

MEETING OF NOVEMBER 3rd, 1884.

Mr. S. G. Sackett gave a partial description of the Duryea experimental furnace at Silver Cliff, Colo., of which he was for a time the superintendent. He described in particular the revolving cylinder characteristic of the furnace, giving the original plan and the alterations or improvements of the same which were found necessary from experience in running the furnace. The remarks were illustrated by diagrams showing the construction of the cylinder.

Mr. Chisolm gave a short description of the mica mines of the Black Hills, Dakota Territory, with statistics of their production up to the present time. The information given was taken from the report in process of preparation by Mr. Chisolm for the next volume of the "Mineral Resources of the United States" to be issued by the United States Geological Survey. Specimens of mica from veins recently opened in Colorado were exhibited.

Mr. Pearce presented to the Society a number of interesting minerals with remarks upon the same.

A specimen of ore from the "Yankee Girl" mine, Red Mountain, San Juan county, Colo., was found to contain disseminated through it a large amount of a mineral probably identical with cosalite, (see page 52), from the following approximate analysis by Mr. A. H. Low.

Bi	36.22	Bi_2S_3	44.57
Ag	8.70	Ag_2S	9.99
Pb	28.22	PbS	32.57
Cu	3.74	Cu_2S	} 12.67
Fe	4.48	Fe_2S_3	
S	18.64 (Dif.)		
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	100.00		99.80

Barite and chalcopyrite are the most intimately associated minerals. Assuming the Cu and Fe to exist as chalcopyrite and subtracting this from the above analyses, the mineral would be found to have the composition

Bi	41.58
Ag	9.98
Pb	32.38
S	16.06

100.00

with the atomic ratio (Pb,Ag₂) : Bi₂ : S=2.03 : 1 : 5.02.

A large piece of stromeyerite from the same mine was also presented.

Some minerals sent to the works of the Boston and Colorado Smelting Co. from Larimer county, proved upon examination to be largely oxide and carbonate of bismuth, bismite and bismutite. The exact locality unknown. A specimen sent from Cummins City, North Park, showed bismutite carrying particles of metallic bismuth. This specimen possibly came from the same locality as the other bismuth minerals. This is believed to be the first observed occurrence of native bismuth in Colorado.

MEETING OF DEC. 1st, 1884.

Mineralogical Notes, BY W. F. HILLEBRAND.

I. ON AN ASSOCIATION OF RARE MINERALS FROM UTAH.

In the American Eagle mine, Tintic Mining District, Utah Territory, occur in intimate association several min-

erals, the majority of which are new to the American continent. All the specimens examined were obtained from an ore heap at the works of the Boston and Colorado Smelting Co., near Denver, where they were first observed and their probable identity established by Mr. Richard Pearce, metallurgist to the above company. Mr. Pearce has already at different times communicated briefly to the Society the results of his observations upon these minerals and presented specimens well illustrating their association. As a more detailed examination than it was possible for him to give the subject seemed likely to prove of interest, the best available material was transferred to me, and a number of more or less complete analyses were made in the laboratory of the United States Geological Survey.

OLIVENITE.

Recognizable by its dark olive-green and wood-brown color and well defined crystal form is olivenite, occurring in a mixture of various brown and yellow oxygen salts of iron, copper and calcium. According to Mr. Whitman Cross, the only faces observed are those of the prism and brachydome. While fine crystals are not of infrequent occurrence, the major part of the mineral occurs in that characteristic, brown, compact, fibrous state to which it owes its old name of *wood-copper*. The amount of material available sufficiently pure for a satisfactory analysis was very limited, on account of the presence of small, firmly adhering hemispheres of conicalcite on many of the crystals. Analysis gave the following results.

CuO	55.40
As ₂ O ₃	40.05
P ₂ O ₅	0.06
H ₂ O	3.39
Fe ₂ O ₃	0.25
CaO	0.16
Zn	tr.
Quartz	0.40
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	99.71

The ferric oxide of the analysis was derived from a little adhering hydrated cupri-ferric arseniate, and the calcium and zinc oxides from attached conichalcite. The oxygen ratio for

CuO	:	As ₂ O ₅ (P ₂ O ₅)	:	H ₂ O	is
4.00	:	5.00	:	1.08	

instead of 4 : 5 : 1, as required by the formula Cu₃As₂O₈ + H₂CuO₂,

CONICALCITE.

Covering the surface of often large pieces of more or less soft and friable mixed arseniates, sometimes uniting to form a complete coating, are innumerable beautiful emerald green, semi-translucent globules, averaging three-fourths of a millimeter in diameter, and showing when broken radiate structure. Notwithstanding the considerable amount of material from which to select, the obtaining of perfectly pure matter in sufficient quantity for analysis was impossible without devoting several days to the work, in consequence of the firm adherence of gangue to the flattened base of the globules and of the fact that the nucleus of each globule usually consisted of some of the same soft gangue matter. The material analyzed was so small in quantity therefore that the analytical results can lay no claim to the highest degree of accuracy, especially as all estimations had to be made upon one and the same portion. No specific gravity determination was attempted for the above reason, and also because there were no means of estimating the allowances to be made for small quantities of impurities other than quartz.

		Conichalcite from Spain.
CuO	28.68	31.76
CaO	19.79	21.36
MgO	0.54	
ZnO	2.86	
Ag	0.30	
As ₂ O ₅	39.94	30.68
P ₂ O ₅	0.14	8.81
V ₂ O ₅		1.78
H ₂ O	5.52	5.61
Fe ₂ O ₃	0.36	
CO ₂	0.97*	
Quartz	0.90	
	100.00	100.00

—*By difference.

The ferric oxide was derived from attached gangue. The carbon dioxide was probably combined with lime, since a temperature was required for its expulsion higher than that at which all the water escaped, the latter having been estimated by direct weight. Part of the water seemed to escape at a much lower temperature than the remainder. The silver was not a constituent of the gangue, since none could be found in the latter underlying the green coating. It was not present as chloride, for nitric acid took it all into solution, nor could any native silver or sulphide be detected. The only conclusion to be drawn is that it exists in the mineral in an oxidized state, presumably as silver arseniate.

In appearance and composition this mineral resembles no other than conicalcite, found hitherto only in Andalusia, in Spain, and represented by a single analysis in Dana's Syst. of Min. 5th edition, p. 563, which has been quoted above for the sake of comparison. It will be noticed that vanadium is wanting in the mineral from Utah and phosphorus nearly so, while zinc, which was not a constituent of the Spanish mineral, here replaces apparently some copper. Allowing for the CO_2 , its equivalent of CaO , the oxygen ratio is as follows:

RO	:	$\text{As}_2\text{O}_5(\text{P}_2\text{O}_5)$:	H_2O	
1.00	:	1.18	:	0.41	or
4.00	:	4.72	:	1.64	

instead of 4 : 5 : 1.5 as required by the supposed formula $(\text{CuCa})_3\text{As}_2\text{O}_8 + \text{H}_2\text{CuO}_2 + \frac{1}{2}\text{H}_2\text{O}$.

Heated in any manner before the blowpipe, most violent decrepitation ensues, the entire fragment flying into fine powder. In a closed tube, after decrepitation has ceased, the particles, by gently tapping, may be made to collect at the bottom as a brown-black spongy mass of great volume. This collected on a loop of platinum wire fuses before the blowpipe, at first with a pale bluish coloration of the flame. This behavior accords in a measure with that mentioned in Dana's Syst. of Min. (l. c.).

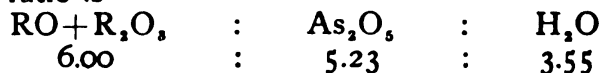
CHENEVIXITE.

Thickly scattered in irregular patches throughout some portions of such ore as occurs in hard lumps, giv-

ing to a broken surface a mottled appearance, is a compact, greenish, opaque body, with little or no lustre, which corresponds in composition very well with chenevixite from Cornwall, as represented by one of the two analyses in Dana's Syst. of Min., p. 583. The hardness, however, is lower, being 3.5 instead of 4.5 as there given. The color is almost an olive-green in the center of the patches, often shading away into a greenish-yellow. The fracture is subconchoidal.

		Chenevixite from Cornwall.
CuO	26.31	31.70
CaO	0.44	0.34
MgO	0.16	
Fe ₂ O ₃	27.37	25.10
Al ₂ O ₃	0.66	
As ₂ O ₅	35.14	32.20
P ₂ O ₅		2.30
H ₂ O	9.33	8.66
Quartz	0.40	
	99.80	100.30

The analysis was made upon air-dried powder, since the latter loses about 0.75 per cent. of water even over sulphuric acid, which loss becomes slightly greater at 100°C. and continually increases as the temperature rises. The oxygen ratio is



while that of the Cornwall mineral quoted above is 6 : 5.35 : 3.30 instead of 6 : 5 : 3 as assumed most probable. The material now analyzed cannot with any certainty be regarded as entirely pure, hence the deviation from the theoretical ratio is not of great importance.

Before the blowpipe the mineral from Utah differs from that from Cornwall in that it does not usually decrepitate, while in other respects the behavior of the two is identical ; they fuse readily on charcoal, give off arsenical fumes and leave a black magnetic scoria.

Chenevixite, as well as conichalcite, appear to be generally regarded as doubtful species, for their names do not figure at all in some of the best mineralogies, but it can hardly be doubted now that they represent definite species whose precise nature, however, is yet a matter for further investigation to reveal.

A HYDROUS CALCIUM ARSENIATE.

In rare instances fine, silky, white needles have been observed, chiefly on conicalcrite, but in such small quantity that the only data as to their composition are the following determinations made by Mr. Pearce on less than a centigram of material.

As ₂ O ₅	38.6
CaO	31.5
CuO and H ₂ O	<u>29.9</u> (by difference)
	100.0

The copper estimation was a failure, but the percentage of CuO was judged to be fully 20 per cent. The composition would then seem to be similar to that of conicalcrite with proportions of CuO and CaO reversed, but in view of the wide limits to be allowed for possible error in the analysis, further comment is useless.

JAROSITE.

Jarosite, in fine, transparent, brown crystals was observed by Mr. Pearce on a few specimens of ore. The identification rests upon partial chemical analysis and upon angle measurements by Mr. Whitman Cross.

Herewith is completed the list of probably distinct species so far as observed, with the exception of one or two others present in too small quantity for even qualitative identification. There are, however, certain characteristic components of the ore which seemed to merit examination.

A portion of the ore is a brown mass showing nodular forms and a granular surface where broken, and of considerable hardness, owing to disseminated quartz. Analysis furnished the following results.

Fe ₂ O ₃	44.22
Al ₂ O ₃	0.48
CuO	1.30
CaO	1.33
MgO	0.10
K ₂ O	1.72
Na ₂ O	0.46
As ₂ O ₅	20.01
SO ₃	6.66
H ₂ O	11.02
Quartz	12.00

99.30

These figures probably represent a mixture of a hydrated ferric-alkali sulphate (perhaps jarosite) and one or more hydrated arseniates.

In places it passes gradually into a brilliant black substance closely resembling jet, and possessing conchoidal fracture, difficult to extract even in very small quantity, but possessing, according to Mr. Pearce, the following composition:

CuO	4.88
CaO	7.27
Fe ₂ O ₃	41.47
As ₂ O ₅	27.65
Ign.	18.49

99.76

The loss on ignition, as ascertained by myself, represents SO₃, as well as H₂O, hence it is useless to attempt the construction of a formula.

Filling interstices between the nodular forms of the brown mixture above described and occurring as an irregular coating on much of the ore, there is a soft powder of a bright straw color, of which the average composition is as follows.

Fe ₂ O ₃	37.84
PbO	13.74
CuO	2.33
K ₂ O } Na ₂ O }	3.93*
As ₂ O ₅	12.22
P O ₅	0.40
SO ₃	16.85
H ₂ O	9.39
Quartz	3.30
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	100.00

—*By difference.

The resemblance to certain products of alteration of galena and pyrite found in several of the Leadville mines is striking, and, like some of these, it seems to be a mixture of lead sulphate, jarosite and a hydrated ferric arseniate.

All of the above described minerals and mixtures, with the exception of crystallized jarosite, may sometimes be observed on one and the same piece of ore. It is not improbable that further investigation at the mine itself might bring to light still other minerals belonging to the group of hydrous arseniates.

In this connection it may be well to repeat that Mr. Pearce has identified pseudomalachite, occurring with hübnerite, from near Phillipsburg, Montana Territory, and brochantite from the Monarch mine, Chaffee county, Colo. The pseudomalachite according to Mr. Pearce's analysis contains CuO 62.56, P₂O₅ 20.10, H₂O 17.34 (by difference). The identification of brochantite, which is said to occur in considerable quantity and very pure, with partial development of crystal form, rests upon the following determinations by Mr. Pearce: CuO 68.70, SO₃ 18.65, H₂O 12.65 (by difference).

II. MISCELLANEOUS.

BINDHEIMITE.

Through Mr. Franklin Guiterman the Society has come into possession of a specimen of bindheimite from Secret

Cañon, Nevada, from a claim near the Bertrand mine, The specimen is massive and without crystal development, except for a few minute crystals lining a cavity and unfortunately impossible of identification. The color is yellowish-green inclining to yellow in places. The spec. grav. at 19°C. is 5.01, after correcting for 4.59 per cent. quartz of gravity 2.65 and 20.33 per cent. lead carbonate of gravity 6.5 (assumed). The composition is as follows :

	a	b	Mean
Sb ₂ O ₃	35.18	35.21	35.20
PbO	49.68	49.32	49.50
CuO	0.58	0.59	0.58
ZnO	0.17	0.19	0.18
CaO	0.66		0.66
MgO	0.03		0.03
K ₂ O	0.14		0.14
Na ₂ O	0.21		0.21
H ₂ O	5.86	5.87	5.86
Fe ₂ O ₃	0.09		0.09
Ag	0.29		0.29
CO ₂	3.35	3.35	3.35
Quartz	4.59		4.59
	100.83		100.68

Of the water 1.95 per cent. escaped over sulphuric acid and further 0.70 per cent. at 100°C. The state of combination of the silver could not be ascertained. The oxygen ratio derived from the mean of *a* and *b*, excluding lead carbonate, ferric oxide and silver is

$$\begin{array}{l} \text{RO} : \text{Sb}_2\text{O}_3 : \text{H}_2\text{O} \\ 3.14 : 10.00 : 5.92 \end{array}$$

If that water which escapes over sulphuric acid be considered true hygroscopic water, the ratio becomes 3.14 : 10.00 : 3.98. The first of these ratios leads to the formula 3PbO, 2Sb₂O₃, 6H₂O, while the second corresponds to 3PbO, 2Sb₂O₃, 4H₂O.

A CHROMIFEROUS PSEUDOMORPH.

From the Rochelle mine on Running Water (?) river, Wyoming Territory, there was obtained through Mr. Frank-

lin Guiterman a single fragment of a dark green mineral, apparently a pseudomorph. Although crystal planes were visible, as well as more than one direction of cleavage, the identity of the original mineral could not be ascertained, partly owing to the addition of artificial faces. In one direction parallel to one of pronounced cleavage, a distinct lamination was observable. Edges and thin flakes were translucent. The lustre was greasy, the color of the powder apple-green, the specific gravity at $12\frac{1}{2}^{\circ}\text{C}$. 2.831, and the hardness about 3. Analysis gave

SiO	a	b
Al ₂ O ₃	45.54	45.24
Cr ₂ O ₃	37.15	38.07
	0.79	
MgO	0.38	0.34
K ₂ O	10.70	
Na ₂ O	0.90	
H ₂ O	4.80	
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	100.26	

It is evident from the analysis that the product of alteration is allied to muscovite. With substitution of Fe₂O₃ for Cr₂O₃, the composition agrees very closely with that of the pseudomorph liebnerite.

ZINCKENITE.

In the Brobdignag mine, Red Mountain, San Juan county, Colo., occurs a massive, iron-gray mineral with greasy metallic lustre, without apparent crystalline structures, but to all appearances of complete homogeneity, of specific gravity 5.21 at 18°C. and hardness 3—3.5, which upon analysis was found to be an arseniferous zinckenite, this being, it is believed, the first observed occurrence of this mineral in the United States. Besides the usual blowpipe reactions for zinckenite, including violent decrepitation, there appear those for arsenic, preceded in the closed tube by a light sublimate of sulphur. The results of analysis are

Sb	35.00	
As	5.64	5.59
Pb	32.77	32.79
Cu	1.20	
Ag	0.23	
Fe	0.02	
CaO	0.31	
K ₂ O	} 0.45	
Na ₂ O		
S	22.50	22.50
Gangue	0.59	
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	98.71	

The oxygen ratio is

$$\begin{array}{rcccl} (\text{Pb,Cu}_2,\text{Ag}_2) & : & (\text{Sb}_2,\text{As}_2) & : & \text{S} \\ 1.00 & : & 1.09 & : & 4.11 \end{array}$$

While this is close enough to the theoretical ratio 1 : 1 : 4 to establish the probable formula $\text{PbS,Sb}_2\text{S}_3$, the result was not such as the care expended on the analysis warranted, supposing that no impurities were present. Calculation shows that, while the antimony and arsenic taken together are in excess of the amount required for lead, copper and silver, the sulphur falls short by half a per cent. The actual deficit in the latter amounts, however, to about one per cent., for it was found that about half of one per cent. existed in the free state and could be extracted by carbon disulphide. The only explanation of these contradictory circumstances was to be sought in the presence of oxygen salts, which would at the same time account for the difference between the sum total of the analysis and 100.

Ammonium acetate failed to extract any lead sulphate, but, nevertheless, pure water extracted a not inconsiderable quantity of soluble matter even when the digestion was carried on in an atmosphere of carbonic acid. The filtrate showed neither acid nor alkaline reaction toward litmus paper. Silver nitrate produced no precipitate whatever, showing the absence of soluble chlorides or sulphides, but hydrogen sulphide threw down a copious orange precipitate of antimony trisulphide together with some of the corresponding arsenic compound entirely free from lead, and barium chloride occasioned a slight precipitation of barium sulphate. The antimony consequently existed in solution in an oxi-

dized state, that of trioxide, as shown by evaporating some of the original solution with hydrochloric acid and adding potassium iodide. The manner of combination was not ascertained, but from the presence of alkalies this seems pretty certainly indicated. The salts, whatever they may be, are not very readily soluble, for six digestions with warm water in an atmosphere of carbonic acid were insufficient to complete the extraction. The sulphur trioxide found was probably combined with lime.

These experiments show that a large part of the apparent loss in the analysis is to be made up by oxygen, which, by requiring a considerable portion of antimony, arsenic and sulphur for combination, brings the ratio of the elements actually constituting the zinckenite very near that required by theory. They also show that the specific gravity given above, even were it corrected for quartz gangue, is too low. Suitable corrections for gangue, free sulphur and soluble salts would undoubtedly bring the spec. grav. quite up to that given in the text books for zinckenite, *i. e.*, 5.3—5.35.

The above method of examination and its results have been dwelt upon somewhat in detail, because they show so clearly that apparent homogeneity in the case of non crystallized metallic sulphides is no criterion of their purity, and also because thereby is indicated a possible way of reconciling with some definite formula the results of many analyses, especially of massive uncrystallized metallic sulphides like the one here described, whose position in a system of classification might otherwise be impossible of precise determination. (See also guitermanite, p. 129)

MELONITE.

Among a number of specimens of tellurium minerals from Boulder county, Colorado, recently acquired by the Society, I have been able to identify with certainty on several from the Forlorn Hope mine a telluride of nickel, undoubtedly the extremely rare mineral melonite. The crystal form cannot be recognized, although the structure is distinctly crystalline.