

DISCUSSION

KYANITE PSEUDOMORPHS AFTER ANDALUSITE FROM DELAWARE COUNTY, PENNSYLVANIA

There are numerous references to the finding of andalusite in central Delaware County, Pennsylvania. The original reference to which all subsequent references ultimately turn is that of Edward S. Dana (1872, p. 473). Samuel Gordon (1922, p. 90) quotes figures telling of the finding of large nodules of andalusite crystals measuring up to 6 x 23 cm. and groups up to 60 pounds. He also refers to the article by Dana and includes two sketches of the andalusite crystal described by Dana. On comparing the drawings in the original and the drawings in Gordon's *Mineralogy* one discovers that the Gordon drawings are idealized drawings of the idealized drawing made by Dana! The "remarkable crystal of andalusite from Upper Providence, Delaware Co., Penna.," presents an irregularity in the number of faces amounting to hemihedrism, and the angles do not accord too closely with those of andalusite. Dana, blaming the irregularities on "an accidental irregularity", drew the crystal as it actually was, and then made an idealized drawing showing how it should be with all the faces present. No optical work was done.

It is very strange that in the course of some 87 heavy mineral separations performed on specimens of the Wissahickon formation from central Delaware County, many of them from areas sighted as andalusite localities, not even a microscopic trace of andalusite was found in the heavy fractions.

A nodule of prismatic "andalusite" crystals weighing approximately 10 pounds was found by the writer during the course of sampling central Delaware County. This nodule is now in the collection at Bryn Mawr College. A fragment of one of the crystals was examined optically and was found to be kyanite. A. W. Postel (1940, p. 123) mentions that there seemed to be a skin of kyanite on some of these nodules, but went no further.

More recently the writer found a nodule of granular quartz near Swarthmore (one of the localities mentioned in Gordon's *Mineralogy*) from which he was able to get five individual prismatic crystals, the largest one 3.5 cm. by 0.9 cm. Two oriented thin sections were made from one of the smaller crystals. One section was made normal to the length of the prism, the other parallel to the length of the crystal. The material is kyanite throughout. The kyanite is in fine prismatic crystals mostly oriented parallel to the length of the prism. A crushed specimen was examined for optical properties and cleavage. The angle between cleavage {010} and cross parting

{001} is 85° . The optical properties are entirely in accord with those given for kyanite in any descriptive mineralogy.

The specific gravity was difficult to measure because of unavoidable contamination by muscovite which coats the surfaces of the crystals. The result finally obtained was 3.36; low for kyanite, but decidedly too high for andalusite. The color on cleaned surfaces is blue.

The crystals are rather rough and the faces dull and iron stained. Although all the crystals have the same general appearance none of them give the same set of readings. The interfacial angles are of the order of those for kyanite, but the crystals are badly distorted (Dana's "accidental irregularities").

Andalusite is described as an antistress mineral, one which is produced by pure thermal metamorphism. Kyanite, on the other hand, is a stress mineral, one which is formed under conditions of regional metamorphism, high temperatures and pressures. The crystals most recently found suggest the following origin and history of the crystals:

The andalusite was formed by the contact of a hot mass of magma (a diabasic sill or flow) with the highly aluminous shale of the original sediments of the Wissahickon formation. Andalusite crystals were formed in quartz sand lenses in the shale. Later the region was subjected to regional metamorphism and the andalusite altered to kyanite by pressure. The argument has been raised that during the metamorphism of the region the crystal forms should have been distorted by the pressure, and that no distortion seems to have taken place. Dana's measurements and the measurements of the writer (measurements so variable as not to warrant publication) indicate very considerable distortion of the crystal form, and even an attempt by the material to attain to the external form of kyanite.

REFERENCES

- Dana, E. S., 1872. On a crystal of andalusite from Delaware Co., Pa.: *AM. Jour. Sci.*, 3d ser., vol. 4, p. 473.
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- Postel, A. W., 1940. Hydrothermal emplacement of granodiorite near Philadelphia: *Acad. Nat. Sci. Philadelphia Proc.*, vol. 92, pp. 123-152.

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