

tivities, dispersion, induced double refraction (Kerr effect, Cotton-Mouton effect, flow birefringence), light scattering, depolarization, double refraction in crystals, relation of structure to optical activity, the present status of theories of optical activity, Faraday effect, Zeeman effect—to name just a few of the many subjects treated.

An interesting feature of the presentation is the frequent use made by the author of historical introductions to trace the experimental and theoretical development of various phenomena.

This treatise should serve as a valuable reference because it gives an excellent coverage of the classical theory of physical optics and its application to chemistry, and also covers in considerable detail many topics which are involved in current research.

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Magnetic Cooling. By C. G. B. GARRETT, Sometime Senior Scholar of Trinity College, Cambridge. The Harvard University Press, Harvard University, and John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. 1954. x + 110 pp. 14.5 × 22 cm. Price, \$4.50.

The author has planned his monograph as an introduction to the study of the properties of matter at temperatures below 1°K. The book covers practically all the phenomena encountered in adiabatic demagnetization and those brought within the range of observation at the temperatures made accessible by magnetic cooling.

The author states that "the book is not primarily aimed at the specialist" and this is borne out, for example, by the fact that the subjects of "Magnets" and "Experimental Arrangements for Magnetic Measurements" are given slightly less than two pages each. However, the book is the best collected source of recent information on its subject and justifies the authors expressed hope that it will be of value to both experimental and theoretical research workers in this field.

Theoretical discussions of thermodynamic-magnetic relationships, measurement of temperature, specific heat and paramagnetism at low temperatures are followed by a chapter on the "Results of Measurements."

There is a 19-page chapter on the important subject of cooperative effects and resultant hysteresis, and a final chapter discusses varied subjects, such as thermal conductivities, experiments on liquid helium and also on metals below 1°K., nuclear alignment, cascade demagnetization and cyclic refrigeration. The author's discussion in this section, of a "formal" case of "negative temperature," based on non-equilibrium nuclear spin states is very unfortunate. It is the sort of thing with which newspaper reporters can, and probably will, do a great deal of damage. Temperature has no meaning when the states used to define it are not in equilibrium. Innumerable cases in ordinary chemical thermodynamics could be cited in which corresponding non-equilibrium systems exist.

There are very numerous references to original papers for those who wish greater detail.

We are glad to recommend the book to those interested in phenomena at very low temperatures.

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The Properties of Glass. By GEORGE W. MOREY, Geophysical Laboratory, Carnegie Institution of Washington, Washington, D. C. Reinhold Publishing Corp., 330 W. 42nd St., New York 36, N. Y. 1954. vii + 591 pp. 16 × 23.5 cm. \$16.50.

The original appeared as No. 77 in the American Chemical Society Monograph Series in 1938. The revised volume is No. 124 in the same series. The table of contents remains unchanged. This is a comparison review.

Chapter I remains unchanged. The history has not been brought up-to-date, not even Table I, 3, on "Estimated World Production" which still does not go beyond 1937.

Chapter II on Devitrification has been rearranged but ex-

cept for the addition of the system Na₂O-B₂O₃-SiO₂ remains unchanged.

Chapter III on Composition contains some new analyses in Table III. 2; 4 have been added to Table III. 3. Some recent high-index glasses are mentioned. Table III. 11 on evolved gases on heating glass has been added. Two short paragraphs on permeability to and diffusion of helium through glass close the chapter.

Chapter IV on Durability adds a reference on Hubbard's humidity-powder test, the Hubbard-Hamilton interferometer studies; Figures IV. 7-8-9 on comparative resistance to various reagents are new. Mention of Wickers, Finn and Clabaugh's tests on chemical ware concludes the chapter.

Chapter V, Viscosity, except for the renumbering of some tables and figures is almost unchanged. The recent counter-balanced sphere method (1000-1400°) is introduced and a table of results follows. In the section on Viscosity of Slags there is a brief reference to recent work on iron-free systems. The chapter closes with Deformation and Transformation Temperatures including some recent contributions.

In Chapter VI, Annealing, recent work on temperature and refractive index correlation with annealing is mentioned.

Chapter VII discusses The Surface Tension of Glass. Fiber elongation apparatus and the dipping cylinder method are included. The chapter closes with a discussion of the anomalous behavior of B₂O₃ and includes extensive surface tension tables on Borates and Silicates. Additive relationship concludes the discussion.

In Chapter VIII on Heat Capacity of Glass a table of conversion factors for units of energy has been added.

Chapter IX is on Thermal Conductivity. Except for very brief references to the measuring of combined heat transfer by conduction and radiation, and the thermal conductivity study of rocks, the chapter is unchanged.

Chapter X on The Density of Glass opens with a presentation of recent views on additive factors, and includes extensive tables to indicate their applications. It closes with a discussion of the effect of heat treatment.

In Chapter XI on The Coefficient of Expansion of Glass a short paragraph on Li₂O-Al₂O₃-SiO₂ has been inserted. Effects of MgO, BaO, ZnO in dolomitic limestone glasses; of Fe₂O₃, B₂O₃, K₂O, Li₂O conclude the three-component section. Under Multicomponent and Commercial Glasses Vycor and silica glasses are mentioned, and the comments on Nonsilicate Glasses include Na₂O-B₂O₃ and K₂O-B₂O₃.

In Chapter XII on Elastic Properties under Dimension and Units, strain discs and large astronomical lens-castings are referred to. A section has been added on Effect of Temperature on Elastic Constants. Strain-time relationships (tables) and effects of low and high temperatures conclude this discussion.

Additions in Chapter XIII on The Strength of Glass are on weak secondary bonds, effect of moisture, strength of fibers, micro-strength, effect of temperature on strength and fatigue.

Chapter XIV on Thermal Endurance is unchanged except that sections on Temperature Distribution during Heating and Cooling, and Optical Path Differences have been deleted.

In Chapter XV on Hardness, abrasion is mentioned; hard glasses for jewel bearings are referred to; diamond indentation of optical glass is compared with grinding hardness.

Chapter XVI on Optical Properties, the first section has been enlarged, rearranged and augmented to great advantage. Tantalum, tellurium have been added. There are new four-component and multi-component systems with accompanying tables, and under miscellaneous glasses, arsenic, lanthanum, and new beryllium and germanium types are given. Fluoride and phosphate glasses are discussed. The new additive factors and methods are important. Effects of temperature and heat treatment on refractive index are stressed. New infrared absorbents are listed, and reflection-prevention is given a place. Finally, there are new sections on solarization, fluorescence and thermoluminescence.

Chapter XVII on The Electrical Conductivity of Glass is practically unchanged, and very little has been added.

Chapter XVIII on The Dielectric Constant, Dielectric Loss and Dielectric Strength, like the preceding chapter, is almost unchanged. High-frequency Effect and Conduction, relaxation, deformation and vibration losses receive consideration. There is an added paragraph in the section on Effect of Temperature on Power Factor.

In Chapter XIX on The Magnetic Properties of Glass, the discussion of Verdet's constant has been extended.

In Chapter XX on Constitution, discussion has been added at the close concerning network-formers other than silicon.

While much of the volume is a repetition of the original, new material has been added. Both editions are valuable reference books in the glass library.

A more detailed index is desirable, especially for tables and figures, reference to which must be gleaned from descriptive portions of the text.

The closing index of Properties of Glasses in Various Systems has been revised and improved. The old index was too congested.

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Metallurgy of the Rarer Metals—1 Chromium. By A. H. SULLY, Ph.D., M.Sc., F.Inst.P., F.I.M. Academic Press, Inc., Publishers, 125 East 23rd St., New York 10, N. Y., 1954. xii + 272 pp. 14.5 × 22.5 cm. \$5.50.

This first book in a series expected to cover chromium, zirconium, titanium, molybdenum, manganese, platinum and allied metals, and uranium sets a high standard for the series. A physicist, Dr. Sully combines a scholarly treatment with clear evidence of appreciation of the engineering and economic aspects. The designation of chromium as a "rare metal" in spite of its wide occurrence and manifold usage is based on the fact that only recently has application of pure chromium and of chromium rich alloys stimulated the development of a large body of reliable literature on the properties of the pure metal and of rich alloys. This is most clearly demonstrated by a table of reported values for the m.p. of pure chromium, starting with the 1510° figure reported by E. A. Lewis in 1902 with an almost steady climb to 1850° in 1951 and 1900° in 1952, with perhaps a 50° present uncertainty.

A short introductory chapter on the properties, occurrence, mining and dressing of chromite ore is followed by a chapter covering commercial methods of producing ferro-alloys and commercially pure chromium and of methods of preparing high purity chromium. The chapter on physical properties of pure chromium comprises a critical evaluation of literature values for crystal structure, elastic moduli, thermodynamic properties, electrical and optical characteristics, and in addition a discussion of oxidation resistance and vacuum reaction at high temperatures. The abnormalities exhibited as apparent discontinuous changes in some, but not all, of the properties at several temperature levels is discussed, but not resolved. A table of recommended values of properties is given at the end of the book.

Melting, casting, powder metallurgy and workability of pure chromium and rich alloys with the attendant difficulties due to contamination by impurities and to sharp transitions from brittle to ductile behavior are described in the fourth chapter. The author makes every effort to explain the characteristics of the processes in terms of properties of the metals and of reactions due to impurities, but again a number of apparently anomalous phenomena are evident.

Surface treatment with chromium, by electrodeposition and by chromizing (chromium introduction into the surface by diffusion) is described in the following two chapters. Methods, theory, thermodynamics and rates of the processes and properties of the coatings produced are discussed with the emphasis on surface treatment of steel base stocks. Corrosion resistance of the coatings and surface deposition of chromium from its carbonyl and by vacuum evaporation and by sputtering are briefly described.

The final chapter is devoted to descriptions of the composition and properties of chromium alloys. Phase equilibria are given for many of the binary systems and for a few ternary systems. The author concludes this chapter with a rather pessimistic outlook for increasing use of chromium-rich alloys for high temperature use.

The book is well illustrated with numerous charts, photographs, flow sheets and drawings of equipment. Reference is made to well over 300 original articles and the author gives evidence not only of thorough conversance with the literature, but of a great deal of first-hand laboratory experience in the high-temperature alloy field.

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CAMBRIDGE, MASS. GLENN C. WILLIAMS

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NICHOLAS D. CHERONIS. "Technique of Organic Chemistry." Volume VI. "Micro and Semimicro Methods." Edited by Arnold Weissberger. Interscience Publishers, Inc., 250 Fifth Avenue, New York 1, N. Y. 1954. 628 pp. \$12.00.

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STIG VEIBEL. "The Identification of Organic Compounds." A Manual of Qualitative and Quantitative Methods. G. E. C. Gad, Publisher, Vimmelskaftet 32, Kobenhavn K, Denmark. 1954. 346 pp. 45 sh.

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ARTHUR R. VON HIPPEL (edited by). "Dielectric Materials and Applications." John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. 1954. 438 pp. \$17.50.