Epistolite, a new mineral,

by O. B. Boeggild.

Among the minerals, which Gustav Flink brought from Greenland in the summer of 1897 [1]) were some silverwhite plates, which he supposed to be brucite, but on analysis they have proved to be an absolutely new mineral, which seems to have no relation to any other. The name has been derived from ἐπιστολή, a letter, on account of the mineral's flat rectangular form and white color.

The quantity of epistolite collected has been found in four different localities, all in the neighborhood of Julianehaab in Greenland. Flink states in his above mentioned report that it has been found at Tutop Agdlerkofia and Nunarsiuatiak, two places on the Northern Side of the Firth of Tunugdliarfik. I have also found it on the pieces brought from the bottom of the Firth of Kangerdluarsuk and from the small island Kekertanguak situated in the innermost part of this Firth. The surrounding rock is always nephelite-syenite in which the epistolite is found partly in the pegmatitic veins, partly in masses of marblelike grained albite.

Crystalline form. Crystals with free faces projecting into a cavity have only been found on one of the pieces. However the condition of the faces made the determination of angles very difficult. It was impossible to use the reflecting goniometer, the

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[1]) Gustav Flink: Berättelse om en Mineralogisk Resa i Syd-Grönland sommaren 1897. Meddelelser om Grønland. XIV. 1898, p. 247, 257.

faces being too poor to give a reflection; the necessary angles were either measured with the contact goniometer or with a microscope. The observations made with the mineral, which is imbedded in the neighboring rock were by far not as good as the above and therefore cannot be taken into consideration. The mineral being extraordinarily brittle, it is impossible to separate it from the surrounding minerals, with which it is connected, without breaking it. The impressions of the faces of the epistolite, which were found, are always too indistinct to make it possible to measure them with exactness, and consequently the following results can only be considered approximately accurate:

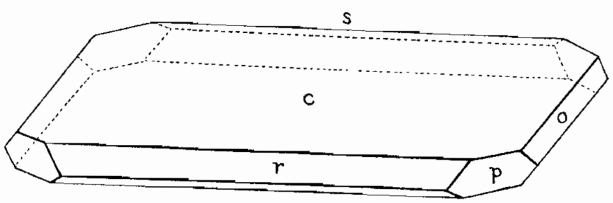

Fig. 1. Epistolite.

Crystallisation monoclinic.

$$\beta = 74^\circ\, 45' = (001) : (100)$$

$$\grave{a} : \bar{b} : \grave{c} = 0{\cdot}803 : 1 : 1{\cdot}206$$

The following were used as fundamental angles:

	Average value	Number of measurements	Variations
(001) : (110)	= 78° 0′	4	76°—80°
(001) : (011)	= 49° 20′	3	48°—50°

further on cleavage faces the angle, which the traces of (110) and $(1\bar{1}0)$ make on (001):

Average value	Number of measurements	Variations
= 102° 30′	13	99°—105° 30′

The faces considered are:

$c\{001\}$, $p\{110\}$, $o\{011\}$, $r\{504\}$, $s\{\bar{1}02\}$.

The two last forms are determined by:

	Average value	Number of measurements	Variations	Calculated value
001 : 504	= 50° 20′	3	49° 0′—51° 30′	50° 30′
$001 : \bar{1}02$	= 42° 7′	1		42° 6½′

The crystals with free faces have the form of flat, rectangular plates $\neq \{001\}$; thickness about 1 mm., the diameters about 20 mm.

More or less of the faces r, s, p and o may be absent or be very indistinct; especially $\{101\}$ and $\{\bar{1}02\}$ are almost always very imperfectly developed. The crystals appear in groups of parallel or subparallel individuals.

The greater part of the epistolite is however formed perfectly inclosed by and connected with the surrounding minerals, especially the grained albite. The epistolite having in most cases crystallized before the greater part of its surroundings, it has also nearly kept its original shape. Generally it appears in big flat plates of a diameter extending upwards to 1 dm. The shape, as mentioned above, is rectangular, with corners cut aslope if the limits are not altogether indistinct. As a rule the plates are nearly parallel and separated by sharp wedges of the surrounding minerals. Frequently the plates are found without any regularity and in some cases appear as a perfect network. On most of the deposits from Kangerdluarsuk the mineral appears as a massive and irregularly shaped aggregate of arched leaves.

Physical and optical properties. The specific gravity as determined with Thoulet's fluid, is 2·885. Hardness 1—1½. The brittleness is so great, that the mineral is easily pulverized between the fingers. The cleavage is very characteristic especially perfect $\neq \{001\}$; the leaves, which can be cleaved out from epistolite are however, on account of its brittleness, not quite as thin as those of gypsum or mica. There appears also on the base a distinct tendency to cleavage in two directions, after the traces of (110) and $(1\bar{1}0)$ under the angle of 102° 30′. However it has not been possible to measure the angle of these cleaving faces with the base on account of their unevenness, and it is therefore not certain whether they correspond to the prism or another face in the zone [110, 001]. The epistolite has no special color. The crystal faces are dim, grayish or brownish; the cleaving faces after {001}, which in most cases is all, that is visible of the mineral, have a very strong silverwhite pearly luster; this is the case especially as regards the pieces from Nunarsiuatiak, which represent the purest variety of the mineral. The deposits from the other localities are more or less yellowish or brownish. When seen under the microscope the small plates only appear transparent to a very slight degree. In the direction of the diagonal cleaving lines two systems of very fine, darker striae are visible, often specially distinct in one direction. Of interpositions aegyrite is most conspicuous and appears in thin rectiliniar needles, generally following two directions $\neq$ the axes $\grave{a}$ and $\bar{b}$, more seldom in other directions.

The refraction was determined by Thoulet's fluid. In a solution of specific gravity 2·865 the limits of the mineral almost disappear, and the approximate index of refraction is thereby found to be 1·67. The epistolite is optically biaxial; the axial plane being $\neq$ the plane of symmetry. The apparent angle of the optic axes for faces $\neq$ {001}, taken with Adam's apparatus for measuring the axial angle, gives values from 81° to 101°; the average of 7 measurements was 89° 30′. The index of refraction for the glasshemispheres I have found by measuring to be 1·53; from this the interior angle of the optical axes is found to vary from 73° 2′ to 89° 58′, on an average $2\,V_a$ = c. 80°. The least axis of elasticity is situated in the

obtuse angle β and forms with the axis $\grave{a}$ an angle varying 4° 5′—10° on the average 7°; the mineral is accordingly optically negative. There is inclined dispersion; $\upsilon < \rho$; the double refraction is strong and is for faces $\neq$ {001} = 0·0297, as measured by Babinet's Compensator.

Occurrence. As mentioned above the epistolite is found in pegmatitic veins and in masses of grained albite. In the different localities it is found with somewhat different surroundings; the greater part of the mineral from the two places North of the Firth of Tunugdliarfik appears in flat plates, almost always surrounded by albite, which has evidently crystallized later than the epistolite, as it follows exactly the form given by it. Of the other minerals from these places sphalerite has evidently also crystallized later than the epistolite and the same is the case as regards the new mineral schizolite (Winther), which Flink calls «pink columns». The relation to the sodalite is not so clear, it seems however as if the epistolite had crystallized first. The steenstrupite presents itself in an essentially different way in the two localities; at Nunarsiuatiak it protrudes through the plates of epistolite and is accordingly older, at Tutop Agdlerkofia its form has evidently been influenzed by the epistolite and therefore must it have been formed later. The relation to the aegyrite is very different; this mineral had partly crystallized before, partly after the epistolite and as mentioned above they could also have crystallized at the same time.

When examining the pieces found in the localities at the Firth of Kangerdluarsuk the age relations are more difficult to trace. The epistolite is generally found here as irregular masses imbedded in albite, microcline-microperthite, sodalite, arfvedsonite, aegyrite, steenstrupite, eudialyte and sphalerite and it seems to be a later formation than most of these minerals. It is also found together with rinkite and polylithionite and is often connected with these minerals in a more charateristical way. It is thus sometimes seen, that thin layers of the epistolite are imbedded in rinkite crystals parallel with their cleaving direction; there is therefore reason to believe, that these two minerals have developed at the same time. The relation of the epistolite to the polylithionite is even stranger; it is found inclosed in the polylithionite, so, that it replaces greater or smaller parts of it, and especially is it found very often in the center of the large polylithionite rosettes, but it can also appear in isolated parts towards the circumference. The cleaving directions of both minerals run parallel and plates can be cleaved out, which consist of both together; the limit between them is always very irregular and there does not seem to be any crystallographic uniformity as regards their position, the mutual direction of {001} excepted.

Chemical properties. According to an analysis, made by cand. polyt. Chr. Christensen the epistolite has the following composition:

		Quot.
SiO_2	27·59	0·460
Nb_2O_5	33·56	0·126
TiO_2	7·22	0·096
FeO	0·20	0·003
MnO	0·30	0·004
CaO	0·77	0·014
MgO	0·13	0·003
Na_2O	17·59	0·284
H_2O	11·01	0·612
F	1·98	0·104
Total	100·35	
Less oxygen-equivalent of the fluorine	0·83	
	99·52	

Ta and *Zr* could not be traced in it; it contains a minimum of *K*.

Concerning the method, in which the analysis was made, Christensen states as follows:

«The mineral was fused with sodium carbonate and evaporated with nitric acid. The mixture of silica, niobic acid and titanium dioxide was ignited and weighed. The silica was expelled with hydrofluoric and sulphuric acid. The silica was then deduced from the difference in weight.»

«In the mixture of titanium dioxide and niobic acid the titanium was found by dissolving in hydrofluoric and sulphuric acid, by volatilizing the hydrofluoric acid and treating the rest cautiously with cold water, by which process all went into solution. In this the titanium was determined colorimetrically by adding hydrogen peroxide and comparing the yellow color with a solution in sulphuric acid of pure titanium dioxide produced in the same way.»

«A small quantity of niobic acid was found in the original solution containing nitric acid and could as regards the greater part be precipitated by boiling; the remainder was found together with the alcalies.»

Of the 11·01 per cent H_2O 1·75 per cent disappears already under 100° and accordingly is probably present as hygroscopical water; as the approximate formula is found for the epistolite: $19\,SiO_2 \cdot 4\,TiO_2 \cdot 5\,Nb_2O_5 \cdot (Ca, Mg, Fe, Mn)O \cdot 10\,Na_2O \cdot 21\,H_2O \cdot 4\,NaF$.

Since the mineral is possibly somewhat altered and since it is not known, how much H_2O belongs to the molecule itself, it will hardly be possible either to fix this formula more definitely or to classify the composition under a certain group of silicates. On account of the small quantity of basic component parts, which it contains, the mineral must be classified among the very acid silicates.

The epistolite has neither in its chemical nor its physical properties any similarity to any other mineral. It has a separate position since it contains the most niobium of all silicates without however being in any respect related to other silicates containing niobium. It has a certain similarity to the minerals of the clintonite group, but in most respects it is also very different from these.

Britholite, a new mineral,

by Chr. Winther.

This mineral, which G. Flink found in 1897 in the district of Julianehaab, South Greenland, was provisionally called by him «the cappelenitelike mineral» (Meddelelser om Grønland XIV, 245). It is found in the locality of Naujakasik as small brown, apparently hexagonal, prisms imbedded in the pegmatite of the nephelite-syenite which is to be found there.

The name has been formed from βρῖθος, weight, gravity on account of the mineral's high specific gravity.

Crystalline form. Several of the crystals are fully developed at both ends and their exterior appearance is exactly like a combination of the hexagonal prism $\{10\bar{1}0\}$ and pyramid $\{10\bar{1}1\}$, sometimes with small faces of the prism of second series $\{11\bar{2}0\}$.

If the crystals are therefore considered as belonging to the hexagonal system, they will have the axial ratio $\dot{c} = 0{\cdot}732$.

However by further examination it is quickly found, that this simple form is only apparent and that the crystals really are polysynthetic crystals of rhombic single individuals, the crystals having a somewhat similar form to that of the well-known aragonite crystals from Aragonia.

This was found from the fact, that the measurements of the angles gave very different values for the edge angles and it could be seen distinctly in the transverse sections, that every crystal consisted of a number of united individuals of another system of crystallization (optic biaxial). Experiments were

made in measuring angles on the transverse section under the microscope, but without much success; in the few cases, where it could be positively determined, that it was a single individual that appeared, the edges were as a rule more or less rounded off or in other ways damaged.

Among the numerous measured values for edge angles there are especially two, which appear frequently. The average values are 28° 11′ and 30° 2′. On the transverse sections edge angles were frequently measured, whose average value was the sum of the above mentioned angles, = 58° 13′. Attention was then directed to the possibility of discovering a case, where the two above mentioned angles followed each other in a regular order and where there at the same time was an angle of 90° between the two faces (rhombic pinacoids). Such a case was found, as will be seen from the following statement, which also shows the ordinary variation in the size of the edge angles:

$a_1 : a_2$	= 25° 58′	
$a_2 : a_3$	= 32° 48′	
$a_3 : a_4$	= 25° 41′	
$a_4 : a_5$	= 28° 57′	
$a_5 : a_6$	= 34° 21′	
$a_6 : a_7$	= 31° 26′	
$a_7 : a_8$	= 31° 10′	
$a_8 : a_9$	= 31° 31′	
$a_9 : a_{10}$	= 31° 43′	89° 55′
$a_{10} : a_{11}$	= 30° 7′	
$a_{11} : a_{12}$	= 28° 5′	
$a_{12} : a_1$	= 28° 14′	

On the transverse sections, as above mentioned, the angle 58° 13′, corresponding to $a_{10} : a_{12}$ above, was measured several times and the optic axial plane was found to make a right angle with one of the faces, which included this angle. The