Proustite from Cobalt, Ontario.

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DURING the summer of 1913 the Royal Ontario Museum of Mineralogy secured a number of samples of ruby-silver from the collection of a deceased mining engineer who had been employed in the Cobalt district. Judging from their association it is presumed that they were obtained from the O'Brien mine. The crystals for the most part are less than two millimeters in length and very few exceed a millimeter in diameter. They are light ruby-red in colour and exceedingly brilliant, and casual inspection suggested that they were proustite. As this mineral had not been described from the Cobalt region, it seemed desirable to confirm this supposition by chemical analysis and crystallographic measurement.

Chemical Examination.

The material for analysis was obtained by floating the crystals from a large quantity of fine material which had broken away from the larger specimens. In this operation it was found that certain impurities accompanied the proustite, so that the final separation was made by means of a brush and lens. It was observed that many of the crystals still had a slight trace of what appeared to be smaltite attached to one end, but with the material at hand it did not appear feasible to remove the last trace of impurity.

It was also observed that in some instances the crystals were somewhat dark for proustite and in most cases these were discarded, but the small amount of antimony found in the analysis would indicate that a little pyrargyrite is mingled with the proustite.

The analysis was made by Mr. H. V. Ellsworth, M.A., Fellow in Mineralogy, with the following results:

Ag	64·12
As	15·90
S	19·28
Sb	0·08
Fe	0·25
Co (including trace of Ni)	0·12
Insoluble in HNO_3 . .	0·38
	100·13

The percentages for silver, arsenic, sulphur, and iron are the averages of two determinations for each. The determinations for antimony and insoluble were made only once, while the cobalt-nickel determination was obtained by combining the cobalt-nickel contents of two analyses.

If we assume that the iron is combined with sulphur in the form of pyrite and the cobalt with arsenic in the form of smaltite, the recalculation gives a nearly pure proustite with a small excess of arsenic as follows:

	Per-centages.	Atomic ratios.	Pyrite.	Smaltite.	Pyrar-gyrite.	Prous-tite.	Arsenic.
Ag	64·12	0·595	—	—	0·021	0·574	—
As	15·90	0·212	—	0·004	—	0·191	0·017
S	19·28	0·602	0·008	—	0·021	0·573	—
Sb	0·08	0·007	—	—	0·007	—	—
Fe	0·25	0·004	0·004	—	—	—	—
Co	0·12	0·002	—	0·002	—	—	—

Converting these atomic ratios into percentages we get:

Proustite .	94·62
Pyrargyrite .	3·77
Smaltite . .	0·04
Pyrite . .	0·05
Arsenic . .	1·27
Insoluble .	0·38
	100·13

Besides adding proustite to the already large number of minerals from Cobalt, this analysis is of interest in that it suggests the presence of native arsenic from this region. Up to the present time the latter has not been found at Cobalt, though it is a mineral which is to be expected.

Crystallographic Examination.

Inspection with a pocket-lens showed that the crystals were of two types, one characterized by a rhombohedron and a prominent prism (fig. 1), while the other showed in addition to the above certain scalenohedral faces (fig. 2). In no case was a doubly terminated crystal found.

For purposes of calculation five crystals were carefully measured on a Goldschmidt two-circle goniometer, while a sixth crystal was examined, but without success, for new forms. The table given below shows the forms found and the number of faces of each form found on each crystal.

Forms.	Crystals.				
	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.
a $(11\bar{2}0)$	6	5	6	6	6
b $(10\bar{1}0)$	3	1	1	4	5
r $(10\bar{1}1)$	—	—	1	1	—
e $(01\bar{1}2)$	3	3	3	3	3
s $(02\bar{2}1)$	—	3	—	—	3
Γ $(07\bar{7}2)$	—	—	—	—	1
v $(21\bar{3}1)$	—	5	6	4	6
y_1 $(13.7.2\bar{0}.6)$	—	?	5	—	—

The form y_1 $(13.7.2\bar{0}.6)$ is new for proustite and was identified with certainty on one crystal (No. 3) only. The signal is a distinct cross in a path of the light-figure extending from v $(21\bar{3}1)$. The observed and calculated positions for this form are:

	Observed.					Average.	Calculated.[1]
ϕ	10° 04′	9° 51′	9° 35′	10° 02′	9° 39′	9° 50′	9° 50′
ρ	69° 29′	69° 42′	69° 50′	69° 29′	69° 59′	69° 42′	69° 48′

In crystal No. 2 a series of signals in the light-paths extending from v $(21\bar{3}1)$ were observed, and some of the signals lie close to the position for the new form y_1, but they were not sufficiently definite for calculation and showed little agreement among the readings for the various faces on the same crystal.

The form e $(01\bar{1}2)$ affords the best defined of the terminal faces, and usually gives a distinct signal which agrees well with the calculated position for this form. Observed ρ 25° 0′, 24° 57′, 24° 59′ (calculated

[1] Calculated from the angle $cr = 42° 51'$ of Miller (1852); corresponding with the axial ratio $a : c = 1 : 0{\cdot}8034$.

24° 53′). The greatest variation from the calculated position is in crystal No. 3, where the angle ρ is uniformly about 7′ too great.

The form r $(10\bar{1}1)$, which was found on two crystals, gives readings for ρ which are slightly lower than the calculated value. Observed ρ 42° 40′ and 42° 46′ (calculated 42° 51′).

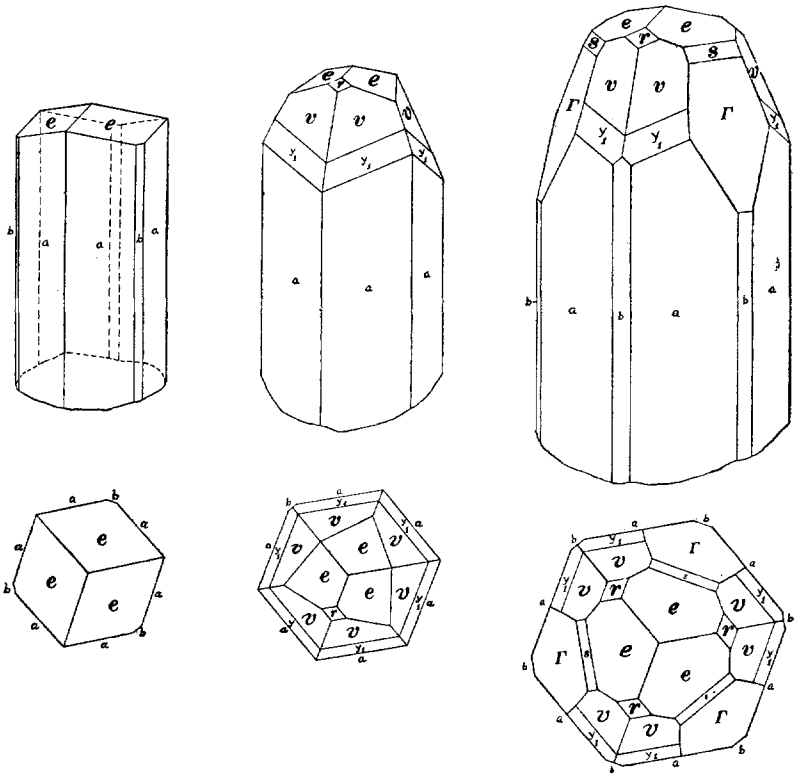

FIG. 1. FIG. 2. FIG. 3.

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The form s $(02\bar{2}1)$ is apparently an etched surface. The faces are well defined, but give hazy signals which indicate positions between $\frac{19}{10}$ and $\frac{21}{10}$. The mean of these values is taken as the best value for the form.

The form Γ $(07\bar{7}2)$ is found as a single face on crystal No. 5. The face is fair, but the signal is hazy and lies between $-\frac{7}{2}$ and -4, being nearer $-\frac{7}{2}$. Exact measurements could not be made, and the form must be considered doubtful.

The form v (21$\bar{3}$1) was found on four crystals and may be considered the dominant scalenohedral face. The faces are well defined, but the signals are characterized by pronounced light-paths, which in crystal No. 3 extended to the new form y_1 (13.7.2$\bar{0}$.6).

	Observed.				Calculated.
ϕ	10° 38′	10° 56′	11° 03′	10° 50′	10° 53′
ρ	67° 45′	68° 02′	67° 55′	67° 47′	67° 50′

The prism a (11$\bar{2}$0) was found on all the crystals. The faces are well developed, but have a slight etching which tends to displace the signal from the calculated position. In some cases the signal shows a U-shaped curve which might be considered indicative of hemimorphic development if found with a greater degree of regularity. The prism b (10$\bar{1}$0) was also found on all the crystals, and is usually shown as a slight truncation of the prism a.

The accompanying text-figures illustrate the two types of crystals: fig. 1 representing crystal No. 1; fig. 2 representing crystal No. 3; but showing the new form y_1 with six faces instead of five as actually observed; and fig. 3 representing the combination of all the observed forms in idealized development.

The average value obtained for the axial ratio by taking all the measured angles is $a : c = 1 : 0{\cdot}8015$, but rejecting the measurements from the form y_1 (13.7.2$\bar{0}$.6) the average is $1 : 0{\cdot}8025$. The average of all values for crystal No. 1 is $1 : 0{\cdot}8027$. These are slightly lower than the value ($a : c = 1 : 0{\cdot}8039$) given by Miers in 1888.