tionen in Stählen und Superlegierungen entwickelt. Im Falle der Carbide ergibt sich auch eine natürliche Verknüpfung der Probleme in der Metallurgie der Stähle und der Hartstoffe. Leider sind infolge der raschen Entwicklung auf diesem Gebiete viele der versuchsweisen Zustandsdiagramme: Übergangsmetall–Kohlenstoff schon wieder überholt. Ausserdem beziehen sich die Bildungswärmen der Carbide und Nitride in den Tabellen auf kcal je Formeleinheit und nicht g-Atom. Das Kapitel über Nitride ist analog dargestellt, aber wegen der weniger zahlreichen Arbeiten kürzer; nichtsdestoweniger wird hier ein aussichtsreiches Gebiet für zukünftige Forschung vor Augen geführt. Die nächsten zwei Abschnitte sind Boriden und Siliciden gewidmet, bei welchen zwar andere Bauprinzipien in der Vielfalt der auftretenden Verbindungen herrschen. Miteinbezogen sind wegen der ausgeprägten Silicium-Aluminium-Substitution auch Dreistoffe von der Art: Übergangsmetall–Silicium–Aluminium. Hier ist eine Fülle von neuem Material zusammengetragen und in einheitlicher Form besprochen. Es werden zwar noch die kubischen Monoboride von Titan, Zirkonium und Hafnium angeführt, die nur in Gegenwart beträchtlicher Mengen an Kohlenstoff oder Stickstoff existieren, doch rechtfertigen auch andere Beispiele der Bor–Kohlenstoff–Substitution wieder die Heranziehung des Einlagerungsprinzips für eine allgemeine Systematisierung Metall-reicher Phasen. Einen ziemlich grossen Umfang nimmt naturgemäss die Behandlung der Oxide ein. Ausgehend von der Sauerstoff-Löslichkeit in Übergangsmetallen über Suboxide folgen Evolutionsdiagramme, die bis zum Aufbau der Oxide maximaler Valenz führen. Sehr wertvoll ist hier die Zusammenstellung von Metall(I)–Metall(II)–Sauerstoff-Systemen, die Diskussion der zu den η-Carbiden analogen η-Oxide sowie die vielen Hinweise und Ausdeutungen von praktischen Problemen. Ferner findet man ein ausgezeichnet zusammengefasstes Kapitel über Hydride. Den Abschluss bilden gemischte Systeme, wobei erstmalig eine ziemlich geschlossene Kompilation von Daten über zum Teil recht ungewöhnliche Kombinationen wie Borosilicide, Silicid–Oxide, Nitrid–Hydride u.ä. gebracht wird.

Der Verfasser geht am Ende des Buches auf eine Verallgemeinerung des Interstitial- oder Einlagerungsprinzips über, indem der behandelten Stoffgruppe ganz andersartige Gerüststrukturen an die Seite gestellt werden. Solche sind Zeolithe, Molekülsiebe oder Clathrate, welche ebenfalls kleine Teilchen in spezifischer Weise in dem dreidimensionalen Wirtverband einzulagern vermögen.

Das Buch ist sehr gut lesbar und in einem lebhaften Stil geschrieben. Es enthält eine Unmenge wohl geordneter Daten und Referenzen, kann also dem immer grösser werdenden Kreis von Festkörperchemikern und Metallurgen als Lektüre und Nachschlagewerk bestens empfohlen werden.

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Experimental magnetochemistry. Nonmetallic magnetic materials. By MICHAEL M. SCHIEBER, being Vol. III of *Selected topics in solid state physics*, edited by E. P. WOHLFARTH. Pp. xxiv+572. Amsterdam: North Holland. Publishing Co, 1967. Price *f.* 90.

The author of this book has provided an interdisciplinary text in magnetochemistry which will be of value to a variety of scientists with different scientific backgrounds. The volume is intended to serve both as a text and a reference at an intermediate level, and should be a useful source of information to students of magnetic materials, regardless of whether their primary interest is synthesis, magnetic property measurements, crystal chemistry, or physics of magnetic interactions.

The volume is divided into four principal parts: (1) outline of magnetic principles, (2) preparation of magnetic materials, (3) methods of characterization and measurement, (4) review of crystallographic and magnetic data. The first three parts are brief, succinct summaries intended to provide background and nomenclature for understanding the latter, major portion of the book.

The chapter on magnetic principles is approximately equally divided between non-cooperative phenomena in paramagnetic solids and cooperative phenomena in magnetically ordered states. The topics covered include spectroscopic and magnetic data for $3d$ and $4f$ ions, crystal field and spin-orbit effects, direct and superexchange interactions leading to ordered spin arrangements, crystallographic transformations and critical phenomena. Chapter 2 is concerned with the preparation of magnetic materials and describes the principal methods used for synthesis of single-phase polycrystalline compounds, and for the growth of crystals from the vapor, from the melt, from solution, or in the solid state. Chapter 3 is on measurements and includes brief discussions of the wide variety of physical techniques used to characterize magnetic materials, including magnetic susceptibility, resonance methods, Mössbauer measurements and neutron diffraction.

The last three quarters of the volume deal with experimental results and probably will prove the portion most appreciated by experimentalists undertaking research in magnetic solids. The material is organized on the basis of chemical compounds and emphasis is given to the crystal and magnetochemical aspects. The subject matter is subdivided into iron oxides and their compounds, non-iron transition element oxides, rare earth oxides, and non-oxide compounds of the transition and rare earth elements. Intermetallic compounds and alloys are not included. A typical subsection on paramagnetic rare-earth iron perovskites reviews the crystallographic and magnetic properties, the spin arrangements deduced form neutron diffraction, and Mössbauer studies of the hyperfine fields acting on the nuclei. Extensive use is made of tables and figures for summarizing data.

The utility of this book as a reference source is enhanced by separate reference, author, subject, and formula indices. The latter contains references to more than 700 compounds. Because the scope is large and the treatment tends to be brief and non-critical, the volume probably will not find its major use as a text, but rather as a reference source for the experimentalist active in the field of magnetic materials. The book gives evidence of hasty compilation and incomplete coverage of some materials. The specialist will find errors in detail and would be well advised to consult the

original references when specific numbers or critical interpretations are required. However, on balance the book should be a valuable adjunct to the library of anyone contemplating work in the field of nonmetallic magnetic solids and I would recommend its purchase subject to the qualifications noted above.

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Structural chemistry and molecular biology. Edited by ALEXANDER RICH and NORMAN DAVIDSON. Pp. iv+907. San Francisco and London: W. H. Freeman, 1968. Price $ 10.

The editors and authors have dedicated this volume to Linus Pauling in recognition of his outstanding contributions to structural chemistry and molecular biology over the last 40-odd years.

In a historical introduction J. H. Sturdivant demonstrates the strongly coherent development of Pauling's knowledge and understanding of molecules, beginning with the early elucidation of coordination rules governing the structures of ionic crystals, and leading, through quantum-mechanical interpretation of directed valency, to structural principles applicable to the largest molecules of biological origin. These principles combined the possibilities suggested by quantum theory and a mass of experimental observations, particularly the molecular geometry revealed by X-ray crystal structure analysis.

Pauling taught his fruitful approach to many others, and it provides a unifying theme in this book, which contains some 60 essays on a wide variety of topics. The section headings give some indication of the range: structure of proteins; chemistry of proteins; antibodies; molecular biology; nucleic acids; hydrogen-bonding, water and ice; chemistry and structure of smaller molecules; metals and minerals; chemical theory. Such diversity cannot be adequately reviewed here, but it may be useful to draw attention to some contributions which are likely to have a wide appeal as background reading.

The theme of the chemistry of proteins section is the attempt to predict the conformation of a protein molecule from its amino-acid sequence. The apparent ease with which, in nature, the molecule finds its way from disorder to order makes Edsall optimistic that we can learn how it is done. In the same section Hamilton and McConnell review the use of spin labels to investigate conformational detail.

A group of papers on inherited diseases which are associated with defective proteins is appropriate: Pauling was the first to recognize that human sickle-cell anaemia must reflect a difference in haemoglobin molecules. Among many similar variants of haemoglobin and other proteins discovered since, not all are disadvantageous to the organism; some offer useful variety in activity or in the rate of their synthesis.

The papers on hydrogen bonding are sufficiently closely related to show some 'resonance' between them. Donohue effectively criticizes four common assumptions: (1) that H-bond geometry around the acceptor atom correlates well with the arrangement of orbitals occupied by unshared electron pairs; (2) that bifurcated hydrogen bonds are readily admissible; (3) that short H-bonds must be linear; (4) that CH ... O H-bonds exist. Two essays presenting different experimental approaches to the problem of structure in water both conclude that the H-bonding is sufficiently flexible for almost all molecules to take part in four bonds; separate molecular species with different numbers of H-bonds cannot be detected.

Complex intermetallic compounds whose structures are based on Friauf polyhedra are described by Samson in a beautifully illustrated essay. This is nicely complemented by the discussion of σ-phase-related transition-metal structures from David and Clara Shoemaker.

The volume concludes with a variety of papers on chemical theory, a reprint of Pauling's *Nature of the Chemical Bond* (1931) and a bibliography of his scientific publications.

The great range of topics discussed is a suitable tribute to Pauling's wide interests, and a sense of occasion has inspired the authors to produce some very shapely contributions. My only regret is that these shapes do not fit together very well: the book is most successful where a single topic is closely discussed from several different points of view.

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