a preliminary note. The specimen showed exceedingly small needle-shaped white crystals, at most 0.5 m.m. in length, implanted in small cavities in black, massive hausmannite. Under the microscope the crystals were found to be formed in the shape of hexagonal prisms $\infty P (10\bar{1}0)$ terminating only in the basal plane $oP (0001)$ (Fig. 10, Pl. V.), the prismatic faces were definitely striated in the direction of the axis. A section vertical to the axis shows an uniaxial image with negative character. Also a decided zone structure is observable (Fig. 11, Pl. V). A qualitative analysis of a very minute quantity of material proved $As_2 O_5$ and CaO to be present and so the identity with svabite was regarded as fixed.

The Harstigen crystals allow of an accurate determination of their crystallographical form, while their constitution could not exactly be fixed, on account of the small quantity of material employed for the analysis. On the other hand, the mineral from Jakobsberg, which was not crystallized, allowed of a complete and exact determination of its chemical formula. So there can now be no doubt as to the constitution and systematical relations of the mineral.

The mineral is named after the eminent Swedish mineralogist and metallurgist of last century »Bergsråd» Anton SVAB.

Characters. Hexagonal, probably pyramidal hemihedral; $a : c = 1 : 0.7143$. Isomorphous with apatite etc. Cleavage ∞ P, imperfect. In crystals of prismatic habit (Harstigen and Jakobsberg) and massive (Jakobsberg) H = 5. G = 3.52 (Harstigen) or 3.77 — 3.82 (Pb-bearing, Jakobsberg). Lustre vitreous to subresinous. Crystals colourless or white, massive yellowish white; streak white. Transparent or translucent. Fracture uneven and chonchoidal. Brittle. Composition $HO . Ca_5 As_3 O_{12} = 9 CaO . 3 As_2 O_5 + Ca (OH)_2$ with some $P_2 O_5$ replacing $As_2 O_5$ and PbO, MgO, MnO, FeO and alkalies replacing CaO; H and Cl also enter instead of (HO). Before the blowpipe fuses with difficulty to a black slag; gives with sodium on charcoal arsenical odour. Occurs in the Harstigen iron and manganese mine, in druses as small crystals on massive schefferite and garnet, together with brandtite, sarkinite and manganophyllite and massive or as very minute crystals in hausmannite in the manganese mine of Jakobsberg in Vermland.

8. Adelite a New Basic Arseniate from Nordmarken, Jakobsberg and Långban, Vermland[1]. Pl. V. Fig. 12, 13.

1. Adelite from the Kittel-mine. Nordmarken.

In the year 1887 or 1888 there was found in the Kittel-mine, Nordmarken, a grey, massive mineral occurring in considerable quantities, which, before the blowpipe, gave the reactions of berzeliite. Further in-

[1] Part of this paper was already published as a preliminary note in Geol. Fören. Förhandl. Vol. 13, p. 781, 1891.

vestigations have shown that it constitutes a new mineral, with a different composition to that of berzeliite. It occurs together with hausmannite and other manganese ores in a layer, separate from that of the iron ore.

The mineral is grey in colour, translucent and has a resinous lustre.

It occurs as great massive pieces, thickly permeated by magnetite in small grains and scales of metallic copper. Fracture uneven or chonchoidal. Streak uncoloured; hardness $=$ 5. In the microscope the mineral is colourless and in polarized light shows grey, bluish-grey, yellew or yellow-grey. Before the blowpipe, the mineral fuses easily to a grey enamel; with soda on charcoal it gives an arsenical odour. Soluble in diluted acids.

Analysis VII.

Adelite from Kittel-Mine (R. Mauzelius).

Gravity 3.71 at $+$ 14° C.

|	$\%$	Molecular Ratio		
As_2O_5	50.04	0.218	0.218	0.97
CaO	25.43	0.454		
MgO	17.05	0.423		
BaO	trace	—	0.902	4.
MnO	1.64	0.023		
PbO	0.39	0.002		
Cl_2	0.24	0.007	0.243	1.08
H_2O	4.25	0.236		
$Fe_2O_3 +$ Al_2O_3 . . .	0.30	—	—	—
Copper	0.26	—	—	—
	99.60	—	—	—
O corresponding to Cl_2	—0.05	—	—	—
	99.55	—	—	—

The amount of water given in the analysis has been determined as loss by heating. An attempt has been made to determine the amount of water directly but without decided results. By heating in a gas-oven, to the greatest heat the oven could give, the loss was only 1.5 per cent, which was directly determined.

That the mineral contains still more water is evident from the fact that when the powder, already heated in the oven, is further heated in a closed glass-tube over the full flame of a Bunsen burner it gives off water freely. This amount, given off only at a high temperature, is determined at about 2.75 percent.

The molecular ratio corresponds closely to the formula

$$2\,Ca\,O\,.\,2\,Mg\,O\,.\,H_2\,O\,.\,As_2\,O_5$$
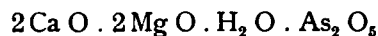
or, as it may also be written

$$HO - Mg\,O \diagdown$$
$$Ca \diagup{O} - As\,O$$
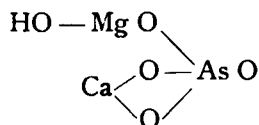
The mineral is therefore a basic orthoarseniate of lime and magnesia.

Its relations to berzeliite must now be considered. The composition of the minerals known under the common name of berzeliite is not yet decided, as the latest analyses show different results[1]. But whether the formula $3\,RO\,.\,As_2\,O_5$ or $10\,RO\,.\,3\,As_2\,O_5$ is adopted, the difference of its composition from that of adelite is evident. The berzeliites are either true normal orthoarseniates $3\,RO\,.\,As_2\,O_5$ or come very close to this formula, while adelite, on the contrary, is a highly basic arseniate with the formula
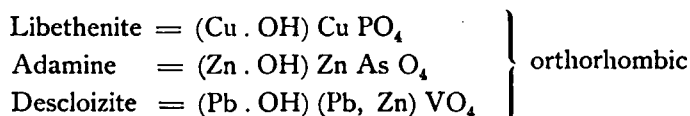
$$5\,RO\,.\,As_2\,O_5.$$
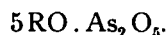
Another essential difference is that adelite contains basic hydrogen while berzeliite is a saturated arseniate.

With regard to its composition, adelite is closely related to the natural group of minerals, the general formula of which is

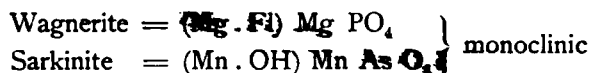$$(\overset{II}{R}.OH)\,\overset{II}{R}\,\overset{V}{Q}\,O_4$$
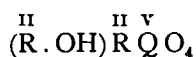
in which R is some biatomic metal and Q five-atomic P, As or V. To this group, which contains an orthorhombic and a monoclinic section belong among others the species

Libethenite	= (Cu . OH) Cu PO$_4$	
Adamine	= (Zn . OH) Zn As O$_4$	orthorhombic
Descloizite	= (Pb . OH) (Pb, Zn) VO$_4$	

[1] The analyses of LINDGREN and FLINK, the former of an anisotrope, the latter of an isotrope berzeliite from Långban, both give the formula of a normal orthoarseniate $3\,RO\,.\,As_2\,O_5$; on the other hand, HÖGBOM's analysis of an isotrope variety from the same locality seems to confirm the formula proposed by KÜHN $10\,RO\,.\,3\,As_2\,O_5$ while IGELSTRÖM's analyses of berzeliite from Nordmarken come between these formulas. LINDGREN Geologiska Föreningens i Stockholm Förhandlingar Vol. 5, p. 552; FLINK Bihang till Kongl. Vet. Akademiens Handl. Vol. 12, p. 27. HÖGBOM Geologiska Föreningens Förhandlingar Vol. 9, p. 398. IGELSTRÖM Geologiska Föreningens Förhandlingar Vol. 7, p. 101.

and

$$\text{Wagnerite} = (Mg \cdot Fl) \, Mg \, PO_4$$
$$\text{Sarkinite} = (Mn \cdot OH) \, Mn \, As \, O_4 \Big\} \text{ monoclinic}$$

Of these sarkinite also occurs in the Swedish manganese mines under the same conditions as adelite.

It was not possible, from the Kittel-mine find, to determine whether adelite belonged to the orthorhombic or monoclinic system, as it did not occur in crystals. In one of the thin sections of massive adelite I happened to find some grains which were cut normal to the acute bisectrix and in convergent polarized light showed a wide optical angle, which, by measurement under the microscope, was approximately determined at

$$2\,E = 106° \, 40'$$

The dispersion of the axes is $\varrho > \nu$ [1]; the acute bisectrix is positive.

2. A Mineral related to Adelite from Moss-mine, Nordmarken.

It is of interest to compare, with the above described mineral, another found some years earlier in the Nordmark mine. It was described by me in a paper on »the Paragenical Relations of the Arseniates of Nordmarken» in the year 1884 [2]. It was found as irregular grains in the »manganese vein» of Moss-mine, together with calcite, hausmannite, pyrochroite, manganosite, manganostibite and the hydrous arseniates, allaktite, diadelphite [3], synadelphite, hemafibrite, manganostibiite, etc. and I suggested that it was the primary arseniate, from which all the secondary, hydrous arseniates above mentioned were derived.

On this occasion I gave an analysis of the mineral, made by Dr C. H. LUNDSTRÖM, which showed a loss of 2.32 per cent, but the water was not determined. The mineral further contained 1.44 per cent of insoluble, foreign material. On the supposition that the loss is only water, the analyses, calculated at 100 per cent, show

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[1] In my preliminary note in Geol. Fören. Förhandl. Bd. 13, p. 787 it stands $2\,H = 106° \, 40$ which may be corrected to $2\,K = 106° \, 40$; also $\varrho < \nu$ is erroneous and must be $\varrho > \nu$.

[2] Geol. Fören. i Stockholm Förhandl. Vol. 7, p. 407.

[3] I use the name diadelphite (A. Sjögren) instead of aimatolith (hematolith Igelström) for the following reason. The papers of the two authors were published *simultaneously* i. e. in the same number of the Geol. Fören. i Stockholm Förhandl. (Number 88 for April 1884). Therefore it cannot justly be said that the one "name has the priority" (Dana's System Ed. VI, p. 803). As IGELSTRÖM's analysis later on was considered to be partly incorrect and his name declared objectionable, the two authors agreed that the name "aimatolith" should be disused and replaced by "diadelphite". This agreement was published in Geol. Fören. Förhandl. Vol. 7, p. 726. In spite of it, GROTH (Tabell. Uebersicht d. miner. Ed. 3, p. 78 as well as DANA, seem to prefer the name given by IGELSTRÖM after having changed it to the more proper form of hematolith.

Analysis VIII.

Adelite-like Mineral from Moss-mine (C. H. Lundström 1884).

|	%	Molecular Ratio		
As$_2$ O$_5$	49.73	0.216	0.216	1
Ca O	25.52	0.455		
Mg O	18.98	0.474		
Ba O	0.81	0.005	0.958	
Mn O	1.69	0.023		
Zn O (?)	0.08	0.001		
Al$_2$ O$_3$ + } Fe$_2$ O$_3$ } . .	0.83	—	—	5.041
H$_2$ O (loss). . .	2.36	0.131		
	100.00	—	—	—

This mineral is therefore like adelite represented by the general formula

$$5 RO . As_2 O_5$$
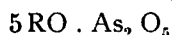
but it seems that the mineral from the Moss-mine only contains half as much water as that from Kittel-mine. This circumstance may be looked at in two different ways. Either the former mineral really only contains half the amount of water and is composed as

$$9 RO . H O_2 . As_2 O_5. \qquad (R = Ca, Mg)$$
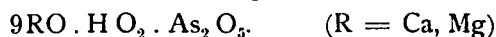
or it was originally an anhydrous compound

$$10 RO . 2 As_2 O_5,$$
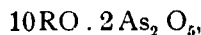
the small amount of water being due to incipient decomposition. This interpretation is supported by the fact, that the mineral in thin sections proves to be somewhat decomposed.

The mode of occurrence in the two mines is also rather different although the minerals in both cases occur together with manganese ore.

In order to prevent ambiguity I confine the name adelite to the mineral of the composition $4 RO . H_2 O . As_2 O_5$ and leave future examinations to decide the relation of the mineral from Moss-mine to the true adelite.

3. Crystallized Adelite from the Jakobsberg-mine.

During a visit at this mine in October 1891 I found a yellowish-grey, berzeliite-like mineral, occurring massive in hausmannite-bearing limestone together with manganophyllite, piedmontite etc. The mineral shows externally no resemblance to the Nordmarken adelite and only the chemical analysis proved the identity. By cautiously dissolving the calcite in acetic acid I happened to get some crystals and fragments of crystals, which allowed the determination of the crystallographical form and optical

properties. The chemical composition of the adelite from Jakobsberg is shown in the following analysis.

Analysis IX.

Adelite from Jakobsberg (R. Mauzelius).

Gravity 3.72 at 15° C.

	%	Molecular Ratio		
$As_2 O_5$ . .	48.52	—	0.211	0.95
SO_3 and Cl	trace	—	—	—
Pb O . . .	2.41	0.012	—	—
Fe O . . .	0.09	0.001	—	—
Mn O . . .	1.27	0.018	0.922	4.15
Ca O . . .	23.13	0.413	—	—
Mg O . . .	19.25	0.478	—	—
$H_2 O$ . . .	3.99	0.222	0.222	1
Si O_2	1.88	0.031	—	—
	100.54			

If we leave the silicic acid out of consideration, as this certainly does not belong to the mineral, the molecular ratio is $As_2O_5 : RO : H_2O =$ 0.95 : 4.15 : 1 which evidently answers to the formula of adelite.

The agreement with the formula will be still greater if we subtract from the basic components as much as corresponds to the silicic acid for constituting ortho-silicate. This way of interpreting the existence of the silicic acid in the analysis is probably the most natural as a mineral of the olivine group often occurs in crystalline limestones of this kind and such a mineral, by its yellowish-grey colour, could easily escape detection when picking out the material for analysis. The above molecular ratio then will be

$$1 : 4.08 : 1.05$$

evidently corresponding to the formula

$$\left. \begin{array}{c} HO . Mg \\ Ca \end{array} \right\} As O_4$$
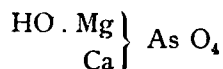
in which small amounts of Ca are replaced by equivalent quantities of Pb, Mn and Fe.

The crystallographical form of adelite. The disengaged crystals are a few millimetres in size, and mostly fragmental. They show rounded edges and corners and only few faces are smooth enough to allow of measurement. The measurements of four crystals have shown that the mineral belongs to the monoclinic system with the following system of axes:

$$a : b : c = 1.0989 : 1 : 1.5642$$
$$\beta = 73° 15'$$

This axial system is derived from the following fundamental angles

$$c \ (001) : a \ (100) \ = \ 73° \ 15'$$
$$M(110) : M(1\bar{1}0) \ = \ 87 \ \ 5$$
$$M(\bar{1}10) : d \ (\bar{2}21) \ = \ 24 \ 45$$

The following faces are observed:

$$a \ = \ \infty \, \bar{P} \, \infty \ (100)$$
$$c \ = \ oP \ \ (001)$$
$$M \ = \ \infty \, P \ \ (110)$$
$$f \ = \ \dot{P} \, \infty \ (011)$$
$$d \ = \ P \ \ (\bar{2}21)$$

The crystals are either tabular parallel with $c(001)$ (as fig. 12, Pl. V) or prismatic with $M(110)$ dominating (fig. 13 Pl. V). The faces M are smooth and give good reflections; distinct cleavages are found parallel to these faces. The face a is smooth but less brilliant than the M-faces; c is often curved and gives double or indistinct images; this face is deeply striated parallel with the edge of intersection with $a(100)$. The pyramid d is uneven and allows only of approximate measurements The dome f is observed only on one crystal.

Table of Angles.

	1.	2.	3.	4.	Calculated.
$M(110) : M(1\bar{1}0)$	87° 0'	86° 56'	87° 12'	87° 20'	87° 5'
$c \ (001) : M(110)$		79 3		79 5	78 33
$M(\bar{1}10) : d \ (\bar{2}21)$		24 58	25 15		24 45
$c \ (001) : a \ (100)$				73 15	73 15
$c \ (001) : f \ (011)$				56 27	56 17
$c \ (001) : d \ (\bar{2}21)$		76 26			75 27

Optical Properties. The examination in polarized light shows that the mineral is strong double refracting. The optical axes lie in the plane of symmetry and the acute bisectrix makes an angle of 38° 45' with the c axis; this bisectrix lies in the obtuse angle between the crystal axes. The double refraction is positive. The optical orientation is thus

$$B_a \wedge c \ = \ + \ 38° \ 45'.$$

The optical angle for Na-light was measured in a solution of mercuric iodide in potassium iodide ($n = 1.6703$) with the following result

$$2 K_{ay} \ = \ 58° \ 47'.$$

The dispersion is $\varrho > \nu$.

The chemical relation to the wagnerite group has already been alluded to. On account of showing the crystallographical agreement with

this group one may multiply the a-axis by 2. The correspondence is then evident as shown in the following comparison:

Triploidite $a:b:c = 1.8572 : 1 : 1.4925$ $\quad \beta = 71°46'$

Wagnerite $\qquad\qquad = 1.9145 : 1 : 1.5059$ $\qquad = 71\ 53$

Sarkinite $\qquad\qquad = 2.0017 : 1 : 1.5154$ $\qquad = 62\cdot13\frac{1}{2}$

Adelite $\quad 2a:b:c = 2.1978 : 1 : 1.5642$ $\qquad = 73\ 15$

One may thus refer adelite to a system of axes fully corresponding to that of the wagnerite but I found it preferable to use the system of axes which gives the simplest symbols to the faces.

Also in optical properties adelite agrees with the other members of the wagnerite-group as they all have the plane of optic axes parallel to that of symmetry.

4. Adelite from Långban.

Adelite occurs also at Långban but with a somewhat different appearance and in different association from that at Nordmarken. Specimens show a pale yellow-grey colour, much resembling certain varieties of berzeliite. It occurs together with impure calcite, braunite and asbestos-hedyphane[1].

Analysis X.

Adelite from Långban (R. Mauzelius).

G. = 3.76 at 15° C.

	$^o/_o$.	Molecular Ratio.		
As$_2$O$_3$	50.28	0.219	0.219	0.97
Ca O	24.04	0.429		
Mg O	17.90	0.444		
Ba O	0.23	0.002		
Pb O	2.79	0.013	0.900	4
Cu O	0.32	0.004		
Fe O	0.08	0.001		
Mn O	0.48	0.007		
Cl	trace	—		
H$_2$O	3.90	0.217	0.217	0.97
	100.02			

[1] The designation of a peculiar compound of two minerals, found at Långban for some years in different parts of the mine. It formed fibrous aggregates up to an inch in length of a grey to brownish colour and silky lustre. A microscopical examination has shown that it is composed of two different minerals of which one, in the form of thin needles with a starlike intersection permeates the other, and gives the whole compound a fibrous, asbestos like appearance. The needle-like mineral is a hydrous silicate of magnesia with a composition similar to that of serpentine; the other mineral is chiefly an arseniate of lead with some lead chloride, but it does not seem to be identical with the common hedyphane. Both minerals are double refracting.

It is evident that this mineral is of exactly the same composition as that from Kittel-mine, Nordmarken. The water is also here determined partly direct (1.52 per cent, which goes off at a moderate heat) partly as loss by heating (2.38 per cent).

The name is derived from $\alpha\delta\eta\lambda o\varsigma$ i. e. unclear.

Characters. Monoclinic but seldom crystallized. $a : b : c = 1.0989 : 1 : 1.5642$ $\beta = 73° 15'$ Forms a(100), c(001), M(110), f(011), d($2\bar{2}1$). Geometrically isomorphous with the wagnerite-group. Generally massive or compact. Cleavage parallel M(110), distinct. H $= 5$. G. $3.71 — 3.76$. Lustre resinous. Colour grey (Kittel-mine, Nordmarken) or yellowish-grey (Jakobsberg and Långban). Streak uncoloured. Translucent. Fracture uneven or chonchoidal. Double refraction strong, positive. Angle of optic axes $2H = 58° 47'$ (in a medium of the refracting power $n = 1.6703$). Dispersion $\varrho > \nu$. Composition: $2CaO . 2MgO . H_2O . As_2O_5$ with small amounts of Mn, Pb, Fe, and Ba replacing some Ca or Mg, thus in composition analogous to wagnerite, sarkinite etc. Before the blowpipe fuses easily to a grey enamel; with soda on charcoal arsenical odour. Soluble in diluted acids. Found in the Kittel-mine, Nordmarken, in Jakobsberg and Långban-mines, Vermland, together with other arseniates and manganese minerals. A closely related mineral is known from the Moss-mine, Nordmarken, with the composition $9RO . H_2O . 2As_2O_5$. (R $=$ Ca, Mg).