

Fortunately, the symposium was a masterpiece of dis-organization. I say fortunately because any effort to treat such a massive topic comprehensively would have been hopelessly superficial and an attempt to treat a particular biochemical phenomenon would likely have resulted in the typically boring and parochial 'update' of interest only to the specialist. The participants simply presented what they considered to be interesting and relevant with no apparent consistency of format, content or style. For example, there was a comprehensive (35 pages plus 13 pages of discussion), ponderously detailed and highly informative account of the physical and chemical properties of lysozyme which summarized a long, well planned siege by the combined X-ray and NMR forces of Oxford on this little 14 000 dalton molecule. This was immediately followed by a short (5 pages) EPR study of the putative free radical mechanism of ribonucleotide reductase, a 160 000 dalton molecule for which there are no hard three-dimensional data.

Whereas the formal presentations vary in content and style to the point of distraction, the discussions which follow are uniformly lively, articulate, well edited and referenced, and very interesting. These discussions are the strength of the volume. Issues were raised and debated which represent many of the most critical problems that face molecular biophysics and biochemistry. Lipscomb set the tone for these discussions in the very first paper on model systems by trying valiantly to correlate the intuitive structural notions of enzymology with the hard numbers for the energetic and kinetic constants of catalysis. Thus glib clichés about 'conformational change', 'disorder', and other all-purpose caveats were poorly tolerated in favor of chemically meaningful statements. Concern was focused especially on a more precise understanding of conformational flexibility, leading to a constructive discussion on how one can use X-ray crystallography, NMR and other spectral tools in a complementary way to describe more accurately the dynamic aspects of molecular structure. There was a notable re-emergence of 'compactness' and thus of volume and surface as important parameters to exploit theoretically and experimentally in understanding stability in proteins.

On completing this volume one is left with the optimistic feeling that we have not yet begun to saturate our capacity to understand the structure and behavior of macromolecules and their aggregates. We have made good strides in beginning to extract the microscopic rules of the game but the global generalizations (if any) are yet to be realized. Most importantly we are beginning to define the problems in precise enough terms to understand the limits of our experimental techniques and what we ought to do next.

In order to read this book one requires a certain familiarity with the principles of protein structure and function; therefore this book is not for persons first entering the field – indeed, the neophyte will be discouraged if not irritated by the chaotic format. However, it should be read by serious students and practitioners of molecular structural studies in biology, crystallographers very much included.

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Coordination chemistry of macrocyclic compounds.

Edited by G. A. MELSON. Pp. xiii + 664. New York and London: Plenum Press, 1979. Price US \$49.50.

This is a major book on the coordination chemistry of macrocyclic compounds written by and for chemists. Because X-ray crystal structure analysis is one of the most important techniques used in the investigation of the compounds and their complexes, the results are described in several of the chapters.

Familiar examples of macrocyclic complexes are the porphyrin rings in haem and chlorophyll and the corrin rings in vitamin B₁₂. These biologically important macromolecules have in common a macrocyclic ring containing four donor nitrogen atoms complexed to a cation of radius less than 0.8 Å. Compounds, natural and synthetic, with four nitrogen donors have been investigated most extensively and, for the purpose of this review, I shall call them type 1. Macrocyclic rings do exist with other kinds and numbers of donor atoms; complexes of such compounds with transition-metal cations I refer to as type 2 and with other cations, such as alkali metals, as type 3.

In his introduction the editor, G. A. Melson, explains that each chapter is intended to stand alone so some necessary duplication is to be tolerated. This policy has resulted in a few inconsistencies. His intention that each chapter should provide a collection and correlation of a great deal of information has been realized. Most chapters contain extensive tables packed with information; these show what comparisons are available and also, frustratingly, what are not. The authors have been allowed enough space to develop their themes properly so that the chapters are readable as well as being valuable works of reference. The editor has suggested and illustrated a numbering scheme and nomenclature for monocyclic compounds, but has allowed the authors to retain the names in the current literature.

Apart from the last one, the chapters reflect the division of effort between different laboratories and particularly the dominance of compounds of type 1. For example, they occupy 67 of Melson's 116 page chapter on synthesis.

There are two chapters by L. J. Boucher exclusively on type 1, the phthalocyanins and the porphyrins; each has a small amount on the structural aspects. Types 1 and 2 also provide the subject matter for ligand-field spectra and magnetic properties (F. L. Urbach), for chemical reactivity (J. F. Endicott and B. Durham), and for a survey of structures by N. F. Curtis.

In this survey Curtis has divided the compounds into 11 classes for each of which he discusses the conformation, including the effect of substituents, the metal–donor bond distance (in pm) and the chelate angles; a listing of individual structures in each class follows. These listings show the formula, the daunting systematic name and Melson's suggested name for the macrocycle. For each crystal structure containing this macrocycle, the *R* value and number of observations, with a star rating for completeness of the original publication, is given with a brief description which may include bond lengths (to the nearest pm averaged over chemically equivalent ones), coordination geometry and ligand conformation. Because several chelate rings are formed on complexation, the possible combinations of conformations are formidable, but those formed appear to

minimize intramolecular strain. This 126 page chapter has 222 references and covers approximately that number of structure determinations, including those published in 1978.

There are two chapters primarily on type 3 compounds. *Thermodynamics and Kinetics* by the Brigham Young University group provides a most valuable survey of known results on various cations, not only metals, but also RNH_3^+ ions; type 1 compounds occupy only about 5% of the space. For the complexes of alkali and alkaline-earth metal cations crystal structure results up to 1976 are presented by A. I. Popov and J.-M. Lehn as among the physicochemical studies of crown ethers and cryptates; this aspect occupies 12 pages compared with 40 pages on solution studies.

Finally, V. C. Goedken covers types 1 and 3 under the heading *Natural Product Model Systems*. He deals explicitly with the biological relevance implicit in other chapters. He includes a thoughtful discussion on the validity of model systems as well as accounts of the work reported. One section, *Importance of X-ray Structural Analyses*, deals with the need for accurate analysis of model compounds to complement the, necessarily inaccurate, investigation of natural macromolecules such as proteins. Particularly important examples of this are Fe-N distances in, and coplanarity with, porphyrin rings. It is in this chapter that the biological implications of the macrocyclic compounds of type 3 are considered. A good test of the reader's understanding is provided by the interchange of (a) and (b) on the formulae of the two antibiotics in Fig. 1 on p. 610.

Chemical crystallographers should read at least part of this book as an opportunity to see ourselves as others see us, *i.e.* to see what part of the findings are seen as of importance by coordination chemists. I recommend the exercise not only to authors, but to referees of papers and editors of journals.

The book is well produced, with clear diagrams and print. I found few errors. There is a good subject index. Although it is large, 664 pp., it weighs a manageable 1 kg. good quality paper having been used.

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Handbook on the physics and chemistry of rare earths.
Vol. 2. Alloys and intermetallics. Edited by K. A. GSCHNEIDNER and L. EYRING. Pp. xiv + 620. Amsterdam: North-Holland, 1979. Price US \$97.50, Dfl 200.00.

The *Handbook on the Physics and Chemistry of Rare Earths* is a timely, four-volume work which attempts 'to cover the entire rare-earth field in an integrated manner'. With the second volume, *Alloys and Intermetallics*, this laudable

attempt has succeeded admirably, producing a book which will be an invaluable guide, albeit a heavy one, to all workers involved in this particular part of the field.

The first chapter is concerned with the fascinating problems of the crystal chemistry of intermetallic compounds, notably the range of structure types and compositions. The scale of the problem may be appreciated by the fact that over 1800 crystal structures have been determined for the binary intermetallic compounds alone. The article concentrates discussion on the most frequently occurring compositions, namely the R_5X_3 , RX , RX_2 and RX_3 compounds.

The major chapter, some 176 pages long, is concerned with the magnetic properties of the intermetallic compounds. Faced with a perhaps overwhelming amount of information, a necessarily subjective review is given which concentrates on the magnetically ordered systems, and results in an eminently informative, self-consistent account of this often complex field.

The Laves-phase $R\text{Fe}_2$ compounds, which exhibit uniquely large magnetostrictive properties, are considered, rightly, to be worthy of a dedicated chapter. The same applies to the much studied europium chalcogenides and the technologically important amorphous alloys.

The book also contains an extremely clear and concise exposition of the important crystal-field interaction, the basis of many of the observable macroscopic properties of rare-earth systems. The inclusion of this chapter in a volume devoted to alloys and compounds may be questionable, but it is a valuable contribution nonetheless.

The applications of nuclear resonance and electron paramagnetic resonance methods are admirably discussed with respect to metal, alloy, compound and insulator compound systems in both the ordered and disordered magnetic states. The final chapter is concerned with valence changes in compounds and presents a clear description of the subject and illustrates the fundamental problems still to be solved in this area.

The volume contains approximately 600 pages of text, 27 pages of references and just over 7 pages of subject index. It is to this last statistic that the criticism of inadequacy may be levelled. There are a number of significant omissions in the index, one example being that there is no listing of SmCo_5 , an important permanent magnet compound dealt with at some length in the text. A further criticism, though minor, is that although the rare-earth element is identified throughout the book by the symbol R , other alloy constituent elements are variously described by the symbols X , B and M .

In spite of these faults, throughout the excellent text the areas of deficiency in both experiment and theory are emphasized and the flavour of the variety and the appeal of rare-earth systems is communicated to the reader.

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