Polonium and Its Lower Homologues

K. W. Bagnall, the author of the small but excellent book **The Chemistry of Selenium, Tellurium and Polonium** (Elsevier, New York, 1966. 208 pp., illus. $13), is well known for his research in the field of polonium chemistry. This research stimulated his interest in the lower homologues, selenium and tellurium, and thus qualifies him as an authority on all three elements.

The book is divided into seven chapters, each followed by a carefully selected set of references. The first chapter deals with the discovery and occurrence, the isotopes, and the uses, health hazards, and handling problems of the three elements. Chapter 2 covers their separation, purification, and determination, in a concise and interesting manner. The modifications of the elementary substances, the hydrides, selenides, tellurides, carbonyl compounds, and nitrides are discussed in chapter 3, and chapter 4 deals with the oxides, oxo-acids, sulfides, and sulfur-oxo-acids of selenium, tellurium, and polonium and with the seleno- and telluro-polythionates. The fifth chapter is concerned with interesting aspects of the chemistry of the fluorides, chlorides, bromides, iodides, and pseudohalides. Chapter 6 gives a discussion of the nitrates, sulfates, chromates, phosphates, and other salts formed with oxo-acids. The last chapter gives an introduction to the better-known classes of organo-compounds of the three elements; these include the alkyl and aryl compounds and their halogen derivatives, chalconium salts, organo-oxides, organo-acids, organo-selenocyanates, and some heterocyclic compounds.

I was pleased to see the structural aspects of the elements and their compounds well covered, with the inclusion of many diagrams of molecular structures and tables of crystallographic data. Unfortunately the space group symbols are carelessly set up in quite a number of cases, and this may cause trouble to some readers.

Errors, other than typographic ones, appear to be few. Among those which might be pointed out to beginners are the inclusion of compounds of the type Se_2X_2 among bipositive compounds on page 90, the listing of both selenium and bromine among the decomposition products of $SeBr_4$ at 70° on page 118, and the statement "Optically active selenonium and telluronium compounds in which four different groups or atoms are bonded to the central selenium or tellurium atom are well known . . ." on page 171. However, on pages 168–69 it is correctly stated that selenonium and telluronium salts are "stable ionic compounds," and an ionic formulation for phenylmethylselenetine bromide given on page 169 shows only three bonds to selenium.

I recommend this book highly to those who seek an introduction to the chemistry of these interesting but somewhat neglected elements. The wealth of references supplied should prove useful even to those who are already somewhat familiar with the field.

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Optical Phenomena in the Atmosphere

Observation of the twilight sky not only gives the observer the pleasure of a beautiful and variable natural phenomenon but also provides him with a powerful method for studying the structure of the earth's atmosphere. In **Twilight: A Study in Atmospheric Optics** [Translated from the Russian edition (Moscow, 1963) by Richard B. Rodman. Plenum, New York, 1966. 368 pp., illus. $20] Georgii Vladimirovich Rozenberg has covered the entire range of twilight, and some daytime, sky phenomena in terms of mathematical models of the atmosphere. The book is, however, hard to read for a person who is interested in a single topic, for symbols are used freely in the text and it is sometimes hard to find where a given symbol is defined.

We would expect the volume to become rather controversial, since it exhibits a curious bias. For example, it discounts the evidence for an aerosol scattering layer at 20 kilometers, rejecting the work of Bigg and others. The very strong criticism of Hulbert's researches is to be deplored. On page 252 the author characterizes much of Hulbert's work on the twilight sky as having "ruinously affected further progress," yet his conclusions a few paragraphs later hardly justify this denunciation. Perhaps the author is showing evidence of Soviet conformance to authoritarianism. As young researchers in the 1950's, we were greatly stimulated by our contacts with Hulbert, and we certainly did not feel that his or any other person's conclusions were a proscription on our research activities, as the author seems to imply was the case. On the other hand, Rozenberg may only be setting the scene for his concluding remarks that "it has been the author's aim to rehabilitate the twilight method of sounding the upper atmosphere."

The work is certainly a valuable addition to the systematic study of twilight phenomena as long as one realizes that it may not be as authoritative as its author feels it to be. As a matter of fact, a controversial book may provide more stimulation to new research than one that succeeds in neatly tying up the solutions to all current problems.

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Mathematics

Robert R. Phelps's **Lectures on Choquet's Theorem** (Van Nostrand, Princeton, N.J., 1966. 136 pp., illus. Paper, $2.50) renders more accessible recent work by Gustave Choquet and by various other mathematicians following in his footsteps. The prerequisites are some rudimentary acquaintance with convexity and with functional analysis (Riesz representation, Hahn-Banach theorem, Krein-Milman theorem, and necessary background to these in measure theory and topology).

A good deal of the material consists of applications of particular interest to readers in quite different fields. These include such topics as completely monotone functions, weak convergence, function algebras, ergodicity, and Markov processes. The last two sections deal also with order relations for measures, a topic of interest in statistics, and give suggestions for further reading. Treatment of all these matters is not actually needed, except for illustration, but it helps to give a much richer understanding of the main ideas of the text.

The theorem of Choquet, to which the title refers, is a representation theorem in terms of extreme points and is intimately connected with the concept of Choquet boundary. In important cases, the Choquet boundary is a refinement of the so-called Silov boundary, which in fact is its closure. Both the theorem and its proof have been through several stages, and the lectures stress the version of Bishop and de Leeuw, as well as Choquet's own later version presented at the Stockholm Congress. In particular, the general procedure of transposing problems on representation by measures into the context of function-spaces and Choquet boundaries is aptly referred to as the "Bishop–de Leeuw setup."

Although two sections are devoted to methods of extension to the noncompact case, the main part of the lectures concern representations in what may be called the compact convex case, and the basic theorem is there a sharper Krein-Milman theorem. It can also be regarded as a stronger form of the Riesz representation. Incidentally, the notes discuss not only the existence of a representation, but also its unicity.

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Quantum Mechanics: Applications and Problems

A high-energy experimental physicist, David Frisch, commented to me recently that his graduate students, who were brought up on the electron volt (eV) and leaped over the kilovolt and million electron volt regions directly to the billion electron volt (BeV) regime, frown with a faint glimmer of recognition at the mention of an MeV but register a complete blank at KeV. The comment was made only partly in jest. Even today the bulk of our quantum mechanical knowledge lies in the eV region, and a thorough exposure to this material is extremely useful to students of high-energy and nuclear physics as well as to students of atomic, molecular, and solid-state physics and various branches of chemistry and biology, for it develops a "feel" for such basic concepts as the uncertainty principle and wave functions.

Quantum Mechanics [Translated from the Russian edition (Moscow, 1962) by Scripta Technica. Holt, Rinehart, and Winston, New York, 1966. 547 pp., illus. $11], by A. A. Sokolov, Y. M. Loskutov, and I. M. Ternov, is a graduate-level text dealing primarily with this low energy domain. The translation is a good one. A remark in the introduction notwithstanding, there is only a slight pretense at a thorough grounding in the foundations of quantum mechanics. (Some interesting formal material has been appended by G. Frye.) The emphasis throughout is on applications and problems. Many interesting applications, largely from the field of atomic structure, are worked out in considerable detail; the problems are good, and, with their solutions, take up almost 10 percent of the volume. (The length of time it is taking for worked-out problems to become standard textbook material is incomprehensible to me.)

Many subjects covered in great detail in most modern texts receive scant, if any, attention in this one. Group theory, Green's functions, projection operators, and unitary operators play no role; all of scattering theory is compressed into one short chapter, the Dirac equation is written in its original version rather than in the modern manifestly covariant form, and so on. On the other hand, there is a nice treatment of the Fermi-Thomas model of the atom—what a magnificently simple yet useful model it is—and there are a number of examples from solid state; the Dirac equation in the approximate form appropriate to low-energy phenomena is applied extensively in the study of atomic energy levels, the transition between the quantum-mechanical and classical equations of motion is handled well, there is material on lasers and masers, and so on. Some brief comments on mass and charge renormalization and on recent developments in the theory of beta decay are basically qualitative and serve primarily to whet the appetite.

The brevity of the treatment of the foundations of quantum mechanics renders the book unsuitable as a basic text in a graduate physics course on the subject, but its many applications could make it a useful subsidiary text. (It could also be of value to nonphysicists interested in applications.) It has one serious drawback as a subsidiary text, only partially compensated for by an excellent table of contents, and that is the lack of an index. In the small hope that it will have the desired effect, let me say, mustering all my authority as a member of the educational establishment, that I categorically believe that students have no right to picket university bookstores in protest against indexless texts.

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New Books

Mathematics, Physical Sciences, and Engineering

Adhesion and Adhesives. R. S. R. Parker and P. Taylor. Pergamon, New York, 1966. 148 pp. Illus. $4.

Advances in Bioengineering and Instrumentation. vol. 1. Fred Alt, Ed. Plenum Press, New York, 1966. 372 pp. Illus. $17.50. Four papers.

Advances in Chromatography. vols. 2 and 3. J. Calvin Giddings and Roy A. Keller, Eds. Dekker, New York, 1966. vol. 2, 395 pp., $14.50, nine papers; vol. 3, 285 pp., $11.50, seven papers. Illus.

The Analysis of Nickel. C. L. Lewis, W. L. Ott, and N. M. Sine. Pergamon, New York, 1966. 224 pp. Illus. $8.50. International Series of Monographs in Analytical Chemistry, vol. 28.

Analysis of Numerical Methods. Eugene Isaacson and Herbert Bishop Keller. Wiley, New York, 1966. 557 pp. Illus. $11.95.

The Analysis of Physical Measurements. Emerson M. Pugh and George H. Winslow. Addison-Wesley, Reading, Mass., 1966. 256 pp. Illus. Paper, $4.75.

Applied Boolean Algebra: An Elementary Introduction. Franz E. Hohn. Macmillan, New York, ed. 2, 1966. 287 pp. Illus. $7.95.

Beryllium Technology. vols. 1 and 2. Proceedings of the Second International Conference (Philadelphia), October 1964. Sponsored by the Nonferrous Committee of the Metallurgical Society, American Institute of Mining, Metallurgical, and Petroleum Engineers. L. McDonald Schetky and Henry A. Johnson, Eds. Gordon and Breach, New York, 1966. vol. 1, 690 pp.; vol. 2, 589 pp. Illus. Paper, $19; cloth, $35 each volume. There are 52 papers.

Book of ASTM Standards: With Related Material. pt. 24, *Textile Materials—Yarns, Fabrics, and General Methods* (704 pp. $13; members, $9.10); pt. 25, *Textile Materials—Fibers and Zippers* (654 pp. $12; members, $8.40). American Soc. for Testing and Materials, Philadelphia, 1966. Illus.

Cadmium. D. M. Chizhikov. Translated from the Russian edition (Moscow, 1962) by D. E. Hayler. Pergamon, New York, 1966. 279 pp. Illus. $8.

Calculus of Variations and Optimal Control Theory. Magnus R. Hestenes.

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