sociated with galaxies can give useful checks. The linearity of the relation between the red shift and the photometrically derived distances gives some confidence about the internal consistency of the cosmological distance scale and also provides a useful method of determining the distance of an isolated galaxy by spectroscopic observation of its velocity; it does not verify the slope of the velocity-distance relation.

Astronomical History

Colin A. Ronan's **Changing Views of the Universe** (Macmillan, New York, 1961. 206 pp. $3.95) is for the serious amateur and student; it is designed to provide a historical background against which the contemporary picture of astronomical research may be compared. Prehistory, early civilizations, Greek ideas, and the growth of astronomy in Western Christendom are well explained and make for good reading, although the book as a whole suffers from a dearth of explanatory drawings and pictures. The stature of Hipparchus, probably the greatest observational astronomer of antiquity, is clearly shown. A good modern biography of this great man would be most welcome. The stagnation of astronomy after the work of Ptolemy is a peculiar affair. A final death blow to Greek astronomical ideas and accomplishments occurred in A.D. 640 when the Mohammedan fanatic, Caliph Omar, ordered the destruction of the Alexandrian library. One might well ask, is it possible for such a thing to happen again?

The importance of the impact of technological developments such as the telescope is well emphasized: for example, "Photography brought the truly achromatic reflector back into favour, and it would be no exaggeration to say that the advent of spectroscopy and photography virtually changed the face of observational astronomy, as well as certainly having a profound effect upon cosmological speculation." It has often been said that technology depends on basic science; the reverse can also be true. Astronomers now study distant stars and galaxies in a variety of new ways because of highly developed and complex vacuum tubes, or multiplier phototubes, or, in the future, rockets.

The last chapter—"The twentieth century"—is unfortunately a real disappointment and mars an otherwise excellent book. A volume entitled *Changing Views of the Universe* should end with an adequate picture of what we *now* know about the universe and of how we learned these things. The great 20th century developments are given in the last 30 pages in vague or scrambled form or not at all. Shapley's great "leap of faith" which drastically changed our viewpoint from heliocentric to galactocentric is not described. The measurement of cosmological distances is not given nor is the greatest observed velocity of recession (now up to 46 percent of the velocity of light). Although there are a considerable number of pages on relativity and English cosmological speculations, there is but one sentence on the Lemaitre-Gamow "Big Bang" hypothesis and little or nothing on current ideas of stellar evolution. The exciting probable future history of the sun for the next 6 billion years is not given; an excellent account of this can be found in Stokley's book. The accomplishments and implications of radio astronomy are poorly presented. Half a sentence is devoted to 21-centimeter (hydrogen) radiation and nothing at all to colliding galaxies or radio signals from Jupiter or to radar contact with the Moon, Sun, and Venus. The definitions in appendix 5 for right ascension, celestial longitude, and stellar parallax are incorrectly given.

Galaxies Again

Harlow Shapley's contributions to astronomy over the past half century are numerous and fundamental. His discovery of the size of our galaxy and of the position of its distant center was one of the truly great accomplishments of this century. Shapley is also a successful popular writer, and his revised edition of **Galaxies** (Harvard University Press, Cambridge, Mass., 1961. 186 pp. $5), one of the Harvard Books on Astronomy, should sell well. In the 18 years since publication of the first edition large new optical telescopes at Lick, Palomar, Pretoria, Canberra, and Harvard Kopje have made notable contributions in this field; some of these are presented in this edition, but a great deal of current progress is omitted. As the author states in the preface, the contributions from radio telescopes, the motions of spiral arms, the new color-luminosity arrays for globular clusters, red-shift details, and new views on the ages and evolution of stars and galaxies are treated briefly or not at all. The new edition includes a number of the recent best photographs taken at Palomar or with the ADH Schmidt in South Africa. The discussion is essentially nonmathematical because, although it has often been found necessary to investigate the solar system with a ten-place electronic calculator, a 10-inch slide rule still suffices for most calculations in the realm of the galaxies.

Summary

Shapley's book is the only one of the seven which will be of substantial assistance in the training of astronomy students at the graduate level. Although a number of excellent advanced monographs are now available or are in the making, textbooks on the junior, senior, and first-year graduate level are sorely needed.

The other volumes will be useful, in one way or another, to students and in informing the general public about astronomy. Both Schneider's and King's volumes will be helpful at the junior-high and high-school levels, and they will also be of interest to the general public. The volumes by Stokley and Inglis will probably find their greatest use at the beginning college level. *Music of the Spheres* is thoroughly enjoyable reading and should become a popular classic. Ronan's book, except for the shortcomings of the final chapter, gives a readable and well-balanced account of astronomical history.

Avian Functional Biology

Biology and Comparative Physiology of Birds. vol. 2. A. J. Marshall, Ed. Academic Press, New York, 1961. x + 468 pp. Illus. $14.

This volume contains 14 chapters, which, together with the 12 chapters of the first volume, offer the reader a comprehensive, carefully selected, and well-presented account of the functional biology of birds. As in the first volume, each chapter deals with a discrete subject and has a useful bibliography which readily enables non-

specialists to pursue further any topic of interest. The chapters deal with the central nervous system, with the sense organs having to do with taste, smell, equilibration, vision, and hearing, with the complex actions and interactions of the endocrine glands and their effect on other bodily functions, with the various problems of sex, secondary sexual characters, and of reproduction, and with those of energy metabolism, thermoregulation, and body temperature. The other topics covered are less often included in physiological treatises, but they clearly have physiological "roots"; these are flight, breeding seasons, migration, long-distance orientation, the nature and analysis of behavior, and demographic aspects of bird populations—such as longevity, sex ratio, territorial behavior, and the natural regulation of population numbers.

The contributing authors are R. H. J. Brown, D. S. Farner, J. A. Gibb, R. A. Hinde, E. O. Höhn, J. R. King, the late G. Kramer, A. J. Marshall, A. Portmann, R. J. Pumphrey, W. Stingelin, and E. Witschi. To them and to those who gave of their time and energy to the first volume of this highly useful compendium are due the continuing gratitude of all who have occasion to use the volumes.

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Modern Physics for Laymen

The Atom and Its Nucleus. George Gamow. Prentice-Hall, New York, 1961, 153 pp. $1.95.

Atomic Physics Today. Otto R. Frisch. Basic Books, New York, 1961. vii + 254 pp. Illus. $4.50.

The Atom and Its Nucleus is both brief and densely packed with ideas. It is carefully organized with a definite continuity that begins with the early chemical evidence for the existence of atoms. The next four chapters present the experiments and the theoretical ideas which led up to the modern view of atomic structure. The development is well handled, within the limitations of extreme brevity.

The two chapters on radioactivity seem less impressive, perhaps because so many others have dealt with this topic on the popular level. The later chapters come alive when the author discusses the atomic nucleus, nuclear reactions, and the great variety of newly discovered elementary particles.

The careful reader who remembers some elementary algebra and elementary physics will find this book a rewarding summary of the highlights of atomic physics. There is very little mathematics, but this minimum is quite essential to the presentation. One can hardly criticize the author for the inevitable defects of a condensed treatment, but one can criticize the publisher for what seems to be hurried production with errors that will trouble the reader. The illustrations, in particular, show signs of undue haste; for example: I think the reader will wonder how the Davisson Germer experiment could produce a circular diffraction pattern. In one or two other cases the caption and the figure do not agree with each other, nor with the text.

Atomic Physics Today is a collection of articles and lectures and is therefore less rigidly organized. It is almost entirely qualitative and requires a minimum of technical background. Several chapters of this book, also, are devoted to developing the modern picture of atomic structure. In addition, Frisch covers such topics as the economics of nuclear power, the biological effects of radiation, and the use of radioisotopes in medical research and treatment. It should therefore appeal to a much wider audience than *The Atom and Its Nucleus*.

Perhaps the most worthwhile part of *Atomic Physics Today* is the section which describes the "hardware" of modern physics. Here the author does a remarkable job of explaining and putting in proper perspective various devices such as the bubble chamber, nuclear emulsions, scintillation counters, and other instruments essential to particle physics. He gives an excellent summary of the techniques of experimental physics, giving proper credit to the vital instruments which enable us to "see" elementary particles, but which are not so glamorous as the well-publicized accelerators.

The chapters on nuclear models and elementary particles are good, but perhaps suffer from being entirely nonmathematical and from making minimum use of illustrations. The concluding chapters present an interesting speculation about the notion of causality in relation to quantum theory and a well-argued justification for basic research. In spite of the limitations of a wholly verbal approach this may be an excellent first book for the adult with no previous exposure to physics.

In summary, both books endeavor to present modern physics to the nonphysicist; they differ in style and content, and each will appeal to a different group of readers.

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Administration in Education

Governance of Colleges and Universities. John J. Corson. McGraw-Hill, New York, 1960. vii + 209 pp. $5.50.

The author of this book, the director for an international management consultant firm, who himself has had broad experience not only in business management but also in higher education as a professor and as a trustee, has investigated the obligations and responsibilities of college and university regents, administrators, and faculties. From a survey of institutions of higher education representative of private, public, and denominational colleges and universities with enrollments varying from 800 to 27,000 students, he has sought to determine how such schools are governed and how their governance might be improved.

The study was made to elucidate the general theory behind decision making in such institutions and to determine at what level decisions are made and how they are carried out. Unprecedented demands are about to be made upon colleges and universities because of the imminent increase in the numbers of students, the necessity of adapting higher education to the needs of modern society, and the need to continue to stimulate creativity.

Governance in colleges and universities differs from that of businesses and industries in that it serves a multiplicity of purposes. It must therefore be more dispersed than that of a typical business. The problems of decision making are carefully analyzed from the viewpoint of the board of trustees, the president, the deans, the department chairman, and the faculties. Among the problems are whether the final authority in matters of education policy should be delegated to the faculty, to what extent the faculty should act as advisors to the president and deans, and whether the president should hold himself apart