cludes the page number of the description. To date the format of treatment has been kept fairly consistent, despite the fact that several collaborators have contributed to the work.

Although this series of volumes will be of the greatest utility to Coleoptera specialists and amateurs and will be a classic in future years, it should also be widely used by identifiers, ecologists, and zoogeographers.

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Modern Lunar Research

A Fundamental Survey of the Moon (McGraw-Hill, New York, 1965. 157 pp., $4.95), by R. B. Baldwin, is the second volume of the McGraw-Hill series in astronomy; the series is intended to supply new material to undergraduate majors in astronomy, physics, and space science. The volume is also Baldwin's third book on the moon.

His first book, *Face of the Moon* (1949), made a deep and lasting impression on our thinking about the origin of the lunar craters and dark maria, establishing for the first time satisfactory qualitative and quantitative correlations between these features and their postulated terrestrial counterparts. Baldwin did not originate the meteoritic impact theory, but he certainly made it very respectable. His *Measure of the Moon* (1963) is an updated and amplified version of the earlier book.

The two earlier works are mentioned to make clear Baldwin's position in lunar research and because he has drawn on them for materials and mode of exposition. The latter is perhaps a little unfortunate, since the propagandist tendencies, appropriate enough in these earlier works, are rather out of place in a text for undergraduates.

The book includes well-organized chapters on the lunar orbit, the tides, tidal friction and the shape of the moon, the major surface features, the origin of the lunar craters, the origin of the maria, the birth of a meteoritic crater, the surface temperatures, the optical characteristics of the surface, changes on the moon, the lunar atmosphere, and the Ranger photographs. I could find no discussion of the moon's thermal history, a topic that certainly belongs in a book of this kind. The bias mentioned above appears only in those chapters that bear on the mode of origin of the surface features. Because the author's principal tenets are generally accepted, I do not consider this occasional subjectiveness a real drawback.

The chapter on the moon's origin is excellent even if, as dictated by the present state of our knowledge, it does not lead to a definite conclusion. I wish that the discussion of the moon's figure had been written in the same vein, since contrary to Baldwin's ideas, we still do not know how the moon acquired its shape. Baldwin's identification of the earthward elongation of the moon as a fossil tide will not do, since the known ratio of the differences of the moments of inertia is not consistent with the solidification of the moon as a synchronous satellite of the earth.

Each chapter closes with a short list of problems for the reader. There is a useful eight-page glossary which, however, is not flawless. The definition of *maria* may be correct but is needlessly subjective. The *limb* of a celestial object is the edge of its image, rather than the edge of the object itself. The index is adequate for a book of this scope. The line diagrams are clear and relevant. There are eight photographic views of the lunar surface, and one of these is a Ranger VII picture.

Despite the above criticisms, this book comes close to its stated purpose, for it presents the student with a very readable account of modern lunar research.

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Stars and Stellar Systems

Galactic Structure, edited by A. Blaauw and M. Schmidt (University of Chicago Press, Chicago, 1965. 626 pp., $15), is volume 5 (and the sixth volume published) in the 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. The editors have felt, and rightly so, that this volume more than others of the compendium, should help to fill the gap caused by the lack of a good textbook on this most important domain of modern astronomy. The price is so low, thanks to the National Science Foundation, that all graduate students in astronomy can afford the book, and it should be closely and carefully studied by them. Volume 7, *Nebulae and Interstellar Matter*, is now in the galley proof stage; it too should be of special importance, and for the same reason.

Our present picture of the structure of the galaxy is remarkably different from the picture that we had only 15 years ago. Spiral arms have been identified and traced, still in rather hazy fashion, out to distances far beyond the galactic center. This hidden center has been observed and pinpointed by radio observations to within a few minutes of arc, and its remarkable nature has been investigated in a preliminary sort of way. A very thin disk of neutral hydrogen is amazingly flat to distances of 200 million billion kilometers from the center and, at greater distances, is systematically distorted from the galactic plane—which it defines—along a line in the direction of the Magellanic Clouds.

Remnants of many old supernova explosions have been located close to the galactic equator; but recently a number of high-velocity, neutral, hydrogen clouds have been discovered far from the plane, and there undoubtedly are many more such. The interstellar gas, magnetic fields, and cosmic rays are dynamically coupled in ways that are still little understood. A gigantic corona of radio radiation and faint blue stars surrounds the galaxy and may extend to nearby galaxies. We have discovered a few dozen nearby subdwarf stars which have orbits "plunging" into the galactic nuclear bulge. The number of stellar population types has grown from Baade's original two to five—or perhaps more. Stars that were once thought to be all of one chemical composition are now known to be widely different in their chemistry, and those differences are correlated with their kinematics and their ages.

Most of the 23 chapters in this volume are significant contributions to the literature; I will comment on only two of them. In chapter 6 Olin Eggen reviews the evidence for a number of moving groups of stars, a subject that he has made peculiarly his own. A moving group of stars, like a moving cluster, presumably has a common origin in time and place and nearly identical space velocities. In a moving group, however, there is a non-negligible dispersion of the velocity components perpendicular to the galactic plane. Identification of group membership is made from the identical velocity components *in* the plane (within observa-

tional errors), not from a common convergent point. The reality of these groups can be further checked by their H-R diagrams and, in some cases, by the peculiarities of their spectra and of their ultraviolet excesses. If most stars have been born in just a few groups, as seems possible, this would have many far-reaching implications. Eggen's groups, in Woolley's view, are the ghosts of old spiral arms. Identification of new moving groups and of new stars in known groups is greatly hampered by the appalling inaccuracy of the proper motions presently available. For example, more than 27,000 of the 33,342 stars in the *Boss General Catalogue* have proper motions less than 0.01 sec/yr and with probable errors of the order of half that figure. Clearly it is important to take the more than a hundred recent positional catalogs and derive more accurate proper motions, and this is being done. Even more desirable for the future would be the photography of the entire sky with wide-angle astrographs having focal lengths from three to five times longer than those that have been used in the past; this, most unfortunately, is not being done.

Perhaps the most outstanding contribution in the book is Jesse Greenstein's chapter on subluminous stars (chap. 17). This experienced astrophysicist has had continued access to the magnificent and (unfortunately) unique spectroscopic instrumentation available at Palomar. This equipment is ideal for the spectroscopic investigation of faint blue stars and of the faint, nearby stars of large proper motion. Much of his chapter is new and fundamental to our understanding of these objects. One should remember, however, that Greenstein's work has been made possible by astronomers such as Luyten who, during the years, have patiently and laboriously sorted out these unusual specimens—by means of a blink microscope—from tens of millions of ordinary star images. Greenstein lists seven major groups of subluminous blue stars, all of them objects of considerable astrophysical interest. An eighth major group of faint blue "stars" was identified by Sandage after the chapter was written, a group that is even more interesting. These are the extragalactic and superluminous quasi-stellar galaxies, the faintest of which are at the edge of the observable universe. Although there may be more than 100,000 of these objects brighter than 19th photographic magnitude, scarcely a hint of their possible existence can be found in Greenstein's chapter or in Luyten's chapter on blue stars at high latitudes.

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Mathematics

One finds no new subject matter in this book, **The Theory of Sets and Transfinite Arithmetic** (Saunders, Philadelphia, 1965. 420 pp., $10), by Alexander Abian. It is a basic treatment of the classical theory of sets, designed specifically for upper university or graduate students in mathematics. The coverage of the theory is complete and fairly rigorous. In sequence, one finds the study of sets and logic; axiomatic set theory; the algebra of sets; Boolean rings; order relations; equivalence and real numbers; finite and infinite sets and denumerability; similarity and ordinal arithmetic; and the cardinal numbers.

In good pedagogical style, sets and logic are introduced simultaneously with a minimum of symbolic language. All concepts are defined in terms of the fundamental set $\{x, \exists, \epsilon, \sim, V,$ and $(,)\}$. This leads to clarity and simplicity.

The presentation is clear, with the mathematical theory elaborated by descriptive paragraphs which sometimes become repetitive. While making a clear distinction between a theory and a model of the theory, the author does not make a fetish of such metamathematics. The set theory is based on the six axioms of Zermelo-Fraenkel. The real numbers are achieved by a set theoretic development in the common order, cardinal-integers-rationals-irrationals-reals. The treatment of denumerability, finite sets, equipolent sets, and Bernstein's theorem reflects the classical treatment of these topics by Cantor himself. The text closes with a rather voluminous treatment of similarity, ordinality—although ordinal types are not developed—and cardinality.

The book is not for the initiate. For one who has read or used elementary notions of sets, for example, Halmos's *Naive Set Theory*, this is an excellent subsequent treatise.

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Ornithology

In this little book, **Birds Around the World: A Geographical Look at Evolution and Birds** (published for the American Museum of Natural History by Natural History Press, Garden City, N.Y., 1966. 187 pp., $3.95), the author, Dean Amadon, attempts to express in nontechnical language the problems and ideas associated with a study of the distribution and evolution of various kinds and families of birds of the world. Starting with simple questions—for example, "Why does one bird occur only in a very restricted area, while another, fairly similar one has a wide geographic range, or why do some areas have many kinds of woodpeckers while other equally forested places have few or even none"—Amadon goes on to explain how the present picture may be clarified in terms of the past history and evolution of species and of faunas. This is the content of the introductory chapter, properly entitled "First principles."

Several chapters deal with the limiting effects on distribution of physical barriers (for example, land and water), of ecological requirements of individual species (such as vegetational types, food, shelter, and migratory paths), and of other factors (climate and the impact of man's inroads on the environment which has resulted in the disappearance of forests or swamps, or the production of new types of local terrain).

All of this leads to a discussion of how species react (in the long-range, historical sense) to areal movement—what happens when similar species meet, why some species are declining and others are becoming more abundant. Then, on the basis of these individual cases, the author leads into a discussion of the existing distribution of families and higher groups of birds, and, in turn, to a discussion of the distinctive features of avifaunas in several parts of the world, what evolutionary significance these geographic aggregates of higher systematic units may have, and how recently each began or was cut off from others. The discussion terminates with a brief description of life zones, biotic provinces, and biomes.

Throughout, the author has drawn on significant examples from all parts of the world, and his presentation has the clarity and understandability necessary to reach and to inform the lay audience for which it is intended. On