Semseyite from Dumfriesshire.[1]

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EARLY in the year 1918 Mr. Arthur Russell picked up at the old antimony-lead mine at Glendinning[2] in Eskdale, Dumfriesshire, specimens of the antimony-lead ore found there, in which were small cavities lined with a drusy layer of minute crystals; these, being markedly deeper in colour than the stibnite forming part of some of the specimens, belonged to a different species, and probably a sulphantimonite of lead. Mr. Russell brought some of the specimens to the Museum, and some of the small crystals were examined with the view of determining the species to which they belong. He afterwards presented to the Trustees the two specimens[3] used in the investigation. The crystals are associated with stibnite, valentinite, ankerite, calcite, blende, and pyrites.

[1] Published by permission of the Trustees of the British Museum. The paper was read under the title, 'A plagionite-like mineral from Dumfriesshire.'

[2] A brief description of the mine is given by Robert Jameson in his book, ' A Mineralogical Description of the County of Dumfries,' Edinburgh & London, 1805, pp. 73-74 :—' About ten years ago, a vein of grey antimony ore was opened in Glendinning in Eskdale. The working was continued for some time with much profit to the adventurers, but it has been lately given up, it is said owing to want of skill in the miners and energy in the proprietors. The vein traverses greywacke; but its extent, direction, dip, or width, I was not able to ascertain, as the workings had fallen in. The vein stones are quartz, and calc-spar; the ores grey antimony, brown blende, fine-grained lead glance, and iron pyrites.'

[3] The specimens are numbered 404 and 405 for the year 1918 in the General Register of Acquisitions in the Mineral Department.

So closely are the crystals intergrown, and so small are they, that it was a matter of extreme difficulty to isolate any of them sufficiently to permit of their being measured on the goniometer. The instrument used was the smaller three-circle goniometer [1] in the British Museum. Without the facilities provided in a goniometer of this kind it would scarcely have been possible to disentangle the reflections given by these complex intergrowths of tiny crystals. Altogether seven crystals were examined, but the measurements of only two of them are worth recording.

Crystal No. 1 (fig. 1) measures about 0·4 mm. in its greatest width,
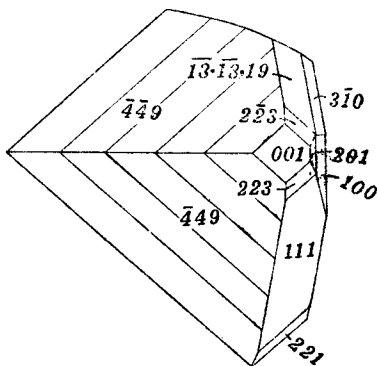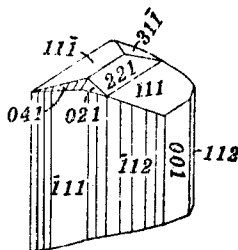

FIG. 1.   FIG. 2.

Crystals of Semseyite from Glendinning, Dumfriesshire.

and is the largest and by far the best developed of all the crystals observed. So much does it excel the other crystals examined that it alone was used for determining the fundamental constants and calculated values of the bi-angular co-ordinates. In its habit it closely resembles one of the crystals of plagionite figured and described by Luedecke.[2] Two conspicuous zones of faces intersect in a lozenge-shaped face; the zone of symmetry is present, but is far less noticeable. Two points call for remark. In the first place, the face that should correspond to the face (111) on the other side of the equatorial plane of symmetry is not quite in the place where it would have been expected to be; it lies in the

zone [001 : 1Ī1], but its angular distance from (001) is more than
a degree of arc less than is required for the face (111), and the lowest
indices that can be given to it are as high as (18.18.19). Shifts of this
kind testifying to a disturbance in the growth of the crystal are not un-
common in a heterogeneous intergrowth of crystals which have originated
from different centres. In the second place, the large faces belong to
the form (449) and not (Ī12) as is suggested by the apparent parallelism
of the large pair of opposite sides.

The angles used as data for calculating the fundamental constants and
the values of the bi-angular co-ordinates were the angular distances of
origin face (001) from the faces (100) and (201) respectively and the
azimuthal angle of the face (111) subtended at the origin. All the
measurements were made from the face (001) as origin.

*Table I. Calculated and observed values of the angular co-ordinates of
the faces on Crystal No. 1.*

Facial Indices.	Refl.[1]	Observed.		Calculated.	
		φ	ρ	φ	ρ
(Ž01)	f	0° 0′	73° 31′	0° 0′	73′ 32′
(201)	f	,, ,,	49 18	,, ,,	49 18
(100)	f	,, ,,	74 14	,, ,,	74 14
(310)	f	20 52	75 5	20 44	75 12½
(449)	s	48 35	33 50	48 38	33 8½
(223)	f	,, ,,	37 6	,, ,,	36 54
(111)	f	,, ,,	46 32	,, ,,	46 28
(221)	f	,, ,,	60 9	,, ,,	60 23
(449)	b	48 41	33 40	,, ,,	33 8½
(223)	b	,, ,,	37 23	,, ,,	33 8½
(2Ž3)	b	,, ,,	37 23	,, ,,	36 54
(18.18.19)	f	,, ,,	45 16	,, ,,	45 13

Crystal No. 2 (fig. 2), which was much smaller than the preceding and
measured less than 0·2 in its greatest width, was the best of an inter-
grown group of crystals, of about the same size as it, which could not
safely be broken up any more. All these crystals simulate a prismatic
habit, but the two prominent zones are the same as those shown by the
preceding crystal, although the forms present differ. Signs of a distur-
bance in the growth of the crystal are revealed by the presence of a face,
to which the simplest indices that can be assigned are (556). As before,
the measurements were made from the face (001) as origin.

[1] The letters indicate the quality of the reflections, viz. f fair, b bad, s striated.

Table II. Calculated and observed values of the angular co-ordinates of the faces of Crystal No. 2.

Facial Indices.	Refl.	Observed.		Calculated.	
		φ	ρ	φ	ρ
(2̄01)	b	0° 0′	73° 23′	0° 0′	73° 32′
⁚201)	b	,, ,,	49 2	,, ,,	49 18
(100)	b	,, ,,	74 0	,, ,,	74 14
(31̄1)	b	20 58	84 9	20 44	84 30
(111)	b	48 20	46 40	48 38	46 28
(221)	b	,, ,,	60 46	,, ,,	60 23
(112)	b	48 31	30 39	,, ,,	30 16
(1̄12)	b	,, ,,	35 53	,, ,,	36 43
(1̄11)	f	,, ,,	59 40	,, ,,	60 0½
(111̄)	b	48 35	59 33	,, ,,	,, ,,
(223)	b	48 51	37 15	,, ,,	36 54
(111)	b	,, ,,	46 34	,, ,,	46 28
(556̄)	b	49 25	63 17	,, ,,	63 24
(021)	b	89 49	62 50	90 0	63 2
(041)	s	,, ,,	76 30	,, ,,	75 43½

The crystalline constants as determined from the data found from measurements made on Crystal No. 1 are

$$a:b:c = 1·1356:1:1·0218\,;\ \beta = 105° 46′.$$

The forms observed are as follows :—(100), (001), (201), (2̄01), (310), (021), (041), (223), (111), (221), (112), (1̄11), (1̄12), (4̄49), (311). The faces (1̄8.18.19) and (5̄56) are probably vicinal to (1̄11), and do not represent distinct forms.

Dr. G. T. Prior made an analysis of the drusy lining of one of the small cavities referred to, together with the compact black material immediately surrounding it. Owing to the extremely small size of the crystals it was not practicable to collect enough of them for analysis; but, inasmuch as there is no difference in colour and texture between the drusy lining and the underlying mass, it is not unreasonable to presume that the composition was uniform except for the carbonates from which the material for analysis could not be wholly freed. The mineral was decomposed in chlorine, and the lead was determined as sulphate, and the antimony as sulphide, after heating in carbon dioxide. The sulphur was estimated in a separate portion fused with sodium carbonate and potassium nitrate. Arsenic was tested for by the Babo method, but none was detected. The weight of the material used in the main analysis was 1·0980 gram, and that used for the sulphur determination was 0·7972

gram. As will be seen from the following table, the results of the analysis are in fair agreement with the figures previously obtained by Dr. Prior on material from Wolfsberg[1] and from Oruro[2], and by Sipöcz for the original semseyite described by Krenner, and with those required by the formula $9PbS.4Sb_2S_3$.

Table III.   Analyses of Semseyite.

	I	II	III	IV	V
	Prior Glendinning.	Prior Wolfsberg.	Prior Oruro.	Sipöcz Felsöbánya.	$9PbS.4Sb_2S_3$.
Pb	52·37	51·84	52·9	53·16	53·29
Sb	25·49	28·62	24·8	26·90	27·47
S	18·81	19·42	18·7	19·42	19·24
Ag	—	—·	1·6	—	—
Fe	0·67	—·	—	0·10	—·
Zn	trace	—	—	····	—
CaCO₃ ...	1·66	—	—	—	—
MgCO₃ ...	trace	—	—	···	—
Insoluble	0·81	—	—	—	—
	99·81	99·88	98·0	99·58	100·00
Sp. gr. ...	5·84	5·92	5·82	5·95	

The chemical analysis points conclusively to the crystals being semseyite; but a comparison of the crystallographical constants found above with those recorded for plagionite and semseyite, viz.—

Plagionite $a:b:c = 1\cdot1331:1:0\cdot8456$; $\beta = 107° 10\frac{1}{2}'$.[3]
Semseyite $a:b:c = 1\cdot1442:1:1\cdot1051$; $\beta = 108° 56'$.[4]

shows the agreement to be far from satisfactory. As regards the value for the angle between the axes, the value found for the Dumfriesshire crystals is 3° 10′ less than that recorded by Krenner for the Felsöbánya crystals, and, moreover, lies on the other side of the value for plagionite. Since the observations made on the present crystals were sufficiently trustworthy to preclude the possibility of any large error in the constants determined from them, it was considered advisable to review Krenner's

[1] Mineralogical Magazine, 1899, vol. xii, p. 62.

[2] Ibid., 1907, vol. xiv, p. 315.

[3] O. Luedecke, Neues Jahrbuch für Mineralogie, etc., 1888, ii, p. 116.   His value for c is half that given above.

[4] J. Krenner, 'Egy Felsöbányán talált új ólomérczről.' A magy. tud. Akad. Értesitöje, 1881, vol. xv, pp. 111–113; abstract 'Ueber ein neues Bleierz von Felsöbanya.' Zeits. Kryst. Min , 1884, vol. viii, pp. 532–533.

method of calculating the constants for the crystals examined by him. He made use of the following three angles :—

$(113):(001) = 22° 44'$; $(221):(001) = 59° 38'$; $(221):(2\bar{2}\bar{1}) = 98° 58'$. From the last two angles the azimuthal angle of the face (221) may be calculated to be 48° 51', which differs little from the corresponding value, viz. 48° 38', found for the Dumfriesshire crystals. The distance angles, which are respectively 59° 38' and 60° 23', differ by 45', which is perhaps not unduly large considering the comparatively rough character of the Felsöbánya crystals. The face (113) did not occur on the Dumfriesshire crystals, but its distance angle may be found by calculation to be 21° 59', which again differs 45' from the value given by Krenner, viz. 22° 44'. The apparently large discrepancies between the constants found for the crystals from the two localities may therefore be really due to comparatively slight errors in the readings due to the imperfect development of the Felsöbánya crystals; certainly none of the latter crystals in the British Museum Collection will admit of goniometrical measurements which could in any degree be described as trustworthy.

On a comparison of the data determined for the semseyite from Dumfriesshire with those given for plagionite, it will be noticed that with the variation in chemical composition the first axial ratio remains almost, if not quite, unchanged, but the second ratio and the angle between the axes both vary.