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Fire og tyvende Hefte.

Med 20 Tavler,
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og en
Résumé des Communications sur le Grönland.

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I Commission hos C. A. Reitzel.
Bianco Lunos Bogtrykkeri.
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I.

Undersøgelser
af
Mineraler fra Julianehaab

indsamlede af G. Flink 1897.

Af

G. Flink, O. B. Bøggild og **Chr. Winther**

med indledende Bemærkninger af

N. V. Ussing.

1899.

Part I.

On the Minerals

from Narsarsuk on the Firth of Tunugdliarfik in Southern Greenland

by

Gust. Flink.

It ought, therefore, to be heavier, though one might not have expected to find the discrepancy so great as it really is.

As for the hexagonal crystallization of the original parisite I have already pointed out that it may possibly be only apparent and due to constant twinning parallel to the base.

In other respects there is great agreement between the two minerals, and judging only from the outward appearance one could not consider the Narsarsuk mineral to be distinct from parisite. As, moreover, experience proves the necessity of great caution in announcing a substance as a new mineral species, I desist for the present from claiming for the one here described the position of a new mineral. It may be united to the parisite, and the true explanation of the discrepancies stated may depend on future investigation.

The parisite is of fairly common occurrence on Narsarsuk. At the locality No. 2 it has been found in the greatest quantity. Small crystals are most common here, but also larger individuals have been found in this place. The accompanying minerals here are neptunite, epididymite, ægirine, microcline etc., all of which are older than the parisite. Of more recent or of contemporaneous origin are albite, elpidite, fluorite, cordylite and polylithionite. Also at the localities No. 12 and 13 parisite has been met with tolerably abundantly. At the former locality the largest of the known crystals (see page 31) was found. The best developed, medium-sized crystals were found at the locality No. 17 associated with the same minerals as at the locality No. 2 and, besides, with arfvedsonite, rhodochrosite, and spodiophyllite.

10. Cordylite (Barium-parisite).

The name of this new mineral is derived from the Greek word *κορδύλη*, a club; the reason is that its crystals often have a club-like form.

Cordylite has as yet only been found in the crystallized state; the crystals are always of minute size. The largest individuals met with reach only 3^{mm} in length by 1^{mm} in diameter. Most of the crystals, however, do not even reach 1^{mm} in the greatest dimension.

The crystals belong, as far as can be yet ascertained, to the bipyramidal class of the hexagonal system. They are bounded by a hexagonal prism, three pyramidal forms, and the base. Their habit is partly prismatic (figs. 7 and 8, Pl. II) partly pyramidal (fig. 1, Pl. III). In most cases the faces are dull or show only a waxy glimmer, so that sharp reflections can seldom be obtained. A few selected crystals, however, have admitted of angular measurements that have given most accurate and agreeing results. Thus, five independent measurements of the angle between the base and the faces of the uppermost pyramid gave the same result, viz. 46° 12′; other values obtained deviate by only a few minutes.

In order that the crystallographical relation between cordylite and parisite may be made clear, the aforesaid pyramid (p in the figure) must be given the somewhat complicated symbol

$$p = \{4.0.\bar{4}.15\}.$$

From the angular value given above, viz.

$$(4.0.\bar{4}.15):(0001) = 46^\circ\,12'$$

the following axial ratio for the cordylite is calculated:

$$a:c = 1:3{,}3865,$$

which comes very near to the axial ratio of the parisite, viz.

$$a:c = 1:3{,}3646.$$

The forms observed on cordylite will, according to the above axial ratio, obtain the following symbols:

$$c = \{0001\},\ p = \{4.0.\bar{4}.15\},\ q = \{10\bar{1}3\},$$
$$r = \{20\bar{2}3\},\ m = \{10\bar{1}0\}.$$

The most common combination of faces is shown by fig. 7, Pl. II. The forms are here the hexagonal prism and the lowest pyramid, *p*. The prismatic faces are almost always dull or feebly glimmering. The faces of the pyramid *p*, on the other hand, are in most cases brilliant. On crystals of this development they, however, regularly show a distinct horizontal striation, due to the alternation of the forms *m* and *p*.

The base is comparatively seldom present on the cordylite crystals. It forms a small, hexagonal plane, which is always smooth and very brilliant. On such crystals on which the base is developed, the pyramidal faces generally are less striated than on those where the base is absent. It may be stated, as a rule, that among the faces of these crystals, the base is the most brilliant, while the prismatic faces have the least lustre. Among the pyramidal forms, *p* has the most, and *r* the least brilliant faces. Thus, the lustre gradually diminishes from the base to the hexagonal prism.

In the face-combination of the cordylite crystals the forms *q* and *r* play a subordinate part. They mostly occur on the comparatively rare crystals of pyramidal habit (figs. 1, 2, Pl. III). These faces are in general very narrow, and on account of their feeble lustre they can only in exceptional cases be determined. Often they (apparently) form a continuous rounding of the edge between *p* and *m*.

The following table contains the measurements from which the different forms have been determined.

$(4.0.\bar{4}.15):(0001)$ =	46°12′	$(4.0.\bar{4}.15):(\bar{4}.0.4.15)$ =	92°44′
	46° 9′	calculated	92°24′
	46°12′	$(10\bar{1}3):(0001)$ =	52°51′
	46°12′		52°29′
	46°15′		52°25′
	46°12′		52°51′
	46°12′	Calculated	52°30′
Mean	46°12′		

$(4.0.\bar{4}.15):(4.0.4.\overline{15}) = 87° \ 9'$

calculated $87° 36'$

$(20\bar{2}3):(0001) = 69° 47'$

calculated $69° \ 1'$

$(10\bar{1}3):(10\bar{1}0) = 37° \ 4'$

calculated $37° 30'$

$(10\bar{1}0):(01\bar{1}0) = 59° 55'$

$60° \ 4'$

Calculated $60°$ —

The cordylite crystals are mostly attached by one end to the surface on which they rest; hence, of course only the free end has been capable of crystalline development. Sometimes, however, they are attached by one side (longitudinally); sometimes also two individuals have grown together so as to form a cross. In the latter cases both ends are developed.

The development of these crystals presents a peculiarity of form: they often have a sceptre- or club-like appearance (hence the name of the mineral). This shape is due to the circumstance that the common pyramidal crystal, instead of being, as usual, terminated at both ends by the fundamental pyramid or the base, has got a thinner prismatic prolongation by which the crystal is attached to the surface on which it rests (fig. 9, Pl. II). Sometimes there are two such pyramidal crystals grown together by the base (fig. 2, Pl. III). The reentrant angle thus formed round the middle of the crystal might be regarded as a mark of twinning. Such a formation is not, however, possible here, if the base, which would be the composition-face, is a plane of symmetry. Should there be a real twin formation, then the mineral must belong to one of the classes of the hexagonal system in which the base is not a plane of symmetry. There are, however, no other signs indicating that this should be the case. The crystals are too small to be subjected to the Kundt test for pyroelectricity; nor have I been able to produce any distinct and decisive etching figures on them. It must therefore be presumed that the cordylite crystals belong to the bipyramidal (holohedral) class of the hexagonal system and that in this case there is nothing but a parallel growth.

The colour of the mineral is pale wax-yellow; sometimes it is nearly colourless, sometimes inclining to brownish yellow. In the fresh condition it is nearly clear and transparent, but by a superficial alteration the crystals usually become ochre-yellow and dull. This is generally the case with the prismatic faces and with the pyramidal faces that lie nearest to them. The faces of the base and the fundamental pyramid, on the other hand, generally are, as has already been stated, free from this alteration. On the fresh fracture the mineral has a vitreous to adamantine, on the base generally a pearly, lustre.

In microscopical sections the mineral is colourless or shows a hardly perceptible tinge of yellow. Sections oriented parallel to the vertical axis show extinction parallel to this axis without perceptible pleochroism. Sections oriented parallel to the base are optically perfectly isotropic. In converging polarized light a normal uniaxial interference figure with negative character is exhibited. The rings are rare, which indicates that the mineral has weak double refraction. No attempts have been made to determine the indices of refraction, because the crystals are so small that a prism cannot be made.

A section parallel to the base shows a zonal structure. The zones run parallel to the hexagonal outline of the section and seem to depend upon submicroscopic inclusions (fig. 10, Pl. II). In the middle of the section there is a minute hexagonal area that is clear and without inclusions. This area is surrounded by a hexagon of some opaque yellowish matter. Under high magnifying powers it separates into concentric zones of alternately clear and opaque substance. From its sides (not from the corners) radiate brush-like opaque lines forming a star of six rays. Outside of this hexagon the section is clear and free from inclusions nearly as far as the outer edge, where there is again an opaque zone of the same character as the foregoing. From its sides rays shoot inwards meeting the rays of the central star. These phenomena probably are of a secondary nature and due to alteration of the mineral.

The hardness of cordylite is = 4,5 (the mineral easily scratches fluorite, but not apatite). It is rather brittle; fracture conchoidal. Parallel to the base there is a very distinct cleavage. In this direction the crystals easily break, and the above described structure is often microscopically observable on the cleavage plane.

By weighing in benzole the specific gravity of the mineral was found to be = 4,31 (Mauzelius).

Before the blowpipe, cordylite behaves as follows. When heated alone it decrepitates violently cleaving into thin plates along the basal cleavage. In the most intense heat the splinters become brownish in colour, but do not melt. Moistened with hydrochloric acid they colour the flame green.

The mineral is easily soluble in hydrochloric acid with the evolution of carbon dioxide.

As only a very small quantity of cordylite has been found, the amount that could be procured for the analysis was rather scanty. Nearly all the specimens at hand were scraped, and the impure material thus obtained was subjected to a tedious process of collecting under the magnifying glass. In this way 0,6489 gr. of almost pure material was obtained. This material was divided into two portions, the carbon dioxide being determined on 0,2501 gr. and the other constituents on the remainder. The analysis has been performed by R. Mauzelius, and the result is as follows.

		Molecular ratios.		
CO_2	23,47	0,533	0,534	3
ThO_2	0,30	0,001		
Ce_2O_3	23,72	0,072	0,150	0,84
$La_2O_3\,Di_2O_3$ etc.	25,67	0,078		
Y_2O_3	trace			
FeO	1,43	0,020	0,167	0,94
BaO	17,30	0,113		
CaO	1,91	0,034		
H_2O	0,80	0,044	0,172	0,97
F_2	(4,87)	0,128		
Insoluble	2,58			
	102,05			
O	2,05			
	100			

The molecular ratios of the carbon dioxide, the sesquioxides, the monoxides, and the fluorine are consequently approximately 3 : 1 : 1 : 1. This gives the following chemical formula for cordylite:

$$Ce_2F_2BaC_3O_9.$$

But the values found do not exactly correspond to this formula. The discrepancy might be explained by the material being perhaps in part not quite fresh. That the material for the analysis was not perfectly free from foreign admixtures, is shown by the insoluble residue. It is also to be regretted that the fluorine could not, for want of material, be determined directly.

However, it is evident that the mineral in question is nearly related to parisite, especially to the parisite from Muso. In chemical constitution the two minerals agree excepting that the amount of calcium entering into one is replaced by barium in the other. The specific gravity of cordylite, too, is the same as that of the parisite from Muso; basal cleavage is likewise common to the two minerals. On the other hand, they differ distinctly from each other in cordylite being optically negative with, as it seems, weak double refraction, while parisite has strong, positive double refraction.

If the parisite from Muso is in reality holohedral hexagonal, then cordylite agrees with it also in this respect in contradistinction to the parisite from Narsarsuk, which is decidedly trigonal. It is not, however, proved that the mineral from Muso and cordylite may not be trigonal, as what is regarded as hexagonal bipyramids of the first order might be such pyramids of the second order. Such is, for instance, the case with the mineral spangolite, the rhombohedral nature of which could be established only by etching[1]).

Cordylite has been found only at the locality No. 2 on Narsarsuk. The mineral occurred here very sparingly partly implanted on loose specimens and partly on the pegmatite in situ. On the specimens it is mostly associated with parisite and neptunite, and also with the ancylite described below. The cordylite crystals are often implanted on ægirine crystals, generally in small depressions on the latter. Sometimes the mineral is met with on neptunite crystals of type II and also on tabular crystals of lepidolite. The mode of occurrence shows that the mineral belongs to a comparatively late generation, as both the neptunite and the parisite, which are among the most recent formations, are nevertheless older than the cordylite.

11. Ancylite.

This name is derived from the Greek word *ἀγκύλος*, curved, and has been chosen in allusion to the fact that the crystals of the mineral always have their planes strongly curved.

This new mineral has only been met with in crystals, but these are small in size and not very distinctly developed. There are, strictly speaking, two different kinds of them, though a

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[1]) Amer. Journ. of Science, 1890, Vol. 39, p. 370.