

fibre in the goniometer mounting pin can be brought together by adjusting the *x*, *y* and *z* positions. After a satisfactory position has been obtained, the crystal is backed off, and a small amount of suitable adhesive attached to the glass fibre. The crystal is then brought up to the fibre until contact is made. The apparatus is then left until the adhesive has cured.

Aluminum sheet,  $\frac{1}{4}$ " thick, was used for the frame. The cost of the device, excluding the goniometer is under US \$40.00.

J. BRIAN FAUGHT

*Department of Chemistry  
Dalhousie University  
Halifax  
Nova Scotia  
Canada*

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## Crystallographers

Professor Emeritus **E. A. Owen**, Professor of Physics at the University College of North Wales from 1926 to 1954, died recently.

He worked on Röntgen rays and radioactivity under Sir J. J. Thomson at the Cavendish Laboratory before being appointed to the staff of the National Physical Laboratory, where he subsequently became Head of the Radiology Division. In 1926 he was appointed to the Chair of Physics at University College, Bangor, where he established a research school in metal physics, which became internationally recognized for the precision of its X-ray work and its applications to the study of the equilibrium diagrams of metals and alloys.

## Notes and News

*Announcements and other items of crystallographic interest will be published under this heading at the discretion of the Editorial Board. The notes (in duplicate) should be sent to the Executive Secretary of the International Union of Crystallography (J. N. King, International Union of Crystallography, 13 White Friars, Chester CH1 1NZ, England).*

The Walter C. Hamilton Memorial Fund, established under the auspices of Associated Universities, Inc., will be used to provide financial assistance each year to one or more graduate or advanced undergraduate students for work on

crystallographic problems at Brookhaven National Laboratory, particularly with neutron diffraction techniques. Students will be selected for these awards on the basis of the scientific merits and feasibility of their research proposals, educational background and experience, and letters of reference. U.S. citizenship is not a requirement. It is expected that each student will spend one to two months at Brookhaven collecting and analysing neutron diffraction data under the guidance of a BNL crystallographer. Computational and other facilities of the Laboratory will be made fully available. The individual stipends, intended to cover travel and housing expenses, will generally be in the range of 300 to 600 dollars. The students selected will be designated as Walter C. Hamilton Scholars.

It is anticipated that the first award will be for the academic year 1974–75. The deadline for applications will be March 1, 1974. Applicants should submit the following material to the Chairman, Chemistry Department, Brookhaven National Laboratory, Upton, NY 11973, U.S.A.

- (1) Description of the proposed problem (not to exceed 5 double-spaced pages).
- (2) Educational background and experience (which must include some acquaintance with diffraction techniques).
- (3) Three letters of reference, including one from the sponsoring professor.

## Book Reviews

*Works intended for notice in this column should be sent direct to the Book-Review Editor (M. M. Woolfson, Physics Department, University of York, Heslington, York YO1 5DD, England). As far as practicable books will be reviewed in a country different from that of publication.*

**Laboratory manual on crystal growth.** Edited by I. TARJÁN and M. MÁTRAI. Pp.250, Figs. 128, Tables 12. Budapest: Akadémiai Kiadó, 1972. Price \$10.40.

The number of useful text-books available for the crystal grower is small for such an active field, possibly because few workers are sufficiently familiar with all of the possible techniques in use to write authoritatively about them.

Similarly, the theoretical aspects and 'fringe' interests (*e.g.* characterization of crystals) embrace such a wide range

of topics – from electrochemistry *via* solid-state theory to sophisticated mathematics – that an all-embracing work is unlikely to emerge. However, some valiant initial attempts have been made to remedy the situation, with, for example, Laudise's *Growth of single crystals*. A second approach is to make a collection of articles by specialists on different subjects as in *The art and science of crystal growth*. This usually results in a patchy volume which lacks continuity, although the example given served a very useful purpose when it was first published. Judging by present trends it seems likely that crystal growers will be inundated with textbooks of this type in the near future.

Completely missing at present from the field is a good practical book which states in clear and simple terms the important aspects of setting up and operating growth equipment. The *Laboratory manual on crystal growth* by Tarján and Mátrai is really the first of this type of book to appear, and should therefore fill a much needed requirement. It is with some regret that one finds that it only does this in a rather half-hearted manner. This may partly be psychological, since the presentation leaves much to be desired by current text-book standards. The quality of the numerous illustrations is poor and the diagrams have a curiously out-of-date appearance that was in vogue in publications of two or more decades ago. On closer inspection the content of the diagrams is as reasonably modern as could be expected.

The treatment also has the indefinable air of slight obsolescence. It is divided for obscure reasons into two main parts, *Basic phenomena* and *Techniques of crystal growth*. Neither section contains any theory whatsoever, but the first section tends to deal with growth principles and describes in adequate detail numerous experiments that are appropriate to students who are taking their first steps in the field. It is a pity that the growth techniques in the second part are not covered in similar detail.

It is difficult to say where the fascination of this book lies, but certainly it has an appeal. The charm of the diagrams such as that on p. 136 in which the seed crystals have a small hat over them for 'protecting them against parasitic seeds' cannot be denied. The odd snippets of valuable information appear and a valiant effort is made to give experimental procedures for growing crystals by a variety of techniques. In all cases it is assumed that the necessary equip-

ment, however complex, is available. Consequently it is not detailed enough in this respect for people wishing to start up and obtain practice with a particular technique, neither is the information presented advanced enough for workers who have modern well designed equipment available.

The attempted coverage of the book is good. Most modern growth techniques are mentioned, in at least an abbreviated manner. The Czochralski technique, however, is covered in less than two pages of text with one diagram for InSb, which is hardly proportionate to the importance of this technique – nor even to the effort previously devoted to InSb! The section dealing with 'Devices for Crystal Growth' is hopelessly inadequate, but some attempt is made to deal with processing of crystals and a few simple methods of cutting, drilling and polishing are described. Luckily no attempt is made to describe the characterization of crystals.

I feel that the book will be useful to have for students to read in a general manner, and perhaps to give them the basis of ideas for constructing their own apparatus. I cannot see that it really constitutes a laboratory manual, nor, as is stated on the jacket, will it prove to be a useful instrument for teaching crystallography.

E. A. D. WHITE

Department of Electrical Engineering  
Imperial College of Science &  
Technology  
Exhibition Road  
London SW7 2BT  
England

**Crystal chemical classification of minerals.** By A. S. POVARENENYKH. Translated from Russian by J. E. S. BRADLEY. Vol. 1: Pp. xiv + 458, Figs. 211, Tables 30. Vol. 2: Pp. 308. Figs. 88. New York: Plenum Press, 1972. Price \$46.00.

These two volumes contain the ideas of Professor A. S. Povarennykh on a crystal chemical classification of minerals. It is an important and fascinating contribution to mineralogy – there can be no doubt about this, nor about the fact that it will become the source of much controversy.

The proposed classification has the following scheme: each mineral species

is successively assigned to a type, a class, a subclass, a division (eventually a subdivision) and a group (eventually a subgroup). There are four *types*: I. Homoatomic and similar compounds (e.g. carbides); II. Sulphides and analogous compounds; III. Oxygen compounds; IV. Halides. Within each type there are a number of *classes*, according to the kind of elements combined with sulphur, oxygen or halogen. So far the classification is rather chemical and commonly accepted in mineralogy.

The next division into *subclasses* is a structural one. There are six: coordination, framework, ring, insular, chain and sheet. This classification is not purely topological – based on relative positions in space of coordination polyhedra – but also takes into account the kind of atoms that form the polyhedron. To do this the author introduces the bond strength, for which he gives a formula and a table. Unfortunately the reader cannot check the given values because the formula contains two factors that are not further defined. However, some values of these factors can be found in other tables. When the bond strength is larger than 1 the polyhedron is considered to be a radical. Another criterion is the degree of valency completion, *V*, defined (p. 41) as the cation valency divided by the total number of anion valencies in the polyhedron. A third criterion is the number of common vertices between polyhedra. In most cases it is clear why a certain crystal structure has been assigned to a certain subclass, but sometimes it is not. Why should fergusonite, (Ce,Y)NbO<sub>4</sub>, with a scheelite-type structure belong to the coordination subclass, whereas scheelite, Ca[WO<sub>4</sub>], appears in the insular subclass, although both tetrahedra have a bond strength larger than 1?

The classification into *divisions* and *subdivisions* is based on the complexity of the structural feature, such as the composition of a ring or a chain. The sequence of divisions is not arbitrary, but determined by a decrease in bond strength. Similarly the species within a *group* are also arranged according to decreasing bond strength. For example euclase, BeAl[SiO<sub>4</sub>]OH, is found as the second species after topaz, Al<sub>2</sub>[SiO<sub>4</sub>]F<sub>2</sub>, and classified as: type III, silicate class, insular subclass, division A (with isolated [SiO<sub>4</sub>] tetrahedra), subdivision II (with additional anions), topaz group.

Povarennykh relates the constitution (structure) to habit, cleavage, hardness and density. This must sometimes lead to internal inconsistencies as the habit

is determined by the bonds formed in the crystallization process, whereas the classification criteria consider all bonds. For example, epidote belongs to the insular subclass because of the [SiO<sub>4</sub>] and [Si<sub>2</sub>O<sub>7</sub>] radicals, yet the habit is columnar to acicular because of the Al–O octahedral chains, suggesting a chain subclass.

The concept of *mineral species* is defined by Povarennykh as the total of all mineral individuals characterized by an identical structural group and by a chemical composition lying within the range of continuous variation. This is contrary to the usual definition, in which end members of a continuous solid solution series are considered as separate species. For example, in Povarennykh's system celestine, SrSO<sub>4</sub>, does not occur as a mineral species, because it has a continuous solid solution series with baryte, BaSO<sub>4</sub>; in the new classification baryte is (Ba,Sr)SO<sub>4</sub>, while SrSO<sub>4</sub> is called strontio-baryte and BaSO<sub>4</sub> bario-baryte. Although uncommon, it is straightforward and certainly has many advantages. It implies, however, that the concept becomes dependent on *p*–*T* conditions: separation at a lower temperature creates a new species. Incidentally, it must be remarked that a mineral should be solid, so water and Hg are not minerals; nor are natural organic compounds considered as minerals, even when they are solid.

The *formula* representation is also rationalized by giving the elements in the order of increasing valency and electronegativity, which certainly is an improvement.

The *nomenclature* has also been rationalized by Povarennykh. The name should reflect most or all electropositive elements, the chemical class and the structural pattern. The class is denoted by a suffix (sulphide = -sulite), the structure eventually by another suffix (-tilite for chain, -phyllite for sheet). The author has fortunately refrained from renaming all minerals, only new minerals and new species have new names. For example, (Mg,Fe)CO<sub>3</sub> is magnifercite. However, it is most unfortunate that the author has not taken advantage of the experience gathered by constructors of synthetic languages, such as Esperanto, because he then might have avoided pronunciation difficulties. In various languages -azite (N), -asite (AsO<sub>4</sub>) and -arsite (As) sound much the same, as do -site (SO<sub>4</sub>) and -cite (CO<sub>3</sub>) (why not -kite?).

The book is divided in two parts.