Sulpharsenites of lead from the Binnenthal. Part IV.—Seligmannite: with a supplementary note on Baumhauerite.

By R. H. Solly, M.A.

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Seligmannite.

Professor Baumhauer[1], in January, 1901, described five very small crystals of a new mineral, to which he gave the name seligmannite. They were associated with rathite and binnite in dolomite, and came from the Lengenbach quarries in the Binnenthal, Switzerland. In June, 1902, he[2] described another crystal, the angles of which agreed fairly well with those of the crystals he had previously measured. In habit and twinning, these orthorhombic crystals so closely resembled bournonite that he ventured to assign to the new mineral the chemical formula $Cu_2S.2PbS.As_2S_3$, but from paucity of material he was unable to make a chemical analysis.

In September, 1902, I received from Binn four specimens of dufrenoysite, on which were deposited a number of minute but very brilliant crystals. The largest crystal measured $2 \times 1\frac{3}{4} \times \frac{3}{4}$ mm., and the others varied from $\frac{1}{4}$ to 1 mm. Twelve small crystals were removed for measurement, and proved to be this new mineral, seligmannite. A qualitative analysis of four of these crystals performed, under the kind direction of Mr. H. J. H. Fenton, in the University Chemical Laboratory at Cambridge, proved the presence of copper, lead, sulphur, and arsenic. It is, therefore, highly probable that when more crystals are available for quantitative analysis, the chemical composition of this mineral will be found to be the one suggested by Baumhauer on the grounds of its crystallographic isomorphism with bournonite.

The elements deduced from the crystallographic determination of these twelve crystals differ slightly from those obtained by Baumhauer:—

$$a : b : c = 0{\cdot}92804 : 1 : 0{\cdot}87568 \text{ (Baumhauer)},$$
$$a : b : c = 0{\cdot}92332 : 1 : 0{\cdot}87338 \text{ (Solly)}.$$

[1] Baumhauer, Sitz.-ber. Akad. Wiss. Berlin, 1901, p. 110; abstract, this vol., p. 205.

[2] Ibid., 1902, p. 611.

The latter ratios were calculated from (011) : (001) = 41° 8′, (100) : (101) = 46° 35½′, and (010) : (120) = 28° 26′. These angles were measured on the best crystals, and the reflections were very sharp.

The crystals are all twinned about (110) and some about ($\bar{1}10$).

	Calculated.	Measured.	
	Solly.	Solly.	Baumhauer.
$110 : \overline{\bar{1}\bar{1}0}$	9° 8′	9° 8′	8° 41′, 8° 54′
$111 : \overline{\bar{1}\bar{1}\bar{1}}$	7 13	7 13	6° 48½′.

The (100), (010), and (001) planes are usually well developed. The plane (110) is always large and striated parallel to its intersection with the planes (100) and (111); besides these striations there are sometimes fine striae parallel to the zone-axis [$1\bar{1}\bar{1}$], but not parallel to the zone-axis [$\bar{1}1\bar{1}$] as would be required by the symmetry of the crystal. The planes (111), (101), (011), and (112) are often well developed.

The colour of the mineral is lead-grey; the lustre is metallic and brilliant; the streak, chocolate-colour. The mineral is opaque. No cleavage was observed. Fracture, conchoidal. Hardness, 3. Specific gravity, not determined, owing to lack of material.

List of Forms observed on Seligmannite.

Symbol.	Indices.	Observer.	Symbol.	Indices.	Observer.	Symbol.	Indices.	Observer.
a	100	Baumh.	*z*	021	Baumh.	*C*	311	Baumh.
b	010	,,	*n*	011	,,	*v*	211	,,
c	001	,,	$\frac{2}{5}\kappa$	025	Solly	*D*	322	Solly
i	130	,,	κ	013	Baumh.	*u*	112	Baumh.
f	120	,,	*o*	101	,,	ϕ	113	Solly
m	110	,,	*x*	102	Solly	$\frac{3}{5}p$	229	,,
e	210	,,	ϵ	103	,,	$3p$	331	,,
η	310	Solly	*t*	104	,,	$4p$	441	,,
A	410	Baumh.	Δ	105	,,	ι	213	Baumh.
q	510	,,	ρ	121	Baumh.	*W*	431	,,
B	071	,,	*y*	111	,,	*O*	1.10.2	,,
Σ	031	,,	*s*	212	Solly			

The total number of forms is thirty-five, of these twenty-three were recorded by Baumhauer. The twelve new forms are all well developed. I have not observed Baumhauer's (021), (031), (071), and (1.10.2).

Below are given the calculated angles and the best measurements from the twelve crystals; also the smallest and greatest angles obtained by Baumhauer between similar planes.

Calculated and measured Angles of Seligmannite.

	Calculated.	Measured.			
	Solly.	Solly.		Baumhauer.	
Zone [100,010].					
100 : 510	10°27½′	10°28′		9°57½′	
: 410	13 0	12 59	13° 0′	13 2½	
: 310	17 6½	17 6	17 8		
: 210	24 47	24 47	24 48	24 50½	24° 54′
: 110	42 43	42 43	42 44	42 36	42 47
: 120	61 34	61 34		61 37½	61 50½
: 130	70 9	70 10		70 34	
: 010	90 0	90 0		89 48½	90 2
Zone [100,001].					
100 : 101	46 35½	46 35½		46 35½	46 44
: 102	64 41½	64 40	64 41		
: 103	72 30	72 28			
: 104	76 41½	76 41			
: 105	79 17	79 15			
Zone [001,010].					
001 : 013	16 14	16 14		16 14¼	
: 025	19 15½	19 15½			
: 011	41 8	41 8		41 7½	41 20
: 021	60 16			60 21	
: 031	69 6½			67 44½	69 41
: 071	80 42½			80 36½	80 37½
: 010	90 0	90 0			
Zone [001,110].					
001 : 229	15 58	15 58			
: 113	23 13½	23 15			
: 112	32 46	32 46		32 44	32 51½
: 111	52 9½	52 9		52 8	52 23
: 331	75 29	75 30			
: 441	79 0½	79 0			
: 110	90 0	90 0		90 0	
Zone [001,210].					
001 : 213	34 46½	34 46			
: 212	46 10	46 10			
: 211	64 21½	64 21		64 24½	64 27½
: 210	90 0	90 0			

	Calculated.	Measured.		
	Solly.	Solly.	Baumhauer.	
Zone [100,011].				
100 : 311	25° 4½′	25° 0′	25° 9½′	
: 211	35 3½	35 4	34 54	35° 5½′
: 322	43 6	43 8		
: 111	54 32	54 32	54 35½	54 36
: 011	90 0	90 0		
Zone [010,101].				
010 : 121	38 14½	38 14½	37 59	38 16¾
: 111	57 36½	57 36½	57 33½	57 35½
: 212	72 24	72 24		
: 101	90 0	90 0		
Zone [110,101].				
110 : 431	14 37	14 37	14 20	
: 211	30 56½	30 56½	30 50	30 54½
: 101	59 41	59 41	59 42½	59 48½
: 2$\bar{1}$3	77 24	77 23		
: 1$\bar{1}$2	87 32	87 32		
: 0$\bar{1}$1	116 30	116 30	116 29½	116 37½
: $\bar{1}\bar{2}$1	147 42	147 42	147 50	
: $\bar{1}\bar{1}$0	180 0	180 0		
001 : 121	62 49	62 50	63 23½	
001 : 431	77 44	77 44	77 6½	
010 : 1.10.2	14 13½		14 13¼	
101 : 0$\bar{1}$1	56 49	56 49		

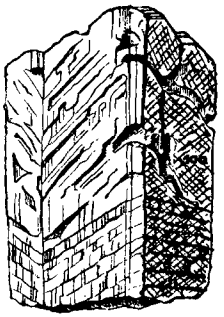
Baumhauerite [1].

In September, 1902, some fine specimens of this recently discovered mineral were found in the Lengenbach quarries in the Binnenthal. The largest crystal measured 25 × 20 × 10 mm.; the colour is steel-grey with very brilliant lustre; and the habit is slightly different from that of the crystals previously described. The difference lies in their polysynthetic growth: the crystals are completely penetrated by numerous, very thin twin-lamellae, closely resembling those parallel to (074) of rathite [2]; further, there is twinning with (100) as twin-plane and face of union.

[1] The following note, which has already appeared in Zeits. Kryst. Min., 1903, vol. xxxvii, pp. 329–331, pl. V, fig. 5, is supplementary to Part III ('Baumhauerite, a new mineral.' This vol., 1902, pp. 151–160) of this series of papers on the sulpharsenites of lead from the Binnenthal.

[2] This vol., p. 80.

The accompanying figure is an exact representation of such a polysynthetic group, showing the twinning on (100) and the twin-lamellae. The cohesion existing between the individual crystals is so slight that the warmth of the hand will cause them to fly apart, and the fresh surfaces which are formed, instead of consisting of cleavage-planes or uneven surfaces, are composed of a number of very brilliant pyramid-faces.



Polysynthetic crystal of Baumhauerite.

In rathite the plane parallel to the twin-lamellae lies in a zone containing two of the axial planes, whereas in baumhauerite it is inclined to such a zone. It was impossible on my Fuess goniometer to do more than determine that the plane did not lie in the zone [100, 010], but Mr. G. F. Herbert Smith kindly measured some of the crystals on the British Museum three-circle goniometer, and found that the plane would have indices approximating to $(76\bar{1})$.

The following is a list of the twenty-five new forms which were observed on six crystals, and have to be added to the ninety-five already recorded. The forms (706), $(50\bar{3})$, $(80\bar{5})$, $(30\bar{8})$, and $(10\bar{3})$, previously observed only by Baumhauer, were also present on these crystals.

$-25\,h\,(25.0.1)$	$-\frac{7}{2}\,h\,(702)$	$+\frac{13}{4}\,h\,(13.0.\bar{4})$	$+\frac{5}{9}\,g\,(50\bar{9})$
$-19\,h\,(19.0.1)$	$-3\,h\,(301)$	$+\frac{11}{4}\,h\,(11.0.\bar{4})$	$+\frac{1}{6}\,g\,(10\bar{6})$
$-\frac{19}{2}\,h\,(19.0.2)$	$+\frac{15}{2}\,h\,(15.0.\bar{2})$	$+\frac{9}{4}\,h\,(90\bar{4})$	$+\frac{1}{7}\,g\,(10\bar{7})$
$-9\,h\,(901)$	$+7\,h\,(70\bar{1})$	$+\frac{11}{6}\,h\,(11.0.\bar{6})$	$+\frac{1}{12}\,g\,(1.0.\bar{1}\bar{2})$
$-\frac{17}{2}\,h\,(17.0.2)$	$+6\,h\,(60\bar{1})$	$+\frac{4}{3}\,h\,(40\bar{3})$	
$-\frac{15}{2}\,h\,(15.0.2)$	$+\frac{9}{2}\,h\,(90\bar{2})$	$+\frac{5}{4}\,h\,(50\bar{4})$	
$-4\,h\,(401)$	$+\frac{7}{2}\,h\,(70\bar{2})$	$+\frac{5}{6}\,g\,(50\bar{6})$	

The table below gives the calculated angles and the best measurements obtained from the six crystals which were measured.

	Calculated.	Measured.		
Zone [100,001].				
100 : 25.0.1	3°15½′	3°14′	3°12′	3°16′
: 19.0.1	4 16	4 20	4 12	4 18
: 19.0.2	8 14	8 15	8 14	8 16
: 901	8 52	8 54	8 50	8 53
: 17.0.2	9 22	9 23	9 21	9 22
: 15.0.2	10 34	10 33	10 32	10 33
: 401	18 54	18 56	18 54	18 55

	Calculated.	Measured.		
: 702	21°15½′	21°14′	21°14′	21°15′
: 301	24 14	24 12	24 12	24 15
100 : 15.0.2̄	11 5	11 4	11 4	11 5
: 701̄	11 52½	11 52	11 53	11 52
: 601̄	13 50	13 50	13 49	13 50
: 902̄	18 21½	18 22	18 21	18 22
: 702̄	23 22	23 24	23 22	23 24
: 13.0.4̄	25 2½	25 1	25 2	25 3
: 11.0.4̄	29 10	29 10	29 10	29 9
: 904̄	34 44	34 45	34 44	34 45
: 11.0.6̄	40 58½	40 58½	40 59	40 58½
: 403̄	51 15	51 15		
: 504̄	53 20	53 20	53 21	
: 506̄	65 35½	65 30	65 37	
: 509̄	75 25½	75 30	75 24	
: 106̄	90 40	90 40	90 40	90 39
: 107	91 37	91 35	91 37	91 36
: 1.0.12̄	93 59	93 59		

ERRATA.

The following baumhauerite forms (this vol., pp. 153, 156, 159) require correction :—

For $+\frac{3}{13}g$ 2.0.13̄ read $+\frac{3}{11}g$ 2.0.11̄
„ $+\frac{1}{9}g$ 109̄ „ $+\frac{1}{8}g$ 108̄
„ $+\frac{1}{12}g$ 1.0.12̄ „ $+\frac{1}{20}g$ 1.0.20̄

Page 156. For 100 : 1.0.12̄ = 95°12½′ read 100 : 1.0. 20̄ = 95°18½′ (calculated).
FIG. 1 (p. 152). For 1̄00 (at top of figure) read 1̄08.