Cupriferous melanterite from the Skouriotissa mine, Cyprus.

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A MAGNIFICENT specimen of melanterite has recently been presented to the British Museum by the generosity of Mr. James L. Bruce, Resident Director of the Cyprus Mines Corporation, through the agency of Prof. C. Gilbert Cullis of the Royal School of Mines, London. The specimen (B. M. 1930,439) appears to merit a short description, for it consists of a group (35 by 25 cm.) of enormous greenish-blue crystals (up to 18 by 13 cm.) of a very unusual habit, being tabular to *b*(010). The photograph (fig. 1) can convey only a very inadequate idea of the beauty of the group, and it is most fortunate that the generous action of Mr. Bruce and the care of Prof. Cullis have ensured its preservation and exhibition for the pleasure of many.

Mr. Bruce states that the specimen 'was found in the Skouriotissa mine in the 820-foot level [i. e. 820 feet above sea-level] at a point 160 feet almost due east from the shaft known as the circular shaft in an ancient caved stope in the ore body', and 'had formed like a stalactite under a crack in the roof'. The cavity in which it was found 'was probably filled by a mixture of nitrogen gas and sulphur dioxide'. The Skouriotissa mine is near the Skouriotissa monastery, about 3 miles south-east of Lefka, Nicosia district, Cyprus, and the ore is a cupriferous pyrites. There is no doubt that the Skouriotissa mine was one of the most important of the ancient mines of Soli, developed by the Romans, and perhaps, even earlier, by the Phoenicians. The site of the port of Soli is only 5 miles off. There are large accumulations of slag, and ancient workings are discovered from time to time.[1] It was in one of these ancient workings that the specimen was found.

[1] C. G. Cullis and A. B. Edge, Report on the cupriferous deposits of Cyprus. London, 1922, p. 15. [Min. Abstr., vol. 2, p. 549.]

Incipient decomposition (efflorescence and oxidation) is visible at one or two places on the specimen, in the shape of yellowish-white dots and patches. To check this, the specimen had been coated with shellac shortly after its removal from the mine, but for greater security, it has now been placed in a moist atmosphere under a glass dome. The dome is made air-tight by standing it in a groove filled with mercury in a well-varnished wood block.

Because of their peculiar habit, the crystals appear anorthic, and this, together with their blue colour, suggesting chalcanthite, made it desirable to confirm their identity by goniometry and analysis. On account of the shellac coating, an accurate analysis could not be made, but optical examination showed the crystals to be monoclinic, and the goniometric measurements agree with melanterite. A partial analysis showed the presence of 2·15 % CuO, corresponding to 7·72 % $CuSO_4.7H_2O$ in isomorphous mixture with $FeSO_4.7H_2O$. This amount of copper is not sufficient to call the mineral pisanite.[1]

The goniometric study could not be made with any great accuracy, owing to the shellac coating and the large size of the crystals. One small crystal was detached, the shellac dissolved off with alcohol, and the crystal measured on the three-circle goniometer, in face-adjustment about the most perfect face, which turned out to be *v*(101). Two of the largest crystals were measured with an improvised contact-goniometer of card strips, to ensure that the crystal edges were not damaged. The measured values agree satisfactorily with the calculated, and show the presence of five new crystal-forms. Examination with a pair of nicols held in the hand shows the extinction-angle on *b*(010) to be about the expected value, further confirming the orientation adopted.

On the small crystal (fig. 2) there are present, besides *v*(101), *r*(111), *o*(011), *c*(001), *m*(110), and *t*($\bar{1}$01), and one face each of the new forms *x*(161) and *y*($\bar{2}$31). The large crystals are differently developed and show *b*(010), *m*(110), *a*(100), *v*(101), *r*(111), *w*(103), *o*(011), *c*(001), *s*($\bar{1}$05), *t*($\bar{1}$01), and *σ*($\bar{1}$21). In addition, one of the crystals (fig. 3) shows a face of the new form *q*($\bar{1}$02); and the other (fig. 4) shows a small facet (about 3 by 1 mm.) of *g*($\bar{1}$12), also a new form.

A face of *b*(010) is not present on the small crystal, whereas on the two large crystals measured, and on most of the others, it predominates, but is strongly curved. Beginning at one extremity of

[1] Cf. H. F. Collins, Min. Mag., 1923, vol. 20, p. 32.

the crystal, b is strictly in the calculated position, but as the other extremity is approached it takes on a curvature about the zone-axis [001], remaining strictly in this zone; it finally merges into a plane portion, making an angle of 10° with $b(010)$, which constitutes a fifth new face $\beta(150)$. The distribution of β and of the curved tracts

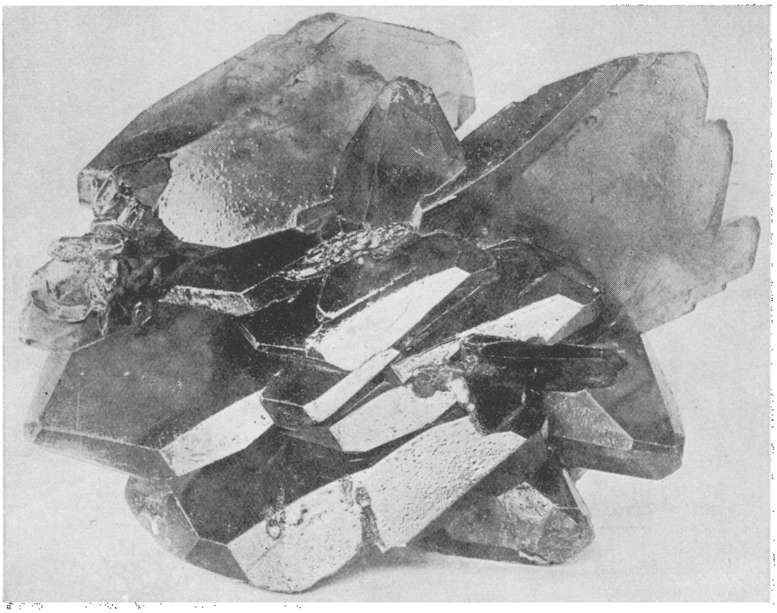

FIG. 1. Group of large crystals of melanterite from the Skouriotissa mine, Cyprus. About 2/7th natural size.

differs on different crystals. The four faces of the form β and the corresponding curved tracts are never all developed. One of the measured crystals (fig. 4) has $\beta(1\bar{5}0)$ and $\beta(\bar{1}50)$ and the corresponding curved transitional regions; the other has $\beta(1\bar{5}0)$ and $\beta(150)$ (fig. 3). It is largely this peculiarity of distribution, which is shared by the other crystals on the specimen, that gives the crystals an anorthic appearance at first glance.

But this is only a part of the difference that this specimen shows from the usual habit of melanterite. Instead of a predominant development of $m(110)$ and $c(001)$, c is present as very small, narrow strips, and m is comparatively small. Next to b and β, $o(011)$ is the largest face, while $v(101)$, $r(111)$, $s(\bar{1}05)$, $t(\bar{1}01)$, and $\sigma(\bar{1}21)$ are fairly large; $q(\bar{1}02)$, $a(100)$, $w(103)$, and $g(\bar{1}12)$ never attain any size.

The measurements made on the three-circle goniometer fall simply into four zones, with the corresponding interzonal angles. The measurements on the larger crystals are mainly interfacial, but several facets were too small for accurate measurements to be made

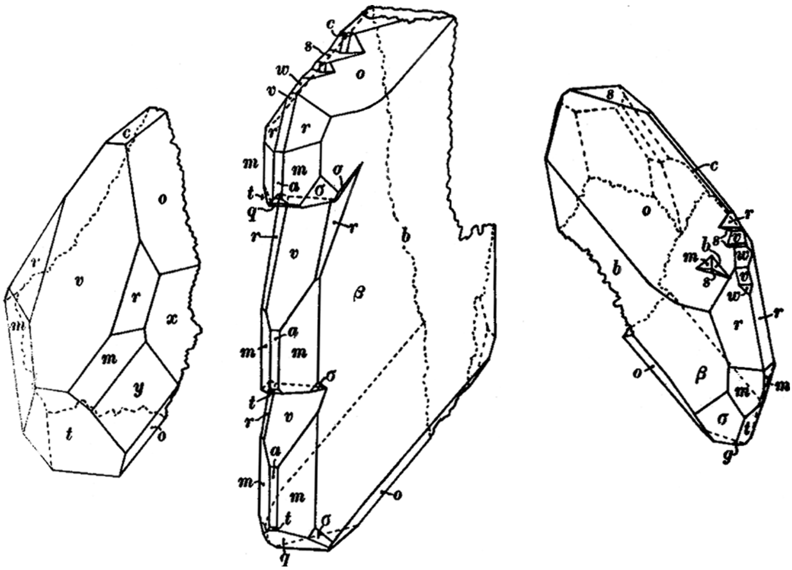

FIG. 2. FIG. 3. FIG. 4.

FIG. 2. Small measured crystal of melanterite. About 5 times natural size.
FIGS. 3 and 4. Large measured crystals of melanterite. About 2/5th natural size.

in this way; instead, interzonal angles were measured, the contact-goniometer being fitted to the angles between suitable edges.

The derivation of a face-symbol purely from such interzonal angles by the ordinary methods of calculation is somewhat troublesome, but the graphical solution is simple. Thus for the facet g, we have $[\sigma t]\ [\sigma g] = 37^\circ$ and $[sg]\ [\sigma s] = 11^\circ$. First, we plot the stereographic pole of the zone $[\sigma t]$, P, then construct in the usual manner the circle of points distant 37° from P; let this cut the trace (cyclographic projection) of σ at Q_1 and Q_2. One of these points must be the stereographic pole of the zone $[\sigma g]$. We draw in the zones, and construct similarly two zones containing s and lying 11° from $[s\sigma]$.

A variety of solutions results from the intersection of the four zones so constructed, but only one lying in the triangle *stσ*, which is known to be the position of *g*. Proceeding to the gnomonic projection, the indices of *g* are immediately read off as ($\bar{1}$1·2). The solution is quite definite. The true interzonal angles are then calculated in the usual manner, and found to be 39° 23′ and 11° 30′.

In the following table of angles measured on the three crystals represented in figs. 2–4, the calculated values have been derived from the constants, $a:b:c = 1{\cdot}1828:1:1{\cdot}5427$, $\beta = 75^\circ\ 44\frac{1}{2}'$, determined by V. von Zepharovich in 1879 on artificially prepared crystals of hydrated ferrous sulphate, $FeSO_4.7H_2O$.

Interfacial angles.

		Fig. 2.	Fig. 3.	Fig. 4.	Calculated.
Zone *ac* = [010]:					
v(101) : *t*(10$\bar{1}$)	...	74° 0′	—	75°, 72°	74° 30′
v(101) : *c*(001)	...	45	43°	45	43 44
v(101) : *a*(100)	...	—	32	35	32 0½
c(001) : *q*($\bar{1}$02)	...	—	39	—	36 58½
c(001) : *s*($\bar{1}$05)	...	—	17	16	14 15½
c(001) : *w*(103)	...	—	21	21	20 50
Zones *mov* = [11$\bar{1}$] and [1$\bar{1}$1]:					
v(101) : *σ*($\bar{1}$21)	...	87	—	84, 83	83 22
v(101) : *o*(011)	...	67, 66°	—	67	66 19
v(101) : *m*(1$\bar{1}$0)	...	55°, 56° 20′	—	55	56 7
v(101) : *y*(23$\bar{1}$)	...	73° 43′	—	—	73 10
Zone *brv* = [$\bar{1}$01]:					
v(101) : *r*(111)	...	38½, 40°	40	40, 39	39 16½
v(101) : *x*(161)	...	78° 28′	—	—	78 29
v(101) : *b*(010)	...	90	90	90	90 0
Zone *bσt* = [101]:					
t($\bar{1}$01) : *σ*($\bar{1}$21)	...	—	67	65, 65	64 22
t($\bar{1}$01) : *b*(010)	...	—	—	88, 89	90 0
Zone *boc* = [100]:					
b(010) : *o*(011)	...	—	33	{34, 34 / 36, 37}	33 46½
b(010) : *c*(001)	...	—	90	—	90 0
o(011) : *o*(0$\bar{1}$1)	...	—	114, 114°	112	112 27
Zone *bma* = [001]:					
b(010) : *a*(100)	...	—	—	90	90 0
b(010) : *β*(150)	...	—	10	10	9 54
m(110) : *m*(1$\bar{1}$0)	...	—	98, 94	97	97 48
Zone *mσ* = [$\bar{1}$11]:					
m(110) : *σ*(12$\bar{1}$)	...	—	27	—	27 14½

Interzonal angles.

	Fig. 2.	Fig. 3.	Fig. 4.	Calculated.
On face $v(101)$:				
$ac[010]:mov[11\bar{1}]$...	65° 13′, 66°	—	—	65° 11′
$ac[010]:brv[\bar{1}01]$ ...	88 27	—	—	90 0
On face $\sigma(\bar{1}21)$:				
$\sigma t[101]:\sigma g[311]$ ...	—	—	37°	39 23
On face $s(\bar{1}05)$:				
$s\sigma[521]:sg[532]$ ...	—	—	11	11 30
On face $r(111)$:				
$rv[\bar{1}01]:r\beta[\bar{5}14]$ ...	—	9°	—	7 45
$ro[\bar{2}11]:r\beta[\bar{5}14]$ ...	—	18	—	15 30
On face $\beta(150)$:				
$\beta r[\bar{5}14]:\beta o[\bar{5}11]$ ...	—	28, 29°	—	26 57
$\beta r[\bar{5}14]:\beta\sigma[\bar{5}1\bar{3}]$ ...	—	85	—	81 12
On face $m(110)$:				
$m\beta[001]:m\sigma[\bar{1}11]$...	—	40	—	39 40