On a new occurrence of Apophyllite in South Africa.

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IN the so-called "blue ground" of the farm Koppiesfontein, in the neighbourhood of Jagersfontein, Orange Free State, a prospecting shaft was put down; and in the 110 ft. level struck a blue-grey, soft, and apparently talcose serpentine-like mass. The latter was densely studded with a great number of small, completely formed, light coloured crystals, which in some places lie very close together. The crystals may be easily isolated from this matrix, in which they leave smooth-sided and sharp-edged moulds. The isolated crystals are nearly colourless, or feebly yellowish, and strongly translucent; attain a maximum size of about $\frac{5}{16}$th inch (0 8 cm.), and are seldom smaller than $\frac{3}{16}$th inch (0·5 cm.), being therefore of almost uniform dimensions. At first sight one would be inclined to consider the eight-sided bi-pyramidal crystals as regular octahedra; however, apart from an inequality of the edges, one notes immediately, even in those individuals which are still imbedded in the hand-specimen, a perfect monotome cleavage cutting off two of the diametrically opposite four-edged solid angles, and forming very perfect smooth cleavage planes with brilliant pearly lustre. This behaviour first gave rise to the conjecture that the above-mentioned crystals were apophyllite. This, however, seemed to be contradicted by the fact that apophyllite generally occurs in crystals encrusting the matrix, whilst in this case the completely formed crystals are imbedded in the mother-rock. However, further mineralogical, physical and chemical investigations have proved that the mineral in question is beyond doubt apophyllite, which therefore occurs in this deposit under very unusual conditions.

Various difficulties presented themselves in the measurement of the crystal angles; such as the presence of hardly separable particles of the surrounding matrix on the faces of the isolated crystals, which rendered a perfect reflection impossible; further, the surfaces themselves were rough, and in parts not quite regularly formed. Accordingly the measurements had to be executed with the aid of thin glass plates, fastened on to the surfaces. Even if the measurements may only be regarded as approximate (the extreme values gave differences up to 1½°), it was nevertheless found, from a large number of determinations, that the crystals, composed of eight triangular faces, possess only two kinds of edges, eight of which gave an angle of about 105°, the other four an angle of about 120°. The former value would correspond to the polar edge angle, the latter to the middle edge angle, of the proto-pyramid *P*{111} of apophyllite. No forms other than the proto-pyramid *P* were observed on any of the many individuals examined. Often two individuals are found interpenetrating being apparently twinned on the same plan as that observed by Schrauf on the apophyllite crystals from Greenland, in which the axis of twinning is the normal to *P*{111}, a face of a more obtuse pyramid representing the plane of composition.

The specific gravity of the crystals, determined in Thoulet's solution by means of Westphal's balance, was found to be 2·371 ; thus agreeing with that of apophyllite. The hardness, again, is 4 to 4·5. The excellent basal cleavage, with its characteristic pearly lustre, has already been mentioned above. These thin basal cleavage plates are excellently adapted for examination in polarised light. As it is not necessary for the object of this communication to enter upon a detailed description of the optical phenomena, or even to compare the latter specially with the optical behaviour of the mineral from other localities lately investigated so exhaustively by C. Klein, it will be sufficient here to discuss only those phenomena which prove that the optical behaviour of the South African crystals lies within the limits of the phenomena already observed in apophyllite. Basal cleavage lamellæ of square form, examined under the microscope, reveal a colourless substance traversed by two dull grey lines which cross the crystals diagonally. These fine lines, visible even to the naked eye, seem to be composed of included substance from the surrounding matrix. As they correspond to the horizontal axes, *a*, in the basal plane, they divide the square lamella into four equal triangular quadrants. The small breadth of this layer of impurities imbedded in the plane of the axes, *a*, *c*, appears to be uniform in all the various lamellæ taken from the same crystal in different heights. In parallel polarised light, between crossed nicols, no position of the object gives total darkness. An isotropic square central field, as has sometimes been observed, does not present itself in any part of the crystals. In each of the four quadrants, thin polarising systems of bands appear on a dark ground, and lie more or less perpendicular to the respective sides of the tetragonal sections, running together in the centre, at the point of intersection of the grey lines.

In convergent polarised light the interference figures in each of the four quadrants may be examined separately. They prove to be biaxial, with a very small optic angle, but still with a distinct separation of the hyperbolic brushes; the optic axial plane appears to be parallel to the corresponding side of the square section, so that in the two opposite quadrants the axial planes are parallel, while in two contiguous quadrants they are at right angles to each other. The lamellæ taken from different heights of the crystal proved themselves conformable to each other in every respect. The interference figure, with its approximately black and white rings, resembles in character that of leucocyclite.

The mineral fuses easily before the blowpipe; a splinter imparts the violet potassium colour to the flame. Heated in a closed tube, the mass exfoliates, gives off water in considerable quantity, and becomes opaque. The powdered mineral, moistened with water, gives a strong alkaline reaction with litmus, as well as with turmeric paper. Hydrochloric acid decomposes the powder with separation of slimy silica. The solution gives, with chloride of platinum, the microchemical reaction for potassium. In all these points it shows a behaviour completely identical with that of apophyllite.

An analysis of these crystals, made by Dr. Röhrig, of Leipzig, gave the following composition:—

SiO_2	= 51·16
$Al_2O_3+Fe_2O_3$	= 1·60
CaO	= 25·44
MgO	= 0·29
K_2O	= 3·35
Na_2O	= 0·43
H_2O	= 16·73
F	= 1·04
NH_3	= 0·11
	100·15

This analysis proves the mineral to be undoubtedly apophyllite, since it agrees very closely with the best analyses of this mineral. With regard to the amount of fluorine, in accordance with the results of Ch. Friedel (*Zeitschrift für Krystallographie* XXVI. 1896, p. 221), it was found that this apophyllite also does not give any fluorine by treatment with sulphuric acid, but that if the mineral be treated with dilute hydrochloric acid, according to his method, and the filtrate precipitated with ammonia, a precipitate containing Ca, Si, and F is formed, from which SiF_4 can be obtained. On a plate of glass the name and locality of the mineral could be etched. The ammonia was driven off by decomposing the fine powder with dilute sulphuric acid, and by afterwards boiling with an excess of soda.

This occurrence of apophyllite is remarkable, on the one hand, because the crystalline form is solely confined to the development of P{111}; and on the other, because it occurs in an imbedded condition, instead of incrusting the matrix, as is more usually the case. Only two occurrences of imbedded apophyllite are, it appears, mentioned in the literature, namely, the "lenticular, more or less radially foliated," apophyllite described by J. Rumpf as imbedded in thin coaly strata, which lie in a decomposed basaltic tufa, near the church of S. Pietro, close to Montecchio-Maggiore (*Tscherm. Min. Mitth.* II. 1880, p. 388), and the xylochlore of Sartorius von Waltershausen (apophyllite, according to Kenngott), which was found in pyramidal crystals in a fossil tree trunk in the volcanic tufas of Halbjarnastadr Kambur, in N. Iceland (*Vulcan. Gesteine von Sicilien und Island*, 1853, p. 298). The nature of the surrounding matrix is, however, in South Africa quite different from that of the last-mentioned occurrences.

It is difficult to determine, from the scanty material at disposal, how far this matrix of the crystals, called "blue ground" at the place of discovery, corresponds with the well-known and much-discussed diamondiferous "blue ground" of Kimberley. In favour of the similarity of the two deposits is the fact that from the "blue ground" of Koppiesfontein under discussion red garnets, particles of titanic iron ore and smaragdite were washed, which latter are characteristic of the Kimberley "blue ground." It is unknown to the author if the former is diamantiferous; the "blue ground" of Jagersfontein is, as is well known, diamond bearing.

If the matrix of the crystals be finely pulverised, and placed in Thoulet's heavy solution, having a specific gravity of about 3, one observes in the scanty sediment a large number of sharp prismatic crystals of zircon, completely formed at both ends, and measuring up to 0·002″ (0·05 mm.) in length. An analysis of the Kimberley "blue-ground," by Flight gave I., whilst a not quite complete analysis of the apophyllite matrix yielded II.

	SiO_2.	Al_2O_3.	Fe_2O_3.	FeO.	MgO.	CaO.	CO_2.	H_2O.
I.	39·73	2·31	—	9·69	24·42	10·16	6·57	7·55
II.	34–35	15·44	3·55	14·80	7·16	10–11	—	11·34

Although considerable differences, especially in the amount of alumina and magnesia, appear, and though it would be difficult to ascribe a serpentinous character to the matrix of the crystals in Koppiesfontein, yet a certain geological analogy between the two materials is not excluded as impossible. Finally, it may be mentioned, that in the "blue-ground" of Kimberley also zeolites, chiefly mesolite and natrolite, are found.