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