a number of authors will show some lack of uniformity in treatment. The present book would have been improved by more vigorous editing to insure uniform nomenclature practices, to make certain that critical experimental details are not omitted at times, to insure that the basis on which yields are reported is stated, to follow conventional usage of physical chemical symbols, and to avoid a few definite errors in names, formulas, and usage of terms. Yet these items are minor compared to the overall usefulness of the book.

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Physics for the General Reader

The Nature of Matter. Physical Theory from Thales to Fermi. GINESTRA AMALDI. Translated from the Italian edition (1961) by Peter Astbury. University of Chicago Press, Chicago, 1966. 332 pp., illus. $5.95.

Enrico Fermi had unusual ability in attracting first-rate men as co-workers. His group, moreover, seems to have had the ability to attract talented women as their wives. Laura Fermi's biography of her husband and her books on Galileo and Mussolini are well known. Now the wife of Edoardo Amaldi, herself a former physics student in Rome, has written a popular account of particle physics in the 20th century.

As the subtitle indicates, her story begins with the ancient Greek philosophers. The entire period up to the mid-1890's, however, is disposed of quickly in the first chapter. The meat of the book consists of the topics of radioactivity, atomic physics, nuclear physics, and quantum theory. These the author discusses in a manner intended, according to the book jacket, to attract the "cultivated general reader without an understanding of advanced mathematics."

The book is clearly written and reasonably accurate, but not distinctive. There is no theme, argument, quality, or feature that distinguishes it from the many such works which attempt to make modern science comprehensible to the nonscientist. When I first saw the subtitle I hoped that perhaps we might be treated to a discussion of the significance of Fermi's contributions to an understanding of matter. But the author does not thus justify the use of his name; nor, in fact, does it serve as an end-point, since she includes more recent topics (fusion experiments, fundamental particles, and so on).

The book cannot be considered a history, for no attempt is made to uncover causes, trace trends, and fill in background information. The text tells us nothing about personalities, and the plates are only of cloud chamber tracks and accelerating machines (not even one of Fermi!). The illustration captions, incidentally, merely identify the tracks or machines, without explaining the characteristics or pointing out individual pieces of apparatus. If the layman needs a good-sized text to explain modern physics to him, why is it assumed that he can view technical photographs intelligently without extensive captions?

The book is, in effect, a catalog of discoveries. The "intelligent layman" who reads it must be a determined individual indeed, for it is no mean task to digest such a concentrated dose of information about science. A large part of the market for such a book may, however, consist of scientifically trained people who desire a synthesis or overview of this very important subject, hoping to see the forest instead of the trees. They will be disappointed.

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An Innovator within Bounds

Revolutionary Doctor: Benjamin Rush, 1746–1813. CARL BINGER. Norton, New York, 1966. 326 pp. $7.95.

Charles Caldwell was no doubt right when he said that the great ambition of his teacher Benjamin Rush was to be an "original." This signified the will to establish in theory and in practice a new, distinctive, individual system, upheld and propagated by a band of loyal pupils but reaching out beyond the profession to the judgment of the enlightened citizenry—the yearning to be a Sydenham, a Cullen, or a Brown. There was also to be a national element in the new medicine; Rush's system was to be the "American System." His success and his failure were intimately bound together. As an apostle of nationalism, as a Signer, as America's first great medical celebrity, he was indeed a "revolutionary doctor." A case can be made out for him also as an "original" in the more modern sense, particularly in psychiatry. But as the ultimate heir of the 18th-century systematists, as the leading American disciple of those aptly termed by Binger the "metaphysical Scottish physicians," he had turned his face to the past. He was not really behind the times unless one looks to the very greatest or most singular of his contemporaries. He was rather an innovator within the bounds of strict tradition, bounds which he could never transcend, not even in the psychiatric realm. Like the humblest of inventors, he tinkered (although on a large scale) with other men's notions. To many of his countrymen, however, he appeared to be a major prophet, and his influence did not die with him. Nevertheless he was the last of his larger-than-real-life kind. Carrying similar ambitions to the middle of the 19th century, Caldwell became a mere figure of fun.

Binger's very readable biography ("telling comments" from the "glowing mind" of Catherine Drinker Bowen helped to teach him the biographer's art) is an advance over Goodman's hitherto standard work, thanks in part to the aid of Corner and Butterfield with sources, and to the perceptions of Shryock and Carlson in interpreting Rush's many-sided endeavor. It is not the definitive biography, for which we must look to a professional scholar. (One would hardly guess from reading this overall assessment that Rush has for years attracted the special notice of graduate students, and some senior scholars as well, to particular aspects of his work.) Neither is it "psychohistory" or "psychobiography" to the degree that might have been expected. Rush had the misfortune to lose his father when he was eight; as a grown man he had the temerity to write down a little of what he dreamed about at night. Binger bears down on these rather meager materials but has the good sense not to make too much of them. On the whole he succeeds as nobody else has succeeded in making a believable human being of a not very promising candidate. In this achievement there is at least as much of Bowen as of Freud. There remains, however, a flavor to the whole book of the words which conclude the chapters on Rush and diseases of the mind: "he needs no further apology." The setting—in terms of antecedent and contemporary ideas—might well elicit some complaint in detail. Broadly speaking, it is sound but unsurprising. It has the

merit, which is no small one, of making Rush appear the natural denizen of his intellectual milieu, a somewhat perfervid specimen, perhaps, but a genuine child of his time—which is what the title of the book should be taken to mean. It ought to be said, too, that the author of these 300 pages is good company to the last. If we feel that he sometimes labors a trifle over his brief, this is the best of defects in a biographer. To twist a saying of Dr. Johnson's, an apologetic tone is what a great many of Benjamin Rush's biographers cannot help. Rush himself wrote: "My opinions upon many subjects and my innovations in the practice of medicine have so much divided my fellow citizens upon the subject of my talents and character, that it will be impossible for many years to decide the controversy respecting either of them." It has not been decided yet.

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Luminescence Conference

Bioluminescence in Progress. Proceedings of the Luminescence Conference, Kanagawa-ken, Japan, September 1965. FRANK H. JOHNSON and YATA HANEDA, Eds. Princeton University Press, Princeton, N.J., 1966. 664 pp., illus. $15.

This thoughtfully compiled volume is dedicated to the memory of the late E. Newton Harvey. Such a dedication is appropriate, not only because that benevolent and brilliant biologist laid many conceptual foundations upon which much of the current rapid progress in bioluminescence is based, but also because so many of the outstanding contributors to this memorial volume are his scientific heirs—his students and their students. The editors as well as the sponsors of the symposium (the Japan Society for the Promotion of Science, and the National Science Foundation) are to be congratulated on the generally high quality of the science presented in these collected papers.

The liaison between Japanese and American scientists is particularly close and productive in the field of bioluminescence. The editors of this volume are to a considerable extent responsible for this scientifically rewarding collaboration, a collaboration that might have been implicit in the work of Harvey, carried out in the 1920's on the lumino-biochemistry of the ostracod crustacean *Cypridina hilgendorfii,* a species abundant in the waters about Japan. One of the outstanding related contributions of this volume is, appropriately, a definitive report of the structure of *Cypridina* luciferin by Kishi, Goto, Hirata, Shimomura, and Johnson. I view with mixed delight the successful application of mass spectrographic cracking patterns to the problem of the structure of *Cypridina* luciferin, a resolution which was in my own hands unsuccessful in providing a unique clue to the structure of firefly luciferin. (This structure was subsequently determined by White, McElroy, and collaborators.)

A complete listing of the topics covered is not feasible in a review of this length. Of particular interest to biologists and biochemists are the considerable progress on *Cypridina* luciferin, luminous fungi, *Noctiluca miliaris,* dinoflagellates, protochordates, luminous earthworms, a freshwater limpet, fireflies, a New Zealand glowworm, and certain luminous shrimps, and the morphological and biochemical studies on the light organs of teleosts. All in all, this is a most worthwhile book and a fitting tribute to Harvey, who would also have been delighted by the surrealistic photograph on the cover—a cleverly disguised New Zealand cave, illuminated by glowworms and diffuse daylight.

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Electronics

Nonlinear Electron-Wave Interaction Phenomena. JOSEPH E. ROWE. Academic Press, New York, 1965. 605 pp., illus. $18.

Nonlinear interaction is a subject which has reached maturity only in the past decade. The need to understand the behavior of microwave devices for large radio-frequency signal levels has motivated theoretical work in the nonlinear regime. The present book is written by a leading investigator, and it should serve as a basic research monograph. It also may find some use as a graduate textbook, although it presupposes a sound knowledge of linear devices.

The treatment is almost entirely theoretical, although some experimental data are quoted in support of certain calculations. The material is related mainly to those devices which utilize an injected particle stream of some type. The nonlinear interaction is between a directed stream and an electromagnetic wave. Particle and wave velocities both small and comparable with the velocity of light are considered. The specific interaction mechanisms considered are pertinent to klystrons, traveling-wave amplifiers, backward wave oscillators, crossed field oscillators, multibeam devices, and electron-beam-plasma devices. As is not the case in a linear treatment, second- and higher-order terms are retained in the appropriate interaction equations. The solutions are usually obtained by resorting to high-speed computers. As indicated by the author, real insight into the interaction phenomena is obtained only through a detailed study of the reams of the digital computer output. Only in a few cases are closed-form solutions available.

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New Books

Abstract Theory of Groups. O. U. Schmidt. Translated from the second Russian edition (Moscow, 1933) by Fred Holling and J. B. Roberts. J. B. Roberts, Ed. Freeman, San Francisco, 1966. 184 pp. $5.

Acoustics. Alexander Wood. Dover, New York, 1966. 608 pp. Illus. Paper, $3.50. Reprint, ed. 2, 1960.

Advances in Control Systems: Theory and Applications. vols. 3 and 4. C. T. Leondes, Ed. Academic Press, New York, 1966. vol. 3, 356 pp.; vol. 4, 334 pp. Illus. $14.50 for each volume. Twelve papers.

Astronautics Year. An international astronautical and military space/missile review of 1965. David Howard, Ed. Pergamon, New York, 1966. 336 pp. Illus. $10.

Basic Microscopic Technics. Ruth McClung Jones. Univ. of Chicago Press, Chicago, 1966. 348 pp. Illus. $6.50. Based on Michael F. Guyer's *Animal Micrology* (ed. 5, 1953).

Brandeis University Summer Institute in Theoretical Physics, 1965. vols. 1 and 2. vol. 1, *Axiomatic Field Theory,* 528 pp. $32.50; vol. 2, *Particle Symmetries,* 703 pp. $35. M. Chrétien and S. Deser, Eds. Gordon and Breach, New York, 1966. Illus. Eleven papers.

Carnegie Institution of Washington Year Book 1965–1966. vol. 65. Carnegie Institution, Washington, D.C., 1966. 642 pp. Illus. $1.50.

Celestial Mechanics. vols. 1 to 4. Marquis de LaPlace. Translated, with a com-

(Continued on page 921)