# Book Reviews

## Science Education in Australia

**An Introduction to Modern Physics** (273 pp. $5); **Space Physics and Radio Astronomy** (174 pp. $4.25); and **The Universe and Its Origin** (147 pp. $3.75). H. Messel and S. T. Butler, Eds. St. Martin's Press, New York, 1964. Illus.

During the past several years, there has been an enormous increase in the publication of low-priced semipopular books on science. Most of the books are intended for a mixed audience of educated laymen, beginning science students, and science teachers, and they reflect the sudden growth of special programs in science education during that period. Indeed, many are a direct outgrowth of such programs: for example, the Science Study Series is sponsored by the Physical Science Study Committee and the Momentum Books by the Commission on College Physics.

It is becoming clear that a similar ferment in science education is occurring outside the United States. These three books result from one of the new programs in Australia. A series of Nuclear Research Foundation Summer Schools have been held there to help bring teachers up-to-date on recent developments in science. At the summer schools participants attended talks by leading Australian scientists and distinguished visitors from outside the country. The lectures from the third summer school have been edited by H. Messel and S. T. Butler and are published in three volumes: *An Introduction to Modern Physics*; *Space Physics and Radio Astronomy*; and *The Universe and Its Origin*.

The books concentrate on current work in physics and astronomy. *An Introduction to Modern Physics* contains sections on atomic theory, nuclear physics, quantum mechanics, elementary particles, and solid state physics. *Space Physics and Radio Astronomy* discusses radio and visual astronomical techniques, some problems in interplanetary physics, and an introduction to the physics of flight and artificial satellites. *The Universe and its Origin* consists of lectures on cosmology, stellar evolution, the origins of the solar system, and cosmic radiation. Since 15 lecturers contributed to the three volumes, the separate discussions frequently assume different scientific backgrounds. However, anyone with a good command of secondary school physics and chemistry can read and understand almost all of the material. Hopefully, this describes the original audience.

Messel and Butler themselves wrote the longest section of *An Introduction to Modern Physics*. It is a sound survey of the development of modern atomic and nuclear physics. An emphasis on historical background gives the nonprofessional reader insight into the profound philosophical revolution involved in the growth of modern physics. This is reinforced by three extremely well-prepared chapters on quantum mechanics, written by E. E. Salpeter. Salpeter faces up to the enormous difficulty of simplifying highly abstract ideas for an audience with limited mathematical backgrounds. "Some statements I will make, without the use of complex numbers, will be wrong in detail, but the general ideas will be correct." This may offend the purist, but the approach is followed effectively and with complete scientific integrity. In the next three chapters, C. B. A. McCusker gives a brief and straightforward summary of current research on elementary particles. In the last section W. Boas presents a rather disjointed but competent introduction to solid state physics.

*Space Physics and Radio Astronomy* begins with two sections on radio astronomy by E. G. Bowen and B. Y. Mills. R. G. Twiss discusses interferometry techniques in radio and optical work. W. G. Elford describes problems in meteor astronomy and its relationship to upper atmospheric studies. H. G. Rathgeber gives a brief survey of recent information on the earth's radiation belts and speculates on their role in causing aurorae. In the last two sections, P. T. Fink presents an introduction to the principles of aeronautics and astronautics, and D. F. Martyn sketches briefly some problems in space physics. Perhaps because it contains the work of so many different lecturers, this is the least unified of the volumes.

*The Universe and Its Origin* contains a section on cosmology by G. Gamow, prepared in his characteristically clear style, and three chapters on stellar evolution by B. J. Bok. T. Gold reviews theories of the origins of the solar system. C. B. A. McCusker discusses cosmic radiation, stressing primarily the astrophysical significance of the problems of its origins.

All three books contain material that is sound and usually well written. Almost all the lectures are at an appropriate level for active science teachers and most of them will probably prove equally useful to beginning students and laymen with some previous background in the physical sciences. Indeed, many have been televised successfully to a more general audience throughout Australia. The lectures are fairly up-to-date (several references by different authors to colliding galaxies indicate that the lectures are at least 2 years old, but I wish the editors had stated the date of the summer school) and reflect well the scope of recent research in astronomy and physics. Messel and Butler deserve praise for organizing this effective contribution to Australian science education. The three volumes can be used profitably in the United States as well.

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## Modern Chemistry

**A History of Chemistry**. vol 4. J. R. Partington. Macmillan, London; St. Martin's Press, New York, 1964. xxxii + 1007 pp. Illus. $42.

In this final volume of his monumental *History of Chemistry* Partington has set himself a truly Herculean task. In 1000 closely printed pages he attempts to tell the story of the development of modern chemistry. The magnitude of the job can be dimly comprehended if one simply lists what was *not* known at the time the volume begins—that is, about 1800. There was no atomic theory as we know it today; indeed, Lavoisier had rather cavalierly rejected atoms as essentially metaphysical. There were, then, no atomic weights, no theory of definite proportions, no theory of multiple proportions. The very foundations of analytical chemistry were lacking.

There was no adequate theory of the nature of the chemical bond, hence little or no understanding of the very essence of chemical compounds. There was only a slight feeling that electricity had anything to do with chemistry. Electrochemistry was a child of the 19th century.

Organic chemistry did not even deserve the name of "science." It was restricted to the classification of a few organic compounds and their gross analysis by means of combustion products.

Physical chemistry simply did not exist.

In the century and a half covered in this volume, all these areas became the centers of great activity and excitement. The entire structure of modern chemistry was raised, and the chemist himself evolved from the apothecary or empirical metallurgist to a scientist with acknowledged, even enviable, status.

To tell that story, Partington has adopted a method which is not entirely satisfactory. The volume is divided into five parts: The first is largely biographical, centering around the works of Davy, Gay-Lussac, Thénard, Faraday, Liebig, and others. This takes Partington down to the 1860's. He then goes back to the beginning of the 19th century and traces out the history of physical chemistry; in this part, individuals are subsidiary to the main theories and problems with which physical chemists wrestled. Organic, inorganic and radiochemistry are treated in similar fashion. This method undoubtedly reflects the evolution of chemistry itself, for as the 19th century waned, the number of chemists increased greatly—so much so that Partington almost certainly found it necessary to abandon the biographical approach. The disadvantage of Partington's combination of biographical and subject organization is that in the subject-oriented sections people keep popping up in various places so that it is difficult to assess the entire career of an individual, and, in the biographical part, it is sometimes difficult to gain a clear idea of what subject is being considered.

As in previous volumes, Partington reveals his mastery of the bibliographical aspect of the history of chemistry. He lists every major publication of each of the chemists discussed at length. Given the Royal Society's *Catalogue of Scientific Papers* and Poggendorff, however, this aspect is not of so great importance as it was in the earlier volumes. But I did miss thorough coverage of the modern secondary literature; this is what is difficult to come by, and such coverage would have been most welcome.

Again, as in the previous volumes of the treatise, Partington has seen his role as that of a reporter who fairly summarizes the works of his intellectual ancestors. He relies heavily, therefore, on quotations from the original authors, and carefully eschews the role of analyst or interpreter. This has two rather serious disadvantages. We are never really taken behind the scenes but are presented with the finished product. Thus, the *genesis* of new hypotheses, hidden in laboratory journals and notes, is not treated. Nor do authors' words always speak for themselves. In the case of Faraday, for example, Partington's quotations from the electrochemical researches do not reveal Faraday's unorthodox theory of matter, which led him from discovery to discovery. Neither does Faraday's challenge to action at a distance, which marked the beginning of his field theory, receive the attention it deserves. It is merely cited and dismissed.

My criticisms are not meant to obscure the real value of this work. It contains a wealth of information unavailable in any similar volume. Furthermore, it is unique in another sense. No history of chemistry has hitherto come to grips with the wealth of material on the later 19th century and the 20th century. Teachers of the history of science who wish to deal with these most exciting times will be eternally grateful to Partington for having carved the first path through this wilderness of detail. Increasingly, too, it is to be hoped that research efforts in this era will increase, and Partington should be gratified by the knowledge that all future work must start from where he has left off.

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## Moon

**Rectified Lunar Atlas.** Supplement 2 to the *Photographic Lunar Atlas* (Contributions, Lunar and Planetary Laboratory, No. 3). E. A. Whitaker, G. P. Kuiper, W. K. Hartmann, and L. H. Spradley. University of Arizona Press, Tucson, 1963. Unpaged. $35.

This atlas maintains the high standards set by Kuiper and his collaborators in its predecessors—the *Photographic Lunar Atlas* [reviewed in *Science* **132**, 290 (1960)] and the *Orthographic Atlas of the Moon* [reviewed in *Science* **134**, 322 (1961)]. The "duoblack" process of reproduction, which uses two printing plates for each sheet, gives results of superior quality.

Plates from the Yerkes, McDonald, Lick, and Mt. Wilson observatories were again used, with the addition of some new plates from Yerkes and McDonald to obtain more favorable conditions for some of the limb regions. These plates were projected on a precision hemisphere 3 feet in diameter. The projector was placed a distance of 30 to 55 feet from the globe, depending on the plate scale. The camera distance was 4⅔ globe radii, sufficient to cover fields on the moon 30° by 30°, with some overlap between adjacent strips. Each field is presented under three different illuminations: early morning, full illumination, and late afternoon. The clearest photograph for each field is reprinted with the addition of (i) the latitude-longitude grid and (ii) the standard nomenclature adopted by the International Astronomical Union, with amendments and additions that are described in the introduction to the atlas. The longitudes and latitudes for the limb regions are as precise as is possible until we have suitable observations made from spacecraft.

The boundaries of the 30° by 30° fields are shown on the field index sheet, with the visible parts of the polar cap divided into three sectors covering 60° longitude each. This results in a total of 30 fields. The atlas contains 118 different photographs. Nineteen fields are represented by 4 charts each, and 6 charts are used for the remaining 11 fields. The adopted scale is 1:3.5 million, or approximately 55 miles per inch.

The degree to which Kuiper and his associates have successfully removed