



## Mineral Notes.

A series of articles describing the uses, appearance and occurrence of minerals and other materials of particular significance in relation to the mining heritage of the South-West of England.

### 2. Silver

Silver occurs in many places as up to 99% pure metal contaminants are usually copper or gold. The most common mineral deposited is the sulphide argentite ( $\text{Ag}_2\text{S}$ ), also called silver glance, common in 'argentiferous' lead, copper or zinc ores. However, below 177 C the crystal structure of argentite rearranges from cubic to monoclinic forming the mineral acanthite. In galena the silver content rarely exceeds 0.1% (approximately 35oz per ton) and in the south-west commonly ranged from 10oz up to 200oz per ton of ore. However, laboratory analysis is required to determine the silver content.

Silver ore is found as veins, alluvial deposits, contact metamorphic or replacement deposits. Supergene enrichment yields both native silver but also a silver-halide gossan head deposit in the oxidation zone above the water table.

Pure silver is known as 1000 fine though market price is based on 999 fine. Sterling silver is 925 fine, copper is added to give the alloy strength and allow sharper edges in casting. Aside from coinage and jewellery silver is used in batteries, electronic components, photographic emulsions and medical devices. It is resistant to oxidation in air and some acids and alkalis but is quickly affected by sulphides.

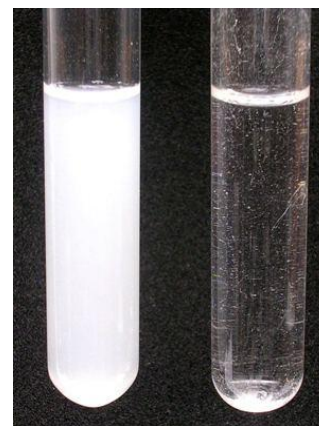
Metal recovery is a 2 stage process. Molten silver-lead is cooled slowly so that lead crystallises and can be taken off giving an enrichment to about 2.5% silver whereupon the whole solidifies. It is re-melted and mixed with molten zinc. The silver preferentially dissolves in the zinc which floats on the surface of the lead and solidifies first on cooling allowing it to be taken off. The silver and zinc are separated by distillation of the zinc or electrolysis. Before this process was developed the silver was recovered by cupellation. The molten silver-lead is stirred and exposed to a continuous blast of air which oxidises the lead forming a surface scum that can be taken off. However, the vast majority of lead-oxide was then of no use, the lead could not be recovered profitably, and was discarded as a very expensive toxic waste product.

In the south-west silver has been recovered from most areas where lead-lodes were worked and Holmbush mine near Callington was renowned for specimens of native silver. The Bere Alston peninsula mines were also rich in silver and worked under the control of the crown from about 1300 until 1600. The mines then closed as the ore was beyond the reach of the technology available to extract it. Flooding was the problem as these mines were at about the same level as the water table

and could only be worked to shallow depths. Steam power became available in the late 1700s, mines reopened and in 1814-15 South Tamar mine produced 3 tons of silver.

The Combe Martin silver-lead mines were productive from about 1300; these deposits are thought to have formed around deep sea 'black smokers'. The mines are situated on a steep hillside and there is little problem with drainage but bunches of ore are very sporadic so work has gone in phases of boom and bust as each new deposit was found.

Fig. 1.



Galena from a location in the south-west was dissolved in nitric acid and the solution filtered. A few grains of table salt were added to the left hand tube precipitating silver chloride. The result is about equivalent to galena with 1% silver metal added and treated in the same way.

Native silver gives a black streak. Acanthite is black-grey also giving a black streak which appears silvery. Silver minerals heated on charcoal form a malleable silver bead. Silver, its ores and argentiferous galena will dissolve in concentrated nitric acid. The solution is boiled dry and the solid boiled again in water with a few drops of nitric acid added. A pinch of common salt added to the solution will produce a white silver chloride precipitate,

insoluble in acids but readily soluble in ammonia. A clean piece of copper placed in the solution for a few hours will become silvered. Or a drop of the solution is placed on a dry filter paper saturated with 5-(4-dimethylaminobenzylidene)-rhodanine where a purple-red colour is a positive result. The precipitation and rhodanine tests are at the limit of their sensitivity for about 0.05% silver content in galena.

Fig 2.

Purple colouration is a positive silver test with rhodanine.



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