of comet orbits, asteroid rotations, collapsing galaxies, and craterlets on the moon.

Sky and Telescope, a journal with high standards of editorial competence and a wide coverage of astronomy, is attractive to laymen and amateur and professional astronomers alike. Papers from 13,000 pages of it and its predecessors (dating from 1931) were expertly selected by Thornton Page and Lou Williams Page, the editors of **The Origin of the Solar System: Genesis of the Sun and Planets, and Life on Other Worlds** (Macmillan, New York, 1966. 350 pp., $7.95), in order to present this account, which is necessarily speculative at times, of our increasing understanding of the origins of the earth and the solar system. The Pages have provided continuity by inserting numerous appropriate commentaries, especially necessary in a book of this type and on this subject, where many of the contributions are "dated" and need to be put into proper perspective. The book will be enjoyed by all those who enjoy reading *Sky and Telescope*.

Selections of special interest are "How did it all begin," by Henry Norris Russell; "The solar energy spectrum" by Harriet Malitson; "Finding the age of the earth," by Otto Struve; "Barnard's star as an astrometric binary," by Peter van de Kamp; "The origin of comets," by Otto Struve; "Some astronomical aspects of life in the universe," by Su-Shu Huang; and "How can we detect radio transmissions from distant planets?", by Frank Drake.

This last contribution concerns Project Ozma, the controversial observational program of listening for radio signals from possible intelligent life outside the solar system. It seems to me that this program may well have been based on a fundamental misconception. *If* there is such life "nearby" (and one should remember here that only one possible planet has been tentatively located outside of the solar system), it would be almost completely improbable that its level of technology would be within 50 years of ours; it may be at a pre-Stone Age level, or it may be highly developed beyond our wildest imaginings. If the latter, such intelligence would have radio reception and transmission facilities not just billions of times more powerful than ours, but something really "out of this world." Some of our own transmissions, made during the past half century, are spreading out through space and should eventually reach such life—if it is there—and be readily detected and interpreted—there. An answering transmission would be so powerful that it would be readily received without special preparations, and so intelligently put together that its source would be obvious. Perhaps we should just sit down and wait. And perhaps we shouldn't answer!

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Biochemical Engineering

Suichi Aiba (Institute of Applied Microbiology, University of Tokyo) was joined by A. E. Humphrey, a visiting American engineer, and Nancy F. Millis, a visiting Australian microbiologist, in writing **Biochemical Engineering** (University of Tokyo Press, Tokyo; Academic Press, New York, 1965. 339 pp., $15). That the authorship should span three continents is appropriate because the subject draws on the separate disciplines of biology, chemistry, and physics which, like the world, are being drawn closer together. Books like this one can help knit the sciences through practical engineering problems.

The authors properly define biochemical engineering as "concerned with economic processing of materials of biological character or origin to serve useful purposes." Then they promptly narrow the scope of the book to fermentation engineering—that is, the application of chemical engineering to the industrial use of microorganisms. It is the only thorough book on the subject now available, and I believe it will be widely used as a reference source and text book.

In the first chapters, which describe microorganisms and their fermentation pathways, particular attention is given to practical application. These chapters are so valuable that one wishes Miss Millis had participated in the writing of the rest of the book, which suffers from disregard of the underlying biology or biochemistry. On the whole, the subjects treated are the right ones: kinetic patterns of growth and product formation, aeration and agitation, sterilization, special equipment, and control devices. The approach is also correct in that it provides an analytical rather than a descriptive account of the fermentation process. Frequent references to data in the current literature and the citing of worked-out numerical examples aid the reader. A logical innovation is the early discussion of continuous fermentation, even though the technique is not used much in industry.

It is stated in the preface that no mathematical understanding beyond calculus is required, but microbiologists will be confused by engineering quantities (eddy diffusivity, for example) that are not adequately explained in physical terms. Although it is stated that modern theories of mass transfer, which are briefly described, are useful for solving aeration problems, the authors do not provide additional discussion. Even engineers will feel that the mathematical manipulations are often cumbersome. For example, a rather involved discussion of the cumulative age of cells in continuous culture leaves the reader unsure about whether they are older or younger than indicated by their mean retention time in the fermentor. The treatment of batch sterilization of media is unnecessarily elaborate. A practising engineer would either make a linear approximation to the proposed exponential and hyperbolic heating curves, or he would realize that his knowledge of heat transfer coefficients was inadequate and do a graphical integration of measured heating and cooling curves. Neither approach is mathematically very elegant.

The strong point of the book, then, is that it provides a starting point, not that it is a complete designer's manual or student's text. Many new ideas are presented and there are some data from the Japanese literature about which we in the West are too often ignorant. Thus, in many ways it is a pioneering effort.

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"Tree Grasses"

This handsome volume, **The Bamboos: A Fresh Perspective** (Harvard University Press, Cambridge, Mass., 1966. 362 pp., $10) by F. A. McClure, contains a wealth of information, much of it new, that has been distilled from a lifetime of experience in the study of bamboos. Probably no botanist, past or present, has had so intimate an acquaintance with these "tree grasses," in all parts of the world in which they grow, as the author of

this book. His scientific researches on bamboos began in 1924 in China, where he was a member of the botanical faculty of Lingnan University. With the exception of a 4-year period of study in the United States and Europe, and two short furloughs, he continued these investigations in the Orient until 1941. During that period he was able to make numerous field trips into the Chinese interior and to Indochina. A bamboo garden containing more than 600 living plants was also established at Canton. This work was supported in part by the U.S. Department of Agriculture, which he served for a time in the capacity of an agricultural explorer. Since 1941, with his headquarters at the Smithsonian Institution in Washington, D.C., he has carried on field studies of bamboos in many Latin American countries, as well as in India, Pakistan, and several Pacific Islands, including Java and Luzon.

The book is divided into three parts: The Bamboo Plant; Elite Bamboos and Propagation Methods; and Bases of Classification. The subject matter is organized further under seven subheadings, numbered consecutively. In the first part we find (1) Vegetative Phase: The Maturing Plant; (2) Reproductive Phase; and (3) Vegetative Phase: The Seedling. The second includes (4) Selected Species, and (5) Propagation. The topics treated in the third part are (6) Flowering and Fruiting Behavior in Bamboos of Different Genera and Species, and (7) Bamboos from the Point of View of Taxonomy. It seems rather curious that a discussion of flowering and fruiting should be included under the general heading of classification. Such information might more appropriately be considered under the subhead, "The Reproductive Phase." Following the main body of the text, there are two appendices, a detailed glossary, an extensive bibliography, and two separate indices (the first to scientific names, the second to subjects). Appendix 1 is "A generic key to bamboos under cultivation in the United States and Puerto Rico"; Appendix 2 is a list of "Bamboos offered and nurseries offering them in the United States."

The author of this volume is a taxonomist, and for this reason he is primarily concerned with organizing the world's bamboos into a readily understandable system. In pursuit of this objective he has "sought fresh ways of looking at familiar things" and has "challenged established concepts and usages." In some cases he has felt it necessary to adopt new terminology or to modify some of the old. He points out that many plants of this group rarely flower, thus it is often impossible to obtain flowering or fruiting material. Conventional herbarium specimens tend to be fragmentary and frequently are quite inadequate for meaningful determinations. If we are to have a clear understanding of the relationships of this complex group of plants, the author feels, an interdisciplinary approach is needed. In the meantime, however, when study materials are being collected in the field, they can be made in a uniform manner and comparable parts of the plants assembled. As a result of his many years of experience with the group, McClure has come to know which features are taxonomically significant. His discussion of these should serve as a valuable guide to those who contemplate the collection of bamboo study materials.

Perhaps the author's greatest contribution to our knowledge of bamboo affinities is his emphasis on the branching habit as expressed in the rhizome, the culm, and the inflorescence. He tells us that the rhizome systems are of two basic types, and that these and their modifications have considerable taxonomic value. He emphasizes also the importance of the prophyllum, an understanding of which is essential for the correct interpretation of the branching habit, particularly of certain inflorescences.

Although a few botanists in the past have treated the bamboos as a distinct plant family, the author has wisely included them within the Gramineae. Somewhat at variance with current agrostological opinion, however, he considers that the subfamily Bambusoideae consists of bamboos only. Although he mentions that some authors have included within this subfamily grasses of the tribes Streptochaeteae, Olyreae, Phareae, Parianeae, and so forth, he states that these "were excluded from consideration." No explanation is offered. In recent years studies of a fundamental nature (embryo structure, cytology, and leaf anatomy, for example) carried out by a number of different workers, have indicated that these and some other grasses have obvious bambusoid affinities. As a result, a broader concept of the subfamily Bambusoideae is rather generally accepted by students of grass systematics. In view of this, some discussion of these matters by McClure would seem quite appropriate, as well as useful.

This well illustrated and informative volume contains much of general interest. Those concerned with the uses, propagation, and taxonomy of bamboos will find it especially valuable. Botanists who anticipate a trip into areas where the "tree grasses" are common and who expect to make botanical collections would do well to consult this book in advance.

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New Books

Mathematics, Physical Sciences, and Engineering

About Vectors. Banesh Hoffmann. Prentice-Hall, Englewood Cliffs, N.J., 1966. 144 pp. Illus. Paper, $4.35.

Advances in Chromatography. vol. 1. J. Calvin Giddings and Roy A. Keller, Eds. Dekker, New York, 1965. 408 pp. Illus. Ten papers: "Ion-exchange chromatography" by F. Helfferich; "Chromatography and electrophoresis on paper and thin layers: A teachers guide" by Ivor Smith; "The stationary phase in paper chromatography" by George H. Stewart; "The techniques of laminar chromatography" by E. V. Truter; "Qualitative and quantitative aspects of the separation of steroids" by E. C. Horning and W. J. A. Vandenheuvel; "Capillary columns: Trials, tribulations, and triumphs" by D. H. Desty; "Gas chromatographic characterization of organic substances in the retention index system" by E. sz. Kováts; "Inorganic gas chromatography" by Richard S. Juvet, Jr., and Franjo Zado; "Lightly loaded columns" by Barry L. Karger and W. D. Cooke; and "Interactions of the solute with the liquid phase" by Daniel E. Martire and Luigi Z. Pollara.

Advances in High Pressure Research. vol. 1. R. S. Bradley, Ed. Academic Press, New York, 1966. 406 pp. Illus. $16. Six papers: "The design and performance of U.H.P. equipment: An interim report on the tetrahedral anvil apparatus" by J. Lees; "Effects of intense shock waves" by S. D. Hamann; "Effect of pressure on the refractive and dielectric properties of solids and liquids" by E. Whalley; "The status and future of high static-pressure geophysical research" by Robert C. Newton; "Stability of solids under pressure" by Mario Tosi and Tadashi Arai; and "High pressure optics" by Linda S. Whatley and Alvin Van Valkenburg.

Advances in Hydroscience. vol. 2. Ven Te Chow, Ed. Academic Press, New York, 1965. 302 pp. Illus. $13.50. Five papers: "Tsunamis" by W. G. Van Dorn; "Chem-

(Continued on page 1544)