TABLE I

	R[1] Substituent[a]	Formula[b]	M.p., °C.[c]	Minimum effective feed level, %	Antithiamine index, C = chick, M = microbiological
I-a	CH_3	$C_{12}H_{15}N_4Br \cdot HBr$	233–234	0.006	270 C 320 M
I-b	C_2H_5	$C_{13}H_{17}N_4Br \cdot HBr$	266–270	.001– 0.002	140 C 345 M
I-c	n-C_3H_7	$C_{14}H_{19}N_4Cl \cdot HCl$	248–249	.003	500 C >1000 M
I-d	CF_3	$C_{12}H_{12}F_3N_4Br$	208	.002	200 C
II-a	n-C_3H_7	$C_{12}H_{17}N_4SBr \cdot HBr$	241–243	.0125	1400 C

[a] R^2, CH_3; R^3, H. [b] Acceptable analyses were obtained on all compounds. [c] With decomposition.

In the same table are presented the results of anticoccidial evaluation with *Eimeria tenella*, obtained by a previously described method.[3] Antithiamine indices for the chick[4] and *Lactobacillus fermentum*[5] also are listed.

Considerable anticoccidial activity was found with the compounds listed. Of these practical interest centers on the compound 1-(4-amino-2-*n*-propyl-5-pyrimidinylmethyl)-2-picolinium chloride hydrochloride (I-c) which has been assigned the generic name of amprolium.[6] In laboratory tests amprolium is effective at 0.0125% feed level against a mixed infection of *Eimeria tenella*, *necatrix* and *acervulina*.

The antithiamine indices of these and related compounds reveal a definite although rough correlation between antithiamine and anticoccidial action. In addition, reversal of anticoccidial action is demonstrated by the fact that chickens on a normal diet are protected against an *Eimeria tenella* infection by 0.0125% amprolium but addition to the diet of 0.003% thiamine causes a marked decrease in protection.

Pyrithiamine is ineffective against coccidiosis at the maximum tolerated feed level of 0.05%, despite a chick antithiamine index of 16. Apparently the absence of the hydroxyethyl side chain in the analogous active quaternary (I-a) is an advantage for inhibition of the target enzyme system, which is possibly protozoal thiamine phosphorylase located at the cell wall.

(3) A. C. Cuckler, L. R. Chapin, C. M. Malanga, E. F. Rogers, H. J. Becker, R. L. Clark, W. J. Leanza, A. A. Pessolano, T. Y. Shen and L. H. Sarett, *Proc. Soc. Exptl. Biol. Med.*, **98**, 167 (1958).

(4) The chick antithiamine index is the number of milligrams of compound calculated to counterbalance the vitamin activity of one milligram of thiamine mononitrate in the chick.

(5) H. P. Sarett and V. H. Cheldelin, *J. Biol. Chem.*, **155**, 153 (1944). *Lactobacillus fermentum* (36 ATCC 9833) was grown in standard thiamine assay medium. Increasing amounts of thiamine, up to 0.2 γ, were added to tubes containing 25 γ of the test compound. Growth was measured turbidimetrically after 16 hours of incubation at 36°. The ratio test compound (25 γ) divided by the quantity of thiamine required for 50% transmittance is given in Table I as the antithiamine index (M). We are obliged to Mr. Hyman Wallick for the microbiological data.

(6) AMPROL is the trademark of Merck & Co., Inc., for this compound.

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BOOK REVIEWS

Landolt-Börnstein. Zahlenwerte und Funktionen aus Physik, Chemie, Astronomie, Geophysik und Technik. Sechste Auflage. Band II. **Eigenschaften der Materie in Ihren Aggregatzuständen.** Teil 6. **Elektrische Eigenschaften I.** Edited by K. H. HELLWEGE and A. M. HELLWEGE. Springer-Verlag, Heidelberger Platz 3, Berlin-Wilmersdorf, Germany. 1959. xvi + 1018 pp. 20 × 27.5 cm. Price, DM. 448.—.

This volume is a compilation of values of the electrical properties of matter. [The editors have announced that electrochemical and magnetic properties will be treated in Parts 7 (1960) and 9 (in preparation), respectively.] The 1018 pages give evidence of the same high level of scholarship and thoroughness that have gone into the preparation of earlier parts of this compendium. The five sections, each prepared by one or more experts, cover the following subject areas: (1) Electrical conductivity of metals and solid ionic conductors, by W. Meissner, F. Schmeissner, R. Doll, M. Näbauer, R. Jaggi and F. Hulliger, 250 pp.; (2) semiconductors, by W. Jost, H. G. Wagner, K. Weiss, H. Welker, G. Heiland, and E. Mollwo, 162 pp.; (3) the elastic, piezoelectric and dielectric constants of piezoelectric crystals, by R. Bechmann, 33 pp.; (4) dielectric properties, by H. Stuart, Th. Gast, W. Maier, A. W. Fink, E. Truscheit, and E. Gast, 459 pp.; and (5) thermoelectric and emission effects, by W. Kluge, J. Nyström and R. Kollath, 109 pp. The extensive tables and graphs of each main section are preceded by a short introduction containing definitions and explanatory material. A complete list of references follows the tabular material.

The section on electrical conductivities of metals and solid ionic conductors covers specific resistance and its temperature coefficient for pure metals and binary alloy systems, resistance ratio relative to 0°C. or other specified temperature, effect of pressure and tension on resistance, Wiedeman–Franz–Lorenz number, superconductivity, galvanomagnetic and thermomagnetic transverse effects, ionic conductivity in crystals, and transport number in solids. The second section deals with properties of semiconductors such as energy gaps, electron and hole mobilities, conductivity or resistance *vs.* temperature, and Hall coefficient *vs.* temperature, and with the effects of doping, imperfections or dislocations on the foregoing properties. In section three, values are presented for the elastic, piezoelectric and dielectric constants of piezoelectric crystals and their temperature coefficients. The forth section, on dielectric properties, is by far the largest. It covers the dielectric properties of crystals and crystalline substances, glasses, plastics, liquid crystals, the elements, and organic and inorganic compounds and their aqueous and non-aqueous solutions. The properties treated include the dielectric constant and its dependence on temperature and pressure; and the molar polarization. The last section, on thermoelectric and emission effects, is subdivided into thermionic emission, thermal e.m.f., Peltier and Thompson effects, and photoemission and secondary electron emission of solids.

The organizational framework of the material by property and by substance compensates in part for the absence of an index. The arrangement of substances within sections is based on a scheme derived from the periodic system. Similar but not identical schemes are employed in the Gmelin "Handbuch," in "Selected Values of Chemical Thermodynamic Properties" (NBS Circular 500), and in "Selected Values of Properties of Chemical Compounds" (Manufacturing Chemists Association Research Project, Carnegie Institute of Technology). Universal acceptance of a single scheme would be advantageous.

The binding and apparent durability of the volumes are above average. The paper is good and the type legible. The tables are well arranged and not crowded. The numerous graphs, although small, are clear and always present experimental data as well as smooth curves. The comprehensive presentation of the original values from the literature and pertinent references is one of the greatest values of this and other volumes of the series.

The literature "cut-off" dates for the five sections of Volume II, Part 6 range from January 1, 1956 to April 4, 1958. Thus, part of the coverage of this active area of science is already four years behind the times. This is not a reflection on the diligence of the editors. The complete revision of a compilation covering all of physical science and technology is a massive undertaking. New editions are necessarily infrequent and long in preparation. The first part of the sixth edition appeared in 1950; the last part will appear in the 1960's. The rate of increase of numerical data makes it improbable that another revision in the same form will be attempted. Science should be grateful for the present monumental revision of Landolt-Börnstein as a holding action in the struggle to keep up with the flow of data produced by modern research. New methods are urgently needed for rapid and continuing evaluation and consolidation of the numerical data of science and technology.

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Advances in Inorganic Chemistry and Radiochemistry Volume 1. H. J. EMELÉUS and A. G. SHARPE, Editors, University Chemical Laboratory, Cambridge, England. Academic Press Inc., 111 Fifth Avenue, New York 3, N.Y. 1959. xi + 449 pp. 16 × 23.5 cm. Price, $12.00.

There is a modern trend to publish scientific review articles in books issued annually instead of in review journals. Since a new book has an appeal which the familiar review journals have lost, publications of reviews in book-form presumably increases the scope of a scientists reading. There are, however, disadvantages to publishing reviews in book-form. Review journals are widely subscribed to by libraries and individuals, articles may be submitted without invitation, and journals have the policy of making reprints available. Reprints allow one to have copies of particular articles for easy reference without being accompanied by a large volume of other material, which represents additional expense to the scientist. Journals are usually sponsored by a scientific society and have continued to be published through periods of economic stress. The present policy of publishing technical reviews in book-form does tend to spread the scientific literature into what is effectively a large number of specialized review volumes. The reviews presented in the present volume are typical of the ones found in review journals.

The editors have selected a set of reviews for this volume that should attract interest in the series. In general the reviews are on subjects pursued actively in recent years and are of interest to research workers in inorganic chemistry. A brief summary will be given of the contents of this volume.

The articles *Compounds of Aromatic Ring Systems and Metals* by E. O. Fischer and H. P. Fritz, Munich, Germany (60 pages), covers the recent research on ferrocene and allied compounds. The preparation, chemical properties and structure are covered in detail along with a discussion of six- and seven-membered ring compounds. The review of W. Rudorff, Tuebingen, Germany, on the *Graphite Intercalation Compounds* (43 pages), discusses another system of compounds in which an atom or molecule is bound to a layer of carbon atoms composing the graphite structure. Graphite oxide, graphite halogen compounds, the intercalation compounds of alkali metals and graphite salts are treated. Aside from the basic inorganic chemistry of these compounds, the article should be of interest to those using graphite in various technical applications. Both of the above articles should be of general interest to chemists.

Two reviews are devoted to structural chemistry. *Recent Studies of the Boron Hydrides* by W. N. Lipscomb, University of Minnesota (39 pages), deals with the structure of boron hydrides, and is written for the specialist interested in these structural problems. T. C. Waddinton of Cambridge, England, *Lattice Energies and Their Significance in Inorganic Chemistry* (64 pages), is a detailed review of the methods of calculating lattice energies, and a summary of the results. This field is highly developed and the review should have a long-standing value in future years. The last comprehensive review of this subject was that of Sherman in 1932. The reviewer feels that this article is of primary interest in the solid state field, and the author's purpose might have been served better by publication in a review journal.

Three contributions to radiochemistry are presented. H. Taube's, University of Chicago, *Mechanisms of Redox Reactions of Simple Chemistry* (53 pages), is a review of electron transfer reactions in solution, a subject that is being actively studied. This article is tedious reading and directed at the specialist. It contains many ideas that should stimulate future work. The paper on *Szilard-Chalmers Reactions* in solids (47 pages), by G. Harbottle and N. Sutin, Brookhaven Laboratory, U.S.A., reviews comprehensively the work in this active field. The theoretical understanding of the phenomenon is emphasized and the discussion is illustrated with experimental results. *Activation Analysis* by D. H. F. Atkins and A. A. Smales, Harwell, England, (30 pages), is very well organized. Trace analysis by the activation method is a branch of analytical chemistry that is rapidly expanding and the method will be exploited in the future. The present review serves as an introduction to the subject and is illustrated with applications of interest to the experienced analyst. The treatment could serve as a basic reference in this subject for a course in analytical chemistry.

A review of the *Phosphonitrilic Halides and Their Derivatives* by N. L. Paddock and H. T. Searle, Birmingham, England (36 pages), discusses a series of inorganic compounds with properties similar to organic compounds. The presentation is written in an interesting manner, and includes a good summary of the physical and chemical properties and a discussion of the structures. The review of R. J. Gillespie and E. A. Robinson, London, England (38 pages), on the *Sulfuric Acid Solvent System* presents an interpretation of the solvent reactions of sulfuric acid derived from solubility, cryoscopic, conductometric and spectroscopic measurements. The review is well written and summarizes the work of the authors on this subject.

DEPARTMENT OF CHEMISTRY
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A Guide-Book to Biochemistry. By KENNETH HARRISON, Lecturer in Biochemistry in the University of Cambridge. Cambridge University Press, 32 East 57th Street, New York 22, N. Y. 1959. viii + 150 pp. 14 × 22 cm. Price, $3.50.

This short book covers in skeleton form such topics in Biochemistry as energy, production, enzymes, proteins, oxidation, photosynthesis, carbohydrate metabolism, fat metabolism, protein metabolism and the control of metabolism. A short appendix has been added to include the structural formulas of various molecules (usually cofactors) which are represented in the text only by names or abbreviations.

The book is intelligently planned and well written, but suffers to some extent from an uneven treatment of important subjects. The high spots of cellular metabolism, including the electron transport system, are very clearly presented. However on the one hand the pentose cycle for glucose-6-phosphate oxidation may be given in more detail than is necessary, while on the other hand the topics of protein synthesis and nucleic acid metabolism, which are fascinating forefronts of present day Biochemistry, are dealt with