definition. Crystals enter only on p. 13, and then only as liquidus phases calculated using Ghiorso's model for a series of mixtures of a basalt and a dacite. I may be slow in the head, but some sentences seemed extremely hard to understand. For example (p. 166) what does 'The liquidus surface for basalt–dacite melt mixtures is compared to the temperatures derived by mixing the two end-member melts (on Fig. 9)' mean to you?

Chapter 7, by Carmichael and Ghiorso, is about oxygen fugacity and its effect on natural liquids and crystallising phases. It starts with a portentous opening paragraph in which it is claimed that '...the testing of igneous hypotheses has been liberated [by thermodynamic modelling] from the parochial restrictions imposed by simple phase diagrams'. The petrologist who does not compare his phase assemblage with the nearest appropriate phase diagram is liberated only to construct a house-of-cards, it seems to me. The two approaches (really one approach, because they depict the same thing) should always be used in conjunction; the literature is full of temperatures calculated from pairs of phases which a glance at a phase diagram would show cannot conceivably be in stable equilibrium. The rest of the chapter is, however, excellent, dealing with the oxidation state of liquids and the effects of redox state on olivine–liquid, pyroxene–liquid and hydrous mineral–liquid equilibria. And the final paragraph is a justified plea to bring 'wet' methods of Fe^{2+}–Fe^{3+} determination back into routine use, so these authors too have a feeling for the part of the ancient which is necessary to the modern.

Jaupart and Tait return in chapter 8 to deal with the dynamics of eruptive phenomena. This interesting chapter covers the many variables connected with magma uprise and eruption, and draws attention in particular to the importance of the large volume fraction of gas which will be released on crystallisiation of magmas with only a few per cent of dissolved volatiles. Next, G. W. Bergantz attempts to link the chemical evolution of magmas (usually considered with respect to the thermodynamic variables, T and P) with physical processes, usually concerned with time and length. This paper is a good guide to the literature but is written in rather too general terms to be directly helpful. It did remind me rather forcibly of H. J. Greenwood's recommendation that models should be testable and to wonder how, with so many variables, we can hope to do this. The final paper, by K. V. Cashman is on textural constraints on the kinetics of crystallisation of igneous rocks. She deals with crystal nucleation and growth, in simple and then complex systems and then with the coupling of nucleation and growth through the expanded Avrami equation. The treatment is interesting and clear.

This worthwhile volume is an anthology of 'modern methods' rather than an exhaustive treatment. The quality is a little uneven, but the overall value is outstanding altogether, very well worth the modest price. It is a pleasure to be able to end a review in the knowledge that a high proportion of readers will actually be able to afford the product!

I. PARSONS

Wilson, A. J. C. *International Tables for Crystallography. Volume C. Mathematical, Physical & Chemical Tables.* Dordrecht, The Netherlands (Kluwer Academic Publishers Group), 1992. xxix + 883 pp. Price Dfl. 400.00 ($244.00; £139.00).

On any reckoning, this is a formidable volume. It is the latest in the current update of a series which began in 1935 with two volumes of Internationale Tabellen zur Bestimmung von Kristallstrukturen published in German, with English and French abstracts at the beginning of every chapter. Sir William Bragg and Max von Laue were the Honorary Editors, Carl Hermann was the Editor, and there were 16 authors invovled. The compilation ran to 700 pages, and was the result of decisions taken at a Faraday Society Conference in 1929. The preface explained that 'these tables arose from the need of an international standard work with a nomenclature to which all papers on crystal structure might be referred'.

After the 1939/45 war, the Editorial Commission of the newly established International Union of Crystallogrpahy was originally charged with the task of preparing a new edition of the International Tables for the Determination of Crystal Structures, but so much new material was involved that the work was considered as a separate publication and given a new name; The International Tables for X-ray Crystallography, published in English with a dictionary of crystallographic terms in English, French, German, Russian and Spanish. It was intended 'to facilitate the work of three categories of scientists: those who were actually engaged in the determination of crystal structures, those who were using X-ray methods in the study of crystals in general, and students of crystallography'. With Kathleen Lonsdale, one of the contributors to the original 1935 publication as General Editor, the Editorial Commission produced three volumes: symmetry groups, mathematical tables, and physical and

chemical tables between 1952 and 1962, and the newly available electronic computers were used to prepare many of the tables. Volume 4 containing revised and supplementary tables, was published in 1974.

Among those who helped in their preparation was Arthur Wilson, whose contributions to the development of crystallography as such have been supplemented by a long spell as editor of Acta Crystallographica and by service on various Commissions of the International Union of Crystallography concerned with publications and nomenclature, and who is uniquely qualified to design and prepare such a wide-ranging compendium of information. The name has been changed once again, since X-rays are no longer the only important radiation used by crystallographers. Published volumes A and B deal with Space-Group Symmetry and Reciprocal Space respectively.

In his Preface, Professor Wilson explains that in 1981, Volume C was conceived as an editorial condensation of the old Volumes II, III and IV, with obsolete material deleted and tables easily reproduced on a pocket calculator reduced to skeleton form or omitted altogether, but once again the advances in the subject made this impracticable, so that Volume C consists largely of new material. The editorial path through various committees proved lengthy, but the result is impressive, although 'Tables' is a misnomer: this is really an Encyclopedia, with 87 contributors approved by the I.U.Cr. Executive Committee, and well able to meet the demands of the three groups of users envisaged for the post-war tables nearly 50 years ago.

Now to the volume itself. The technical quality is excellent, with informative diagrams, decipherable equations and legible tables, which incidentally, occupy less space than the text. There is an admirably detailed Table of Contents, under ten main headings; crystal geometry and symmetry, diffraction geometry and its practical realisation, preparation and examination of specimens, production and properties of radiations (X-rays, electrons and neutrons), determination of lattice parameters, interpretation of diffracted intensities, measurement of intensities, refinement of structural parameters, basic structural features, and precautions against radiation injury. Each chapter is supported by a substantial collection of references, and though the Editor explains that the volume only contains those contributions received by a January 1990 deadline, it is not easy to see what is missing.

How far does this huge volume meet the specific needs of mineralogists? Much of the information concerning crystal geometry and symmetry they already know, but the section on diffraction geometry will be of value in interpreting the results from whatever type of equipment happens to be available, including the national or international facilities for which access is competitive. Electron diffraction they may well have in the laboratory, but neutrons, which are useful in problems involving atoms whose atomic numbers are too close together or too far apart for run-of-the-mill X-ray work, can help in compounds that may easily be found in minerals, while synchrotron radiation is virtually essential for investigations involving details of X-ray absorption-edge structure which can give information about the local environment of a specific atom.

The largest section of the volume deals with the production and properties of radiations, and contains much of the numerical data actually used in crystallographic experiments, and it is certainly essential to have the most up-to-date values of these quantities, which reflect a prodigious amount of co-operative research. Again the much expanded sections on electron and neutron diffraction reflect recent developments in the techniques available to the experimentalist. Accurate determination of lattice parameters, the subject of the next section, depends, among other things, on a knowledge of the wavelength used for the measurement, and the Editor, himself an expert in this field, warns in his introduction that perhaps the most important factor is careful experimental technique: lack of care can produce larger errors than the lack of the latest equipment. Studies of solid solutions, which abound among minerals, require an accurate knowledge of lattice parameters, and of factors which affect diffracted intensities, the subject of the next section. Among these factors is absorption, which affects most mineralogists in the interpretation of electron microprobe data, quite apart from its importance in structure determination. This part of the volume is completed by a relatively brief section on the measurement of intensities and assessment of the errors involved.

The section on the refinement of structural parameters is also brief, and probably reflects the fact that most crystallographers will either have written their own programs, in which case they are familiar with this material, or are using some program in general use with their equipment, possibly supplied by the manufacturer. There is a section on the Rietveld method of analysing powder diffraction data now in quite general use and a section on the analysis of charge and spin densities, only possible, as the authors point out, using data of the utmost accuracy, and not

generally obtainable from routinely collected data sets, but it will be useful for specialists.

The section on basic structural features contains much material of interest mainly to chemists concerned with organic and organometallic compounds, but it does include a section on incommensurate and commensurate modulated structures which will certainly be of interest to mineralogists, and the section on precautions against radiation injury ought to be required reading for all users of radiation.

What, then is missing? Mineralogists are concerned largely with crystals formed long ago and far away, and there is almost no mention on crystallography at controlled temperatures or pressures, although of course electron diffraction invovles vacuum technology. Such work requires as much, if not more, skill and attention to detail as RTP experiments, and plays a large part in the study of minerals. Site occupation and solid solutions are not discussed, nor kinetic experiments to follow continuous processes, although synchrotron radiation is certainly capable of such research.

'Crystallography' in this context only involves interaction with radiation, excluding radiography, and excludes all other techniques such as goniometry or spectroscopy which give information about crystals, but in the areas which it has chosen to cover, it is a tour de force, and a must for anyone seriously interested in crystal structures and in how they are determined. The 1935 title is still the most accurate description of this international series.

M. J. MENDELSSOHN

Ferguson, G. and Trotter, J., Eds. *Structure Reports 1990 vol. 57A Metal and Inorganic Compounds*. Dordrecht, The Netherlands (Kluwer Academic Publishers Group), 1992. vi + 339 pp. Price Dfl. 150.00 ($82.00; £46.00).

The avowed aim of the I.U.Cr., in whose name this series is published, is to present critical accounts of all crystallographic structure determinations of metals and of inorganic compounds. Details of the arrangements in the volumes, symbols used etc., given in Volume 53A, though occupying only two pages, are not reproduced, which seems an absurd omission, considering the blank areas in the first few pages. [Further details concerning the metals section are to be found in 47A, V11, but mineralogists may be spared this further excursion into other volumes.]

Most of the entries have illustrations of the structure and tables of co-ordinates, interatomic distances and bond angles, apparently photocopied from the original paper, since the typographic styles differ widely. This may prevent the introduction of errors, but the quality of some of the illustrations, *at least in this review copy*, is extremely poor, about ten being seriously defective (e.g. pp. 20 and 307).

On the positive side, mineralogists will find new information from complete structural analyses on nearly a thousand inorganic compounds from ahlfeldite to zirconium vanadium silicates, most with R-factors of 5% or better, including some obtained from neutron powder data or synchrotron radiation, and covering topics as diverse as copper oxide superconductors and the compressibility of stishovite. The structures are grouped as elements, boron hydrides, carbonyls, P–N and S–N compounds, halides, cyanides, oxides, double oxides, hydroxides, sulphides, borates, carbonates, nitrates, phosphates, arsenates, sulphates, perchlorates, iodates, silicates and silicate minerals. An equivalent section with a similar classification scheme deals with some 500 metals and metal compounds.

In the absence of editorial information, it is not clear whether comments in the text are those of the authors or of the editors. For example $Ce_4Pt_{12}Sn_{25}$ [p. 18] 'high thermal parameters for Sn(3) may indicate disorder of this site', is not bracketed, whereas $Al_{12}CuLi$ [p.14], (Li sites are not well determined) is bracketed. Of course the R-factor is a useful indicator of general quality, but as there are no themal parameters and no e.s.d. values, we cannot tell, and as the authors' names are not given, it is not easy to seek more information in abstracting journals.

All this may sound like carping criticism. Abstracting is a thankless task, and we should all be grateful to those who undertake it for the common good, but this series comes with the imprint of the international organisation concerned with setting and maintaining high standards of crystallographic publishing, and states that its purpose is to present *critical* accounts of structure determinations. It may be felt that R-factors of 2–3% speak for themselves, but the entries in this volume are now so terse that while they do indeed alert the reader to the fact that structural work has been published on a particular compound, they seldom provide any critical assessment, and as far as minerals are concerned, no provenance. It is nice to have some new information on clinopyroxene, but did they make it or find it, and if so where?

M. J. MENDELSSOHN