Precious metal refining

The purity of gold could be estimated by using a touchstone but the only effective way of determining the purity of silver was by assaying (see below). Whatever their purity, much gold and silver had to be refined before use or re-use as they were often significantly debased. The process known as cupellation was used to separate precious metals from base ones, while silver was separated from gold by parting.

Cupellation
In cupellation the metal to be refined was melted with an excess of lead which was oxidised, forming litharge (lead oxide) which dissolved any base metals present, separating them from the silver or gold.

Silver was refined on a relatively large scale in hearths lined with absorbent material, usually burnt and crushed bones (bone ash) or calcareous clay. The litharge soaked into the lining but the precious metal was mainly left on the surface. The archaeological finds which provide evidence for this process are usually described as litbarge cakes. These plano- or concavo-convex circular lumps of litharge-impregnated bone ash, typically 8-15 cm in diameter, are dense and usually grey in colour though sometimes they contain sufficient copper (which has subsequently corroded) so they look green. They are rarely found complete, the fractures showing a variety of textures ranging from massive to powdery or granular.

Small scale cupellation or fire assaying (testing the purity of a sample of precious metal) was carried out on small shallow dishes or discs known as tests or cupels. Bone ash was also used for making these, but the earliest surviving examples are 16th century ones. All earlier finds of cupels are made of ceramics, of variable quality, which have vitrified upper surfaces, normally rich in lead and highly coloured; potsherds were sometimes used in the same way. There is a central depression in the vitrified surface where the metal being assayed solidified, though sometimes droplets of silver or gold which had failed to coalesce were trapped in the surrounding area. Archaeological examples were noted before their function was accurately identified and many of these have been described as heating trays.

Many of the cupels containing gold have only low lead contents in their vitrified surfaces. In these cases the metal has probably just been melted in strongly oxidising conditions to burn out the base metal impurities, perhaps with a flux of some sort, rather than being cupelled. Cupels with traces of gold are usually made of harder, more refractory fabrics than those with silver residues.

Parting
Archaeological evidence for parting, the separation of silver from gold, has only recently been recognised. Parting was a solid state process until the introduction of distillation in the later medieval period made the production of strong mineral acids possible. It involved making thin sheets of the mixed metal, packing them into a pot interleaved with a 'cement' of crushed brick or tile mixed with salt, sealing up the pot and heating it (below the melting point of the metal) so the salt reacted with the silver in the metal, forming silver chloride which was volatile and was absorbed by the cement and the walls of the pot. When the pot cooled the gold could be removed and remelted and the cement smelted to recover the silver.

A wide variety of vessels were used for parting, and not all were purpose-made. They are usually oxidised fired (the only metal-working vessels that are) and are readily identifiable as they usually have a pale pinky-purple colour on the inside (not the orangey-brown normally associated with oxidised fired ceramics). Sometimes specular haematite crystals, areas of lemon-yellow colour or even flecks of gold are visible. Some show no vitrification while others have a thick, exterior glaze that may be coloured turquoise or deep green.

Further reading

The following publications all contain illustrations of cupels or parting vessels and/or further details of precious metal refining processes.

Bayley, J (1988) Non-ferrous metalworking: continuity and change. In E A Slater and J O Tate (eds) *Science and Archaeology, Glasgow, 1987*,193-208. BAR Brit Ser 196.

Bayley, J (1990) *Evidence for metalworking*. Datasheet 12. Finds Research Group 700-1700.

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Bayley, J (1991) Archaeological evidence for parting. In E Pernicka and G A Wagner (eds)*Archaeometry '90*, 19-28.

Bayley, J (1992) Metalworking ceramics. *Medieval Ceramics* 16, 3-10.

Moore, D T and W A Oddy (1985) Touchstones: some aspects of their nomenclature, petrography and provenance. *Journal of Archaeological Science*, 12(1), 59-80.

Oddy, A (1983) Assaying in antiquity. *Gold Bulletin*, 16(2), 52-9.

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