New determinations of the specific gravity of linarite

5.30 Red Gill, Cumberland (Berman balance)
5.25 Mono County, California } C. Frondel, private
5.26 Rezbanya, Hungary } communication—May 13, 1946

combined with the volume of the unit cell and any of the closely agreeing analyses clearly indicate a structural formula:

$$2PbO \cdot 2CuO \cdot 2SO_3 \cdot 2H_2O = 2[PbCuSO_4(OH)_2]$$

with calculated specific gravity 5.319.

TABLE 1. LINARITE—$PbCuSO_4(OH)_2$: *X*-RAY POWDER PATTERN
Monoclinic, $P2_1/m$; $a=9.70$, $b=5.65$, $c=4.68$A, $\beta=102°40'$; $Z=2$

I	*d*(meas.)	*hkl*	*d*(calc.)	*I*	*d*(meas.)	*hkl*	*d*(calc.)	*I*	*d*(meas.)	*hkl*	*d*(calc.)
2	4.82A	110	4.851A	1	2.81A	020	2.825A			410	2.182A
4	4.48	$\bar{1}01$	4.518	1	2.68	120	2.707	4	2.16A	311	2.181
7	3.53	210	3.628	3	2.56	$\bar{3}11$	2.587			$\bar{1}12$	2.161
		011	3.551	1	2.39	021	2.402			320	2.105
		300	3.155			$\bar{1}21$	2.395	4	2.09	$\bar{2}02$	2.097
10	3.12	111	3.153	3	2.30	$\bar{4}01$	2.318			$\bar{3}02$	2.078
		$\bar{2}11$	3.105	3	2.24	$\bar{2}02$	2.259				
2	2.94	201	2.977			$\bar{2}21$	2.249				

I	*d*(meas.)	*I*	*d*(meas.)	*I*	*d*(meas.)	*I*	*d*(meas.)	*I*	*d*(meas.)
6b	1.791A	½	1.532A	1	1.324A	½	1.118A	1b	0.869A
1	1.758	½	1.514	½	1.299	2	1.056	1b	0.860
½	1.734	1	1.492	½	1.287	1	1.047	1b	0.849
2	1.675	½	1.439	1	1.214	½	1.025	2b	0.839
½	1.631	1	1.400	2	1.192	1	0.993	½b	0.830
½	1.610	1	1.375	1	1.152	1	0.914	1	0.821
3	1.566	½	1.347	½	1.130	1b	0.896	1	0.813

b—broad line; using CuKα = 1.5418A, mass factor 1.6602.

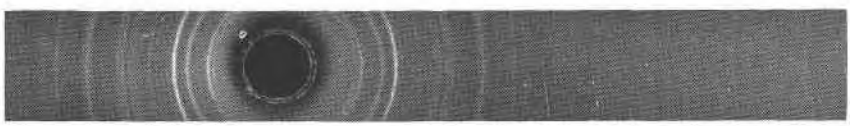

FIG. 1.—*X*-ray powder photograph, Cu/Ni radiation, $1°\theta = 1$ mm. on film, actual size print.

THE UNIT CELL OF MAGNETOPLUMBITE

L. G. BERRY, *Queen's University, Kingston, Canada*

Magnetoplumbite was described by Aminoff (*Geol. För. Förh.* **47,** 283, 1925) from Långban, Sweden, with cell dimensions and analysis by Almström. The mineral was later re-analysed by Blix (*Geol. För. Förh.* **59,** 300, 1937); this later analysis showing the true valence state of the manganese. Adelsköld (*Ark. Kemi.*, **12** (29), 1938) determined lattice

dimensions for $PbO \cdot 6Fe_2O_3$ which he states corresponds to magnetoplumbite. In Dana (*System*, **1**, 728, 1944) it is shown that the structural formula deduced from the mineral data bears no similarity to the composition of the artificial lead ferrite.

Recently a powder photograph (Figure 1, Fe/Mn radiation) was taken of magnetoplumbite from a specimen from the type locality (Queen's University Museum). The pattern could not be indexed with the cell dimensions of Aminoff. A small fragment was detached and oriented on the two-circle goniometer with the perfect basal cleavage (0001) polar to the axis of the vertical circle. Rotation, zero and first layer Weissenberg films about the *c*-axis yielded the following cell dimensions

$a = 5.88$, $c = 23.02$A (Magnetoplumbite)[1]

$a = 6.06$, $c = 23.69$A (Aminoff, 1925)

$a = 5.877$, $c = 23.02$A ($PbO \cdot 6Fe_2O_3$, Adelsköld, 1938)

The systematic extinctions, $(h.h.\overline{2h}.l)$ present only with $l = 2n$ are characteristic for the space group $C6/mmc$ as found by Adelsköld for artificial $PbO \cdot 6Fe_2O_3$.

The new cell dimensions combined with the measured specific gravity, 5.517 (Dana) give the molecular weight of the cell contents $M = 2290.6$. The cell content is calculated from the analysis by Blix in Table 1.

TABLE 1. MAGNETOPLUMBITE: ANALYSIS AND CELL CONTENT

	1	2		3		4	
PbO	20.02	2.08	Pb	2.08	2.08	2	2
MnO	3.73	1.21	Mn''	1.21			
Al_2O_3	1.86	0.41	Al	0.82		1	
Fe_2O_3	52.22	7.55	Fe'''	15.10	23.37	15	24
Mn_2O_3	17.27	2.52	Mn'''	5.04		7	
TiO_2	4.14	1.20	Ti	1.20		1	
Rem	0.76		O	37.13	37.13		38
	100.00						

1. Magnetoplumbite, Långban, Sweden, anal. Blix (1937). 2. Unit cell content. 3. Atomic content of unit cell. 4. Ideal content corresponding to $Pb_2(Fe_{15}Mn_7Al,Ti)O_{38}$.

The number of atoms (3) indicates a structural formula $Pb_2(Fe_{15}Mn_7AlTi)O_{38}$ with calculated specific gravity 5.59 in close agreement with the measured value. This structural formula is the same as for the arti-

[1] Using wavelength CrKα 2.2909A, Mass factor 1.6602.

TABLE 2. MAGNETOPLUMBITE—$Pb(Fe,Mn,Al,Ti)_{12}O_{19}$: *X*-RAY POWDER PATTERN
Hexagonal, *C6/mmc*: $a=5.88$, $c=23.02$A, $Z=2$

I	θ(Fe)	*d*(meas.)	*hkīl*	*d*(calc.)	*I*	θ(Fe)	*d*(meas.)	*hkīl*	*d*(calc.)
1	11.2°	4.99A	$10\bar{1}1$	4.972A	3	19.7°	2.87A	0008	2.878A
1	11.95	4.68	$10\bar{1}2$	4.657				$11\bar{2}2$	2.849
½	13.15	4.26	$10\bar{1}3$	4.243	10	20.5	2.77	$10\bar{1}7$	2.763
2	14.6	3.84	0006	3.837	10	21.6	2.63	$11\bar{2}4$	2.618
			$10\bar{1}4$	3.814	½	22.3	2.55	$20\bar{2}0$	2.546
½	16.45	3.42	$10\bar{1}5$	3.415	5	23.5	2.43	$20\bar{2}3$	2.417
5	19.1	2.96	$11\bar{2}0$	2.940	4	25.65	2.24	$20\bar{2}5$	2.228
					3	27.05	2.13	$20\bar{2}6$	2.122

I	θ(Fe)	*d*(meas.)	*I*	θ(Fe)	*d*(meas.)	*I*	θ(Fe)	*d*(meas.)
1	29.95°	1.940A	7	36.7°	1.621A	½	59.95°	1.119A
1	32.35	1.810	6	40.95	1.478	1	60.95	1.108
½	34.5	1.710	2	44.35	1.386	3	61.75	1.100
5	35.4	1.672	½	47.35	1.317	2	62.4	1.093
1	36.0	1.648	1	47.95	1.304	2	70.95	1.025
2	36.3	1.636	2	55.45	1.176	1	73.3	1.011

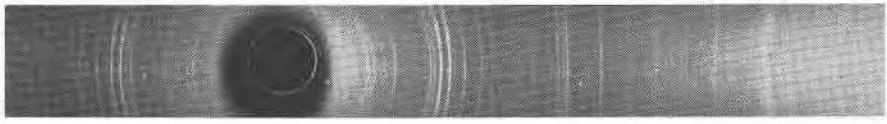

FIG. 1.—*X*-ray powder photograph, Fe/Mn radiation, $1°\theta=1$ mm. on film, actual size print.

ficial ferrite $2[PbFe_{12}O_{19}]$ given by Adelsköld, with substitution of manganese, aluminum and titanium for iron.

The estimated intensities and measured interplanar spacings from the powder pattern (Fig. 1) are given in Table 2 together with indices and spacings calculated from the cell dimensions.