Primary Sources and Secondary Analysis

Relativity Theory: Its Origins and Impact On Modern Thought

L. Pearce Williams, *ed.*
159 pp. Wiley, New York, 1968. $2.95

Reviewed by PETER G. BERGMANN

This book is one of a series titled "Major Issues in World History," whose editor is C. Warren Hollister of the University of California at Santa Barbara. Both he and L. Pearce Williams, the editor of the present collection, are historians not scientists. Each volume of the series, according to the preface by Hollister, presents to the undergraduate student of history one issue and its history "through a deft interweaving of primary sources and secondary analysis, fused together by the skill of the scholar–editor."

The material is organized into four parts: the first two provide a selection of scientific writings from Newton through Einstein; the third is devoted to the historically oriented controversy between Sir Edmund Whittaker and Gerald Holton concerning the relative contributions by Poincaré, Lorentz, and Einstein to the birth of special relativity, whereas the fourth part deals with the impact of relativity on scientific and on extrascientific thinking.

I tend to feel that even undergraduates might be permitted the freedom of a library, instead of being confined to selections of primary materials made by someone else, but I am aware of what would happen to the average college library if it were to be invaded by several hundred students looking for materials in exactly the same area, and laboring under the same deadline for submitting their essays. As for the selection actually made by Williams for the first two parts, I consider it judicious. He has included articles, or excerpts, by Ernst Mach, by A. A. Michelson and E. W. Morley and by J. H. Poincaré, which are otherwise hard to come by, although several other papers are as readily available in the collection *The Principle of Relativity,* which was put together in the early 1920's and is now a reprint by Dover.

As for the third part, I can understand the challenge to a professional historian to unravel the conflicting claims made by eminent historians of science. I doubt, though, that an undergraduate student of history, whose science background is sketchy, will be able to make much sense of the controversy. Besides, it is an issue of secondary significance. All agree that the problems of relativity and of electrodynamics were being worked on at the time by a large number of theorists as well as experimentalists. That relativity became a powerful motivating force inside and outside physics only after Einstein's series of papers is also generally conceded.

The weakest part of the collection is part four, devoted to the impact of relativity. The three selections of comments offered by physicists range in dates from 1912 through 1922; they necessarily omit all interaction between relativity and quantum physics. The six items by nonphysicists have one thing in common: None of the authors has understood more about the theory of relativity than that it claims that "everything is relative." That nonscientists will comment on scientific issues without having taken the trouble of becoming acquainted first with the subject matter is an old and depressing story, which hardly required such extensive documentation as offered here.

This is a pity, all the more as there exist many perceptive investigations in which, for instance, the philosophical implications of the theory of relativity have been examined competently. Perhaps, if the editor had had the help of a competent philosopher of science, the selections for part four might have been made differently.

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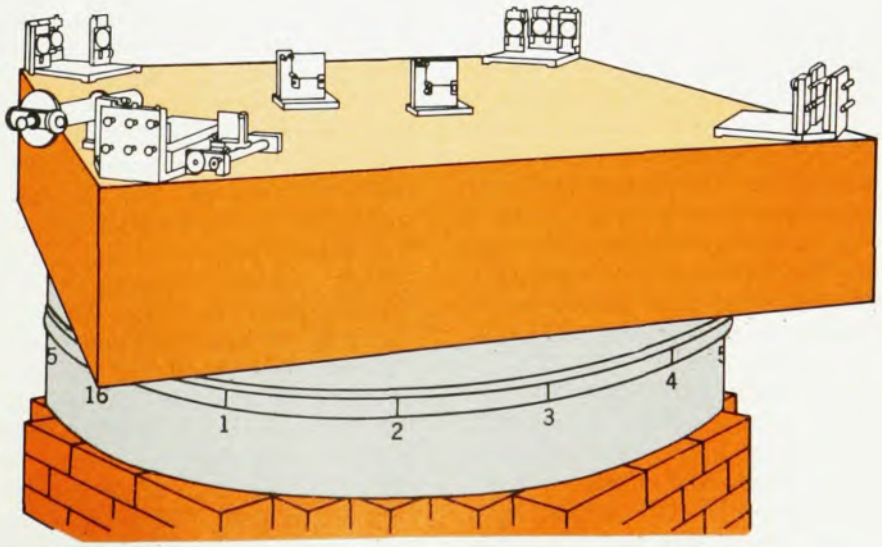
The reviewer, a physics professor at Syracuse University, worked with Einstein in the 1930's and has continued doing research in relativity.

The Big Machine

By Robert Jungk
245 pp. Charles Scribner's Sons, New York, 1968. $6.95

In this book, Robert Jungk gives a very readable account of the world of high-energy or elementary-particle physics as it is conducted at the vast, modern research institutes that house the largest particle accelerators and that involve the expenditure of tens of millions of dollars annually.

The title refers to the proton synchrotron at CERN and the book is concerned mainly with describing the



MICHELSON–MORLEY EXPERIMENT of 1887. Stone slab is 1.5 meters square.

project from its conception to the present. Corresponding laboratories in the US and USSR are, however, also covered, so that the book is truly a commentary on the whole scene viewed through the eyes of an historian and journalist.

The book was not written specifically for the research physicist and caters largely to the nonscientist. The physicist, therefore, should not expect information on the principles or design of the proton synchrotron or the concepts, problems and solutions in high-energy physics. Indeed, the specialist may occasionally be nauseated (or intoxicated) by the attempts to convey in lay terms the underlying physics and engineering principles. The language may perpetuate the aura of mystery and magic about the activities at these advanced-research institutes.

What the physicist will find most rewarding, however, is the discussion of those things that can not be found in scientific journals. The book, for example, covers the very beginnings of CERN; the interplay of scientists and politicians; the problems, pressures and competition that motivate the research worker and influence the program, in addition to the pure search for knowledge (this is nicely illustrated with a rather full account of the famous "second" neutrino experiments and of the courses followed at Brookhaven National Laboratory and CERN), and the scientist's role in the development of modern civilization.

The research manager will be interested in the discussions of management philosophies adopted during the construction and operation phases of the CERN machine under the direction of John Adams and later Victor F. Weisskopf. The desire to foster the productivity and originality of the research scientist, the requirements of ensuring that the visiting scientist achieves recognition through publications for his contributions, and many other factors lead to tension within a large laboratory particularly between the "beam makers" and beam users. This led Weisskopf to exercise considerable restraint in making authoritarian decisions.

The author rarely offers his own opinions and relates very successfully the ideas and comments of the many people with whom he talked during the book's preparation. I found this a fascinating book that can be thoroughly recommended, because the author and translators have succeeded in making it very easy to read. The author, Robert Jungk, born in Germany but now a US citizen living in Austria, is well known for his previous works: *Tomorrow is Already Here*, *Brighter than a Thousand Suns*, and *Children of Ashes*, for which he was awarded the International Peace Prize.

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Annual Review of Astronomy And Astrophysics

Leo Goldberg, David Layzer, John G. Phillips, *eds.*
528 pp. Palo Alto, Calif., 1968. $8.50

It is impossible to be fair in reviewing a collection of 17 articles, each of which deserves a page or two of discussion. I, therefore, have to concentrate upon a few of them that happen to interest me personally. I shall tend to overemphasize the new techniques of observation and neglect the large number of excellent articles concerned with old techniques. This is perhaps the fundamental cultural gap between physics and astronomy; a physicist instinctively prefers to use new techniques, yet an astronomer prefers to make new discoveries with old techniques.

The scope of this volume covers almost all branches of astrophysics, from planetary dynamics to cosmology. It provides a good overview of the rapid progress made during recent years by many diverse types of astronomers. Each of the articles is thoroughly professional. There is no wild speculation, and there is no attempt to include the latest developments in such fashionable areas as pulsar astronomy.

Sir Martin Ryle, in a short article, summaries the results of 20 years of observation of the statistical distribution of radio sources. The old source counts, including the third and fourth Cambridge catalogs, showed an excess of faint sources, indicating an increased density of emitting objects at very large distances. The new counts, including the fifth catalog, extend to sources about 100 times as faint as the old. One now sees a clearly defined peak in the apparent density of sources, followed by a decrease at still greater distances. These data are well fitted by an evolutionary model in which radio emission rose to a maximum at the time of formation of galaxies early in the history of the universe. Irrespective of the cosmological interpretation, Ryle's great work in surveying the sky for radio objects down to the 29th bolometric magnitude has been basic to the whole development of radio astronomy.

Hanbury Brown has written an equally authoritative article on the measurement of stellar diameters by optical interferometry. He describes the old measurements using the phase interferometer of Michelson, and the new measurements using the intensity interferometer invented by Twiss and himself. It is remarkable that nobody has been able to do substantially better with phase interferometry than Michelson did 50 years ago. The Michelson interferometer can measure only red-giant stars, and the Brown–Twiss interferometer can measure only blue and white stars. Brown vividly describes the frustrations that attend efforts to improve the performance of these devices, and discusses the chances of future success.

An article on electronic image intensifiers by Kent Ford discusses in detail the various techniques of image intensification and the snags that held up for so many years their fruitful application to astronomy. The snags are now finally being overcome, and the resulting revolutionary improvement in the speed of optical telescopes is gradually being exploited. One application to which image intensifiers are particularly well suited is the spectroscopy and red-shift determination of faint galaxies and quasars.

A beautiful article by Peter Gold-

PHOTO BY JOHN T. SCOTT

SIR MARTIN RYLE