

The work of Moldavskii and Nizovdima¹ upon the equilibrium constant for this reaction from 70–150°, combined with the measurement of Montgomery, McAteer and Franke² at 27° furnishes an independent value for the entropy difference of the two isomers. Two of these equilibrium measurements, at 27° (Montgomery) and at 70° (Moldavskii) were made in the liquid phase at pressures of about 3 and 10 atmospheres, respectively. The constants were calculated to the gas phase with fugacity data for *n*-butane³ and *i*-butane⁴ reported by Sage, Webster and Lacey. The assumption that the liquid follows Raoult's law is in accord with the results of Montgomery, *et al.*² The other equilibrium measurements were made in the gas phase by a flow method. The heat of isomerization -2200 ± 200 cal./mole was obtained from the slope of a $\log K - \frac{1}{T}$ plot. Essentially a straight line was obtained, which indicates that over the temperature range in question ΔH is constant to within a small fraction of the experimental error in the equilibrium values. This constancy of ΔH has been confirmed by statistical mechanical calculation.

From the equilibrium data two values of ΔS_{298}°

(1) Moldavskii and Nizovdima, *Compt. rend. acad. sci. U. R. S. S.*, **23**, 919–20 (1939); *Chem. Abs.*, **34**, 931 (1940).

(2) Montgomery, McAteer and Franke, *THIS JOURNAL*, **59**, 1768 (1937).

(3) Sage, Webster and Lacey, *Ind. Eng. Chem.*, **29**, 1188 (1937).

(4) Sage and Lacey, *ibid.*, **30**, 673 (1938).

for the isomerization reaction may be obtained, one using the measured heat⁵ (A), the other using the heat of isomerization from the slope of the plot (B). These two values are compared with our experimental value of ΔS_{298}° (C) in Table I.

TABLE I

ΔS_{298}° cal./deg./mole	$n\text{-C}_4\text{H}_{10}$ (g) = $i\text{-C}_4\text{H}_{10}$ (g)	Source of data
-2.1 ± 0.6	Equilibrium measurement (Montgomery, <i>et al.</i>) ²	Heats of combustion (Rossini ⁵)
-3.7 ± 0.3	Thermal data to 11°K. <i>n</i> -butane submitted for publication in <i>THIS JOURNAL</i>	<i>i</i> -butane, unpublished data
-4.0 ± 0.8	Temperature coefficient of equilibrium constant. Montgomery <i>et al.</i> , ² and Moldavskii and Nizovdima. ¹	

The agreement between (B) and (C) is well within experimental error. There is thus at present no reason to doubt⁶ the practical applicability of the third law of thermodynamics to these compounds.

The assistance of the Standard Oil Development Company in portions of this work is gratefully acknowledged.

(5) Rossini, *J. Chem. Phys.*, **3**, 438 (1935).

(6) Kassel, *THIS JOURNAL*, **59**, 2745 (1937).

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NEW BOOKS

Die exakten Methoden der Mikromassanalyse. (The Exact Methods of Titrimetric Microanalysis.) By Dipl.-Ing. JOSEF MIKA. (Die chemische Analyse. Edited by WILHELM BÖTTGER, Hannover. XLII. Band.) Ferdinand Enke Verlag, Hasenbergsteige 3, Stuttgart W, Germany, 1939. xii + 180 pp. 19 figs. 16.5 × 25 cm. Price, RM. 18; bound, RM. 19.60.

The author limits himself to a discussion of such titrimetric methods as can be applied to samples of approximately 10 microequivalents, *i. e.*, 1 to 10 milligrams of material. As a rule it is tried to attain a relative precision of 1 part in a thousand. Methods giving a relative precision of 10 parts in a thousand are included, however, if they offer practical advantages. Hundredth normal standard solutions are suggested for the use with burets of approximately 1 ml. total capacity, which permit de-

livery and determination of volume with a precision of 0.001 to 0.0001 ml.

In the general part are discussed: the recognition of the end-point with the use of colorimetric, potentiometric, and conductometric methods; the concentration of the standard solutions and the determination and accuracy of their titer; burets, pipets, and aliquot partition; storing of standard solutions; containers for the titrated solutions, stands for titration; apparatus for potentiometric and conductometric titrations; and the testing for purity of the reagents and the water used as solvent. The special part comprises: neutralimetry with the use of dyestuff indicators and of potentiometric and conductometric indication of the end-point; oxidimetry, redox indicators, and electrometric indication; titrations based on the formation of precipitates or complexes with the use of colori-

metric, potentiometric, and conductometric indication. Author index and subject index complete the book.

The treatment of the subject is critical and the problems arising in the small scale performance of titrations are properly emphasized. The book is highly recommended to those interested in the field. Even if the reader should not be willing to agree with the author in all points, he will be compensated by the stimulating originality of the presentation of the subject. The author is a student of Friedrich Emich and he has dedicated the book to his teacher.

A. A. BENEDETTI-PICHLER

Essentials of College Chemistry. By G. H. WHITEFORD, Ph.D., Professor of Chemistry, and R. G. COFFIN, M.S., Associate Professor of Chemistry, Colorado State College. Second edition. The C. V. Mosby Company, 3523 Pine Blvd., St. Louis, Missouri, 1939. 534 pp. 32 figs. 14.5 × 22 cm. Price, \$4.00.

Teachers who do not wish to overwhelm the beginner with discouragingly large reference texts will be interested in this book. At first sight it seems to be an expanded form of carefully prepared lecture notes. The order is the conventional one and the assignments (chapters) are of such length as to encourage further readings. Most of the references are to material in the *Journal of Chemical Education* or *Industrial and Engineering Chemistry*. Historical material and factual data are minimized, allowing each instructor to present material of his own selection during the class and lecture hours or by use of references.

The book has an unusual feature in the inclusion of three chapters entitled "General Review." These review chapters take the form of a series of questions followed by groups of terms under various titles such as "Laws, Theories, Topics, Terms." Many instructors present material of this kind in mimeographed form but this is the first instance that has come to the reviewer's attention, where this type of review is included in the text. The review chapters correspond to the three-term academic year. The authors have included numerous exercises, a 6-page glossary, no photographs, 96 drawings on 32 plates, a 3-table appendix, and a 19-page 2-column index.

C. R. CONARD

Volumetric and Phase Behavior of Hydrocarbons. By BRUCE H. SAGE, Assistant Professor of Chemical Engineering, and WILLIAM N. LACEY, Professor of Chemical Engineering, California Institute of Technology. Stanford University Press, Stanford University, California, 1939. xli + 299 pp. 188 figs. 16 × 23.5 cm. Price, \$5.00.

In this book, which is admirable in its self-sufficiency, the authors have presented a qualitative treatment of the fundamental principles relating to the volumetric and phase behavior of hydrocarbons. Separate chapters are devoted to the behavior of single, two, three and multi-component systems. Other chapters cover such subjects as: the phase rule, partial quantities, fugacities, ideal and non-ideal solutions, and the retrograde phenomena.

The omission of the concept of the pseudo-critical point

weakens the chapter on multi-component systems. The inclusion of a chapter dealing with the computation of the isothermal pressure correction to such thermodynamic properties as the entropy and the enthalpy from volumetric behavior data would have added to the value of the book.

No quantitative data or correlations that can be used in making volumetric or phase behavior calculations are presented. This will no doubt be a disappointment to many. However, the fundamental principles presented in this volume will be quite helpful to the physical chemist and chemical engineer in developing such correlations from data already available and in revising them as new data become available. In this respect the book should prove to be of much industrial and academic value.

W. C. EDMISTER

Lecture Demonstrations in General Chemistry. By PAUL ARTHUR, Assistant Professor of General and Analytical Chemistry, Oklahoma Agricultural and Mechanical College. McGraw-Hill Book Co., Inc., 330 West 42nd Street, New York, N. Y., 1939. xvi + 455 pp. 113 figs. 14.5 × 21 cm. Price, \$4.00.

A lecture demonstrator of long years of experience may be able to dispense with a guide in conducting experiments in general chemistry before large classes. An interested, gifted person may even devise new and unusual experiments and in time become renowned for his accomplishments. Time to gain experience and unusual aptitude are gifts seldom afforded the young man charged with such duties. To him, "Lecture Demonstrations in General Chemistry," by Paul Arthur, substitutes the years of Dr. Arthur's experience for an apprenticeship that in most cases is a trying one.

Within the compass of four hundred and fifty pages, the author presents complete instructions for conducting over one thousand experiments. Demonstrations are provided illustrating all principles that would commonly be included in a comprehensive course in inorganic chemistry. The principle to be illustrated is set forth under each experiment, followed by explicit quantitative details regarding the procedure to be employed. Abundant references are provided in each instance, including publications almost as recent as the date of publication of the book. The inclusion of so much modern material justifies the recommendation of the purchase of this volume by either the experienced demonstrator or the untutored novice.

H. S. LUKENS

Handbook of Chemical Microscopy. By ÉMILE MONNIN CHAMOT, B.S., Ph.D., Professor of Chemistry, Emeritus, and CLYDE WALTER MASON, A.B., Ph.D., Professor, Chemical Microscopy and Metallography, Cornell University. Volume II. Chemical Methods and Inorganic Qualitative Analysis. Second edition. John Wiley and Sons, Inc., 440 Fourth Avenue, New York, N. Y., 1940. xi + 438 pp. 233 figs. 15 × 23.5 cm. Price, \$5.00.

The subject of chemical microscopy, unlike some branches of microchemistry, has grown to maturity and its

principles and procedures have been well-established and thoroughly tested over a period of years.

The revision of Volume II reflects this maturity in that the changes have not been extensive. The first two chapters dealing with manipulative methods and methods of applying reagents have some new material and new references added. The number of cuts has been increased by about fifty, with the result that twenty-seven new pages have been added. The chapters on the separation and qualitative detection of specific elements and groups have been brought up to date by adding recent references and making necessary changes in the text. The authors have continued their critical attitude toward the many new tests which have been published, and take the view that, in many cases, the methods have not been adequately studied from the standpoint of interfering ions. New tests under such conditions can often lead to erroneous conclusions when applied to an unknown mixture. Hence, the volume continues to be a thoroughly workable and practical guide in the application of the microscope in qualitative analysis, and not merely a compendium of isolated tests. The mature microscopist in his work on problems in his field should seek new methods and tests, but he will do well to evaluate his methods and technique by the criteria set forth in this volume.

Because of the proper balance between the academic and practical side of microscopy, this handbook continues to be an excellent text for teaching the subject.

L. T. HALLETT

Handbuch der Lebensmittelchemie. A. BÖMER, A. JUCKENACK and J. TILLMANS. Vierter Band. **Fette und Öle. Lipoide, Wachse, Harze, Ätherische Öle.** (Handbook of Food Chemistry. Vol. IV. Fats and Oils. Lipoids, Waxes, Resins, Ethereal Oils.) Editorial direction of J. GROSSFELD. Verlag von Julius Springer, Linkstrasse 22-24, Berlin W 9, Germany, 1939. xxi + 966 pp. 247 figs. 17.5 × 26 cm. Price, RM. 135; bound, RM. 138.60.

Sponsored by an editorial board headed by J. Grossfeld and including besides A. Juckenack, E. Bames, B. Bleyer and J. Grossfeld, there has appeared another volume, the eighth in order of completion, of the "Handbuch der Lebensmittelchemie." In its general pattern and excellence of quality it follows its predecessors; the combined efforts of a group of specialists are concentrated within its covers.

Approximately one-half of this volume had been written by the one time dean of German fatty oil chemists, the late A. Bömer, J. Grossfeld collaborating. A long chapter on general methods for the examination of edible fats (326 pp.), followed in turn by one on the preparation of fats and their constituents (54 pp.) and another on the occurrence, recovery and properties of the food fats (278 pp.), is the contribution of this pair to this volume. The latter chapter is divided into three parts, *viz.*, the occurrence, recovery, properties and composition of individual vegetable fats and oils; animal fats and oils treated in a somewhat similar manner; and artificially altered, or processed, fats. These chapters are up to date with respect to time of publication, and include among other topics that of the prepara-

tion of fatty acids by oxidation of the paraffin hydrocarbons.

The remaining chapters of this volume are devoted to the microscopical examination of oil-bearing seeds and fruits (44 p.), the contribution of C. Griebel; the lipoids (51 p.) (fat-soluble vitamins) by Wm. Halden; waxes, resins, ethereal oils and fruit essences (Fruchtäther) (94 p.) by R. Grau; the German laws pertinent to fat production (37 p.) by H. Holthöffer with a brief Austrian supplement by E. Bames who also wrote the section on foreign laws (13 p.). A table summarizing the simpler physical and chemical constants of 424 fatty oils and nine others pertinent to the analysis and technology of fatty oils complete this volume.

This volume, in particular the first half, may be regarded in a sense as a memorial to the late Prof. A. Bömer. It is an invaluable and authoritative aid not only to those working in the field of fatty oil chemistry itself but in the larger one of food chemistry.

H. A. SCHUETTE

Semimicro Qualitative Analysis. By WILLIAM LLOYD EVANS, ALFRED BENJAMIN GARRETT and LAURENCE LARKIN QUILL, The Ohio State University. Ginn and Company, 15 Ashburton Place, Boston, Massachusetts, 1940. 245 pp. 30 figs. 20.5 × 27.5 cm. Price, \$2.00.

This is another addition to the rapidly increasing number of text-books and manuals on semi-micro qualitative analysis. The authors are to be commended for presenting their material in a logical, well-arranged fashion. They have obviously adopted a conservative policy and have deliberately set out to follow as closely as possible the usual macro-qualitative scheme of analysis.

In general each group is covered in the laboratory by a series of precipitation and separation reactions, confirmatory reactions, and supplementary reactions. Then the group is studied as a whole. Finally, numerous review and supplementary questions are given. Most of the equations are given both in the molecular and ionic forms. In regard to the ionic equations, it is the opinion of the reviewer that it would have been better if the authors had adopted the convention of writing ions for only those substances that furnish a high concentration of ions. Thus, $\text{Cd}^{++} + \text{H}_2\text{S} \rightleftharpoons \text{CdS} + 2\text{H}^+$ is preferable to $\text{Cd}^{++} + \text{S}^{--} \rightleftharpoons \text{CdS}$ in the precipitation of sulfides by hydrogen sulfide from acid solution. Similarly, precipitations with ammonium hydroxide are better expressed by ionic equations in which the NH_4OH is written in the molecular form. That the authors are not always consistent in this respect is shown in several instances, for example the dissolving of cadmium sulfide in nitric acid (p. 47) and the less satisfactory equation for dissolving copper sulfide in nitric acid (p. 170).

Throughout the book the authors have attempted to be concise and yet clear. This object has been attained by careful arrangement of the material, by the use of numerous charts, diagrams and flow-sheets, and by the use of cross references. The last quarter of the book is devoted to an adequate discussion of theoretical principles. The book is bound in loose-leaf form which has the obvious advantage of lying flat on the laboratory bench and of facilitating the removal of report sheets which are in-

cluded in the volume. At the same time durability is necessarily sacrificed, for, unless handled carefully, the book will undoubtedly suffer badly in physical condition during a semester's work. It is unfortunate that such an excellent work should be a "one year" book.

Instructors who favor the semi-micro method of teaching qualitative analysis will find in this book a well-presented course, flexible enough to be adaptable to varying conditions of available time and equipment.

STEPHEN G. SIMPSON

The Chemists' Yearbook 1939. Founded by F. W. ATACK, M.Sc.Tech., D.Sc. (Manc.), B.Sc. (Lond.), Fellow of the Institute of Chemistry. Edited by E. HOPE, M.A. (Oxon), D.Sc. (Manc.), Fellow of Magdalen College, Oxford. Chemical Publishing Co. of New York, Inc., New York, N. Y., 1939. 1257 pp. 10 X 15.5 cm. Price, \$6.00.

In this edition of the Yearbook the sections dealing with general properties of inorganic and organic compounds have been enlarged, the chapter on crystallography revised, the atomic weights brought up to date and the table of alkaloids improved. A comparison with the 1923 copy of the same book shows that while some new topics have been added and old ones changed, yet, by and large the book has remained the same in size and subject matter. In fact many pages have been transposed without change into the later editions.

About one-third of the book is text material. This includes detailed instructions for analyses and examination of many substances ranging from the usual inorganic qualitative analysis scheme to discussions of fuels, clays, tobacco, hydrogen ion, essential oils, milk products, etc. Approximately 3000 organic and 1500 inorganic compounds are listed. This is to be compared with 4400, 4950 and 5000, 4000, respectively, for two comparable American handbooks. The Yearbook contains very little of the data of Physics and the mathematical section is quite brief. A number of sections are included which are not found in similar American handbooks. Among these are: Patent Law and Chemical Invention, Notable Dates in the History of Chemistry, Tobacco, Coal Tar, Cellulose and Paper, Leather Analysis, Lubricants, Tanning Materials, Paints and Pigments, Identification of Dyestuffs, Agricultural Chemistry, Textile Fibers, Analysis of Clays,

Firebricks and Silica Material, Analysis of Portland Cement.

Unfortunately the price is out of line with that of the corresponding American books.

ROBERT TICHENOR

BOOKS RECEIVED

April 10, 1940 to May 10, 1940

CHARLES F. H. ALLEN, Editor. "Organic Syntheses." Vol. 20. John Wiley and Sons, Inc., 440 Fourth Avenue, New York, N. Y. 113 pp. \$1.75.

FRANK BAMFORD. "Poisons. Their Isolation and Identification." The Blakiston Co., 1012 Walnut St., Philadelphia, Pa. 344 pp. \$4.00.

HAROLD SIMMONS BOOTH AND VIVIAN RICHARD DAMERELL. "Quantitative Analysis." McGraw-Hill Book Co., Inc., 330 West 42d St., New York, N. Y. 246 pp. \$2.25.

CARLETON ELLIS. "Printing Inks. Their Chemistry and Technology." Reinhold Publishing Corporation, 330 West 42d St., New York, N. Y. 560 pp. \$7.00.

LOUIS P. HAMMETT. "Physical Organic Chemistry." McGraw-Hill Book Co., Inc., 330 West 42d St., New York, N. Y. 404 pp. \$4.00.

C. N. HINSHELWOOD. "The Kinetics of Chemical Change." Oxford University Press, 114 Fifth Avenue, New York, N. Y. 270 pp. \$4.50.

JOSEPH REILLY AND WILLIAM NORMAN RAE. "Physico-Chemical Methods." Volume I. "Measurement and Manipulation." Volume II. "Practical Measurements." D. Van Nostrand Co., Inc., 250 Fourth Avenue, New York, N. Y. 686 and 580 pp. \$17.50.

ARTHUR K. SOLOMON. "Why Smash Atoms?" Harvard University Press, Cambridge 38, Mass. 174 pp. \$2.50.

"Effect of Sulphur Dioxide on Vegetation." Prepared for the Associate Committee on Trail Smelter Smoke of the National Research Council of Canada, Ottawa, Canada. 447 pp. \$15.00.

"Index of Research Projects." Volume III. Works Progress Administration, 1734 New York Avenue NW., Washington, D. C. 243 pp.