The first key section on data recording and retrieval is basic and easy to follow, and offers sound advice to the beginner. Hard-copy information sources are listed (including advice on how to interpret this information), together with Internet addresses. The sections covering basic laboratory equipment start right at the beginning, describing items ranging from glass stoppers through to almost anything that more experienced students would come across in the laboratory, including rubber septums, syringes and how to look after them, and of course microscale equipment. Whilst some of this may seem elementary, there is also information that will be of use to the more experienced practical chemist.

The description of the standard techniques is detailed and the section on microscale column chromatography, a simple yet effective technique, is useful. The chapters covering instrumentation in the laboratory are brief, with a few reference tables, but they are adequate and have an emphasis on the preparation of samples and operation of equipment.

Overall, this is a very good laboratory manual guide that is easy to read. Zubrick has a light-hearted writing style and his sense of humour comes across very strongly. It is pitched at such a level that students with a range of abilities and backgrounds would find it useful and it is available at an affordable price.

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Articles in this Series are expected to be authoritative, specialized and topical, and the eight contributions to Volume 47 certainly conform. However, chemical review articles come in many types. At their most basic, they are compilations of published results, of considerable use to those seeking catalogues of detailed information about a specialist area. At the other extreme, they give a description of an area of research, showing its importance to its field and setting it in context with chemistry as a whole, and follow this with a selective, well-explained critique of the available data. The very best also include comments and/or suggestions not found in the original papers surveyed. The present contributions span almost the whole range; they are reviewed here in the order of appearance.

The first ('Terminal chalcogenido complexes of transition metals', by G. Parkin; 166 pages, 353 cited references) is an in-depth treatment of compounds containing M=E bonds (E=O, S, Se, Te). The introduction gives statistics on publications in this field and an interesting discussion on bond orders and lengths. This is followed by group-by-group descriptions of the preparation, structure and reactions of the known compounds.

Chapter 2 ('Coordination chemistry of azacryptands', by J. Nelson, V. McKee and G. Morgan; 149 pages, 294 references) begins with a brief survey of the history of this type of ligand. A description of synthetic methods is followed by a concise summary of applications, actual and potential. Then comes a series of well-selected topics: small cages, templated cryptands, conformational aspects, Schiff-base cryptands, photoactive systems, solution studies, oxygen-uptake systems, anion-complexers. Generality, depth, breadth and detail are nicely balanced.

'Polyoxometallate complexes in organic oxidation chemistry' (R. Neumann; 53 pages, 195 references) gives a fascinating survey of the ways in which heterometals are incorporated into poly-molybdate and -tungstate clusters and the role of these materials as catalysts for atmospheric or peroxide oxidation of organics in aqueous media. Overall, the impression is given that they are useful in applications where their high specificity can be advantageous. Two principal applications are treated: the heterogeneous gas-phase preparation of methacrylic acid (with many references to patents) and mixed-metal systems for peroxide oxidation.

'Metal phosphonate chemistry' (A. Clearfield; 140 pages, 231 references) is a highly academic account, mainly focused on zirconium organophosphonates. Structures and spectroscopic and chemical investigations are reviewed. It appears that many of these systems may have (so far unrealized) potential for interesting applications.

Chapter 5 deals with the 'Oxidation of hydrazine in aqueous solution' (D. M. Stanbury, 51 pages, 193 references). It is a review of the literature on the mechanisms of reactions involving a wide variety of oxidants, both one- and two-electron agents, and correlates the mechanism and type of products (principally N_2 and/or NH_3) with the nature of the oxidant. It was disappointing that only kinetic reaction schemes are given, with no indication of how the molecular and electronic rearrangements occur, and there is no clear statement as to why these reactions should have attracted so much interest.

On the other hand, 'Metal ion reconstituted hybrid haemoglobins' (B. Venkatesh, P. T. Manoharan and J. M. Rifkind; 121 pages, 332 references) is full of clear and critical explanations, both of the nature of the problems addressed and of the significance and method of interpretation of the wide range of techniques employed. The difficulty of unscrambling the factors responsible for co-operativity between the four metal atoms in O_2 binding and the need for variously modified tetramers are beautifully presented.

Then comes a survey entitled 'Three-coordinate complexes of "hard" ligands: advances in synthesis, structure

and reactivity (C.C. Cummins; 151 pages, 211 references), which begins by limiting the target complexes to those containing anionic ligands and almost entirely to homoleptic systems. The aim is 'to stimulate new exploration involving these complexes', and a comprehensive review of the literature is provided.

'Metal–carbohydrate complexes in solution' (J.-F. Verchère, S. Chapelle, F. Xin and D. C. Crans; 108 pages, 470 references) begins with a nice survey of the possible conformations of carbohydrates and the techniques for investigating their metal complexes, with caveats on the use of solid-state methods to deduce behaviour in solution. Then follows a systematic review of data, largely for complexes of vanadium, molybdenum and tungsten. It is shown that chelate complexes are usually formed, and the possible applications are given.

The volume finishes with a cumulative index to Volumes 1–47, listing titles of articles under their authors.

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Chemistry of Arsenic, Antimony and Bismuth

N. C. Norman (ed.)
Blackie Academic and Professional, London, 1998
xii + 483 pages. £109
ISBN 0-7514-0389-X

Moscow State University has the interesting custom of designating each year a specific element as their 'Element of the Year' and are working their way through the Periodic Table. So far they have arrived at arsenic as the 1998 element and it is an interesting coincidence that this year also marks the publication of Dr Norman's new book on arsenic and the two heavier Group 15 elements. The Group 15 elements are an intriguing set; they begin with two that are essential for life, only to be followed by arsenic, one of the best-known poisons which still claims lives either accidentally or by design, and antimony, which is really no better in this respect. The general public, however, knows neither the element nor its toxic properties. Finally there is a return to more benign properties with the final member, bismuth.

First of all the book is going to be useful in providing a good, up-to-date introduction to the chemistry—in the widest sense—of these three elements. As in most multi-author works, some aspects seem to have been overlooked and there are some inconsistencies in presentation, but they are not particularly serious. The publishers, however, have failed to match the contents with the presentation, which has a very old-fashioned look about it.

Chapter 1 by N. C. Norman and C. Carmalt provides an exceedingly good introduction to the three elements; however, in Table 1.1 the authors should have decided what units to use for cell dimensions, and I cannot believe that the reserves of antimony are as low as 44×10^{-6} tonnes. Chapter 2 (I. J. Polmear) on the metallurgy of the elements, seems a little out of place, but it also gives a listing—still rather small—of the uses for these elements. Clearly, the electronic properties of gallium arsenide and similar 3/5 species are becoming important and there are also possibilities for superconducting compositions.

The next three chapters by S. M. Godfrey, C. A. McAuliffe, A. G. Mackie and R. G. Pritchard, authors with long experience in Group 15 chemistry, cover 'Inorganic derivatives', 'Coordination chemistry and solution chemistry', and 'Organoarsenic and organoantimony compounds', respectively. The first of these provides good coverage of transient and stable binary species and time is spent describing methods for generating the hydrides used in the electronics industry. Binary compounds with the Group 16 and 17 elements are given full treatment, and there is a good description of the rather complex oxyanion behaviour of these elements. Chapter 4 is quite a mixture but the variation of Lewis acidity of the halides in the +3 oxidation state leading to an increasingly complex series of halogenoanions as the group is descended is well treated. There is, however, a curious diagram in Scheme 4.6, supposedly of $[Bi_2Br_{10}]^{4-}$, which shows an octahedral BiX_6 unit.

Chapter 5, on the organic derivatives of arsenic and antimony, does less than justice to this subject and the 76 pages devoted to the topic should be compared with the 61 pages on 'Organobismuth compounds' in Chapter 6. Chapter 5 begins with synthetic methods; the authors provide guidance to practising chemists by drawing particular attention to those methods which they consider either to give good yields or to make use of readily available reactants. The chapter does seem to be dominated by the use of these compounds as ligands and I would have liked to see wider coverage of, for example, low-coordination-number species, which are barely mentioned, and the problems of the stereochemistry at five-coordinate arsenic and antimony centres.

The chapter on organobismuth compounds (H. Suzuki and Y. Matano) provides a more systematic approach and anyone wishing for an introduction to the area could well start here; it also contains a good account of the organic synthetic uses of bismuth compounds. Dr Whitmire's 'Organotransition metal compounds with element to transition metal bonds' (Chapter 7) similarly provides an excellent introduction to this rather specialized and complicated area. All three Group 15 elements (E) readily form bonds to a good number of transition metals. Some of the compounds produced are fairly uncomplicated, for example when ER_3 molecules behave as straightforward electron pair donors, but reactions are generally much more complex, as in that between $Co_2(CO)_8$ and $(AsPh)_6$ where the product, $[Co_8(\mu_6\text{-As})(\mu_4\text{-AsPh})_2(CO)_{16}]$, contains not only bridging AsPh groups but dephenylated arsenic bridges as well. Reactions leading to the

