Book Reviews

Works intended for notice in this column should be sent direct to the Book-Review Editor (J. H. Robertson, School of Chemistry, University of Leeds, Leeds LS2 9JT, England). As far as practicable books will be reviewed in a country different from that of publication.

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Advances in structure research by diffraction methods. Vol. 7. Unconventional electron microscopy for molecular structure determination. Edited by W. HOPPE and R. MASON. Pp. 225. Braunschweig/Wiesbaden: Friedr. Vieweg & Sohn, 1979. Price DM 84.00.

This collection of reviews is Vol. 7 of a series which is well known to crystallographers. The publication of this series is quite expeditious because it reflects the rapidly developing theoretical and experimental problems of the structure analysis of substances. This volume contains a number of interesting papers by outstanding scientists engaged in the field of electron microscopy. It opens with a review by B. M. Siegel which is devoted to the progress and problems of instrumental techniques; in particular, it elucidates the problems of mechanical and thermal stability and of external disturbances.

Of much interest is the paper by E. Kellenberger and J. Kistler in which the authors attempt to analyze the physical phenomena arising during specimen preparation; this process may be accompanied by the creation of artefacts. The most evident factors having a strong influence are the following: surface tension and phenomena of capillarity arising on drying, absorption, and aggregation or collapse on freeze drying. When considering the problems of preparation, the authors give, in the main, qualitative conclusions and some useful suggestions. However, the problem remains very complicated and, to specialists in the field of electron microscopy, there is much still left to do.

Kellenberger and Kistler think that the occurrence of 'optical artefacts' in dark-field imaging is less frequent than in bright-field imaging, *i.e.* one can gain better resolution accessible to direct visual instrumentation. This is a moot point. On considering the 'freeze etching' method they hold the opinion that solid water can have properties which are close to those of organic solvents and can possibly lead to a denaturation of proteins, but here the process of denaturation is very slow. This is also a question to be discussed.

Professor A. V. Crewe elucidates the problems of scanning transmission electron microscopy (STEM).

V. Cosslett and O. Scherzer consider the theoretical and experimental problems of radiation damage. In particular, Cosslett dwells on the methods of investigating radiation damage: electron diffraction, mass loss, energy-loss spectrometry, infrared spectrometry. The results obtained with the aid of all these methods differ, of course, one from another, but this is not unexpected, since diffraction, for instance, mainly yields data on the mutual arrangement of molecules, whereas infrared spectroscopy gives information on intramolecular interaction. Also reviewed are possibilities of reducing radiation damage, low doses, high accelerating voltage, low-temperature operation and protective media (effects).

J. Gussmann presents a theoretical analysis of the various possible ways of measuring amplitudes and phases in electron microscopy.

This volume includes two papers concerned with three-dimensional reconstruction (by W. Hoppe, and D. Typke and W. Hoppe). This aspect, which came into being in electron microscopy over ten years ago, greatly extended the possibilities of the method – especially in the field of the investigation of biological macromolecules. In the papers just mentioned the emphasis is placed on aperiodic objects. The experimental and theoretical methods necessary for a reconstruction are also described.

Consideration is given to the problem of best-suited-data collection, to the problem of restricted tilting angle, to the influence of radiation damage and to the experimental techniques: microgoniometers, correlation methods, quasi-continuous projection recording, and electron beam tilting without mechanical shifts of object.

Methods of object stabilization allowing one to improve the resolution are considered. One is the replacement of water in fixed protein crystals by a hydrophilic monomer followed by its polymerization. This makes it possible to obtain a diffraction field of 4–8 Å.

Consideration is also given to freezing, and replacement of water by small hydrophilic molecules of, in particular, sugar. Brief mention is made of data collection for subsequent reconstruction: three-dimensional crystals, two-dimensional layers, one-dimensional aggregates – for helical and cylindrical individual molecules.

A serious defect of the reviews on three-dimensional reconstruction is the inadequate elucidation of the results obtained in other laboratories: for example, of works of the English School on helical structures and spherical viruses, and of works of the Soviet School on tubular structures, bacteriophages and individual protein molecules, whereas precisely these works lay the foundation for the 'three-dimensional electron microscopy' that the authors dwell upon.

In spite of some shortcomings, this volume is one of today's best works on electron microscopy.

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Engineering physical metallurgy and heat treatment. By YU. LAKHTIN, translated from Russian by N. WEINSTEIN. Pp. 424. Moscow: MIR, 1980. Price £5·95.

This book is interesting; it deserves to be read with the same care and attention that is devoted to the study of the poetry

of the lesser Victorian poets, and of William McGonagle in particular, for it involves the same sense of period, of a mannered bygone age linked with an incredulity that such offerings were meant to be taken seriously. But let us consider the facts. It appears that an English edition of this book was first published in 1974 and subsequently this was 'thoroughly revised' to give rise to a second edition in 1977 from which the present translation was prepared for publication in 1979. The text is aimed at undergraduate students, but if the translator knew anything about the British educational system, he would have converted the units to SI. Stresses are given in a variety of CGS units.

As much of the underlying basis of heat treatment of alloys is to produce supersaturated solid solutions and then to decompose them in a controlled manner, it might reasonably be expected that a translator would have knowledge of the major technical terms related to the text he is translating. But no – supersaturated appears as 'over-saturated' whilst there is a widely used phrase 'surplus phases', the meaning of which is far from clear. *In situ* transformations are described as 'on the spot' transformations and weld beads have become 'weld seams'. One should not be too hard on an author for infelicities of his translator, but the terms used by Mr Weinstein could leave a young British student somewhat perplexed.

The study of physical metallurgy and its relation to heat treatment requires a detailed knowledge of the origins of microstructure and the factors influencing microstructural change linked to an understanding of the relationship between microstructure and mechanical properties.

Professor Lakhtin does not have a grasp of these topics. There are eleven electron micrographs; two look as though they are from thin foils and the remainder are from replicas, but the captions would not help those wishing to understand what is being illustrated. There are no scanning micrographs. It is stated that the book deals with the mechanical properties of alloys and up-to-date concepts of structural strength and failure. The majority of these concepts have been developed during the last twenty years from the observations made with various electron optical instruments, but it seems that the author has ignored much of this work. As just one example, stacking faults and stacking-fault energy are not even mentioned.

A British student who produced answers in his final examinations to the standard questions on the structure and properties of martensite, on the tempering of carbon steel and the relationship between structure and properties of solution-treated, quenched and aged Al–4% Cu alloys, based solely on knowledge gleaned from Professor Lakhtin's book, would not merit a classified Honours degree. A generous external examiner might just agree to an 'Ordinary' on the grounds that at least the student had read something. But the poor student would know very little about secondary hardening in alloy steels – the explanation given runs to three lines, and is wrong. Low-temperature temper embrittlement (blue brittleness) is attributed to 'the development of a three-dimensionally stressed state obtained in non-uniform decomposition of martensite'. It is difficult to know what this means – a masterpiece of metallurgical gobbledegook – but it is far removed from the views expressed by modern metallurgists. The explanation given for high-temperature temper embrittlement makes no reference to the extensive work carried out over the last fifteen years on Auger spectroscopy. The definition of overheating is that put forward by Heyn in 1902 and this was found to be in error during extensive work in the 1930's. Burning is dismissed as being solely due to oxide-film formation and no reference is made to the work of Stead in 1915 who showed that phosphorus was partially responsible. The more recent studies showing the formation of a sulphide eutectic in a phosphorus-rich liquid region at the austenite grain boundaries have been completely overlooked.

There are lessons to be learnt from this book. The author, after paying tribute in the *Introduction* to the work of the renowned crystallographers von Laue, Bragg, Westgren and Phragmén, gives a bibliography at the end in which all but three of the many authors mentioned are Russian.

By ignoring work in Western Europe and the USA, the author has clearly got himself into difficulties. Are there areas of science and engineering where Western authors, through ignoring Russian contributions, could be equally guilty of misleading their readers and perhaps whole generations of students about the extent of knowledge?

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Molecular interactions and activity in proteins. Edited by RUTH PORTER and DAVID FITZSIMONS. Pp. viii + 279. Amsterdam, Oxford, New York: Excerpta Medica, 1978. Price US $28.50, Dfl 64.00.

This volume is the proceedings of a symposium of the same title held in December, 1977, at the Ciba Foundation in London. The term symposium derives from the Greek tradition of drinking bouts laced with intellectual discussion – or *vice versa*. Although I wouldn't deny that elements of this ancient rite prevailed, these proceedings are more reminiscent of the modern American tradition of the 'pot-luck supper' in which a very tasty assortment of uncorrelated offerings are presented by each of the attendees and lively critical comments are then passed between the contributors.

Despite the fact that several notable potential contributors were absent and over half of the contributions were from England, the 24 participants – all outstanding scientists – presented a well balanced variety of experimental and conceptual approaches to the subject. Crystallography was well represented with a plurality of 30%. Applications of NMR, EPR and various optical techniques were reported and discussed, including three recent additions to the armory of protein probes: spin echo Fourier transform NMR which increases the sensitivity to local conformational changes; two-dimensional representation of NMR spectra which semi-orthogonalizes the display of multiplet fine structure and chemical shifts; and perturbed correlation of γ emission from radioactive metallic ligands – a technique which is purported to solve the problem of comparing dynamic information from molecules in viscous solution and in crystals. Theoretical analysis of protein stability and a strong representation in physical organic chemistry rounded out the program. If there was one regrettable omission it was the absence of any discussion of cryoenzymology and low-temperature crystallographic studies.