Book Reviews

Navigation to Space Probes

Astronomy of the 20th Century. Otto Struve and Velta Zebergs. Macmillan, New York, 1962. 544 pp. Illus. $12.50.

The remarkable progress in astronomy, its accelerated pace, its interaction with other disciplines, and the changes in its practical importance, are all characteristic of our modern technological culture, and all are well displayed in this book, without being degraded to shallow description. The timing of the book's publication is just right—at the close of an era in which astronomy was almost purely academic —and the senior author is one of those best qualified to write such a book. History is seldom written by one who has been so thoroughly and broadly involved. Although the publishers may have gone a bit too far in their advertising claims, "the world's greatest astronomer" telling "what he really thinks about his colleagues," *Astronomy of the 20th Century* is of great interest to astronomers, to other scientists, and to intelligent laymen. The illustrations are good, and they show people as well as astronomical bodies; the style is businesslike, and there are glossaries for the uninitiated, useful references to other writings, an up-to-date appendix on stellar spectroscopy for the professional, and a complete index useful to all readers.

In their preface, the authors identify the last 50 to 60 years as a "Golden Age" of astronomy. Earlier, the profession was devoted primarily to the practical problems of navigation; in the last 5 or 10 years it has again become "useful" in the space age. In the interim, astronomers "sought truth only for its own sake." Whether or not this concept is oversimplified, Struve and Zebergs have produced a clearly worded testament to the far-reaching success of the relatively few research astronomers working between 1900 and 1960 in various parts of the world. Such a bold review reveals the process of scientific advance; it emphasizes the human origin of our accepted world picture. Most astronomers will find in it many facts they have overlooked and a refreshing reminder of how recent much of our astronomical understanding is.

Each chapter traces the development of a technique or a concept over the 60 years: radial velocities from W. W. Campbell's painstaking spectra of individual stars to C. Fehrenbach's recent double-exposure objective-prism technique; photometry from inaccurate visual estimates of star brightnesses to the use of photoelectric cells and the electronic image tube; the full development of radio telescopes that have shown, since 1940, interstellar hydrogen gas and strange sources of radio emission outside our galaxy (though as yet no evidence of intelligent beings radioing us from other planets!). Solar observations are traced from the spectroheliograph to modern balloon and rocket photographs taken from outside most or all of the earth's atmosphere. The book treats a wide variety of theories of the origin of the solar system, the growing idea of stellar evolution (with a useful collation of the lifetimes of stars in various stages of evolution), double stars and mass determinations, Cepheid variables and distance estimates, and the growing concern with interstellar material. From the early photographs of the Milky Way, which show dark markings, through the studies of more general obscuration, to photographs of filmy nebulae (as on the cover of this issue) and spectroscopic analyses, there runs a story of changing concepts based on the fluorescence of gases, shock waves, magnetic fields in plasma, polarization of light due to the magnetic orientation of interstellar dust grains, and the acceleration of free electrons in magnetic fields. In an unintentional parody of human thought, our Milky Way Galaxy shrinks, grows, rotates, and takes shape under the sequence of probing studies reported.

Through all of this, a reasoned balance is maintained remarkably well. The authors have no axe to grind and no personal favorites to aggrandize. Early in the book Struve recognizes that he may be a "dinosaur" repreenting archaic interests and points of view in a rapidly evolving science. If so he has the advantage of being a dinosaur that lived and learned up to Darwin's day. Both sides are presented fairly in several major controversies (such as the 1920 Curtis-Shapley debate on extragalactic nebulae), and major personalities are described in a sympathetic manner. A few significant contributions are emphasized purposely (such as E. E. Barnard's photographs of the Milky Way), after the point is made that they are not properly recognized in the literature. The authors announce that astrometry is omitted, and it is only in the last chapter, on galaxies, that they might be criticized for omissions. Cosmology is scarcely touched upon.

Although *Astronomy of the 20th Century* has neither the format nor the organization of a conventional textbook, it may serve well as the foundation for courses in astronomy or astrophysics at several levels. As an account of how modern astronomy developed through the "Golden Age," it will be both interesting and instructive to elementary students; the appendix and literature references can provide effective reading at much more advanced levels.

The breadth and scope of the book reflect both the nature of the subject and the nature of Otto Struve. Third in a family of eminent German-Russian astronomers, Struve was formerly director of the Yerkes Observatory (University of Chicago), and he created the McDonald Observatory (University of Texas). Later he was director of the National Radio Astronomy Observatory (Green Bank, West Virginia), and he is now associated with the Institute for Advanced Study (Princeton, N.J.), with California Institute of Technology, and with the University of California (Berkeley). It is clear from this partial list that Struve's contribu-

tion to astronomy is far more than his very considerable research in stellar spectroscopy. At the Yerkes Observatory during the 1930's, he gathered an outstanding group of research astronomers and influenced a large fraction of the men now active in the field. He knows their work well, and he has acquainted himself with almost all other significant astronomical activity. His Russian origin provides a valuable link with Soviet astronomers, and he makes the point early in this book that astronomy has proved itself above the East-West political controversies of this century.

Otto Struve's own story, which he used to tell on rare occasions, would make another interesting book, quite aside from the astronomy involved. As an officer in the Czarist army, he barely escaped with his life from the Crimea during the Russian revolution, underwent further risks as a military refugee in Turkey, and literally lost his pants to a "con man" in Constantinople. Then the winds of fortune changed; he received a letter from the Yerkes Observatory, chanced on a man in Constantinople who could translate into Russian the enclosed offer of a job and who loaned him money for the passage, and soon established himself in Wisconsin. The stranger who helped Struve at the critical moment was a Y.M.C.A. official from a small Wisconsin town near the Yerkes Observatory.

It was more than luck, however, that brought such men as Chandrasekhar, Elvey, Greenstein, Henyey, Hiltner, Kuiper, Meinel, Morgan, Strand, and Strömgren to the Yerkes Observatory. Building on an effective tradition, and seizing on a variety of opportunities, Struve made the Yerkes Observatory a leading center of astrophysical activity at a time when American astronomy was pre-eminent. Earlier than most he recognized the significance of interstellar material and of variations in cosmic abundance of the chemical elements. In the early 1930's he learned that the University of Texas had received a bequest for a large telescope and an astronomical observatory, although there were then no astronomers at that university to plan and use such an instrument. Out of this situation, Struve devised the McDonald Observatory, located it in the high, dry Davis Mountains of Texas, and equipped it in 1938 with an 82-inch reflector, then the world's second largest. It was promptly put to work by Yerkes astronomers and by visitors from many other parts of the world.

In *Astronomy of the 20th Century* Struve has used his ingenuity and broad knowledge to pull together the many growing ideas of astrophysics, showing not only *what* has been discovered in the past 60 years, but *how*.

THORNTON PAGE
Van Vleck Observatory,
Wesleyan University

Geography and Resources

Soviet Potentials. A geographic appraisal. George B. Cressey. Syracuse University Press, Syracuse, N.Y., 1962. xvii + 232 pp. Illus. $5.75.

There is a constantly growing demand for authentic information about the Soviet Union. The language barrier remains an imposing one, and the supply of Soviet publications does not yet meet the need, at home or abroad. The specialist often wishes to see the work in his own field against a background of the country as a whole. Those fortunate enough to visit the Soviet Union require some preliminary briefing, and the growing number of college courses on the country need up-to-date introductory texts.

George Cressey has provided a book that should meet most of these requirements. In little more than 200 pages he has somehow managed to distill the essence of that country's geography and to combine with it the wisdom acquired by 40 years of study and teaching. And as a former resident of China, he is able to view developments from both East and West. *Soviet Potentials* is the outgrowth of three earlier books on the U.S.S.R., but it has the great advantage over its predecessors of including statistical and other material released during the post-Stalin period.

The author's theme, put briefly, is: Does the Union of Soviet Socialist Republics have the environmental potentials with which to become the world's leading state? During his search for an answer, three main ideas are predominant—the continentality of the U.S.S.R., the physical handicaps of the country's environment, and the vast mineral resources with which it is endowed.

In ten chapters, Cressey assesses the land itself, its varied peoples, its agricultural resources, and the system under which these resources are used; he then provides regional descriptions of Soviet Europe, Middle Asia, Siberia, and the Far East. One chapter touches on international relations, with a particularly valuable, if all too brief, discussion of the future of Soviet policy toward China. The appendix contains a wide range of recent statistical material; the illustrations are many and excellent, and there are adequate maps. The list of selected readings in English is sufficient for the general reader and for introductory college courses.

How, finally, does Cressey appraise the potentialities of the U.S.S.R.? In this case, as in the case of any "thriller," the reviewer should not reveal all, but let it be said that Cressey's conclusions are possibly a shade less assured than in the earlier volumes. One wonders whether even so expert an observer has not been taken a little by surprise at Soviet economic and social progress in recent years. However, "burying" the United States is not in the cards. On balance, it seems that, irrespective of its form of government, the land of the Soviets is unlikely to match in material strength and individual welfare either Western Europe or North America.

TREVOR LLOYD
Department of Geography,
McGill University, Montreal, Canada

Emphasis on Physiography

Great Britain: Geographical Essays. J. B. Mitchell. Cambridge University Press, New York, 1962. xii + 612 pp. Illus. $7.50.

This collection of essays will inevitably be compared with *Great Britain: Essays in Regional Geography*, edited by A. G. Ogilvie and published in 1928. The early essays marked a milestone in the history of British geography, for they represented work by many of the younger geographers only recently appointed to newly established geography departments within British universities. With the exception of work by Emeritus Professor Kinvig, who also contributed to the Ogilvie essays, the present essays are by second or third generation British geographers, and it is only natural to enquire about the geographical progress made in the last 25 years. Were