

CONTRIBUTIONS FROM THE LABORATORY OF THE UNIVERSITY
OF PENNSYLVANIA.

No. XXIV.

CONTRIBUTIONS TO MINERALOGY.

BY F. A. GENTH.

(Read before the American Philosophical Society, October 2, 1885.)

During the last two or three years numerous mineralogical observations have been made, some of which I had intended to investigate more fully, but, as I fear that the time which this would require would delay, if not altogether prevent their publication, I give in the following the more interesting :

1. *Tin, and associated Minerals.*

A highly interesting occurrence of native tin is that at the headwaters of several rivers in New South Wales. About a year ago Dr. Samuel B. Howell presented me with a specimen, and afterwards sent with another the following letter, giving fuller information about its occurrence :

“The washings I gave you sometime back came from Aberfoil river, about fifteen miles from the town of Oban, N. S. Wales. There is within two or three miles a very valuable diamond field, where corundum gems are common. The specimens I now send you are from the Sam river, which runs through the above-mentioned diamond field, twenty miles from the other locality. These rivers are the headwaters of the Clarence river, which empties into the South Pacific ocean. From this locality I have detected platinum, iridosmine, tin and gold ; the mineral formation appears to be the same.”

Both specimens showed the same association of minerals.

Tin.—The tin exists in the form of irregular, somewhat globular grains or aggregations of such grains; they are distinctly crystalline, from 0.1 to rarely over 1^{mm} in size. When magnified 60 diameters they appear to be of an uneven surface, showing planes which are too indistinct, however, for determining their form. They are grayish-white and of metallic lustre. It was impossible to select enough of the pure grains to determine their specific gravity or to make a quantitative analysis. A portion, treated with hydrochloric acid, dissolved readily with disengagement of hydrogen, leaving fine scales of iridosmine behind. Not a trace of any other metal but tin could be found in the solution.

Platinum.—The sample from the Aberfoil river yielded only a very minute quantity of platinum, when the portion insoluble in hydrochloric acid was treated with aqua regia, whilst that from the Sam river contained a considerable amount of this metal.

The grains of platinum are of irregular shape, mostly flattened. Aqua regia dissolves some of the grains very slowly, leaving a crystalline skeleton of very fine scales, probably of iridosmine. Other grains are hardly acted upon and are probably iridium or platin-iridium. The solution contained principally platinum, but also iridium and palladium.

Iridosmine.—The so-called iridosmine seems to be present, both as newjanskite in tin white, flat scales and as sisserskite in grayish-white or lead-colored scales. Some of the scales are indistinct hexagonal plates, but mostly have an irregular shape.

Gold.—The gold which I have observed in these washings is associated with quartz and of a deep yellow color, showing its high degree of fineness.

Copper.—The Sam river washings contain fine particles of native copper in the wire form.

Cassiterite.—I have observed this mineral more largely in the Aberfoil river sample; it is mostly in small, rounded grains, the largest about 10^{mm} in size; some are of a deep aurora red color, others are hyacinth red, reddish-brown or variegated, black, red and white; crystals could not be observed.

Corundum.—Sapphires in rounded grains, also in asteriated crystals, the largest 12^{mm} in diameter, and of a deep blue color occur most abundantly in the washings of the Aberfoil river, but also, with other varieties of corundum, in those of the Sam river.

Besides these and an abundance of quartz I have observed topaz of a yellowish-white color, orthoclase, garnet, brown tourmaline and other minerals, too small to distinguish.

2. *Joséite and Tetradymite.*

The peculiar telluride of bismuth from San José, Minas Geraes, Brazil (Dufrénoy's bornine, which afterwards was named *joséite* by Kennigott), was analyzed by Damour in 1845. The composition being so peculiar

and not in accordance with the present views of chemical combination, a new analysis was very desirable.

Mr. Clarence S. Bement, who has in his magnificent cabinet a fine cleavage mass of about four inches in diameter, has kindly presented me with the material for this purpose.

The specimen received is of a dark steel-gray color and shows the most perfect lamination and cleavage. Between the laminae could be observed a greenish and yellowish coating, which when magnified 100 diameters showed a crystalline structure. I also observed, under the microscope, a very minute quantity of yellowish-white globular aggregations. These coatings are the product of a partial oxidation of the mineral and were readily removed by dilute hydrochloric acid. They are probably montanite.

The analysis of the purified material gave results very close to those of Damour :

		Genth.		Damour.	
Te	=	14.67	—	15.93	— 15.68
Se	=	1.46	—	1.48	— } 4.58
S	=	2.84	—	3.15	— }
Bi	=	81.23	—	79.15	— 78.40
		<hr/>		<hr/>	<hr/>
		100.20		99.71	98.66

This composition cannot be expressed by a rational formula. There is also a doubt about its crystalline form, which is generally taken as hexagonal, with an eminently basal cleavage, although crystals, as far as I know, have never been found or examined.

Similar doubts exist about the form and rational composition of tetradymite, a question left open by Groth and others.

On crystals from Schubkau, in Hungary, Haidinger determined the form as rhombohedral, with perfect basal cleavage.

I am not aware that since then a crystallographic examination of this mineral has been made. These crystals are mostly dull, distorted and striated and not the best material for measurement. No other locality has furnished specimens in well defined crystals. It is very probable, however, that Haidinger's determination is correct, judging from a pseudomorph of gold after tetradymite from the Whitehall Mine, Spottsylvania county, Va., in the collection of the University of Pennsylvania, showing forms which appear to be combinations of a rhombohedron with a scalehedron and the basal plane.

This does not exclude, however, that tetradymite may not also occur in rhombic forms and that the characteristic eminent cleavage may not be basal, but brachydiagonal, as in bismuthinite, stibnite and orpiment, which have an analogous composition.

It was Gustav Rose who first suggested that tetradymite was bismuth with a variable quantity of isomorphous tellurium, and this opinion has

been adopted by many chemists and mineralogists, although many facts do not sustain it.

Bismuth and tellurium are not strictly isomorphous. It is true that both crystallize in rhombohedra of nearly the same angles; bismuth, however, has an eminently basal and rhombohedral cleavage, while tellurium shows a very imperfect basal and no rhombohedral at all, but a very perfect cleavage parallel to the planes of an hexagonal prism.

There is also in all the tetradymites, excepting the two from Fluvanna county, Va., and from Highland, Montana, a portion of the tellurium replaced by sulphur, and, if therefore tellurium replaces bismuth, sulphur necessarily does it also.*

That tetradymite is not a native bismuth, *mixed* with an indefinite quantity of tellurium, becomes more than probable from the fact that all reliable analyses agree very closely with the formulæ of either of the two modifications, viz: $\text{Bi}_2 \text{Te}_3$ or $\text{Bi}_2 \text{S}_3 + 2 \text{Bi}_2 \text{Te}_3$; there are only the Cumberland (England) tetradymite, which, according to Rammelsberg, contains: $\text{Bi} = 84.33$, $\text{Te} = 6.73$, and $\text{S} = 6.43$, and the joséite, for the expression of a rational composition of which we must look for another explanation.

This seems to be very easy, if G. Rose's suggestion would be reversed, and that, instead of making tellurium (and sulphur) to replace bismuth, we make the latter substitute tellurium and sulphur.

This view is supported by numerous examples, and, if we examine the constitution of the natural sulphides, tellurides, arsenides, &c., &c., we find such substitutions very frequently; the hexagonal millerite, Ni S , becomes niccolite, NiAs , or breithauptite, NiSb ; the isometric pyrite FeS_2 , by substituting the greater portion of the iron by cobalt or nickel, smaltite $(\text{CoNiFe}) \text{As}_2$, or chloanthite $(\text{NiCoFe}) \text{As}_2$ or bismuth-chloanthite $(\text{NiCoFe}) (\text{AsBi})_2$; the rhombic markasite, FeS_2 , in the same manner gives: löllingite FeAs_2 , safflorite $(\text{CoFeNi}) \text{As}_2$, and rammelsbergite $(\text{NiCoFe}) \text{As}_2$; or, if only a portion of the sulphur is replaced, we get as analogues for pyrite: cobaltite CoAsS , Ullmannite NiAsS or corynite $\text{Ni} (\text{SbAs}) \text{S}$, and for the rhombic marcasite wolfachite $(\text{NiFe}) (\text{AsSb})_2$, mispickel $\text{Fe} (\text{AsS})_2$, and alloclasite $(\text{CoFe}) (\text{BiAs}) \text{S}$.

In the sulphosalts the substitution of bismuth for arsenic and antimony is still more frequent, but it suffices that in the examples given it is shown that sulphur is very often replaced by arsenic and antimony, and that bismuth, being analogous to these, can therefore replace sulphur and tellurium as well.

These views applied to tetradymite and allied minerals would lead to

* I have already repeatedly called attention to the fact that the analysis of the Virginia tetradymite, made by Coleman Fisher, in which he found 7.23 p. c. of selenium, was made with a part of the *identical* material which I have analyzed, and which contains not more than a trace of selenium. Notwithstanding these statements it seems to be impossible to eradicate this error, as I find it continually repeated in our best books on Mineralogy.

the general formula : $\text{Bi}_2 (\text{TeSeSBi})_3$, and the Cumberland tetradymite (I) and the joséite (II) would be :

		I.	—	II.
Bi_2S_3	=	34.57	—	15.27
Bi_2Se_3	=	—	—	4.04
Bi_2Te_3	=	14.19	—	30.72
Bi_2Bi_3	=	48.84	—	50.17
		97.51		100.20

It would be interesting if a modification of bismuth of a rhombic form with brachydiagonal cleavage would be discovered, as it would throw some light upon the cause of dimorphism.

3. ¹ *Seleniferous Galenobismutite.*

H. Sjögren in 1879 gave the name galenobismutite with the formula : $\text{PbS. Bi}_2\text{S}_3$, to a mineral which is found massive and of a somewhat radiating structure at the Ko Mine, Nordmark, Sweden.

Mr. F. L. Garrison presented me last fall with a specimen of what was considered a selenide of bismuth, which he had received in Fahlun, Sweden, and which was said to have been found a short time ago in that celebrated mine.

The mineral has one very eminent cleavage, very similar to the brachydiagonal cleavage of bismuthinite, no other cleavage could be observed; color, lead gray, but much darker than bismuthinite; lustre eminently metallic; $H = 2$. Sp. gr., corrected for the pure mineral, = 7.145. Very brittle. It is associated with quartz, chalcopyrite and pyrrhotite in a rock composed of greenish-black fibrous and radiating hornblende and quartz.

Unfortunately, only a limited quantity was at my disposal, and the material for analysis could not be obtained in a perfect state of purity, but, as the admixtures were only quartz, chalcopyrite and pyrrhotite, these could be easily calculated and deducted.

They were : in analysis I, 3.96 % ; in II, 4.25 % ; in III, 5.11 % ; in IV, 8.73%, and in V, 8.80 %. The following results were obtained :

	I.	II.	III.	IV.	V.	Mean.	Atomic ratio.
Sulphur =	9.71	not det.	10.54	9.21	9.55	9.75	0.305
Selenium =	not det.	13.65	11.20	not det.	12.43	12.43	0.156
Silver } =	28.23	28.18	0.28	0.39	0.32	0.33	0.002
Lead } =	28.27	27.72	27.69	27.88	0.135	0.135	0.135
Bismuth =	50.19	49.49	49.35	50.49	49.90	49.88	0.238
		99.64			100.27		

This gives the formula : $\text{Pb} (\text{S}_2 \text{Se}_1)_3 \cdot \text{Bi}_2 (\text{S}_2 \text{Se}_1)_3$, giving :

Sulphur	=	10.43 %
Selenium	=	12.94 —
Lead	=	25.30 —
Bismuth	=	51.33 —
		100.00

Another specimen from the same locality, which was considered the same mineral, gave very different results :

This mineral, while it showed an eminent brachydiagonal cleavage, was much whiter, and less brittle. It had the same associations, but there appeared to be also some granular native bismuth in its immediate neighborhood. The analysis, after deducting 3 per cent of impurities, gave :

Sulphur	=	11.87 %
Selenium	=	4.25 —
Lead	=	5.36 —
Bismuth	=	74.44 —
		95.92

There is a loss of about 4 per cent, for which I cannot account, possibly selenium.

There was only a small quantity of the mineral obtainable for analysis, which would indicate that it is a mixture of probably about 20 per cent of the seleniferous galenobismutite with 63 per cent of bismuthinite and about 17 per cent of the native bismuth.

4. *Argentobismutite* (*Silberwismuthglanz*).

Prof. C. Rammelsberg described, in 1876, under the name *silberwismuthglanz*, a compact gray mineral from the Matilda Mine, Peru, corresponding to the formula : Ag_2S, Bi_2S_3 .

Amongst the minerals which the late J. F. L. Schirmer presented me about eleven years ago, was a specimen of granular quartz penetrated by thin needle-shaped iron black crystals, about 1^{mm} in thickness and 10–25^{mm} in length, showing a deep longitudinal striation, apparently no cleavage, but an uneven fracture. It came from Lake City, Colorado, and was evidently a surface specimen. In vain I have endeavored since to get the same mineral again from the mines near Lake City.

I have made several rough tests and found in one about 24 per cent of silver and 55 per cent of bismuth. I have sacrificed the greater portion of my specimen, and by crushing and washing off the quartz and oxidized portion of the mineral, I obtained a small quantity for analysis, consisting of the nearly pure sulphide and quartz with ferric oxide, which latter were left undissolved by nitric acid.

The analysis gave :

			Atomic Ratio.
Silver	=	26.39 %	0.121
Lead	=	4.06 —	0.020
Bismuth	=	52.89 —	0.252
Sulphur, by difference	=	16.66 —	0.521

The lead may be an admixture of galenite, although the mineral had

not that appearance, but it is more probably replacing some of the silver, the analysis nearly agrees with the formula : $(Ag_2Pb) S. Bi_2S_3$.

The pure $Ag_2S. Bi_2S_3$ would have the composition :

Ag	=	28.27
Bi	=	54.97
S	=	16.76

5. *Cosalite*.

The name *rezbanyite* was given, in 1858, by R. Hermann, to a mixture of a sulphobismutite of lead, silver and copper and sulphate of lead; the unoxidized mineral was not analyzed, although he states that the interior mass of his specimen was quite fresh, and of a lead-gray color.

A sulphobismutite of the formula $2(PbAg_2) S. Bi_2S_3$ from Cosala in the Province of Sinaloa, Mexico, was described by me in 1868 as *cosalite*.

In 1874, A. Frenzel reëxamined the rezbanyite and proved its identity with cosalite. For another mineral $4PbS. 5Bi_2S_3$, also found at Rezbanya, he now adopts the name rezbanyite.

In 1877 A. E. Nordenskiöld distinguished as *bjelkite* a mineral from the Bjelke Mine in Nordmark, Sweden, of which Nilson Lundström gave the formula : $FePb_2Bi_2S_6$. H. Sjögren, however, showed, in 1879, that the iron in Lundström's analysis was owing to an admixture of pyrrhotite, and that the pure mineral was identical with cosalite.

About two years ago I received, through the kindness of Mr. F. M. Shideler, of Lake City, Colorado, a mineral from the Gladiator Mine in Ouray county, Col., which contained, besides bismuth, lead and silver, a considerable quantity of copper, but gave the atomic ratio of cosalite; a similar mineral was described at the meeting of the Colorado Scientific Society of Dec. 3, 1883, by W. F. Hillebrand, as coming from the Comstock Mine, near Parrott City, La Plata Co., Col., and finally G. A. Koenig, Proc. Am. Phil. Soc. xxii, 211, made an analysis of that which occurs associated with his alaskaitè (galenobismutite) from the Alaska Mine about six or eight miles above the Gladiator Mine.

The cosalite of the Gladiator Mine occurs associated with galenite, bismuthinite, chalcopyrite and pyrite in quartz. It forms small irregular masses more or less mixed with its associates, the largest which I have seen was not over 25^{mm} in diameter. It is compact, without any apparent crystalline structure; where it appears to be fibrous it is mixed with bismuthinite. Some portions have a fringe of crystalline galenite, surrounding the whole patch of the cosalite. The bismuthinite is present in small particles of a few millimeters in size, and frequently occupies the centre of the cosalite (one fragment of about 4^{mm} long was examined and found to be perfectly pure Bi_2S_3).

The cosalite is between lead gray and iron black, fracture uneven. For the analysis I selected material which was perfectly free from bismuthinite, galenite and chalcopyrite, but I was not able to obtain any which

was not slightly contaminated with pyrite and quartz. From the amount of iron found, the quantity of pyrite was calculated, and this and the quartz deducted from the material taken for analysis.

For comparison I have analyzed the cosalite from the Alaska Mine. This is free from pyrite, but contaminated with chalcopyrite, the amount of iron found gave that of chalcopyrite, which, together with quartz, were deducted from the material used for the analysis.

The following results were obtained after deducting in analysis I, 4.03 % quartz and chalcopyrite; in II, 20.67 % and in III, 19.66 % of pyrite and quartz :

	I.	II.	III.	Mean of	Atomic	
	Alaska Mine.	Gladiator Mine.		II and III.	ratio.	
Sulphur	= 16.80	— 16.72	— 17.52	— 17.17	0.537	
Selenium	= trace	—	—	—	—	
Arsenic	= 0.04	— trace	— trace	—	—	
Antimony	= 0.51	— not det.	— 0.84	— 0.84	0.001	} 0.216
Bismuth	= 44.95	— 45.20	— 44.97	— 45.09	0.215	
Copper	= 8.00	— 5.87	— 5.80	— 5.84	0.046	} 0.201
Silver	= 1.44	— 5.67	— 5.82	— 5.75	0.027	
Lead	= 28.10	— 24.50	— 24.72	— 24.61	0.119	
Zinc	= 0.24	— 0.65	— 0.50	— 0.58	0.009	
	<u>100.08</u>	<u>100.17</u>		<u>99.88</u>		

Atomic Ratio of $(\text{PbCu}_2\text{Ag}_2) : \text{Bi} : \text{S} = 2 : 2 : 5 = 2 (\text{PbAg}_2\text{Cu}_2) \text{S} \cdot \text{Bi}_2\text{S}_3$.

6. Schirmerite and Beegerite.

Under the name *schirmerite* I described, in 1874, a mineral from the Treasury Mine, Geneva District, Park county, Col., of the formula $\text{PbS} \cdot 2\text{Ag}_2\text{S} \cdot 2\text{Bi}_2\text{S}_3$, which I had received about twelve years ago from Mr. Schirmer. Later, he sent me as *schirmerite* several specimens from the Treasury Vault Mine, Summit county, Colorado, and has furnished the latter mineral to numerous friends. He has not been able to give me another specimen of the *original schirmerite*, and I do not know that it has been preserved in any collection.

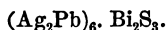
When I took up the investigation of the sulphobismutites above described, I observed that the original *schirmerite*, which was bright and fresh when received, had tarnished, was quite dull, and some portions almost black, while the mineral from the Treasury Vault Mine was quite fresh in appearance. As this indicated a difference in the composition, its true nature was endeavored to be established by an analysis.

That from the Treasury Vault Mine occurs in small particles and patches, the largest about 10^{mm} in size, disseminated through quartz, associated with cubical crystals of pyrite, very little chalcopyrite, and, in some of the cavities, a yellowish earthy coating, probably of bismite.

Only a very small quantity, not over 0.0812 grm., could be taken for analysis, in which the metals were determined, and the sulphur required by them calculated. It gave :

		Atomic ratio.			
Silver	=	15.40	—	0.072	= 1.5
Lead	=	50.16	—	0.242	= 5.1
Bismuth	=	19.81	—	0.095	= 2
Sulphur	=	14.59	—	0.456	= 9.7
		<hr style="width: 50%; margin: 0 auto;"/>			
		100.00			

This seems to indicate that the mineral from the Treasury Vault Mine agrees with the formula of *argentiferous beegerite* :



Dr. Koenig described, in 1881, Am. Chem. Journ., ii, 379, under the name of *beegerite*, a mineral from the Baltic vein, Park county, Colorado, which, however, he found to be entirely free from silver. Lately he described another variety from the Old Lout Mine near Lake City, Colorado, containing about 10 per cent of silver. Proc. Am. Phil. Soc. xxii, 211.

7. *Tetrahedrite. Sylvanite.*

Already about eleven years ago I have received from Mr. Schirmer specimens of a variety of tetrahedrite in quartz, associated with crystallized gypsum and a yellowish waxy oxidation product containing largely oxide of antimony, which came from the Hotchkiss Mine in the San Juan District, Colorado.

Almost identical in appearance and associations in the tetrahedrite from Governor Pitkins' Mine near Lake City, of which Mr. F. M. Shideler sent me a number of specimens.

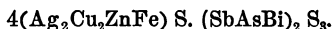
The tetrahedrite does not show any signs of crystallization, but is massive, compact, disseminated through quartz; in the cavities are small crystals of gypsum.

Iron black. Its specific gravity = 4.885.

The material for analysis was slightly contaminated with quartz which was deducted, in I, 2.46 per cent; in II, 3 per cent.

		I.			II.			Mean.
Sulphur	=	25.97	—	not det.	—	25.97		
Arsenic	=	3.30	—	3.14	—	3.22		
Antimony	=	25.51	—	not det.	—	25.51		
Bismuth	=	0.41	—	0.32	—	0.37		
Silver	=	0.51	—	0.69	—	0.60		
Copper	=	37.80	—	37.56	—	37.68		
Zinc	=	lost	—	7.15	—	7.15		
Iron	=	0.57	—	} 0.77	—	0.64		
Manganese	=	0.10	—		—	0.10		
						<hr style="width: 50%; margin: 0 auto;"/>	101.24	

The atomic ratio leads to the accepted formula :



An exceedingly interesting association of this tetrahedrite is that of *syloamite*. There was in the lot of samples from Governor Pitkins' Mine a small piece of quartz, showing very few specks of tetrahedrite and also the antimony oxide coating, which showed a few silver-white, bright metallic particles, 2-3^{mm} in length and less than 1^{mm} broad, with one eminent cleavage. A qualitative examination showed that, when nitric acid was added, the particles at once became black, and on boiling dissolved, leaving bright brown gold; the filtrate gave an abundance of silver chloride on addition of hydrochloric acid, and the filtrate evaporated to dryness yielded crystalline tellurous oxide, readily soluble in ammonium hydrate and ammonium sulphide, which latter solution, on acidulation, gave a black precipitate of tellurous sulphide.

Thus the mineral is proved to be sylvanite, which, I do not believe, has ever before been observed in this part of Colorado.

8. *Polybasite.*

Occurs with argentiferous galenite and pyrite at the Terrible Lode, Clear Creek Co., Colorado.

A crystal had a spec. grav. of 6.009 and contained :

Silver	=	62.70
Copper	=	9.57
Iron	=	0.07
Arsenic	=	0.78
Antimony	=	10.18
Sulphur (by difference)	=	16.70
		100.00

9. *Arsenopyrite and Scorodite.*

A number of years ago I received, from Northern Alabama, several lumps of ore, consisting of quartz with pale grayish-green granular scorodite, showing on some of the fissures microscopic crystals of the usual form of this mineral, the pyramidal planes predominating. The scorodite results from the oxidation of arsenopyrite, a portion of which is left unaltered in the form of grayish-white, granular patches with metallic lustre. Dilute hydrochloric acid dissolved the scorodite and left the arsenopyrite with a little quartz. After deducting 3.34 per cent of the latter the analysis gave :

			Atomic ratio.		
Sulphur	=	18.32	—	0.573	1
Arsenic	=	47.10	—	0.628	1.1
Iron	=	33.84	—	0.566	1
Copper	=	0.70			
		99.96			

1 : 1 : 1 = FeSAs.

10. *Alteration of Magnesian limestone from Berks Co., Pa.*

The magnesian limestones in the neighborhood of Reading, Berks Co., Pa., at Fritz's island, and about two miles east of Fritztown, two miles south of Sinking Spring, at the Wheatfield and Ruth's Mines, frequently undergo very interesting changes.

Evidently by the infiltration of siliceous waters the magnesian limestone is decomposed and from the magnesium carbonate, deweylite and serpentine are formed, while another portion of the magnesia separates as brucite; the calcium carbonate crystallizes, both in the form of aragonite, in small acicular crystals and radiating columnar masses, and in the form of calcite, in crystals and coarse granular masses.

Some of these minerals have already been described by E. F. Smith, jointly with D. B. Brunner and J. Schoenfeld. I am indebted to Prof. Brunner and Dr. Schoenfeld for numerous specimens of these interesting occurrences.

Brucite.—At Fritz's island brucite occurs in several varieties.

a. In coatings of indistinct crystals 3–4^{mm} in diameter and crystalline masses upon a granular limestone, largely altered into serpentine. It is colorless in thin laminæ and shows the characteristic pearly lustre. There is also, on some portions of the limestone, a thin, white coating with slight silky lustre, which may be brucite; analysis *a*1.

This brucite has already been analyzed by E. F. Smith (Am. Chem. Journ., v, 281), whose analysis I give for comparison, *a* 2.

b. A second variety is found in thin seams from 4 to 15^{mm} in thickness. I could not observe any crystals but masses which are highly crystallized, eminently showing the basal cleavage, but always in curved surfaces. It has a slightly brownish-yellow tint, and on ignition becomes dark brown from the oxidation of the considerable quantity of manganous oxide which it contains. Spec. grav. = 2.382. From the analysis it will be seen that in its composition it stands between pure brucite and Igelström's mangan-brucite, although not so rich in manganous oxide, the latter containing as much as 14.16 per cent.

c. The brucite from near Sinking Spring, as Dr. Smith states, occurs in thin colorless laminæ in thin seams in the limestone, but also in silky fibrous masses or even pulverulent, with but a faint silky lustre. Dr. Smith has observed the fine silky fibres, but, not having had a sufficient quantity for analysis, mistook them for hydromagnesite. The brucite is associated with deweylite, coarse grained calcite and aragonite, in dolomite.

I have analyzed a perfectly pure piece of the silky fibrous brucite, which weighed nearly one gram, *c* 1, and for comparison give E. F. Smith's analysis of the laminated mineral, *c* 2, from the same locality:

	Fritz's Island.				Sinking Spring.	
	a 1	a 2	b 1	b 2	c 1	c 2
Water	= 30.92	— 32.52	— 29.70	— 29.47	— 29.91	— 31.05
Carbon dioxide	= —	—	—	—	— 2.42	—
Silica and alumina	= —	—	—	— 0.46	—	—
Ferric oxide	= 0.82	— 0.44	— 0.30	— 0.04	— 0.75	— 1.24
Manganous oxide	= 0.63	—	— 4.04	— 4.66	—	—
Magnesium oxide	= 67.64	— 66.78	— 65.38	— 64.30	— 66.62	— 66.19
Calcium oxide	= —	—	—	—	— 0.11	— 1.68
	100.01	— 99.74	— 99.42	— 98.93	— 99.81	— 100.16

The 2.42 per cent of carbon dioxide in analysis c 1 indicate the presence of 0.20 per cent of calcium carbonate, and about 4.45 per cent of magnesium carbonate or about 6 per cent of hydromagnesite, resulting from a conversion of a small quantity of brucite into these minerals—there are still, however, over 90 per cent of unaltered brucite present.

Deweylite, Aragonite, Calcite.—In the magnesium limestone occur these three minerals, more or less mixed together and associated with brucite.

The deweylite is white, yellowish-white or brownish, amorphous, sometimes in rounded grains or in stalactites or botryoidal forms, in thin plate-like masses or slabs occasionally over one inch in thickness, or in irregular coatings. These slabs are often arranged in layers of white or brownish deweylite of greater or less purity, often intimately mixed with aragonite, which sometimes separates in the form of radiating columnar masses, some of the individuals being over 50^{mm} in length. The layers often separate very easily and the surfaces of such planes of separation are covered with small brilliant crystals of aragonite.

Calcite is also present, both in small and insignificant crystals and in coarse crystalline masses.

This deweylite has been analyzed by E. F. Smith (l. c.), also by my assistant, Mr. H. F. Keller, who found a pure yellowish fragment of waxy lustre to contain :

Silicic oxide	=	39.32
Ferrous oxide	=	0.51
Calcium oxide	=	trace
Magnesium oxide	=	41.14
Water	=	18.41
		99.38

Neither the aragonite nor calcite have been analyzed.

Pseudomorph of deweylite after aragonite.—The needle-shaped crystals of aragonite and the radiating masses undergo a change and are gradually altered into brownish-yellow deweylite.

It begins with a very thin coating of colorless and brownish-yellow deweylite upon the aragonite, which gradually becomes thicker and finally changes the entire aragonite into pure deweylite.

Serpentine.—Another very important alteration of the magnesian limestone of Berks county is that into serpentine, which can be observed in all its stages, from the pure dolomite into the pure serpentine. The latter is generally of a greenish-yellow, greenish-white or yellow color, but also sometimes brownish and grayish. Aragonite and calcite are frequently associated and magnetite in fine grains is occasionally disseminated through the mass.

Several analyses of these serpentines have been made by my assistant, Mr. Harry F. Keller, who found in those of :

		Ruth's Mine.		Wheatfield Mine.
Silicic oxide	=	42.14	—	41.46
Ferrous oxide	=	2.06	—	0.99
Magnesium oxide	=	41.61	—	44.68
Calcium oxide	=	trace	—	—
Water	=	14.20	—	14.07
		—————		—————
		100.01		101.20

M. E. Wadsworth, in his *Lithological Studies*, Cambridge, 1884, page 152, speaks of the serpentine of Fitztown (Fritztown), Berks Co., Pa., as a product of the alteration of *olivine*, showing yet unaltered *olivine*. I cannot imagine how *olivine* could be present in this rock and what it is which he has taken for that mineral.

The alteration of dolomite has produced, directly and indirectly, especially at Fritz's Island, a great variety of interesting minerals. Besides serpentine and deweylite, there are grossular, vesuviane in a beautiful yellow and orange-colored variety, apophyllite, chabazite, gismondite (?), thomsonite, mesolite, stilbite (at Rautenbush), datolite and others. In a subsequent paper I may give a fuller account of some of these.

11. *Ilmenite from Carter's Mine, N. C. Oligoclase.*

In the chrysolite rock (unnecessarily called dunitite by some authors) occurs a vein which contains corundum, and some cross-fissures furnish a white plagioclase feldspar, others a peculiar variety of ilmenite.

My assistant, Mr. Harry F. Keller, has made analyses of both. The ilmenite has been found in two varieties (a) of a brownish-black color of a somewhat purplish hue, in small masses which show an indistinct crystal-line structure and basal cleavage. On the margin it becomes somewhat columnar; fracture uneven. Sp. gr. = 4.67. H = 5.5; the second variety (b) occurs in rounded modules of about 1.5 to 2'' in diameter, irregular in shape, very brittle and breaking up into small fragments of about 5 to 10^{mm} in diameter, without any regular form, with subconchoidal fracture and tarnished with bluish and purplish colors. It much resembles the so-called *Schlackige Magneteisen* from Unkel on the Rhine, although the composition is quite different. Sp. gr. = 4.68. Neither variety is magnetic.

	a			b		
Titanic oxide	=	52.73	—	52.71	—	52.64
Ferric oxide	=	8.08	—	not det.	—	10.07
Ferrous oxide	=	33.08	—	32.96	—	31.11
Magnesium oxide	=	5.33	—	not det.	—	5.33
Silica	=	0.14	—	0.16	—	trace
		99.36		99.15		99.15

The feldspar which is found associated shows large cleavages and is distinctly striated. It gave the composition of oligoclase :

Silicic oxide	=	62.32
Aluminum oxide	=	25.19
Calcium oxide	=	5.01
Sodium oxide	=	8.02
Potassium oxide	=	0.25
		100.79

12. Topaz from Stoneham, Maine.

I have made last fall, at the suggestion of Mr. G. F. Kunz, an analysis of the Stoneham topaz, of which he furnished me with a perfectly transparent and colorless fragment, in order to clear up the doubt then existing about its composition, on account of an analysis published by Mr. C. M. Bradbury (*Chemical News*, *xlvi*, 109), which had given very unusual results.

Although by the very elaborate investigation of F. W. Clarke and J. S. Diller (*Am. Journ. Sc.* [3] *xxix*), the main question has been settled by showing that the Stoneham topaz has the accepted composition of topaz, I may put on record the results which I have obtained :

Spec. grav.	=	3.553
SiO ₂	=	32.03
Al ₂ O ₃	=	57.18
F1	=	18.83
		108.03
Deduct oxygen		7.92
		100.11

13. Orthoclase from French Creek, Chester Co., Pa.

A peculiar variety of orthoclase has lately been found at the iron mines of the French Creek region, of which Dr. A. E. Foote has presented me with several specimens. The crystals are columnar, very imperfect, but appear to show the planes P, M and n (Naumann); they are deeply striated and the slender crystals from 1 to 2^{mm} in thickness and about 50^{mm} in length are radiating from a centre, forming sheaf-like or club-like aggre-

gations. Some portions show the orthoclase cleavage. Color reddish-white to flesh red. Sp. grav. = 2.528. Associated with a chloritic mineral, supposed to be glauconite, and magnetite.

The analysis gave :

Loss by ignition	=	0.67
SiO ₂	=	62.68
Fe ₂ O ₃	=	0.23
Al ₂ O	=	20.90
CaO	=	0.15
Na ₂ O	=	none
K ₂ O	=	15.99
		<hr/>
		100.62

14. *Muscovite, pseudomorphous after Nephelite?*

Dr. A. E. Foote brought last year from Wakefield, Canada, peculiar hexagonal crystals occurring there in the granular limestone, which he gave me for analysis. The form seems to be hexagonal, the angle, between two prismatic planes, measured 120°; the larger crystal 20^{mm} broad and 18^{mm} high shows the basal plane, but no pyramid, some of the smaller but less perfect crystals appear to have a very small pyramidal plane also.

Yellowish-white, finely crystalline, rarely some larger cleavage planes are visible, which are probably calcite; lustre pearly to slightly vitreous. H = 3.0; spec. gr. = 2.755.

The analysis gave :

CO ₂	=	0.69
H ₂ O	=	4.25
SiO ₂	=	45.90
Al ₂ O ₃	=	36.03
Fe ₂ O ₃	=	trace
MgO	=	0.68
CaO	=	0.92
K ₂ O	=	12.08
		<hr/>
		100.55

This is muscovite slightly contaminated with calcium carbonate.

The form suggests a pseudomorph after nephelite. In the same range at Diana, N. Y., as Geo. J. Brush has shown, nephelite is found altered into giaseckite, which latter in all probability is only a more compact and less pure variety of muscovite.

15. *Stilpnomelane pseudomorphs. Ankerite.*

Velvety coatings of a dark olive-green color and submetallic lustre, in pseudomorphs after an unknown tabular mineral. The specific gravity, taken in alcohol, was found to be, 2.957. Powder pale olive-green.

This variety has been analyzed in 1858, by G. J. Brush (Am. Journ. Sc.

[2] xxv, 198), who showed that the so-called chalcodite of C. U. Shepard, in all probability belongs to stilpnomelane, and, if this suggestion is correct, that this mineral contains both ferrous and ferric oxides, while Rammelsberg (*Mineralchemie*, 1875), assumes only ferrous oxide.

From Dr. A. E. Foote, who has lately collected this mineral at the Sterling Mine near Antwerp, N. Y., I have received some very pure material, which made it desirable to reëxamine it, especially with reference to the state of the oxidation of the iron.

For the determination of the ferrous oxide, 0.3522 gm. were dissolved in dilute sulphuric acid, after the air had been driven out by carbonic dioxide; and the ferrous oxide determined by titration with potassium permanganate; the water was determined directly in a chloride of calcium tube from 0.3635 gm. and 0.9854 gm. taken for the other determinations. The analysis gave :

		Atomic ratio.			
SiO ₂	=	44.75 %	0.746	=	10.2
Al ₂ O ₃	=	4.36 —	0.042	} = 0.073 =	1.
Fe ₂ O ₃	=	4.99 —	0.031		
MnO	=	trace			
FeO	=	30.34 —	0.421	} = 0.558 =	7.6
MgO	=	5.47 —	0.137		
H ₂ O	=	9.18 —	0.510	=	7.
			<hr style="width: 50%; margin: 0 auto;"/>		
			99.09		

The empirical formula: $(\text{Fe}_3\text{Mg}_1)_3 (\text{FeAl})_2 \text{Si}_{10}\text{O}_{31} + 6\text{H}_2\text{O}$ agrees closely with the above results.

Ankerite.—Associated with the stilpnomelane is ankerite in groups of curved rhombohedral crystals of a yellowish-white color.

The analysis gave :

CaCO ₃	=	54.98
MnCO ₃	=	0.78
FeCO ₃	=	19.28
MgCO ₃	=	24.91
		<hr style="width: 50%; margin: 0 auto;"/>
		99.95

16. *Calamine*.

A peculiar variety of calamine, which closely resembles hydrozincite, occurs as an incrustation upon a ferruginous calamine, the principal ore, at the Bertha Mine, Pulaski county, Va.

It is earthy and cryptocrystalline and some of the incrustations had a thickness of 5^{mm}.

I observed that after ignition it was dissolved by dilute hydrochloric acid almost instantaneously, far more readily than the hydrous mineral.

The analysis gave :

SiO ₂	=	25.01
ZnO	=	67.42
H ₂ O	=	8.32
		<hr/>
		100.75

17. *Titanite.*

Some time ago Mr. J. A. D. Stephenson, of Statesville, N. C., sent me a fragment of a crystal of titanite from the mica schist of the neighborhood, which also carries a beautiful variety of sunstone-oligoclase.

It was 15^{mm} broad, 2^{mm} thick, of a yellowish-white color, a greasy, vitreous lustre and a sp. gr. of 3.477.

The analysis gave :

SiO ₂	=	29.45
TiO ₂	=	38.33
Fe ₂ O ₃	=	1.61
MnO } MgO }	=	traces
CaO	=	29.11
Ignition	=	0.60
		<hr/>
		99.10

18. *Vanadinite.*

The vanadinite from Wanlockhead, Scotland, occurs associated with calamine, a pale, greenish fibrous coating of pyromorphite, and rarely with minute black crystals of descloizite, in brownish-yellow barrel-shaped hexagonal prisms, generally united into globular groups, the surface of the globules often perfectly smooth and not showing a trace of the form of the crystals which produce them. They have been analyzed by A. Frenzel (Jahrb. Min., 1875, 673), but as it is very difficult to get material perfectly free from admixtures, some of his analyses do not fairly represent the composition of vanadinite. As I had some perfectly pure globules, I made an analysis which gave :

Cl	=	2.53
PbO	=	78.39
As ₂ O ₅	=	0.34
P ₂ O ₅	=	0.27
V ₂ O ₅	=	18.04
		<hr/>
		99.57

19. *Annabergite.*

In a previous paper, read before this Society, August 18, 1882, I mention under niccolite that an apple-green mineral is found with it at the Gem Mine, near Silver Cliff, Colorado.

It occurs as a crystalline coating or in minute somewhat globular aggregations, of a pale green to a rich apple-green color, in limestone associated with niccolite. It is frequently associated with aragonite in fine needle-shaped crystals, which often give it a superficial coating. I was able to obtain a small quantity of a state of fair purity, slightly contaminated with aragonite. After treating it in the cold with very dilute hydrochloric acid, to dissolve the aragonite, I had 0.0722 gm. for analysis, which gave :

H ₂ O	=	23.94
NiO	=	32.64
CoO	=	0.50
MgO	=	3.74
CaO	=	3.51
As ₂ O ₅	=	36.64
		<hr/>
		100.95

20. *Dr. Clemens Winkler and Herderite.*

Dr. Winkler published (Jahrb. Min., 1875, i, 172), a justification of his work on herderite in which he says that *my reproach that he had sacrificed valuable material by the use of incorrect methods, is unwarranted and that he must firmly repel it.*

I had intended to reply to Dr. Winkler, but really do not see any necessity for it, because, he fails to show any error in my work, but only tries to find excuses for his own shortcomings, and mentions experiments made with apatite, a mineral with which herderite has no resemblance, either physically or chemically.

That the minerals from Ehrenfriedersdorf and Stoneham are identical, as I have suggested, he now admits, and as this settles the *main question* it would be a waste of words to say more about this matter.

UNIVERSITY OF PENNSYLVANIA, August 8, 1885.