A meeting of crystallographers in Britain, nearly 20 years ago, discussed the use of punched-card equipment for deciphering x-ray diffraction patterns. In spite of the then recent success of the method in the attack on penicillin the general conclusion of the meeting was negative. A cold calculation showed that machines were more expensive than an assistant with cardboard strips—and the assistant could also perform other services, such as making the tea!

Things have changed since then, however. The development of electronic computers made it possible to handle huge numbers of reflections, and this raised hopes of accuracy that justified a substantial improvement in the precision of measurement. The two developments have continued, and the 20% agreement factor which satisfied crystallographers of the 1940's has now come down to 5% and less.

At a summer school held in Oxford in 1962 students were taught how to go from the crystal to its structure by way of the electronic computer, and the book under review is a report of the lectures given. It contains a great deal of useful information, including even an introduction to FORTRAN programming.

There is always the danger in a book of this sort that hardware, software, and relevant experimental techniques may advance fast enough to make it out of date before it reaches the bookstore. This has not happened here, chiefly because the lecturers placed the main emphasis on fundamental ideas.

There would appear to be some omissions. No reference at all is made to phase-limiting inequalities. Again the Harker section technique, surely suitable for automatic computation, is also entirely ignored.

In spite of minor faults of this kind the book will certainly prove valuable

both to those who practice x-ray crystallography and to those who preach it.

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Physics and philosophy

BEYOND THE EDGE OF CERTAINTY. Essays in Contemporary Science and Philosophy. Robert G. Colodny, ed. 287 pp. Prentice-Hall, Englewood Cliffs, N. J., 1965. $8.75.

by R. B. Lindsay

For the past five years the University of Pittsburgh has arranged, as part of its instructional program, an annual series of visiting lectures on topics in the philosophy of science. The present volume is the second to result from this program. It contains contributions by eight well known philosophers of science in addition to an explanatory introduction by the editor.

All the articles relate to physics in some fashion and most of them rather specifically. Thus, to take them in order, N. R. Hanson (Yale) discusses the logical status of Newton's first law of motion and does not have much trouble in showing that the status is very shaky indeed. Brian Ellis (University of Melbourne) examines the origin and nature of all three of Newton's laws and comes up with some interesting and striking observations. He considers that Newton's debt to Galileo in this business has been much exaggerated and is inclined to believe that the line runs more definitely from Descartes to Newton, largely due to the former's interest in collision phenomena and the conservation of momentum. Ellis calls attention to the way in which Newton phrased the second law, which has been in large measure misinterpreted by his commentators. Ellis believes that when Newton wrote "Mutationem motus proportionalem esse vi motrici impressae . . .," he really meant it, and that the proper English translation is "The change of motion is proportional to the impressed motive force. . . ." In order to fit this to the usual presentation in elementary (and other) physics texts, the first two words are commonly rendered "rate of change." It is clear that a good deal of speculation can be erected on the basis of this difference in interpretation, and Ellis makes the most of it. He does not indeed mention what C. Truesdell called attention to some years ago, that nowhere in the *Principia* does Newton use the second law as a differential equation of motion whose solution by integration can lead to the representation of actual motions of particles. Ellis goes on to examine the laws for their empirical content and reaches the conclusion that they are primarily conceptual in nature, certainly not arbitrary but just as certainly conventional.

Hilary Putnam (MIT) takes a look at some philosophical problems posed by quantum mechanics, and in particular compares the de Broglie–Schrödinger interpretation of the quantum-mechanical wave function with that of the Copenhagen school. He concludes that both interpretations are logically unsatisfactory, but unfortunately provides none of his own.

The somewhat esoteric contribution of David Hawkins (University of Colorado) on "The Thermodynamics of Purpose" explores teleological interpretations of natural phenomena. The reviewer has found his paper hard to understand, but the author seems to be saying that human experience both on the physical and biological sides seems to exhibit ends which are attained or in process of attainment not primarily through the commonly understood cause-effect routine, but rather through operations describable in statistical thermodynamic terms.

Philip Morrison (formerly of Cornell, now of MIT) provides a clear and elegant factual account of "The Physics of the Large," in which he discusses the tools physics has devised for studying the properties of the accessible universe, as well as the results of this study with respect to estimates of age, size, temperature and distribution of matter.

In the longest chapter of the book the philosopher Paul K. Feyerabend (University of California) pays his respects to "Problems of Empiricism." He is definitely against this philosophi-