Description of large crystals of Seligmannite and Dufrenoysite.[1]

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I. SELIGMANNITE.

IN the summer of 1906 some large crystals of seligmannite were found in an irregular, elongated cavity in the dolomite-rock of the Lengenbach quarry at Binn, Switzerland. Owing to their brittle nature many of them were broken when the rock was blasted, but I was in the quarry at
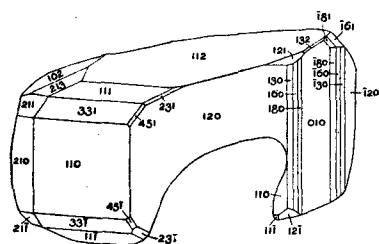

FIG. 1.
Crystal of Seligmannite.

the time and collected all the fragments. The largest crystal broke after it had been measured, and Dr. G. T. Prior's analysis [2] II was made on portions of it, his other analysis, I, being made on measured crystal fragments found with the large crystal. The streak of the present crystals is black and inclined to purplish in colour, while that of the crystals first described by me [3] was chocolate-coloured. Previously no cleavage had been observed, but these crystals show poor cleavages in the same directions as in the case of bournonite, viz. parallel to (100), (010), (001). The crystals examined were of three different types of habit.

[1] The drawings illustrating this paper were prepared by Dr. G. F. Herbert Smith. In order to identify certain of the faces he measured the smaller crystals on the three-circle goniometer in the British Museum and found a few additional new forms on the second crystal of dufrenoysite, which have been incorporated in the list given on p. 286.

[2] G. T. Prior, Mineralogical Magazine, 1910, vol. xv, p. 385, where, through a misunderstanding, it was stated that the analysis was made on fragments of another crystal, which had been found by me in 1905, and described in Mineralogical Magazine, 1906, vol. xiv, p. 186.

[3] R. H. Solly, Mineralogical Magazine, 1903, vol. xiii, p. 337.

Type 1.—The largest of the crystals, on which analysis II was made, belongs to this type. Before fracture it measured 20 mm. in length; part of it, measuring 9 mm. in length, is depicted in fig. 1. The crystal, now in three pieces, is in the British Museum.[1] It is intimately associated with rathite, the boundary between the two minerals crossing the face (120) by the curved line (fig. 1). Altogether twenty-six forms were found, of which the first six were largely developed and the last eight new to the species:

m(110), f(120), b(010), r(210), u(112), a(100), c(001), u(011), o(101), i(130), ρ(121), K(161), y(111), ϕ(113), C(311), $3\,p$(331), ι(213), II(132), k(540), Ψ(450), Φ(140), a(160), Θ(180), β(181), γ(541), ζ(451).

Fig. 2.
Crystal of Seligmannite.

Type 2.—This type differs little from the preceding, but the (210) and (120) planes are marked with fine triangular striations similar to those sometimes seen on the octahedron faces of a cubic crystal. I found six new forms on crystals of this type, viz. λ(781), μ(561), ξ(341), J(651), π(972), δ(752).

Type 3.—This type is distinguished by the prominent development of the face (013), as is shown in fig. 2, which depicts a fine twinned crystal (twin-plane (110)), measuring 6 by 5 mm. At the junction corner of the two individuals of this crystal, close to the planes (031) and (322) and on the smaller individual, are some very small planes whose indices are probably (703), (14.1.1), (11.2.2). The face (110) is striated parallel to (001) and (100); (010) to (001) and (111); (121) to (010); and (130) to (001). Attached to this crystal, on the right in the figure, is a smaller one in nearly parallel position with the larger individual.

The indices of the new forms were based upon the following angles; in certain instances the exact position was determined from the fact that two well-marked zones intersected in the plane.
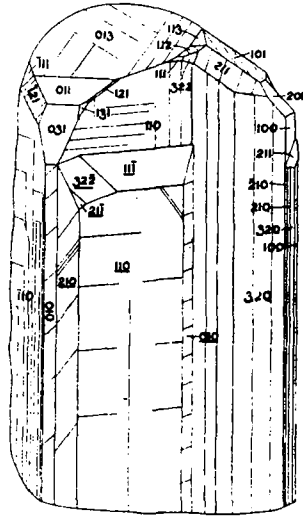
[1] Registered number 1906, 411.

Angle.		Calculated.[1]		Observed.
100 : 540	...	36° 37′	...	36° 20′
: 450	...	49 5½	...	49 1
: 140	...	74 51	...	74 50
: 160	...	79 46	...	79 42
: 180	...	82 17½	...	82 16
010 : 181	...	11 9	...	11 5
110 : 541	...	11 28½	...	11 25
: 451	...	11 41½	...	11 45
: 781	...	7 3	...	7 ·15
: 561	...	9 36	...	9 38
: 341	...	14 56	...	14 10
: 651	...	9 27½	...	9 20
: 972	...	12 50½	...	12 46
: 752	...	16 52	...	16 37

Altogether seventy-one definite forms have now been observed on seligmannite.

II. DUFRENOYSITE.

Some interesting crystals of dufrenoysite associated with seligmannite were discovered on breaking open a small cavity in the dolomite-rock of the Lengenbach quarry on August 1, 1911. I saw lying loose in the cavity a large, brilliant crystal of dufrenoysite with a number of similar but smaller crystals, while other crystals together with pyrites and blende were adhering to the sides. The loose crystals exhibit a dull conchoidal fracture, and on the broken surfaces are deposited numerous minute crystals of seligmannite, which must therefore have been formed after the fracture of the dufrenoysite crystals.

The large crystal (fig. 3) above mentioned measures $25 \times 16 \times 6$ mm., and is by far the finest I have ever seen, being even larger than the one described by Professor Baumhauer.[2] The crystal is now in the British Museum.[3] The crystal is twinned[4] about (001), and is developed at both ends; at the lower end (fig. 3) the individual on the left, owing to want of uniformity of growth, is divided into two parts in parallel position. Certain of the faces in the zone [010 : 001] are finely striated parallel to

[1] The calculated values are based upon the data given in my previous paper. Mineralogical Magazine, 1903, vol. xiii, p. 386.
[2] H. Baumhauer, Zeits. Kryst. Min., 1897, vol. xxviii, p. 551.
[3] Registered number 1912, 144.
[4] Twinned crystals of dufrenoysite have not before been described. The first was found by me in the Lengenbach quarry in 1906, and is now in the British Museum collection (Registered number 1906, 412).

their mutual edges; the face (121) is rough and 12$\bar{1}$ is pitted. Altogether the following sixty-three forms were observed on this crystal: (0. 11. 1), (081), (071), (061), (051), (092), (041), (072), (031), (0. 11. 4), (052), (0. 11. 5), (021), (0. 11. 6), (074), (0. 17. 10), (053), (0. 11. 7), (032), (054), (076), (011), (056), (034), (035), (012), (025), (014), (130), (120), (590), (280), (670), (560), (110), (760), (750), (580), (740), (210), (720), (121), (282), (111), (212), (414), (12$\bar{1}$), (23$\bar{2}$), (11$\bar{1}$), (21$\bar{2}$), (525), (43$\bar{2}$), (53$\bar{3}$), (32$\bar{2}$), (54$\bar{3}$), (33$\bar{1}$), (54$\bar{2}$), (82$\bar{1}$), (100), (010), (001), (101), (10$\bar{1}$). Of these (53$\bar{3}$), (32$\bar{2}$), (54$\bar{3}$), (33$\bar{1}$), (54$\bar{2}$), (82$\bar{1}$) are very narrow

FIG. 3.   FIG. 4.
Crystals of Dufrenoysite.

planes lying on the edges between (43$\bar{2}$) and (10$\bar{1}$), (21$\bar{2}$), (11$\bar{1}$), (230), (110), (210) respectively, the position in each case being taken to correspond to the maximum amount of reflected light given on the goniometer.

The next largest crystal (fig. 4) is much smaller and measures only $8 \times 7 \times 4$ mm.; it also is in the British Museum.[1] It was one of the loose crystals, and its broken surface is partially covered with minute crystals of seligmannite. Its lustre is brilliant, and the faces afford extremely sharp reflections of the object-slit of the goniometer. Unlike the large crystal, it is simple and not twinned. It is remarkable for the number of its pyramid-zones, twelve in all: those connecting (010) with (101), (201), (10$\bar{1}$), (20$\bar{1}$) are well developed, and the face (214) is fairly

[1] Registered number 1912, 542.

large, but in the remaining pyramid-zones the faces are minute. Alto-
gether the following sixty-four forms were observed: (010), (041), (072),
(031), (05̲2), (021), (074), (053), (032), (043), (054), (076), (011), (056),
(034), (012), (013), (014), (270), (130), (250), (120), (350), (230), (450),
(110), (320), (430), (210), (410), (131), (252), (121), (232), (454), (111),
(434), (212), (13Ī), (12Ī), (373), (23̄2), (11Ī), (535), (21̄2), (313), (231),
(452), (221), (432), (211), (643), (412), (43̄2), (21Ī), (41̄2), (214), (100),
(201), (101), (102), (001), (10Ī), (20Ī).

Among the forms found on the two crystals are thirty which are new,
viz.: (0. 11. 1), (071), (061), (0. 11. 6), (0.11. 7), (076), (025), (750), (320),
(740), (720), (450), (131), (373), (12Ī), (525), (533), (543), (33Ī), (54̄2),
(32Ī), (32̄2), (13Ī), (454), (434), (53̄5), (21̄2), (313), (643), (214). These
with the one hundred and three forms given in my previous paper[1] bring the
number of forms found for dufrenoysite up to one hundred and thirty-three.

In the following table are given some of the measurements, particularly
those relating to new forms, made on the crystals. It will be noticed how
closely the angles on the second crystal agree with the calculated values.[2]

First Crystal.			Second Crystal.		
Angle.	Calculated.	Observed.	Angle.	Calculated.	Observed.
100 : 100	1° 7′	1° 5′	100 : 201	28° 6½′	28° 7′
100 : 10Ī	46 26¾	46 25	: 101	47 2¼	47 2
100 : 10Ī	46 26¾	46 30	: 102	65 15½	65 15
010 : 0·11·1	8 26½	8 30	: 20Ī	27 51½	27 51½
: 071	13 7½	13 1	: 10Ī	46 26¾	46 26½
: 061	15 13	15 8	: 00Ī	89 27	89 26½
: 0·11·6	41 41	42 1	010 : 076	54 27	54 25
: 0·11·7	46 5½	46 30	: 320	66 32½	66 10
: 076	54 27	54 24	: 131	36 38	36 40
: 025	76 14	76 12	: 454	60 44	60 43
: 750	65 4	65 5	: 434	71 25	71 29
: 740	69 36	69 27	: 643	68 57	68 59
: 720	79 28	79 21	: 214	82 5	82 3
			: 13Ī	36 54	37 0
			: 373	43 59	44 0
			: 12Ī	48 23½	48 30
			: 535	75 5	75 10
			: 313	81 35	81 20

[1] R. H. Solly, Mineralogical Magazine, 1902, vol. xiii, pp. 160-171. In the list
of forms on p. 165 four—(221), (432), (211), (412)—were omitted, and the
number of forms was 103 and not 99 as there stated.

[2] Based on the data given on p. 162, loc. cit.