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Part I.

On the Minerals

from Narsarsuk on the Firth of Tunugdliarfik in Southern Greenland

by

Gust. Flink.

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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

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

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sharp line can hardly be drawn between them. The least distinctly developed crystals measure less than $^1/_2{}^{mm}$ in diameter and are nearly spherical in form. Single crystals of the other kind reach 4^{mm} across, and they are in general somewhat more distinctly developed. Though their faces are always strongly curved, it may however, easily be observed that the crystals have an octahedral development. It may also usually be seen without difficulty that they are not regular octahedra, being shorter between the opposite corners in one direction than in the two other directions. Another easily observable fact is that two pairs of faces, namely those meeting at two opposite middle edges, if the aforesaid shortest direction is given a perpendicular position, differ as to their physical character from the two other pairs. From all this it is evident that the mineral cannot belong either to the cubic or to the tetragonal system. The optical investigation also shows that we have here a rhombic mineral. As, however, the faces present are of two different kinds they cannot form a rhombic bipyramid. The crystal form of the ancylite must consequently be considered as a combinatian of the prism of the first and that of the second order, viz. (Fig. 3, Plate III)

$$d = \{101\} \text{ and } e = \{011\}.$$

It has not been possible to find a single crystal with faces plane enough for measuring the angles on the reflecting goniometer. That the middle edges of the prismatic faces make angles of very nearly 90° with each other may be perceived without measuring. This is, indeed, all that could be ascertained by the attempts made to measure the angles on the reflecting goniometer, for the values obtained for the same angle vary up to 20°. I was therefore obliged to use another method for measuring the angles, by which, however, only approximate results could be obtained. On microscopical sections orientated parallel to the first and the second pinacoids the angles of the outlines were measured under the microscope with the greatest possible accuracy. As, however, the faces are curved, the

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outlines of course also become curved, so that they could only be approximately adjusted. A great number of adjustments and readings have been made, and of the values thus obtained the means have been taken. The measurements found in this way are

$$(101) : (10\bar{1}) = 90° 5' \text{ and } (011) : (01\bar{1}) = 85° 4'.$$

From them the following axial ratios for ancylite are calculated:

$$a : b : c = 0{,}916 : 1 : 0{,}9174.$$

The larger and better developed ancylite crystals generally occur isolated from one another on the substance to which they are attached. The occurrence of a number of individuals grown together into small groups or druses is rare. They are often developed almost on all sides, being attached in rows along thin needles of ægirine or imbedded in a loose felted mass of such needles. Owing to the curved form of the faces and the circumstance that the corners and edges are more or less rounded the crystals get a somewhat sphere-like habit.

The highest degree of curvature is exhibited by the faces belonging to the prism of the second order, *e*; further they are generally almost quite dull. With the aid of a magnifier one finds that this dullness is due to the fact that the faces are divided into a number of minute triangular elements orientated so that their outlines are parallel to the outline of the whole face. The faces belonging to the prism of the first order, *d*, are more even than the others. They are also often tolerably bright. However, a division into diminutive triangular faces is observable also on them; but this division is here far less distinct than on the other faces.

The smaller, less distinct crystals are generally more rounded than those now described; they are either nearly spherical or have the form of irregular grains. They usually form continuous crusts coating the surfaces of feldspar or ægirine individuals. Masses of small ancylite crystals grown together

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in this manner sometimes fill up tolerably large spaces between crystals of other minerals. Such masses, several centimeters in thickness have been met with; they seldom inclose foreign minerals. The small crystals are generally grown together so as to form thin flat plates, which are aggregated in parallel position, so that the whole forms a porous, schistose structure. The consistency of the whole is so loose that it can easily be crushed between the fingers.

In colour ancylite varies somewhat. Its normal colour is light yellow inclining to orange. Often the crystals are brownish or greyish, sometimes quite resin-brown. The small crystals that form crusts are generally of a yellowish green or yellowish grey colour. The crystal faces, when they are not dull, show a vitreous lustre; the fracture has a greasy lustre. The mineral is only subtranslucent.

Microscopical sections are colourless, but somewhat opaque. With a high magnifying power this opacity is found to be chiefly due to numerous ægirine needles that are imbedded in the mineral mass. The section orientated parallel to the first pinacoid (*a*) is bounded by the traces of the faces that form the prism of the first order. It has, consequently, rhombic boundaries. The extinction is here diagonal, though not quite uniform, and is somewhat undulating, which probably depends on the spheroidal form of the crystals. In the conoscope this section presents an interference figure with large axial angle (the obtuse bisectrix). The section parallel to the second pinacoid (*b*) is bounded by the traces of the faces that form the prism of the second order and, consequently, also has rhombic boundaries. The extinction directions lie diagonally, and an undulation like that in the foregoing section is observable. The conoscope shows an interference figure with a smaller axial angle (the acute bisectrix); also here, however, the axes are not visible within the field of the microscope. The section parallel to the third pinacoid (*c*) is bounded by the middle edges of the

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crystal, and its outline is, consequently, rectangular. The extinction is parallel to the sides of the section and still more undulating than in the foregoing sections. The direction of the greatest velocity of light coincides with the crystallographical *a*-axis.

From the foregoing it is clear that the plane of the optic axes of the ancylite is parallel to the third pinacoid {001}, and that the acute bisectrix coincides with the crystallographic *b*-axis. As the latter also is the direction of the smallest velocity of light, the ancylite is optically positive.

The sections show high interference colours, and even tolerably thin sections show white of a higher order. The mineral, consequently, is strongly doubly-refracting. Owing to the unfavourable condition of the material it has not, however, been possible to determine the indices of refraction.

The hardness of ancylite is = 4,5. The mineral is possessed of a certain degree of toughness, so that, when it is crushed, the splinters do not fly about. The fracture is splintery. Cleavage not observable.

By weighing in benzole the specific gravity of the mineral has been found to be = 3,95 (Mauzelius).

Before the blowpipe in the forceps ancylite is infusible, and, as the carbonic acid is expelled, it assumes a brown colour. Heated in the closed tube it gives off water abundantly. Moistened with hydrochloric acid it imparts an intense red colour to the flame. It is readily soluble in acids with evolution of carbon dioxide.

The material for the analysis was taken from the crusts of small yellowish green crystals above mentioned. The crusts were crushed and the minute crystal grains selected by hand-picking with the aid of a magnifying glass. The material used may be regarded as perfectly pure. For determining the carbon dioxide 0,5514 gr. was used, and for the determination of the

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other constituents 0,2961 gr. The analysis, made by R. Mauzelius, gave the following result.

			Molecular ratios	
CO_2	23,28		0,529	7
ThO_2	0,20		0,001	
Ce_2O_3	22,22	0,068	0,141	1,9
La_2O_3: Di_2O_3 etc.	24,04	0,073		
Y_2O_3	trace			
FeO	0,35	0,005	0,234	3,1
MnO	trace			
SrO	21,03	0,202		
CaO	1,52	0,027		
H_2O	6,52		0,362	4,8
F	trace			
Insoluble	0,60			
	99,76			

As will be observed, the molecular ratios of the carbon dioxide, the sesquioxides, the monoxides, and the water approximate closely to 7 : 2 : 3 : 5 corresponding to the formula

$$4Ce(OH)CO_3 + 3SrCO_3 + 3H_2O.$$

Though this formula certainly is comparatively simple; yet the composition of the mineral must be considered rather remarkable. Besides the high percentage of strontium, which is noteworthy, it is particularly the amount of water that merits observation. The latter can by no means be secondary, because the mineral no doubt is absolutely fresh. According to the formula two molecules of water enter into the group $4Ce(HO)CO_3$. The part played by the remaining three molecules cannot for the present be determined. That they ought to be regarded as water of crystallization, is very improbable, as it has not been ascertained that any part of the water should be more loosely combined than the rest.

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The only mineral, to which one might think of uniting ancylite is the weybyeite described by **Brögger**[1]. The crystals of both these minerals belong to the rhombic system, and both consist chiefly of carbonates of cerium metals. I also started a priori from the supposition that the new Greenland mineral could be identified with the weybyeite. This has, however, proved impossible. The weybyeite crystals resemble small crystals of zircon formed by the fundamental pyramid alone. This may also be said to be the case with the ancylite crystals, but basal sections of the crystals in this position differ from each other. With the weybyeite the extinction-directions are diagonal, with ancylite, on the other hand, parallel, to the borders of the section. The axial ratios calculated for the two minerals are:

for weybyeite $a:b:c = 0{,}9999:1:0{,}64$
- ancylite $a:b:c = 0{,}916 : 1 : 0{,}917$.

Giving the crystals this position, the optic axial plane of ancylite is parallel to the base, that of weybyeite parallel to one of the vertical pinacoids. If the ancylite crystals are given such a position that the plane of the optic axes coinsides with one of the vertical pinacoids, *e. g.* the first, $\{100\}$, and the obtuse bisectrix with the vertical axis, the forms present become

$$e = \{110\} \text{ and } d = \{101\},$$

and we obtain the following axial ratios:

$$a:b:c = 0.917:1:0{,}916.$$

These axial ratios cannot, any more than the former, be brought into a rational relation to that of the weybyeite.

If, lastly, the crystal is revolved 90° about the a-axis, d becomes $= \{110\}$ and $e = \{011\}$. With the crystal in this position the optic axial plane is parallel to the second pinacoid,

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[1]) Zeitschr. f. Krystallogr. Vol. 16, pag. 650.

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and the acute bisectrix parallel to the *c*-axis. The axial ratios then become $a:b:c = 0,9985:1:1.09$ or, if the *c*-axis is shortened to $^2/_3$ of its length:

$$a:b:c = 0,9985:1:0.726.$$

This certainly approximates somewhat to the axial ratio found for weybyeite; yet the difference is considerable.

As to the chemical composition of the two minerals a certain agreement probably exists. However, the composition of the weybyeite is so imperfectly known, owing to the insufficient quantity of material for analysis, that a detailed comparison is impossible.

The larger and best developed ancylite crystals have been found only at the locality No. 5 on Narsarsuk. The mineral was met with here together with needle-shaped ægirine crystals or hair-like ægirine individuals forming felted masses, together with clear, prismatic albite crystals elongated in the direction of the *c*-axis, dark-brown zircon crystals of type II, etc. Of these minerals, the ancylite has been last formed. The minute ancylite crystals grown together into crusts were found at the locality No. 2. The crusts generally occur on strongly corroded feldspar individuals. Among the numerous secondary minerals occurring in the place cordylite is the only one that may be said to have been found as directly associated with ancylite. The latter seems to be the older of the two.

12. Eudidymite.

Eudidymite from Narsarsuk is of extreme rarity, as only three detached crystals of the mineral have been found. They were met with among the loose gravel at the locality No. 3. The largest one is 32^{mm} in length, 20^{mm} in breadth and 11^{mm} in thickness and consists of a large number of crystal tables grown together in such a manner that the *b*-axes of the different individuals are parallel to one another, while the respective *a*-

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