

keelelyite was placed in quotation marks by the writer³ to show it to be discredited, the reason being given that it was a variety of zinkenite.

Shannon and Short now conclude that it "can be accorded full species rank." They supply a good analysis on microscopically homogeneous material, which leads to the formula $PbS \cdot Sb_2S_3$ (with minor amounts of replacement) identical with that universally adopted for zinkenite.⁴ Nevertheless they consider the two minerals distinct because of the presence in the keelelyite of 3.26% of metals other than lead, notably including 1.24% of zinc, and because of certain mineragraphic differences.

Henglein⁵ cites ten analyses of zinkenite, and in the eight of these in which metals other than lead were determined the amounts are: 0.42, 0.76, 0.80, 1.57, 1.83, 2.21, 3.10, and 4.23. Accordingly keelelyite is identical with zinkenite with respect to the presence of a few percent of minor constituents. Although zinc was not reported as such in any of these analyses, it was probably not looked for in any except perhaps Hillebrand's, but was weighed as iron, copper, or silver, one or more of which are present throughout.

The analyzed keelelyite differed mineragraphically on four out of eleven counts from another sulfosalt which Shannon and Short examined. But they gave no data as to the identity of this other sulfosalt except to say that it was labelled zinkenite. There is no information as to whether it had the ratio $PbS \cdot Sb_2S_3$, nor whether it contained zinc replacing the lead.

The claim of keelelyite to be a distinct species accordingly rests on the presence of a little more than 1 per cent of zinc—far too little to be represented in the formula—and a few mineragraphic differences, which may well be due to its zinc content, from a specimen of unknown composition which may have represented zinkenite, and which may or may not have had the same ratio. I therefore regret that I can not agree with the writers in question. They have shown that keelelyite has the zinkenite formula and that it contains enough replacement of the lead to account for minor differences in properties. Instead of establishing its specific rank, it seems that they have thus demonstrated that keelelyite is, as previously suggested, only an impure variety of zinkenite.

M. A. Lacroix, professor of mineralogy at the University of Paris, has been made a foreign member of the Stockholm Academy of Sciences.

J. E. Morrison, secretary of the San Diego, California, Chamber of Mines, has been appointed honorary curator of minerals at the Natural History Museum, San Diego.

At the University of Texas, the Bureau of Economic Geology has moved into new and better quarters. A two story fire proof building has been provided for laboratory and museum space with additional space in other buildings for offices and general storage. A mineralogical laboratory will be installed in the Bureau's new building and will be equipped through a special appropriation recently made by the Board of Regents.

³ *Am. Mineral.*, 9, 175, 1924.

⁴ Dana, *System*, 112; Groth & Mieleitner, *Min. Tab.*, 24, 1921.

⁵ Doelter's *Handbuch Mineralchem.* 4 (3) 449, 1925.

Professor P. von Groth, for many years professor of Mineralogy at the University of Munich, Germany, died Dec. 2, 1927, in his eighty-fifth year. A biographical sketch of his life and contributions to mineralogical science will appear in a later number of the JOURNAL.

REVIEWS

REVIEW OF AN INVESTIGATION OF THE RATE OF GROWTH OF CRYSTALS IN DIFFERENT DIRECTIONS

An excellent piece of research on the growth of crystals, by Dr. Marie Bentioglio, working under the direction of Dr. Barker and Professor Bowman at Oxford University, has just been published in the *Proceedings of the Royal Society*,¹ and as this journal is probably not accessible to many of the readers of the *American Mineralogist*, this review has been prepared to call the attention of crystallographers to the significant results obtained.

While the experimental methods employed were similar to those of Wulff, many important improvements were introduced. The crystal under study was held at the center of a horizontally-placed flask filled with 500 cc. of solution, the zone of faces to be measured being horizontal, and the flask being slowly rotated on the axis of this zone. To hold the crystal a hole was drilled into it, and a long fine pin fixed into this with wax, the pin being then clamped to a rod attached to the stopper of the flask. To measure the amount of growth, the rod was detached and mounted on a tripod so that it could be slid along on a glass plate, under a microscope with magnification of 75 diameters, readings being obtained by means of a milled head, graduated in 0.01 mm.

Crystal growth was effected by slow cooling of the solution, the best initial temperatures being found by trial to be: sodium chlorate, 35–37°; K-alum and double sulfates of Mg or Fe⁺⁺ with K or (NH₄), 30–34°; K and (NH₄) tartrates, 40°C. A fall in temperature of 10–12° in 4–5 hours was attained by wrapping the flask in cotton, and proved adequate. The results are tabulated in detail and illustrated by crystal drawings, and lead to the following conclusions: (a) On crystals bounded by a single form, all the faces grow at the same rate, irrespective of their original sizes. Hence a distorted crystal may tend toward, but never quite attain, ideal development with the faces all equal in size. (b) On crystals bounded by a combination of forms, unlike faces grow at different rates, but like faces grow at the same rate. An exception to the latter relation may occur when the faces lie adjacent to a larger face of another, fast-growing form, for the latter may impoverish the solution in its neighborhood, and slow up the growth of faces surrounding it. (c) On crystals lacking a center of symmetry, the growth-rates of parallel faces may be widely different. (d) In an isomorphous series, the order of increasing rates of growth of different forms is not the same for different members.

While these results are interesting in throwing light on the manner of development of crystal habit, their greatest value lies in their bearing on the theory of the relation between crystal structure and form. The frequently accepted view, favored by Wulff and carried to an extreme by Fedorov, is that the rate of growth of a given form is directly related to its reticular density, *i.e.*, the packing of

¹ *Proc. Royal Soc. (London)* A, 115, No. A 870, 59–87, June 1, 1927.