Astronomy for the Space Scientist

Billions of dollars are earmarked for space research, but few of the people involved can agree on the basic purpose. **Solar System Astrophysics** (McGraw-Hill, New York, 1964. 465 pp. $12.50), by John C. Brandt and Paul W. Hodge, shows most of the reasons for space probing as these reasons are conceived by astronomers and physicists. That is, it shows several frontiers of our knowledge where extra-atmospheric experiments will almost certainly lead to significant advances in astrophysics.

I do not mean to imply that this is a popular book; the authors write in a terse, business-like style, listing the numerical values of constants, specifying units, referring to the most authoritative books and research papers (in a bibliography at the end of each chapter), and getting to the point by identifying dominant parameters in a manner that will endear them to space engineers. By using the words "It can be shown that . . . ," they get through a great deal of astrophysics, with conceptual rigor, in remarkably few pages. For instance, in chapter 2, celestial mechanics and its applications to satellites, moon probes, and comet tails (the 3-body problem) are disposed of in less than 10 pages, in which most of the basic equations are given. Three additional pages are used to treat the advance of perihelion and the stability of planetary orbits.

The next five chapters deal with the sun: the interior, photosphere, atmosphere and corona, magnetic field, and spectrum. In less than 180 pages, the authors cover all types of observations and outline the theories concerning them: luminosity, internal conditions, and nuclear reaction rates; opacity, line strengths, and chemical abundances; convective instability, granulation and magnetohydrodynamic waves; and so on. Tables of important data, such as abundances of the elements in the sun, show differences in the results obtained by different investigators. Recent work on the x-ray and extreme-ultraviolet spectrum, as well as that on the infrared and radio spectrum, is summarized.

Later chapters treat interplanetary gas and dust, comets, meteoroids, asteroids, the moon, and planets and their interiors and atmospheres, including the earth's. Most of the illustrations are diagrams or graphs, but there are several well selected photographs of instruments, solar phenomena, meteors, comets, and the lunar surface (not including this year's Ranger-7 close-ups, however). Tables of data on planets, satellites, the important asteroids, the largest meteorites, meteorite craters, atmospheric escape times, and the like add to the book's value as a reference source.

The coverage of present astrophysical research interest is very near complete. More could be said about disturbances of the earth's magnetic field due to solar wind, and there is nothing about the speculations of Dicke, Weber, and others concerning possible changes in the gravitational constant, possible effects of gravity waves on the earth and moon, use of a laser illuminating a corner reflector on the moon, neutrino detectors, or modifications of the general theory of relativity. Although chapter 1 contains an excellent, abbreviated list of theories of the origin of the solar system (from Decartes's theory to that of Kuiper), no mention is made of theories of the origin of comets.

Solar System Astrophysics partly fills a need long felt by university astronomers for an up-to-date, intermediate-level textbook showing how astronomy hangs together as a subject, defining the core of astronomical knowledge, and showing where the interesting problems of current research lie. In this respect it matches Russell, Dugan, and Stewart's classic two-volume *Astronomy*, first published by Ginn in 1926 but not up-dated since 1945. But to fill this need completely, we must have a similar volume on stellar astronomy, galactic structure, and cosmology.

The rapid developments in astronomy have put severe strains on the unity of the subject and the organization of the profession. Forty years ago spectroscopy tended to split off astrophysicists, 10 years ago it was radio telescopes splitting off the radio astronomers, and now space technology tends to segregate space scientists. The recent National Academy of Sciences–National Research Council report, *Ground-Based Astronomy*, with its joint recommendations for a national effort to provide optical and radio telescopes, demonstrates that astronomy encompasses both astrophysics and radio studies, but that it has not yet made a place for space research. At a recent meeting of the American Astronomical Society's Committee on Education, it was noted that few universities offer a curriculum suitable for students interested in space science—that is, the combination of astronomy, electronics, structural engineering, and biophysics needed to recognize the problems involved in space research. *Solar System Astrophysics* covers almost all of the astronomy needed in such a curriculum.

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Industrial Science

Encyclopedia of Polymer Science and Technology. vol. 1, *Ablative Polymers to Amino Acids*. Herman F. Mark, Norman G. Gaylord, and Norbert M. Bikales, Eds. Interscience (Wiley), New York, 1964. xviii + 893 pp. Illus. $50 (subscription price, $40 per volume).

This encyclopedia is being launched at a particularly propitious time since, in the view of the editors, "a sufficiently secure foundation has now been laid to permit a comprehensive presentation of the basic principles of polymer science and technology." The encyclopedia is not intended to supplant monographs or reviews but rather to present a series of about 450 authoritative articles by specialists from all over the world, which will serve as a unique source of reference in the field. This first volume includes 31 such articles, and the complete encyclopedia is expected to comprise 10 volumes issued during a period of about 5 years.

The titles of the articles are those under which information is most likely to be sought, and the articles are arranged in the following categories: Chemical Substances (such as acrolein polymers, alfin catalysts, and amines); Polymer Properties (such as abrasion resistance and adsorption); Methods and Processes (such as addition polymerization, chromatography, and extrusion); Uses (such as aerospace applications); and General Background (papers that deal with the classification, the literature, and the nomenclature of polymers). The articles in each category are arranged in alphabetical order by title, and interspersed among them are a number of cross-references, also in alphabetical order, thereby making it possible to use the encyclopedia without reference to any classification system.

The contributors are recognized authorities in the fields of their respective articles. Of the 56 contributors to this first volume, 45 are from industry, 8 from universities, and 3 from laboratories of governmental agencies. As one would expect, most of the contributors are from the U.S., but Britain and Germany are also represented.

In order to obtain a broad evaluation of the encyclopedia I asked three members of the staff of the National Bureau of Standards to read articles dealing with subjects on which they had done research. They gave a very favorable account of the encyclopedia for they found the articles thorough, well balanced, and clearly presented. They noted in particular the large number of literature references that follow each article as an indication of the value of the encyclopedia to the investigator who seeks detailed information.

In keeping with the policy of the editors, the individual articles are as self-contained as it is practical to make them; thus, the reader is not required to consult a number of references to obtain essential information. There will undoubtedly be some overlap among articles, but the advantage to the reader will outweigh any saving in space that might have been attained by extensive cross-referencing.

More of the articles in volume 1 deal with chemical substances than with topics in any other category, and the same will probably be true of succeeding volumes. The scope of these articles is illustrated by the following subdivisions under Acrylonitrile Polymers: Physical properties of acrylonitrile; Chemical properties of acrylonitrile; Manufacture of acrylonitrile; Polymerization of acrylonitrile; Properties of polymers and copolymers of acrylonitrile; Processing of Polymers; Uses; Economic aspects; Specifications; Analytical methods; Health and safety factors; and Bibliography. Articles on some other chemical substances follow the same general pattern, while still other articles include relatively large sections on raw materials and manufacturing processes. The article on alkyd resins, for example, includes a considerable amount of information about the commercial production of the resins and their use in the formulation of paints, enamels, and other finishes.

The numerous tables of properties and other critically selected data will be welcomed by the reader who seeks numerical values. It is also gratifying to note that chemical formulas, reactions, and reaction mechanisms are clearly shown in all cases where they are pertinent. Figures are used wherever they are needed to illustrate the text and clarify the presentation, but there is no proliferation of illustrations for the purpose of enhancing the sales appeal of the encyclopedia.

Quite a bit of information is given about current prices, production, and other economic aspects of the plastics industry and related industries. This information will soon be outdated, but I feel that its inclusion is useful and well advised since, in the future, readers can readily obtain data for the intervening years by using the sources cited here.

The presentation throughout the work is as clear as that of a well-written textbook and bears out the editors' statement that particular care has been used in the choice of nomenclature and terminology. Technical jargon has been avoided, and specialized terms have been defined. This in no way detracts from the encyclopedia's usefulness to specialists in the polymer field, but it does greatly enhance its value to the student and the research workers in other fields. Polymer science is now related to so many different fields of endeavor, both academic and industrial, that the encyclopedia will find wide use.

The publishers have done their part by providing an attractive volume with type that is easy to read, good paper, and a binding designed to withstand the many years of use that the encyclopedia will undoubtedly receive.

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Circadian Rhythms

The Physiology of Diurnal Rhythms. Janet E. Harker. Cambridge University Press, New York, 1964. viii + 114 pp. Illus. $3.95.

This book is useful owing to its concise presentation of some general characteristics of circadian rhythms. The suggested explanation of "frequency demultiplication" phenomena in terms of a cycle in the organism's sensitivity to resetting is noteworthy (pp. 35 and 36). Also commendable is the emphasis placed on the desirability of studying rhythms in individuals, as a supplement to population data, to avoid possible pitfalls of interpretation (pp. 46–50).

There are, in the area of my immediate familiarity, instances of inaccurate discussion of the pertinent literature. The studies on the circadian rhythm in nucleic acid metabolism (p. 59) were not performed on liver *slices* in vitro but on liver in the intact animal. Halberg and his associates did not study a circadian rhythm in phospholipid *concentration* in liver (p. 73), but rather the rhythm in uptake of radioactive phosphorus by the phospholipids.

The discussion of the possible role of the adrenal gland in the maintenance of certain circadian rhythms suggests some confusion in dealing with information on the relative importance of the cortical and medullary hormones (pp. 73 and 74). There are also other regrettable inaccuracies and inconsistencies: for example—(i) The reference given at the top of page 14 does not bear on the topic of phase-setting as discussed, nor does that in the last paragraph on page 57; (ii) The ordinate of figure 11 (p. 28) is labeled in a confusing manner—the plus and minus values should be specified as minutes; (iii) The adjective "diurnal" is used in the title and throughout the book interchangeably with "circadian," but common usage of the term "diurnal" (for 24 hours), recognized by the author as ambiguous (p. 3), does not seem sufficient reason for its retention.

The author justly regards circadian rhythms as innate characteristics of biological systems. Her book can be recommended, if not for its bibliography, for its succinct handling of some time-tested aspects of circadian systems.

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