anists, and such portraits are very difficult to locate. Any historian of botany who is searching for illustrations should certainly consult the Hunt Botanical Library.

Finally, the volume contains some informative bibliographical notes, which clarify the usage of such technical distinctions as "edition, issue and state" and the difference between "uncut and unopened copies." The contributors are listed and identified, and the index is adequate.

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## New Science Yearbooks

The standard encyclopedias—*Americana, Britannica, Collier's*, and *World Book*, for example—publish yearbooks or "annuals" that include feature articles or summaries of recent occurrences, update some of the articles in the parent work, or provide for the first publication of new articles that eventually will be incorporated in a major revision. Reflecting the tremendous popular interest in science and technology and the annual progress in scientific and technical research and development, two new science yearbooks have been inaugurated: **Encyclopedia Science Supplement, 1965** (Grolier Incorporated, New York, 1965. 440 pp., $7.95; to schools and libraries, $5.95) and **The World Book Science Annual, 1965** (Field Enterprises, Chicago, Ill., 1965. 393 pp., $6.95).

*Encyclopedia Science Supplement, 1965* is intended to serve those who use *Americana, Encyclopedia International, Grolier Encyclopedia*, and other Grolier sets. The volume contains 54 articles, mostly written by professional specialists. The major headings and the number of articles are as follows: Archeology, four; Biology, seven; Earth Sciences, six; Man and his World, six; Physical Sciences, five; Psychology, six; Space Exploration, eight; Technology, six; and Projects and Experiments, six. Each section or group of articles is preceded by a brief summary of the current developments that are discussed in the individual papers. For example, the preface to the biology section summarizes the classical view of life and tells of the advent of biochemical and biophysical research and the consequent present view of life, emphasizing the insights that have resulted from developments in cellular and molecular biology. In the psychology section the preface and articles indicate the broad and complex nature of psychological studies, the use of computers in psychological research, the relation of physiological disturbances to mental disorders, the role of drugs and hormones in mental disturbances, and the recent trend toward a physiological orientation in dream research which originally was the province only of the psychologist.

The section on space exploration reviews developments in radio astronomy, electronic photography, orbiting observatories, satellites and space probes, and the accomplishments in manned space flight. The coverage in other divisions is equally current and timely. The concluding section, on projects and experiments, is especially worthwhile, for the widespread interest of students in individual science projects and activities demands a constant flow of new and increasingly sophisticated ideas and procedural suggestions. The illustrations, all black-and-white, are of average quality, with some use of brown background tones. The text, which is in good informational and popular science style, will appeal primarily to secondary school students and nonspecialist adults. The index is adequate.

The content of *The World Book Science Annual, 1965* is of the same quality and reading level as the Grolier volume, but because it contains 216 outstanding illustrations in full color it is certain to have much greater popular appeal. The book begins with a series of colored photographs and short notes that describe the world of the scientist. In the introductory essay, "The science explosion," Harlow Shapley tells us that "the outburst of information about the universe and ourselves is the most spectacular phase of this explosion." Next we have a series of "special reports" chosen for their importance and timely interest: "Mission to Mars," by Robert Johnson and Mark Perlberg; "Midway to the moon" by William R. Shelton; "The Soviet space program" by Joseph L. Zygielbaum; "Man in nature" by Paul B. Sears; "The mysteries of plant growth" by John Barbour; "The beleaguered lung" by Edwin Diamond, followed by a "Trans-Vision" that shows the progressive development of lung cancer; "A heart for a heart" (progress in transplantation of organs) by Arthur J. Snider; "Unraveling the code of life" by Isaac Asimov; "The quest for quarks" by Malcolm D. Ferrier; "Beam of the future" (with colored illustrations of the laser) by Arthur L. Schawlow; "Continental engineering" (possibilities for using atomic energy in major construction projects) by Ralph E. Lapp; "Early man in the New World" by Loren C. Eisely; "The frozen frontier" by Richard S. Lewis; and "Best of the fair" by Foster P. Stockwell.

*World Book* then presents the Science File, a collection of short signed articles arranged in alphabetical order, in which contributors summarize developments in various fields, beginning with "Agricultural technology" and "Anthropology," and ending with "Science legislation," "Veterinary medicine," and "Zoology." The file contains a varied fare—a list of outstanding books for the layman published during the preceding year, an account of the progress in the development of new science curricula, and reports on activities of the National Academy of Sciences, NASA, NIH, and NSF. For dessert there is "Men of science," which features a brief account of Harold Urey's research and teaching (by William R. Shelton), and a list, including descriptions and other material, of the major scientific awards and prizes, as well as biographical notes on the winners. An analytical index concludes the volume.

The two yearbooks complement—rather than duplicate—each other. True, the same basic developments and ideas dominate much of both, but in each the approach, the organization, and the treatment are different. Libraries are likely to need both volumes, but the individual will probably find that the World Book volume has the stronger appeal.

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## Quantum Theory, 1900 to 1930

In this delightful book, **Thirty Years That Shook Physics** (Doubleday, Garden City, N.Y., 1966. 239 pp., $5.95), George Gamow, who is professor of physics at the University of Colorado, presents the development of quantum theory from 1900 to 1930 in a popular and anecdotal way.

Gamow treats the introduction of the idea of quanta into radiation by Planck

and Einstein's successful use of the idea to explain the photoeffect, then the Rutherford atom and Bohr's and Sommerfeld's explanation of spectra. This explanation is rounded off by considering Pauli's exclusion principle and his introduction of spin. This brings us to the end of the "semiclassical" period of quantum theory, about 1925. De Broglie's and Schroedinger's wave theories, Heisenberg's matrix theory and uncertainty principle, and Dirac's successful unification of quantum theory and relativity bring this period to a certain close. Fermi and Yukawa's application of the previous results to nuclear forces are treated in two chapters.

The presentation is such that it should be understood by a nonscientist, although the background of the arguments may sometimes be unfamiliar. The book is characterized and made delightful by the fact that the author attaches the development of the physics to the personalities of those who were responsible for its development—Planck, Bohr, Pauli, de Broglie, Heisenberg, Dirac and Fermi, and others. Gamow has known most of the people involved, and he tells illuminating anecdotes and stories about personal encounters with them. The book is illustrated with a number of photographs, most of them not previously published, which show the human sides of these scientists. Each chapter begins with an impressionistic pen drawing by Gamow, which shows the head of the person concerned. The only one that I find uncharacteristic is the sketch of Heisenberg (compare with the excellent photographs of Heisenberg on plates 4 and 8). Because few of Heisenberg's personal characteristics are described, I would like to relate an anecdote.

Heisenberg's father was professor of Byzantine Greek at the University of Munich, and when I taught at that University (1920 to 1926) I occasionally walked home with Professor Heisenberg. The latter commented on the difference between philology and physics, emphasizing the long hesitation of the philologist to publish a new theory or attack somebody else's theory, and continued: "On the other hand, my son says that he ought to put at the end of each of his papers: Six months guarantee."

Gamow's book ends with a parody of Faust which was performed in the spring of 1932 at Bohr's Institute.

Although the printing is very good, there are a few errors, and three of them may confuse the uninitiated: On page 45 a plus sign is used instead of a minus sign; on page 112 two minus signs are used instead of plus signs; and on page 66 the eight-line comment on Fig. 15b appears as comment on Fig. 15a.

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## The Boston Colloquium for the Philosophy of Science

Like Professor Philipp Frank, to whom this volume is dedicated, its contributors range widely over science and philosophy, concentrating mainly in the areas of philosophy of science and physics. The volume, **Boston Studies in the Philosophy of Science,** volume 2 (Humanities Press, New York, 1965. 511 pp., $9.75), edited by Robert S. Cohen and Marx W. Wartofsky, is the proceedings of the Boston Colloquium for the Philosophy of Science, 1962–1964.

The longest sequence of connected essays contains an analysis by J. J. C. Smart of "Conflicting views about explanation" in the work of Nagel, Feyerabend, and Sellars. In an entirely sympathetic manner, Smart presses some of the objections to Feyerabend's radical and seemingly paradoxical thesis that "theory" and "meaning" are interchangeable, and that even our commonsense language must be seen to embody theory, and *false* theory at that, so that it is, in principle, due for replacement. Sellars then enters some caveats with regard to the dispensibility-in-principle of the observation language, and Putnam launches a crisp attack on the whole Feyerabendian enterprise, earning from Feyerabend some equally tart replies. In his essay, "Reply to criticism," Feyerabend develops explicitly his belief in the positive value of theoretical pluralism, and replies more carefully than before to the charge that if alternative theories infect all observations with their own categories and concepts they are incommensurable and untestable. In another interesting contribution in the same area, Sellars discusses "The identity approach to the mind-body problem" in terms of an analogy with the reducibility of chemistry to physics, concluding that the analogy breaks down at the point where we ask what *is* the theory of brain-states which would be adequate to reduce the percipient's "raw feels." We have no such theory, and if we had, it might turn out to require raw feels as irreducible categories.

Three essays are concerned with topics closer to logic and mathematics. In "Instantiation and confirmation" G. Schlesinger has some genuinely new and significant things to say about the much canvassed paradoxes of confirmation. N. R. Hanson explores an admittedly "loose" analogy between the absence of consistency proofs in elementary number theory and the absence of stability proofs in gravitation theory. D. Follesdal carries the attempt to quantify causal contexts into some highly undesirable predicaments, and concludes in despair that all the causal modalities of interest to science should be avoided. The history of physical and biological ideas are represented ably and respectively by E. McMullin's "From matter to mass" and E. Mendelsohn's "Explanation in nineteenth century biology."

Altogether this is in substance an entirely worthy offering to Professor Frank, and the organizers of the Boston Colloquium are to be congratulatd on assembling a series of essays of such consistently high quality. Unfortunately standards of printing and proofreading leave something to be desired; for misprints sometimes interfere quite seriously with sense—for example, on page 69, line 6, where I take it "fact" means "face."

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## History of Science

Editions of classics in the history of science are always welcome. But when the writings of two early investigators, who worked in consort, appear at the same time it is a double treat and an invaluable clue to the ways in which modern science struggled to protect its birthright. The two volumes reviewed here are such a treat: **The Anatomy of Plants: With an Idea of a Philosophical History of Plants and Several Other**