$$a:b:c=0.9305:1:0.7140,$$
$$\alpha=110^\circ\ \tfrac{1}{2}', \quad \beta=111^\circ 59', \quad \gamma=100^\circ 18''$$

The lengths of the primitive translations follow from Hurlbut's c value. They are:

$$a=8.90\text{ kX}, \quad b=9.57\text{ kX}, \quad c=6.83\text{ kX}, \quad \text{with} \quad V=474.4=1897/4\text{ kX}^3;$$

or

$$a=8.92\text{ Å}, \quad b=9.59\text{ Å}, \quad c=6.84\text{ Å}, \quad \text{with} \quad V=477.1=1908/4\text{ Å}^3.$$

This cell is the Delaunay reduced cell (with all three angles obtuse, Dalaunay, 1933; Donnay and Nowacki, 1954, pp. 139–141). It happens to be defined by the shortest three translations of the lattice (its a length is shorter than Hurlbut's a_0').

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STUDIES IN THE MICA GROUP; MANGAN-MUSCOVITE FROM MATTKÄRR, FINLAND

E. WM. HEINRICH and A. A. LEVINSON, *University of Michigan* and The Ohio State University.*

In a series of recent papers Heinrich and Levinson (1955*A*, 1955*B*) and Levinson (1955) have reported a significant frequency of polymorphism among muscovite-type (heptaphyllite) micas. It has been noted, moreover, that these micas exhibit considerable isomorphous substitution when compared with the ideal or theoretical muscovite composition. Significant contents of V_2O_3, BaO, SiO_2 or H_2O characterize the muscovite-type micas that have crystallized as the 1-layer monoclinic (*1M*) or 3-layer trigonal (*3T*) polymorphs, although some of these, particularly the high SiO_2 and H_2O varieties, also have crystallized with the common 2-layer monoclinic (*2M*) structure. Previously it had been generally accepted, on the basis of the work of Hendricks and Jefferson (1939), that muscovite occurs only as the *2M* polymorph. Axelrod and Grimaldi (1949), however, described a muscovite from Sultan Basin,

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* Contribution from the Department of Mineralogy and Petrography, University of Michigan, No. 193.

Washington, which is now known to have a *3T* structure (Levinson, 1955). This is the only reported mica with a composition close to the theoretical muscovite known to have a structure other than *2M*. The purpose of this note is to report the results of chemical and *x*-ray studies on an unusual mangan-muscovite (Eskola, 1914) which exhibits very little isomorphous deviation from the theoretical muscovite composition but has crystallized as the 1-layer monoclinic (*1M*) polymorph rather than the common or "normal" *2M* form.

Eskola (1914, p. 37), in describing the pegmatites of southwestern Finland, briefly notes:

> "A particular manganese-mineral, an intensely blue-coloured, fine-crystalline manganese-muscovite, containing 2.30% MnO, was found at Mattkärr."

This or similar material was studied spectrochemically by Erämetsä, Sahama and Kanula (1943), who determined the presence of 1% Rb_2O and 0.03% Cs_2O. Pehrman (1945) also describes a blue "radial" mica from Mattkärr, that probably represents similar material. He found it to have 2V = 39° 20′ by means of the universal stage.

A specimen of Eskola's mineral was borrowed from the Harvard Mineralogical Museum (No. 87441) for study. The material is deep purplish-blue (the color of some dumortierites), very fine-grained, and shows no megascopic structural features. Microscopic examination shows the mangan-muscovite to be colorless to pale lilac or pale purple in thin flakes. The flakes are actually aggregates of many very fine-grained mica shreds. The mangan-muscovite is mixed with an estimated six per cent of quartz as well as a few scattered grains of a mineral characterized by low birefringence, numerous minute inclusions, and $n = $ ca. 1.63; it may be apatite.

X-ray powder patterns obtained from the mangan-muscovite confirmed the presence of a small amount of quartz. When quartz lines are subtracted the spacings and intensities characteristic of the 1-layer monoclinic (*1M*) mica polymorph remain. The *x*-ray data are recorded in Table 1.

The results of a quantitative spectrochemical analysis are presented in Table 2. The sum of the constituents determined in the analysis is 94.1 per cent; H_2O was not determined but undoubtedly accounts for the remainder. The following elements were not detected: Rb, Cs, Li, Sn, Ti, Co, Sc, Cr, V and F. In view of the fact that approximately six per cent of the bulk material consists of quartz the analysis is recast with this impurity deducted (Table 2). The recalculated results show a SiO_2 content of 45.7 per cent, which is in good agreement for a muscovite of normal composition. The MnO content of 1.7 per cent is high for a muscovite, however. The CaO content of 1.12 per cent possibly may be attrib-

TABLE 1. *X*-RAY POWDER DATA FOR MANGAN-MUSCOVITE
(Filtered copper radiation; $\lambda CuK_{\alpha_1} = 1.54050$ Å)

d(Å)	*I*	*d*(Å)	*I*
10.0	S	2.38	M
4.98	M	2.25	W diffuse
4.49	M	2.14	MW
4.38	VW	2.00	MS
4.11	VW	1.96	VW
3.65	M	1.72	VW
3.33	S	1.65	M diffuse
3.07	M	1.50	M
2.80	W	1.43	VVW
2.69	W	1.35	MW
2.57	MS	1.30	MW
2.46	W	1.25	W

uted in part to apatite, but inasmuch as the occurrence of this mineral within the mangan-muscovite is still in doubt, apatite has not been considered in the recalculation.

It is concluded that the composition of the mangan-muscovite from Mattkärr is close to that of ordinary muscovite and that it is the first mica with such a composition to be reported as having the *1M* structure. It seems doubtful that the *1M* crystallization can have resulted from the presence of 1.7 per cent MnO, because Whitmore, Berry and Hawley (1946) have found that the *2M* muscovite polymorph can accommodate as much as 4.81 per cent Cr_2O_3. Undoubtedly both Cr and Mn occupy octahedral positions, isomorphously replacing Al, in the mica structure,

TABLE 2. CHEMICAL DATA ON MANGAN-MUSCOVITE

Constituent	Experimental	Corrected*
SiO_2	49	45.7
Al_2O_3	32	34.0
K_2O	10	10.6
Fe_2O_3	0.15	0.16
MgO	0.21	0.22
Na_2O	0.08	0.085
MnO	1.6	1.7
BaO	0.0008	0.0008
Ga_2O_3	0.012	0.013
SrO	0.004	0.004
CaO	1.05	1.12

Spectrochemical analysis by C. E. Harvey.

* Recalculated to eliminate quartz contamination estimated to be 6 per cent.

and Cr^{+3} and Mn^{+3} have nearly the same ionic radii. The effect of environmental factors cannot be evaluated owing to the lack of paragenetic data, but from the fine grain size and a comparison with the formation of other pegmatitic manganiferous muscovites, the mineral probably is hydrothermal rather than magmatic in origin.

On the basis of the low Fe_2O_3 content (.16 per cent) in relation to the 1.7 per cent MnO, the intense purplish-blue color can be related to the Mn chromophore (Heinrich and Levinson 1953). Very likely the intensity of the color in hand specimen is in part a function of the very fine grain.

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STRESS AND DOUBLE REFRACTION IN DIAMOND*

C. B. Slawson and R. M. Denning, *University of Michigan, Ann Arbor, Michigan.*

It has become accepted as axiomatic that anomalous double refraction in diamond is due to intense internal strain that makes crystals showing high interference colors unsatisfactory for some industrial uses. This is especially true for wire drawing dies and shaped diamond cutting tools which are made from the finer grades of industrial diamonds. In practice the examination of crystals between crossed polars has never been deemed necessary for some of the less specialized uses of industrial diamonds such as wheel trueing and core drilling, but in some companies it is standard practice to examine all diamonds with a polarizing microscope before cutting for industrial use.

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