ence could develop only when men began to restrain themselves not to ask general questions, such as: What is matter made of? How was the universe created? What is the essence of life? They had to ask limited questions, such as: how does an object fall? . . . Instead of asking general questions and receiving limted answers, they asked limited questions and found general answers." This is nowhere more evident than in the particle physics of today; one has to ask limited questions first about a huge number of experimental facts of a huge number of new particles. The theoretical physicist at times has to stay close to the experiment, without abandoning his search for more general relationships. Thus it is good that this volume also includes lectures on experimental results by P. Franzini, J. Lee Franzini, G. A. Snow, S. Focardi, and V. Meyer-Berkhout.

The Tokyo lectures contain rather brief expositions of a variety of lectures and a larger review by R. E. Marshak on the "Present status of weak interactions." Other topics dealt with are *S*-matrix theory (G. F. Chew), the *S*-matrix at very high energy (L. Van Hove), high-energy behavior of the forward scattering amplitude (T. Kinoshita), and the effects of hadrons on the hyperfine structure of hydrogen (Y. Nambu). There are in addition three papers on symmetries, by Y. Ne'eman, S. L. Glashow, and S. A. Bludman.

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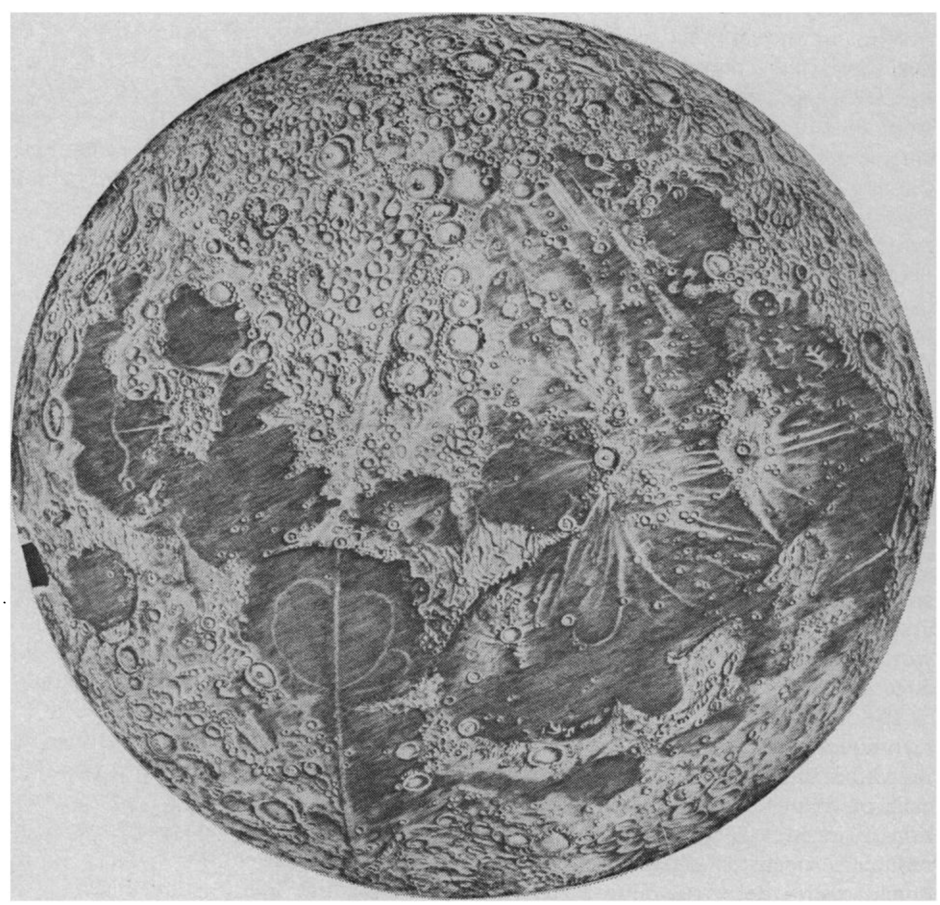
Lunar Astronomy

An Introduction to the Study of the Moon. ZDENEK KOPAL. Reidel, Dordrecht; Gordon and Breach, New York, 1966. 476 pp., illus. $27.50.

Kopal's book is in four parts. Part 1, with six chapters, covers the mechanics and dynamics of the moon regarded as a rigid body in space. It includes the celestial mechanics of the moon's rotational motions but barely touches the orbital problems. The significant problems of distance and mass of the moon are treated in terms of the latest radar information. The second section considers the theory of the moon's interior. First comes the classical hydrostatic theory of Clairaut and his successors; next the thermal history, as it has been treated by Levin, MacDonald, and others; then the stress history; and then what can be surmised about the chemical composition. The third part, on the topography of the moon, includes several chapters on the technical problems of setting up a coordinate system and mapping the moon. There follows a description of the kind of formations which are seen on the moon and some discussion of the origin of the lunar formations in terms of both impact and volcanic theories. In the fourth section, the nature of the lunar surface is deduced from the usual four sources: its photometry (including polarization and color), its thermal behavior, its radiation in radio frequencies, and its radar properties. There follow discussions on the somewhat speculative luminescence properties. Finally, the implications of the previous work are summed up in two chapters on the structures of the lunar surface and the origin of these structures.

The scope of the book is remarkably comprehensive, from gravitational librations to radar reflectivity. This reflects the fact that Kopal is a skillful mathematical physicist and enjoys complexities. Few readers can go straight through this book. Most will have to reconcile themselves to reading only the results in most chapters and reading thoroughly those mathematical sections where they have special interests.

Comparing Kopal's with a book such as Baldwin's *The Measure of the Moon* (University of Chicago Press, 1963) one notices, on the positive side, the aforementioned mathematical facility; on the negative side, one sees that there is no discussion of the recent work on impact metamorphism. The names of E. C. T. Chao and C. S. Beals are nowhere referred to, nor is there any discussion on the significance of the discoveries of coesite and stishovite or the Ries Kessel or the Canadian impact craters. The analysis of the lunar grid system by Fielder is not discussed. One has the feeling that in terms of a physical understanding of the lunar surface, Kopal's book is not as far ahead as it is in his grasp of the mathematical intricacies.



Map of the moon, 1680, by J. D. Cassini, engraved by C. Mellan. This is one of the earliest maps. South is at the top, as was the convention at the time. [From *An Introduction to the Study of the Moon*]

The book lacks a subject index. It is also defaced by a remarkable number of misprints and misspellings, and the punctuation is sometimes definitely misleading.

This book will be useful for persons at the graduate level in astronomy or planetology and for professional students of the moon. Others will be able to find valuable summaries of the problems. As we would expect from Kopal, there are beautiful pictures. On page 205, there is a remarkable set of prints illustrating the value of overexposed photographs for exploring the topography near the terminator. There is a whole chapter devoted to ancient maps of the lunar surface, one of which is reproduced here.

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Solar Physics

A Guide to the Solar Corona. DONALD E. BILLINGS. Academic Press, New York, 1966. 333 pp., illus. $14.

Work of the past decade has shown that the sun's outer atmosphere or corona is far more extensive and dynamic than it appears when visible to the naked eye at total solar eclipse. It extends with appreciable density at least as far as the earth's orbit and is expanding continuously into interstellar space. Not only is the earth imbedded in the sun's outer corona, but most of the phenomena that occur outside the earth's atmosphere in the vicinity of the earth are driven by events that occur in the inner corona close to the sun. Thus it is natural that the growth of geophysics and space science has greatly stimulated interest in the solar corona and not surprising that this book should be directed specifically to "the space scientist or engineer who is not a specialist in Solar Physics but whose work requires a fairly detailed knowledge of the corona."

The first part of the book deals with techniques of observation and the way in which the corona is manifested by each of these techniques. Special attention is given to practical problems of reducing spectrophotometric data obtained with the coronagraph and at total solar eclipse. The next three chapters develop the physical processes at work in the corona. It is this section that makes the book so self-contained. Included are collisions, ionization, excitation, and the variety of ways in which a hot plasma in a magnetic field can radiate. Hydromagnetic theory is presented in a terse but clear outline and then applied to the basic problems of coronal structure and heating. The third section of the book considers models of coronal structure—the distribution of density, temperature, and magnetic field—with emphasis on the observations.

Solar phenomena are so interrelated that it is difficult to describe one aspect of solar activity without being drawn into a discussion of the whole. Billings has made the final portion of the book, dealing with the relation of the corona to other activity (prominences, flares, and geophysical events), deliberately brief. Indeed, the entire book is written with careful economy and is just what the title implies. The careful reader will be led to the frontier of current coronal research and to the current literature. The book is an ideal text for a graduate course in coronal physics, but it will also be read with great interest by all solar astronomers. Not all readers will agree with all of the interpretations or with the emphasis, but this is to be expected of an up-to-date book by a leading expert in a rapidly developing field.

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High-Temperature Stars

The Early Type Stars. ANNE B. UNDERHILL. Reidel, Dordrecht; Gordon and Breach, New York, 1966. 296 pp., illus. $19.50.

"Early type stars" is astronomer's jargon for high-temperature, usually very luminous, young stars that define spiral arms in our galaxy and are associated with clouds of interstellar dust and gas. As stars go, these massive, hot objects are short-lived. They evolve into yellow or red supergiant stars and disappear from the scene in a length of time which is small compared with the earth's age; hence they are valuable for stellar evolution studies and theories concerning the formation of stars from the interstellar medium. The great luminosities of the brighter early-type stars enable them to be detected at great distances. Because of their high temperatures, they produce a copious source of ultraviolet radiation that ionizes clouds of hydrogen in their neighborhoods. These ionized hydrogen H II regions are among the best indicators of spiral arms in our galaxy. Early-type stars appear in, and are useful as distance indicators for, neighboring galaxies that contain interstellar material. More important, these stars help calibrate other criteria (such as H II regions) that can be recognized in much more distant galaxies.

The Early Type Stars is a book that every serious student of galactic structure and stellar spectroscopy will want to have on his shelf. Anne Underhill, who has made distinguished contributions to our knowledge of these objects, has done a valuable service for astronomers in summarizing what is known about them. She discusses their spectra, distances, motions, spatial distribution, appearance in binaries, atmospheres, and other pertinent topics in careful, critical perspective. If the narrative seems to lack conciseness here and there it is because Underhill has tried to be scrupulously fair in presenting views and results obtained by various workers. She has confined her attention to the luminous early-type stars associated with the spiral arms—Baades' stellar population type I—and has not treated the hot stars associated with the Baade type II population, objects such as novae and the central stars of the so-called planetary nebulae.

One is impressed by the many problems that remain to be solved in spite of the effort that has been expended in studies of the hot stars. Throughout our galaxy, these objects tend to occur in relatively small groups—very few of which present samples statistically adequate for fundamental studies in stellar evolution, for example. Some of the best aggregates, such as the Scorpio-Centaurus association, are very unfavorably placed for northern observers. Little is known about the hot luminous stars of the southern Milky Way. But the real opportunities for fundamental studies of the intrinsic luminosities and evolutionary histories of early-type stars lie in the nearest of all galaxies, the Magellanic clouds. Underhill has defined the problems for us; it now remains to get an adequate number of telescopes in the Southern Hemisphere to solve them.

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