VI. *Notes on "Enargite," from Montana, U.S.A.*

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THE deleterious effects of small quantities of Arsenic when present in Copper are well known to all who are concerned with the working of this latter metal, and the elimination thereof is consequently an object to which the copper smelter pays special care. Though a large number of minerals, some of which are of exceeding beauty, are found composed of Copper combined with Arsenic acid, the direct combinations, as Arsenide and Sulph-Arsenide, are comparatively rare.

Dealing to-night only with the latter group, we notice that Brooke and Miller in the 1852 edition mention as its sole representative "Tennantite," with its variety Kupferblende, and note its occurrence in small attached crystals rarely massive. In the appendix another representative is added, "Enargite" from Peru. Dana, in 1874, "System of Mineralogy," gives no new combinations, but adds the further localities for Enargite—New Grenada, Mexico, South Carolina and Colorado. By this time too Breithaupt, Rammelsberg and Dauber had been able to measure its crystals and describe more fully its physical characters. In the first supplement of the "System" a mineral occurring in small black brilliant crystals, also massive and containing copper, sulphur, arsenic, and 6 per cent. antimony, and found in California, is given as a variety of Enargite.

Famatinite containing 10·93 per cent. antimony and 6·43 iron, but otherwise agreeing with Enargite and being found with it, is mentioned in Appendix III. The angles of Famatinite were found by Vom Rath to be identical with those of Enargite.

Clarite from Baden having the composition of Enargite, but differing from it in colour, was named by Sandberger in 1874.

Luzonite from Luzon Island, Manilla, was described by Weisbach in 1874. It is of nearly similar composition to Enargite, but differs from it in cleavage and colour. Dana and Brush consider Clarite and Luzonite are only varieties of Enargite.

These being so far as I knew the only localities where minerals of this composition had been obtained, it was with exceeding interest that I heard of an ore being found in Montana containing 20 per cent. of arsenic. Through the kindness of my friends Messrs. Lawn and Davey I was enabled

to obtain several specimens, and have now the honour of submitting the result of my investigations to this Society.

Crystals are very rare, and are small when found. Though not clearly defined enough to enable measurements to be taken, the crystals give the planes of the rhombic prism, also those of the macro-pinacoid and brachy-pinacoid terminated by macro- and brachy-domes and the basal-pinacoid. The symmetry is therefore that of the ortho-rhombic system. The cleavage planes are remarkably distinct and coincident with those of the rhombic prism and of the basal-pinacoid. They are highly striated like those of stibinite. The mineral thus cleaves into little rhombic prisms. Fracture uneven.

The hardness may be taken as 2·5, for it leaves a black powder on calcite, while it easily scratches gypsum. It soils the fingers when handled. The specific gravity, taking the mean of several specimens, is 4·3. Mr. Grenville Cole, F.G.S., of the Normal School of Science, South Kensington, determined the S.G. of a large specimen with a little quartz in it as 3·92 (by Walker's method), which may be regarded as confirmatory of my results. Colour when fresh broken is lead-grey, but it rapidly tarnishes on exposure, and becomes darker, when it much resembles blende. Streak black.

Pyrognostic Characters.—In closed and open tubes gives ordinary reactions for sulphur and arsenic. The mineral decrepitates at first and also exfoliates before the blowpipe, giving rise to worm-like threads, vermiform. I was much interested when testing the mineral before the blowpipe to find it gave no indications of antimony being present. Its appearance and structure are so similar to Stibnite, that one almost unconsciously looked for the antimony sublimate. But notwithstanding I worked with the aluminium plate of Ross, I could not find a trace of antimony. I therefore asked Mr. Lionel Fulcher of the City of London College, and Mr. Aug. Loos of the Peckham Technical School to test for antimony specially, and the result of their kind efforts agreed with mine. Thereupon my friend Mr. Terrill of Swansea very kindly undertook to make a complete analysis, and the results of two he made are given below—

	I.	II.
Copper	45·80	45·76
Arsenic	18·64	18·66
Sulphur	31·30	31·30
Silica	2·50	2·50
Iron	·80	·80
	99·04	99·02

The silica is evidently an impurity, and the proportions of copper, arsenic and sulphur stand as

Copper	47·84	per cent.
Arsenic	19·47	,,
Sulphur	32·69	,,
	100·00	

The composition is therefore nearly the same as Enargite; but as it differs from this mineral in hardness, cleavage, and pyrognostic characters, I should be inclined to give it a distinctive name, and class it under the Enargite group of sulph-arsenides of copper with Famatinite, Clarite, Luzonite and Guayacanite. All these are essentially similar in composition with a formula $8\ Cu_2\ S + (As\ Sb)_2\ S_5$, but differ in structure and other physical characters from one another sufficiently to be called under specific names.

The mineral is found with pyrites, bornite, covelline and quartz in Montana, U.S.A.