

BOOK REVIEWS

Physics and Astronomy of the Moon. Zdeněk Kopal, ed. 538 pp. Academic Press Inc., New York, 1962. \$16.50. *Reviewed by Otto Struve, University of California, Berkeley.*

DR. Kopal and the Academic Press have produced an intensely interesting volume on the Moon at a time when lunar studies are attracting a rapidly growing number of astronomers and space scientists. Thirteen chapters written by leading authorities in each field range from the theory of the Moon's motion (by D. Brouwer and G. I. Hori of Yale University) to the "Origin and History of the Moon" (by H. C. Urey of the University of California at La Jolla). V. G. Fessenkov of the Soviet Union writes on "Photometry of the Moon"; A. Dollfus of France discusses "The Polarization of Moonlight"; F. Link of Czechoslovakia contributes a long chapter on "Lunar Eclipses"; J. F. Grainger and J. Ring of Great Britain discuss the evidence of "Luminescence of the Lunar Surface"; and W. M. Sinton of the Lowell Observatory writes on "Temperatures on the Lunar Surface".

Of special interest are E. M. Shoemaker's (of the US Geological Survey) chapter on "Interpretation of Lunar Craters" and Kopal's (of Manchester, England) "Topography of the Moon". The next to the last chapter, by J. V. Evans (of the Lincoln Laboratory, MIT) is entitled "Radio Echo Studies of the Moon".

The present "fluid" state of our knowledge of the Moon may be illustrated by two fairly recent lunar "events". The more recent one occurred on September 13, 1959—"a memorable date in the annals of human endeavour", to use Kopal's description of it in his preface—when a Soviet rocket "crash-landed on the surface of our satellite". There are some, apparently reliable, observations made at at least two European observatories (not in the Soviet Union) that suggest the appearance of a small cloud of dust at the point of impact. This is not discussed in the present volume, and more observations of future "crash-landings" will be required to remove all doubt.

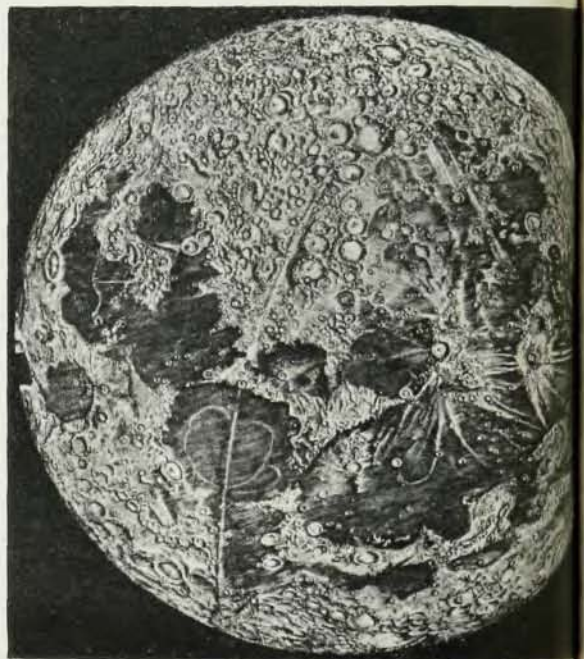
The other "event" is connected with a revival of the hypothesis that small amounts of gas may leak out of the lunar surface layer and cause observable effects. Dinsmore Alter reported some years ago that the bottom of the crater Alphonsus has at times a hazy appearance—as though a thin layer of gas caused an appreciable amount of light scattering. More recently, especially on November 3, 1958, the Soviet astronomer N. A. Kozyrev obtained an emission spectrum from the central cone of Alphonsus. A chapter by Kozyrev entitled "Physical Observations of the Lunar Surface" describes his results.

The work by Alter and that by Kozyrev has been criticized by several distinguished lunar experts, and

enthusiastically endorsed by others. G. P. Kuiper (who has not written for Kopal's volume) was at first highly critical of Kozyrev's observations; but after having met Kozyrev in Leningrad and having seen his spectrograms, Kuiper has reversed his stand. Urey and Kopal, among others, accepted Kozyrev's results from the start. With regard to Alter's work at Mount Wilson, Kozyrev (who was apparently influenced by it, or at least aware of it, when he started his spectrographic



Two views of the moon—three centuries apart. Above: synoptic view (after Urey), a product of photographic techniques; below: map of the moon published in 1680, an engraving based on observations made by Cassini. (From the book, *Physics and Astronomy of the Moon*.)



observations) says: "Even the effect itself, noted by Alter, might easily be called into question."

Similar doubts have been raised and undoubtedly will be raised for some time to come concerning the reality of the luminescence of the lunar surface. The final section of the chapter by Grainger and Ring states that "several distinct characteristics of moonlight all point . . . to the existence of luminescent regions. . . ." Taken individually, different observational procedures seem to leave much to be desired. Nevertheless, the results by these authors constitute a good beginning in a novel, and therefore somewhat difficult, observational study.

Astronomical Techniques. W. A. Hiltner, ed. Volume 2 of Stars and Stellar Systems, edited by Gerard P. Kuiper and Barbara M. Middlehurst. 635 pp. Univ. of Chicago Press, Chicago, 1962. \$12.50. *Reviewed by Cecilia Payne-Gaposchkin, Harvard College Observatory.*

THE broadening scope of astronomy is a result of the application of new techniques. Electronics, the high-speed computer, the rocket, and the satellite are transforming the "oldest of the sciences" into a group of highly specialized fields. Several series of astronomical compendia are filling the need for acquainting astronomers with the results that have been obtained in these very diverse areas.

The inclusion of a volume devoted to the techniques themselves is a most welcome feature of the University of Chicago series. The two dozen articles were written by practicing experts, most of whom have themselves been responsible for the development of the equipment they describe.

The volume has a twofold value. It conveys an understanding of the nature of the observations on which the new astronomy rests. It also contains invaluable practical details, and advice on the use of the techniques, which will stimulate other astronomers to make use of them and will make for a realistic understanding of their applications and possibilities.

Not all of the techniques discussed are new in themselves. Those sturdy foundations of astronomical observation, spectroscopy, spectrophotometry, photographic photometry, and photographic astrometry are presented and described in their most modern forms. The newer field of photoelectric photometry is thoroughly covered, and chapters are devoted to the image converter, the television camera tube, and the spectrum scanner. The measurement of magnetic fields and polarization are discussed, and there is a chapter dealing with infrared instrumentation.

Two phases of modern instrumentation are omitted, or covered in a limited way, but it would be a carping critic who belittled the volume on that account, for to include them in a book of reasonable dimensions would have been impossible. The preface indicates that the coverage is confined to "earth-bound techniques"; none of the chapters deals with rocket or satellite astronomy,

but a comparable volume would have been needed to do justice to the subject. The same can be said of the astronomical applications of high-speed computers, which are, however, represented by a discussion of their use in photoelectric reductions.

Astronomical Techniques is a valuable work of reference, both for those who wish to appraise the data of modern astronomy, and for those who are concerned with making additions to those data.

Fundamentals of Celestial Mechanics. By J. M. A. Danby. 348 pp. The Macmillan Co., New York, 1962. \$8.00. *Reviewed by T. Teichmann, General Dynamics Corporation, General Atomic Division.*

CELESTIAL mechanics is among the oldest of the sciences, and although its methods are basic to astronomy, and replete with mathematical interest (and complication), it had fallen out of fashion till the last few years, perhaps because its main applications were rather stereotyped and beyond human control. The advent of artificial satellites and the impending prospects of space travel have changed this and extended interest in the subject. While the problems of astronautics transcend those of celestial mechanics, they arise from the same foundation, and a sound understanding of the bases of celestial mechanics is necessary in order to proceed very far in astronautical investigation. Danby's book is well adapted to provide such a basis though it was not written with that aim particularly in mind. Starting with an introduction of relatively elementary astronomical and mathematical notions (vectors, particle mechanics), it proceeds through central orbits, extended bodies, and the two-body problem, to orbit determination, 3- or n-body problems, numerical procedures, and perturbation methods. The final chapters deal with the motion of the moon and the earth with particular reference to perturbations and internal motions (extended body effects). There are some useful appendices on conics, physical constants, and series occurring in orbit calculations.

The discussion is clear, and where necessary extended, and though the introductory part is elementary, the end of the book is not. The book does not pretend to be other than an advanced undergraduate or beginning graduate textbook and, as such, meets its aim in a palatable and useful, if not inspiring, manner.

Proceedings of the Rutherford Jubilee International Conference, Manchester 1961. J. B. Birks, ed. 856 pp. Academic Press Inc., New York, 1961. \$32.00. *Reviewed by Evans Hayward, National Bureau of Standards.*

A NUCLEAR physics conference to commemorate the fiftieth anniversary of Rutherford's discovery of the atomic nucleus was held in Manchester from September 4-8, 1961. This thick volume is the complete record of that conference. At the time of the conference, each delegate received copies of the texts of the