Depletion gilding and surface treatment of gold alloys from the Nariño area of ancient Colombia

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Introduction

The pre-Hispanic Indian cultures of the Colombian region of South America are well-known for their mastery of the art of lost-wax casting, for the fabrication of gold-copper alloys (which are often known as tumbaga alloys), and for the gilding of these alloys by surface enrichment techniques. There are many interesting and unusual features connected with the utilisation of gold in South America, especially in the production of gilded surfaces. Examples of some gilding techniques are: the electrochemical replacement plating of gold or silver on copper objects from the Mochea culture of Peru; the depletion gilding of ternary gold-silver-copper alloys from the Chimú culture of Peru; and the fusion-gilding of copper objects from the Esmeraldas district of Ecuador. The present article examines some of the surface treatments which were in use by the Indians of the Nariño area, in the southern highlands of Colombia.

Depletion Gilding

A widespread technology, particularly in the ancient Colombian region (which takes in present-day Panama and Costa Rica), was the gilding of gold-copper alloys by the removal of some of the surface copper, a process variously known as gilding, mise-en-couleur, surface enrichment, depletion gilding and colouring.

Lechtman prefers the term depletion gilding to surface enrichment; he defines it as 'the enrichment of a surface in gold by the removal of other alloying elements already present'. There is some justification for this; surface enrichment is a process which can take place during burial of archaeological metals and can also be used in a more restrictive sense in the investigation of modern alloys which may show some elemental variation over the first few Angstroms of the surface.

Neither of these processes of surface enrichment is directly relevant to the discussion of gilding techniques employed by the ancient Indians, for here we are dealing with a deliberate enrichment technique which results in a gold-rich layer whose thickness can be measured in microns rather than Angstroms. The use of the word 'colouring' is not advisable since it is meant as a process distinct from surface enrichment, which is sometimes known as gilding, mise-en-couleur, surface enrichment, depletion gilding and colouring.

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Figure 1 shows a complete object and some fragments of tumbaga alloy from the Nariño area of Colombia. The disc shown in Figure 1 is in the collections of the Museo del Oro, Bogota (Museum No 21222); it was found in the Municipio of Pupiales, Department of Nariño, in the Andean highlands north of the Ecuadorian border and is from the Pital period, dating from about 800 AD to 1250 AD. This disc is made in a low gold content tumbaga (between about 15% to 25% gold by weight) which has been finished by depletion gilding and which shows a geometric design laid out over both surfaces in contrasting matt gold and burnished gold areas. The geometric design is matched on both sides and there is some evidence that discs like this were displayed by suspension on a cord attached to the central hole in the disc.

There are many examples from the Nariño area of circular discs with geometric designs in contrasting surface colour or surface finish; for example, a disc illustrated by Plazas de Nieto also from the municipio of Pupiales, shows a design combining the use of matt gold, burnished gold and copper-coloured areas. With the permission of the curatorial staff of the Museo del Oro, Bogota, some small fragments of gold and tumbaga were allowed to be taken to the Institute of Archaeology, University of London, for study by chemical and metallurgical means.

Figure 2 illustrates some of the fragments which were examined, including two pieces which show matt gold and burnished gold surfaces (numbers 2a and 2c). Number 2g is a fragment of a circular disc from the Municipio of Pupiales, and is typical of much of the metalwork from the Nariño area. The disc has an estimated diameter of 110 mm and the thickness of the fragment varies from 0.39 mm — 0.41 mm. A characteristic feature of these Nariño tumbaga discs is that their thicknesses do not vary over wide limits; the surfaces have been smoothed and show no evidence of hammer marks. The careful control of the thickness of these sheet metal discs suggests the use of an abrasive finishing process to eliminate unevenness on hammering out the tumbaga ingot, for all of these Pital period discs have been worked to shape rather than cast by the lost-wax process. Table 1 gives some analytical information for the objects shown in Figure 2; fragment 2g contains 15.3% gold, 80.5% copper and 2.6% silver (by weight), and the surfaces have been enriched in gold. They are a deep yellow colour with some purple-brown staining as a result of corrosion during burial.

Figure 3 shows the microstructure of the fragment removed for examination. The tumbaga alloy has been worked to shape with small, twinned grains in which most of the twin lines appear straight, indicating that the final stage in the manufacturing process was an annealing operation. There are some cuprite inclusions in the metal, as well as cuprite lamellae running along the length of the section. Corrosion during burial results in the massive cuprite lamellae to be seen in the microstructure of many low-gold tumbaga alloys. The depletion gilded zone appears as a very thin gold rich layer on both sides of the section. The microstructure shown by this section is essentially that of a single-phased gold-silver-copper solid solution. Native gold was used in the ancient Colombian region without refining by cupellation or cementation, and so invariably contains a certain percentage of silver. The silver content of the native gold from Colombia may vary from approximately 0.1% to 40% silver,