

due to the fact that the volume of sand which was fused to glass must have been much greater than the volume of the resultant glass, leaving a crude cylindrical mould to whose sides the glass was drawn by cohesion while in a viscous state. The included bubbles have most probably arisen from moisture entrapped during the sudden fusion of the sand, wet from the storm, or perhaps in part from volatilization of silica or other components into a gaseous form when the bolt struck. The presence of mullite is undoubtedly due to the short time the mass was liquid, thus giving the alumina of the clay insufficient opportunity to be thoroughly disseminated through the silica glass for complete solution. Hence, at points of high local concentration of alumina, mullite was formed.

Since the above note was written, Prof. A. F. Rogers has called our attention to the fact that Lacroix has given the name "lechatérite" to the glass of fulgurites.⁵ He does not, however, mention the presence of mullite. Professor Rogers⁶ detected water, upon heating in a closed tube a fulgurite containing many bubbles, thus confirming our conclusion that the bubbles are due to entrapped steam.

BOOK REVIEWS

MIKROSKOPISCHE PHYSIOGRAPHIE DER MINERALIEN UND GESTEINE. Rosenbusch-Wülfing, 5th edition, fully revised. Vol. I, First Half, octavo, pages 533-846. The whole volume contains 680 figures and 15 plates. E. Schweizerbart'sche Verlagsbuchhandlung, Stuttgart, 1921-1924.

This is the third and last section of volume one. (For reviews of the first two sections see *Am. Min.*, 7, 211, 1922, and 8, 172, 1924.

The discussion of the microscope and its uses is completed. The other subjects considered are the use and application of the axial angle apparatus and of the conoscopic; investigation of cohesion and density; methods of separation; and chemical methods. The morphological features of crystals are treated in four chapters as follows: (a) Formation, (b) Inclusions, (c) Aggregates, and (d) Deformations. The appendix includes tables of indices of refraction, birefringence, and specific gravities, as also plates of photomicrographs of thin sections of rocks and minerals, and of chemical preparations as well.

E. H. KRAUS.

THE STRUCTURE OF CRYSTALS. RALPH W. G. WYCKOFF. American Chem. Soc. Monograph Series. Chemical Catalog Company. 19 East 24th St., New York, 1924. 462 pp. 231 fig. Price \$6.00 net.

This book consists of two parts; the first dealing with theory and methods, the second with results.

⁵ *Bull. Soc. Fr. Min.*, 38, 182-6 (1915).

⁶ *Jour. Geol.*, 25, 526 (1917).

The first part contains chapters on crystallography, X-rays, interaction of X-rays and crystals, and methods of analysis. These latter chapters are especially excellent. Various types of apparatus are described, and the application of the results is illustrated by actual examples. Beginners, and even older workers in this field will find them helpful. The chapter on crystallography, in spite of excellent figures, seems to lack clearness. It seems as though no one has yet been able to present crystallography, as applied to crystal structure, in a manner intelligible to the average reader. The chapter on X-rays is brief, though it gives the essentials required for crystal analysis. That on the interaction of X-rays and crystals is rather difficult, but formulae are given which can be used even though they are not fully understood.

The second part consists of a bibliography, a review of all structure determinations, and equally important, a critical comment as to the validity of these determinations. This will be of great value to workers who have been unable to keep up with the rapidly accumulating literature of the past few years.

This book will be very welcome to all those who are interested in this new field, for it fills a gap which has existed in the literature in the English language.

L. S. RAMSDELL.

X-RAYS AND CRYSTAL STRUCTURE. Sir W. H. Bragg and W. L. Bragg. 4th edition, revised and enlarged. 322 pages. G. Bell and Sons, Ltd., London, 1924.

KRISTALLE UND RÖNTGENSTRAHLEN. P. P. Ewald. 327 pages. Julius Springer, Berlin W-9, 1923.

The two works cover essentially the same ground, and each costs about the same amount (\$6). The first is adapted especially for beginners, while the second is an excellent general reference work covering the whole field uniformly. The Braggs were pioneers in the working out of crystal structure by means of X-rays, and treat the subject in more or less the same order in which it actually developed in the course of their work, keeping in view the mind of the student, and creating a real text-book. Chapter XII, Crystal Analysis and the Atomic Forces, contains much data on the apparent dimensions of atoms not included in previous editions; and XIV, Organic Crystals, brings out in a striking manner how ingenious reasoning can overcome the difficulties inherent in the absence of X-ray diffraction by hydrogen atoms. It can not be said that the conclusions reached in these chapters are final, but the many cases of agreement between prediction and observation show that the right track is being followed. Chapter XVI, which bears no title but is termed a Supplementary Chapter, comprises a summary of some outstanding recent work, although it is not as complete as might be desired. In it a little over three pages is devoted to the space-group method of looking at crystals, with the conclusion that "We may define in terms of space groups or in terms of arrangements, as we please. The latter is more natural to the X-ray methods; and moreover, it tells us more simply and directly what is necessary for the further study of the structure of the crystal."

The second of these works combines many desirable features. The style is easy to follow, the treatment is non-mathematical, and the development of the subject is logical. Contributions to the working out of crystal structure are cordially welcomed, whether based on any particular mathematical viewpoint or not. Both books are well illustrated, and well printed, with surprisingly few typographical errors, and should be on the shelves of every mineralogist's library. W.