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

foreshortening by the rectification process has to be seen to be believed. For example, it is instructive to compare field F3 in the atlas, or in Supplement No. 1, with field F10 in the rectified atlas. What appears to be a single crater foreshortened (Struve) proves to be two overlapping craters (now named Struve and Russell). The rectified view also reveals a new crater tangent to Struve, and this is named after Eddington.

The rectified views become very fuzzy at the limb, but it is surprising how close one must get to the limb before this becomes objectionable.

In summary, this atlas is a piece of magic. The master magicians who have produced it deserve the gratitude of astronomers, astrogeologists, and (eventually) those who will someday stand on the terrain shown on these remarkable photographic charts.

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Low Temperatures

Cryogenics. Michael McClintock. Reinhold, New York; Chapman and Hall, London, 1964. xii + 270 pp. Illus. $10.75.

For the scientist or engineer not already well acquainted with the subject, this is a fine introductory account of the uses of low temperatures.

In a text that examines the motives as well as the methods of low temperature physicists and engineers, the author has made good his claim that "mathematical statements have been included only when they illuminate rather than substitute for physical explanations," but he has also managed to pack in a surprising amount of basic physics and physical metallurgy. A well-balanced view of the entire field of cryogenics has been achieved by the careful selection of topics for discussion, with examples of the basic technology (refrigeration, insulation, and thermometry), unique low temperature phenomena (liquid helium and superconductivity), physical properties of materials at low temperatures (mechanical properties of solids, magnetic phenomena, and thermal and transport properties of materials), and practical uses (the applications of cryogenics). Each chapter contains a useful bibliography, and there is an entirely adequate index—which is in itself an ABC of cryogenic diversity, with entries from "A.I. (artificial insemination) Dewar" to "Zeroth Law of Thermodynamics."

This is not a book to which one would go for details of experimental techniques or for basic cryogenic data, although there are many line drawings, graphs, and tables (not to mention an appendix) of considerable illustrative value.

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Symposium Papers

Boron-Nitrogen Chemistry. A symposium held at Durham, North Carolina, in April 1963. Kurt Niedenzu, Ed. American Chemical Society, Washington, D.C., 1964. x + 330 pp. Illus. $7.50.

In April 1963 an international symposium on boron-nitrogen chemistry was held at Duke University. Thirty-two contributions presented at that meeting are now recorded in *Boron-Nitrogen Chemistry*, volume 42 of the Advances in Chemistry Series. Kurt Niedenzu, a well-known contributor to boron-nitrogen chemistry, edited the volume. Each paper is written by the original contributor and is presented in the format of a journal publication.

There can be little question that the contributors to this volume represent most of the world's leading contributors to the area of boron-nitrogen chemistry. Contributors from Germany are Goubeau and Becher, the distinguished senior members of the Technische Hochschule at Stuttgart. Goubeau reports on the determination of boron-nitrogen force constants of amine-boranes, aminoboranes, and borazines from vibrational spectra. Becher discusses the elucidation of some structural problems in aminoboranes by means of vibrational spectra. Other contributors from Germany are Roland Köster (Max-Planck Institute, Mülheim) and Heinrich Nöth (Inorganic Institute, Munich). Köster and Nöth, who represent the strength of the younger generation in boron chemistry in Germany, are considered two of the most prolific contributors in the world; Köster works more in the general area of boron chemistry and Nöth more specifically in boron nitrogen chemistry. Köster presents here an extension of work in the bisborolanes system which he discovered earlier. Nöth reports on preparations and reactions of the relatively new hydrazinoboranes. From England, Lappert (University of Manchester) reports on the first example of a cyclic 3-coordinate boron-nitrogen ring compound isoelectronic with cyclobutadiene.

Distinguished academic contributors from the United States are Parry (University of Michigan) who reports on amine addition compounds of borane- and tetraborane carbonyl, Lipscomb (Harvard University) who discusses the relation of the structure of $EtNH_2$-$B_8H_{11}NHEt$ to the problem concerning the "covalent radius" of boron, and Dewar (University of Chicago) who presents a review of the chemistry of a new class of heteroaromatic compounds containing boron atoms as components of six-membered aromatic rings. There are many other fine articles by such well-known contributors as Letsinger (Northwestern University), Zimmer (University of Cincinnati), Seyferth (Massachusetts Institute of Technology), and Laubengayer (Cornell University). Rounding out the contributions of organic, inorganic, and physical-organic chemists are the presentations by Kaufman (Research Institute of Advanced Studies, Baltimore), who once again lends the theoretical support of a quantum mechanician in the areas of interest to organoboron chemists.

Except for a few minor typographical errors (for example, Seyferth's name is misspelled in the headings on pages 261, 263, and 265), the material is presented and reads just like typical journal articles. As for the technical evaluation, who can disagree with such a select group on such specific subjects in their area of specialization?

I have one reservation in recommending a book of this type and that reservation involves the question of whether such papers should be published as a book in the first place. Would not all of these fine articles appear just as promptly, perhaps more promptly, if they were published in the appropriate journal or journals? If one is willing to pay $7.50 for 32 bound papers by well-known authors on boron-nitrogen chemistry, then I