II.—*On some New Minerals from the Collection in the University of Glasgow.*

By J. B. Hannay, F.R.S.E., F.C.S.

THROUGH the kindness of Prof. and Mr. John Young, F.G.S., I have been enabled to examine a number of unclassed minerals belonging to the Hunterian Collection in the Museum of the University of Glasgow. Among them I have found some whose composition differs from anything already described, and it is with the hope that mineralogists may be enabled to identify them elsewhere, that I now publish a detailed account of them. I am sorry that it is impossible for me to state the localities of some of the minerals, owing to the fact that they were unnumbered and unknown specimens, which were found in old drawers of the museum when the collection was being removed to the new buildings, but as the minerals with which they are associated are characteristic, we may obtain some clue to the deposits in which they originally lay. I shall describe the minerals in the order of their complexity, giving the least complex the first place.

The first which thus comes to be described is an arsenide of silver of the composition $Ag_3\,As$. The association of arsenic and silver in the same mineral has been found to be of common occurrence, but these substances have always been more or less mixed with other metals, principally antimony and lead, and what has been called arsenic silver is really a mixed mineral, containing dyscrasite, arsenical iron, &c. The compound I have now to describe, occurs in a very remarkable mineral composed principally of metallic arsenic represented in fig. 5, plate VI. Disseminated through the arsenic are crystals of Trimetric form which by the elongation of the faces $\infty P\infty$ and $\infty P2$ have the form of needles (having no well defined terminal faces), which are composed entirely of arsenic and silver. The crystals which are very imperfect may easily be separated from the matrix of arsenic in which they lie, and have the following composition:—

	Calculated.	Found.
Ag..	81·20	81·37
As..	18·80	18·43
Sp. Gr. 8·825	100·00	99·80

This leaves no doubt that the crystals have the empirical formula of Ag_3 As. When the metallic arsenic containing a little silver is treated with a solution of Sodium Hypochlorite, the arsenic is completely oxidised and the silver converted into chloride, but when the above crystals are treated with the same solution, no re-action takes place unless the solution is concentrated or warmed. Thus we have a method of separating the silver arsenide from the mixed compounds which are dissolved in the metallic arsenic, and by means of this reaction I have found the arsenide to be present in minute crystals where its detection by the unassisted eye was quite impossible.

The original mineral in which this silver compound was found is so curious that a detailed description may not be out of place. The bulk is, as I have said, of metallic arsenic, which on fracture is dark grey, but on cutting with a knife is nearly silver white. Adhering to the arsenic in several places is crystallized quartz, which has a very rich rose-pink colour. The arsenic is not oxidised under the quartz, but as a rule it is more impure near the quartz than in the body of the mineral. Amongst the quartz are some deep blue transparent crystals which seem also to be of quartz, but as they are very small and very few in number, I have not been able to determine them. They are as deep in colour as ordinary cobalt blue glass, and one of them when looked at from the side is reddish purple, so that the crystal is dichroic. The fact of crystalline quartz lying upon unoxidised arsenic is very curious, and its beautiful rose colour makes the mineral recognisable at a glance. Freiberg is probably the source of this mineral.

The next mineral which falls to be described is one from an exceedingly complex piece also unknown, but which I think must have originated in the Hartz Mountains. The upper surface is covered with pure argentite, below which is quartz, and from the fact that quartz prisms project through the argentite in several places, I suppose that the silver sulphide has been deposited upon the quartz. The lower part of the quartz is not so pure as the upper, partaking more of the character of a hard gneiss. The new substance occurred in little pockets in the gneiss and immediately below it, and consisted of a double sulphide of manganese and lead, having the formula 3 $Mn_2S.PbS$ as shown by the following analysis :—

	Found.	Calculated.
Mn..	49·00	49·62
Pb	30·68	31·13
S	20·73	19·25
	100·41	100·00

It has a Sp. Gr. of 4·01, and is of a dark steel grey colour with a bronze tinge when exposed to air for some time. It is easily oxidised by nitric acid, and is slowly attacked by boiling dilute hydrochloric, and even by sulphuric acid. Its crystalline form could not be determined as no crystals were seen—only a confused crystalline mass.

In some places below the silica lay small pieces of a much brighter crystalline body, like lead sulphide, but as hard as specular iron, which gave on analysis constituents nearly in proportion for the formula $6ZnS.\ 2MnS.\ PbS$. The analysis yielded as follows :—

	Found.	Calculated.
Zn..	40·07	39·26
Mn	11·13	11·05
Pb..	20·92	20·78
S	28·85	28·91
	100·97	100·00

Its Sp. Gr.=3·62.

The larger portion of the mineral is made up of a substance resembling fractured cast-iron of a very crystalline nature, and on analysis, yielded the following percentages :—

	Found.	Calculated.
Zn	38·46	37·81
Pb	24·22	25·01
Mn	6·93	6·64
Fe	2·83	2·71
S	27·50	27·83
	99·94	100·00

This substance has a Sp. Gr. of 3·59, and its composition agrees pretty well with a formula.

$$6\,ZnS \left\{ \begin{array}{l} 1{\cdot}25\ Pb \\ 1{\cdot}25\ Mn \\ 0{\cdot}50\ Fe \end{array} \right\} S_3$$

or if this result be multiplied by 4, the formula will be

$$24\,ZnS.\ 5\,PbS.\ 5\,MnS.\ 2\,FeS.$$

This seemed at first so unusual a compound that I suspected it to be a chance number, so two other samples from other parts of the mineral were analysed with the following results:—

	I.	II.
Zn	37·92	37·75
Pb	24·58	22·18
Mn	6·77	7·00
Fe	2·80	3·14
S	26·93	28·99
	99·00	99·06

These numbers show that the mineral is remarkably constant in composition, a fact which its coarsely crystalline nature points to. The whole mineral must be regarded as one of the most complex we have; containing substances rarely associated in their ores. Fig. 6, plate VI is a diagram of the mineral mass, showing the layers very distinctly, as well as the pockets in the quartz. I would remark that in these analyses the quartz which was almost unavoidably mixed with the samples broken off was always rejected as forming no part of the mineral. It was never gelatinous, but always in grains, and contained no other substance than silica. Compound No. 4 seems to be a variety of No. 3, as in both cases we have an aggregate formula of $2\,ZnS.\ R_2S.$ where R indicates a monatomic radicle, but in No. 4 a portion of the manganous sulphide is replaced by ferrous sulphide.

I propose to name the minerals as follows:—

$Ag\ As$ Arsenargentite.

$3\,Mn_2S.\ Pbs$ Plumbo-manganite.

$$\left. \begin{array}{c} 6\,ZnS.\ 2\,MnS.\ PbS. \\ 6\,ZnS \left\{ \begin{array}{l} 1{\cdot}25\ Pb \\ 1{\cdot}25\ Mn \\ 0{\cdot}50\ Fe \end{array} \right\} S_3 \end{array} \right\} \text{Youngite.}$$

The last being named after the learned director of the University Museum. I may mention that in the analysis of the last mineral I noticed a curious reaction of manganese, which has given rise to a good process for separating iron from other metals, and of which I have sent a detailed account to the Chemical Society. On boiling the mineral with nitric acid to oxidise the sulphur, the oxidation being somewhat slow, I added a few crystals of chlorate of potash, when I obtained a precipitate of oxide of manganese containing iron, having the formula

$$2\,Fe_2\,(MnO_4)_3.\ MnO.\ MnO_3\ 12\,H_2O.$$

A manganate of iron combined with manganate of manganese: when nitrate of manganese dissolved in strong nitric acid is treated with potassic chlorate and warmed, a precipitate of manganate of manganese or manganese dioxide is obtained.

Before leaving this subject I would mention a mineral I found amongst the same collection in which the two substances nickel glance and diaspore are associated. The specimen is nearly all the nickel compound, but encrusted all round with small mammillary crystals of this hydrate of alumina. From the appearance it was much like gibbsite, but as it only contained 16 per cent. of water, it could only be diaspore. It is finely coloured by nickel, having a reddish brown colour, but containing no iron. Fig. 7 shows the disposition of the diaspore on the nickel glance.