Book Reviews

Stars and Stellar Systems

The study of the internal structure of the stars would seem, at first thought, to be a singularly futile and unrewarding field of endeavor; it is difficult to imagine a more inaccessible spot than the interior of a star. This subject, however, is one of the classical topics in astrophysics, and it has attracted a continuous succession of outstanding astronomers and physicists. Although much of the theory of stellar structure is necessarily highly speculative, there have been some truly solid achievements. Only a short time after Walter Adams obtained the necessarily poor spectroscopic observations of the companion of Sirius, which suggested an average density of the order of 50,000 for this white dwarf, the theory of a degenerate gas was worked out and successfully applied to (of all things) the behavior of electrons in metals at room temperatures. A short time later, studies of the structures of stars of various masses and luminosities strongly suggested that some kind of atomic-energy generation was taking place in these deep interiors, and thus made it almost inevitable that such processes would first be recognized, then evaluated in detail, and finally controlled and used.

This volume, **Stellar Structure** (University of Chicago Press, Chicago, 1965. 668 pp., $17.50), edited by Lawrence H. Aller and Dean B. McLaughlin, is the fifth to appear in a nine-volume compendium of astronomy and astrophysics, *Stars and Stellar Systems*, which is being published under the general editorship of Gerard P. Kuiper and Barbara M. Middlehurst. In this volume, 11 experts discuss, in 11 long chapters, the problems of internal structure, the sources of stellar energy, the origin of the chemical elements, observational and theoretical aspects of supernovae, the nature of magnetic stars, stellar stability, and stellar evolution and age determinations. Three of the 11 authors are products of the Indiana University school of astrophysics. The book should stimulate the increasingly large numbers of nuclear physicists and astronomers specializing in this field, and should serve as a basic reference source for the many more astronomers who are now active in problems associated with stellar evolution.

A few clarifying graphs or figures would have improved some of the almost completely mathematical chapters. I could find no graph of the march of temperature or pressure with the radius for any stellar model, nor a graph of the premain sequence evolution of any star. It would have been useful to have included the H-R diagram of white dwarfs and a graph comparing their masses and radii with theory. No color-magnitude diagram of a globular cluster is given. The only chapter illustrated with photographs is an outstanding one on supernovae observations; this chapter, by Fritz Zwicky and written in his highly personalized style, might more appropriately have been included in another volume of the series. The chapter on stellar opacities, by Arthur N. Cox, combined with the lengthy and detailed opacity tables that Cox and his associates calculated at Los Alamos, should alleviate a serious stumbling block caused by a previous lack of reliable information of this sort.

The study of stellar structure has been strongly stimulated by the development of electronic computers, by the mounting physical data on nuclear cross-sections and opacities (stimulated in turn by the need to thoroughly understand nuclear explosions), and by the observations of the color-magnitude diagrams of globular and galactic clusters. In one sense the theoretical astrophysicists are far behind the observations; it has taken them about 50 years to "find" the main sequence, and most of the rest of the H-R diagram, so important in a wide variety of astronomical investigations, is largely unexplained.

Some of the theoretical knowledge of stellar interiors that is accepted today and seems "safe" may well not be. Four years ago, for example, C. Hayashi published a classical paper which indicated that the premain sequence evolution of stars was quite different from that previously envisioned, and that gravitational contraction times needed to be drastically reduced. One may well wonder just how close to the truth even this new concept may be. Unfortunately, crucial observational data are not being accumulated sufficiently rapidly; there is an appalling shortage of telescopes. The detailed study of globular clusters to the faintest possible limit and the study of the spectra of supernovae and of white dwarfs, for example, have been, of necessity, limited to a very few observers with the Palomar 200-inch telescope.

In this connection it is worth quoting the editors: "From the standpoint of stellar evolution studies, two of the most valuable objects known are the Magellanic clouds. In either of these, one may observe large stellar populations—all at essentially the same distance from us. The most luminous and easily observed stars are those that are evolving the most rapidly. Whereas one may compare only a handful of bright, rapidly evolving stars in any single cluster in our own Galaxy, in the Magellanic clouds one may compare multitudes of stars at almost any given epoch in their evolution. Unfortunately, there does not yet exist a single fully modern adequate telescope in the southern hemisphere! It is fervently to be hoped that these deficiencies in astronomical instrumentation will be remedied soon."

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Geological Sciences

Solutions, Minerals, and Equilibria (Harper and Row, New York, ed. 2, 1965. 465 pp., $14.25), by Robert M. Garrels and Charles L. Christ, deserves a wider audience than its title may attract; any chemist who is striving to understand the behavior of solutions should be intrigued and inspired by the research of Garrels, Christ, and their co-workers in the chemistry of natural waters. Although much insight has been provided, the failure of presently used laws to fully explain such complex systems points

the way toward exciting fields of research.

The complexity of the book itself should warn prospective earth scientists that those who wish to make real advances in the field will require not only the common sense, keen powers of observation, lively imagination, and strong backs of the traditional geologist but a thorough grounding in mathematics, physics, and chemistry as well.

An earlier work by Garrels, *Mineral Equilibria*, forms the core of the present work, which, because of revision and the addition of new material, is about twice the size of the earlier book and is considerably more than twice as valuable.

In addition to the revised discussion of mineral-solution equilibria at 25°C and atmospheric pressure, a chapter on the effect of temperature and pressure variations on these equilibria has been added to broaden the scope of the book. A much expanded discussion of solution chemistry includes such unique material as the role of complex ions in natural waters, surface chemistry, and the use of ion sensitive electrodes for ion activity measurements. Much of this work is based on research by Garrels and his co-workers.

The introductory chapters on the fundamental laws of solution chemistry and the problems at the end of each chapter have been added to make the book more useful as a textbook. The material remains very specialized and is too advanced for the average student who does not have previous training in physical chemistry. Few graduate geology departments could afford the luxury of a course for which this book would be useful as a primary text. The book has little continuity and is arranged more like a symposium volume than a unified work. This is no drawback to its use as a superior reference book.

The individual chapters are very well written, even engagingly so, and include historical notes and complete bibliography. The many illustrations and problems deal with geologic systems and are likely to be more interesting, even to the nongeologist, than the examples used in most textbooks on the subject. The careful editing and high quality of the book are typical of those published in the Harper Geoscience Series.

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Human Genetics

To inform and to recruit are presumably the aims of every textbook. Most manage to serve the former end with greater or lesser competence, but recruitment is quite another matter. Success in this instance is directly proportional to the intellectual excitement the author succeeds in instilling in the reader. Some authors capture the excitement of their sciences; others do not. Maurice Whittinghill has not. Wherein he has failed is not immediately obvious, but one is eminently aware that his book, **Human Genetics and Its Foundations** (Reinhold, New York, 1965. 447 pp., $8.95), is not as entertaining to read as Curt Stern's *The Principles of Human Genetics*, for example, nor does one sense that element of expertness which typifies Knudson's *Genetics and Disease*. These observations notwithstanding, Whittinghill's *Human Genetics and Its Foundations* will undoubtedly find a niche amidst the growing array of useful textbooks in human genetics. It is not, however, a book for the specialist or even the serious student of human heredity. It is more an effort to teach the basic principles of genetics, using illustrations drawn from man, and the general approach might be characterized as "classical."

Whittinghill elects to develop his subject under four headings: Monohybrid Genic Segregation; Regular Chromosomal Behavior; Biological Interactions; and Mutation and Evolution. The nature of the treatment of these major topics is adumbrated by enumerating the chapters in the section Biological Interactions, where one finds chapters entitled "Biochemical pathways from the genes," "Sex influences upon phenotypic differences," "Reduced penetrance and varied expressivity," "Marker genes and disease risks," "Prenatal interactions," and, finally, "Heredity, environment, and phenotype." The material subsumed under each of these chapters, as well as that in the other sections, is, in general, adequately presented and largely error-free. There are, however, certain aspects of the presentation which do not please me. There is, for example, a preoccupation with diagrams that sometimes serve to confuse rather than enlighten. The MN-locus is constantly referred to as the Landsteiner locus—a convention which can hardly be called universal. Moreover, might not the ABO, P, and Rh loci equally well be designated as "the Landsteiner locus"? At a time when the content of human genetics beggars easy comprehension, it is patently unfair to the student to clutter his mind with "regionalisms." Finally, Whittinghill's language occasionally borders on the picaresque, as witness the following remark—"Among the census records of 5,000,000 births there *lurks* a slight influence of the age of the father on the sex ratio of offspring." But, there are a goodly number of fine features associated with the book which warrant mention. For example, the reader is supplied with a large number of problems of graded complexity, and he is directed to a generally well-selected and representative cross-section of the literature, particularly that of the last decade. And clearly, Whittinghill has made a concerted effort to make the book timely.

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The Sugawara Volume

Professor Ken Sugawara, to whom the volume **Recent Researches in the Fields of Hydrosphere, Atmosphere, and Nuclear Geochemistry** (Maruzen, Tokyo, Japan, 1965. vi + 404 pp.) is dedicated on the occasion of his 65th birthday, is a Japanese chemist who has worked extensively in the fields of limnology, oceanography, atmospheric chemistry, and geochemistry, and who has devoted a good deal of his time to international organizations concerned with these disciplines. The editors, Yasuo Miyake and Tadashiro Koyama, and the committee that planned the volume have therefore presumably invited contributions in all these fields, so the range of topics covered is broad.

Among the 25 articles, six deal with limnological subjects. These include two articles on the preservation of chlorophyll derivatives in sediments; one article is by Gorham and Sanger, the other by Belcher and Fogg. The latter is especially significant in that it describes a method for deducing the previous trophic state of lakes from the "chlorophyll"/epiphasic carotenoid ratio of their sediment extracts. It would be worthwhile to test this procedure on lakes of known recent eutrophication. Of the two articles on photosynthesis, one by Saijo and Saka-