

EXAMINATION OF TWO GOLD OBJECTS OF ABORIGINAL MANUFACTURE

EARLE R. CALEY

Department of Chemistry, The Ohio State University, Columbus 10

As a consequence of his publication in this journal of a paper (Caley, 1949) on the estimation of the fineness of gold objects by means of specific gravity measurements, the author has received a number of such objects for examination. Two of these objects seemed especially interesting as examples of aboriginal gold working, and the results of their examination are here presented. Both objects were submitted by Frederick R. Pleasants, Curator of Primitive Art, The Brooklyn Museum.

One of the objects, a large pendant apparently intended as a breast ornament, came from the Ivory Coast, West Africa, and probably was made sometime in the last century. Its general form is that of a low hollow cone with a diameter at the base of 9.5 cm. and a maximum height of 3.5 cm. It represents a coiled snake holding a frog or toad in its mouth. From directly above, the object appears to be solid, but only the top half of the body of the tightly coiled snake is actually present. Both the scales of the snake and the spots on its victim are conventionally, but artistically, represented. The shape of the object and the absence of any sign of hammering or tooling shows that it must have been cast in one piece by the *cire perdue* method. Its production by casting is further indicated by the traces of carbonized molding sand still present in some of the crevices about the mouth of the snake.

The entire surface of the object has the rich yellow color of gold of high fineness, except for a few minute areas on metal in higher relief on the bottom of the rim of the base where slight wear has occurred. Here the surface is very pale yellow. By making test scrapings in a few inconspicuous places it was seen that the metal below the surface is generally very pale in color, almost like silver in appearance. The weight of the object was found to be 83.49g., and its specific gravity at 25°C was found to be 12.05. Chemical tests on minute specks of the underlying metal showed that the alloy contains both silver and copper, with the latter in slightly higher proportion. The average gold content of this object as derived from its specific gravity and these tests is only about 40 percent, or in other words the metal as a whole is only about 400 fine or about 9.6 karat. Native gold of this composition is very rare, and it therefore is very probable that the alloy was especially prepared.

This object in all probability was colored by the *mise en couleur* process. That is, the original casting of base gold was first treated with some corrosive paste or liquid to dissolve out the baser metals from the surface, leaving pure gold in a finely divided state on the surface. Bowditch, an eye witness of the methods used by native gold workers among the Ashanti of West Africa, in 1819, reports that, "To give the gold its proper color, they put a layer of finely ground red ochre (which they call *inchuma*) all over it, and immerse it in boiling water mixed with the same substance and a little salt; after it has boiled half an hour, it is taken out and thoroughly cleansed." This account is perhaps incomplete, as red ochre and salt water would not be effective in removing base metals from the surface rapidly, though the mixture would be effective for polishing to a clean, bright surface. Possibly some acid vegetable extract was also added, for Zeltner reports that water, salt, and brew from the tamarind fruit was used by the Bambara for cleaning copper castings. Regardless of the way in which the baser metals were removed from the surface, it is unlikely that the color could have been developed only by polishing or

burnishing, for the attaining of a fine gold color after corrosion is very difficult by such means when the alloy is less than 500 fine. It is much more likely that the object was first heated, perhaps with a blowpipe, to fuse the gold on the surface, prior to any final cleaning and polishing. There is no indication of the application of gold leaf or of gilding by amalgamation, and there would be no reason for using such processes when the metal was a gold alloy. The whole method of making this object is indicative of a high state of skill and practice in the art of gold working.

The other object, a plain, hemispherical bowl, came from Colombia, South America, and was said to have been produced by hammering out a single large gold nugget. The date of its manufacture is unknown. Its maximum diameter at the rim is 11.2 cm., its minimum diameter is 10.7 cm., and its height is 5.3 cm. The average thickness of the metal as measured at the rim is 0.15 cm. Both the inside and outside surfaces of the bowl are covered with small hammer marks. A few cracks and indications of closed cracks and folds are evident on the outside surface, especially at the bottom.

The color of the metal is decidedly lighter than that of fine gold, and is similar to that of brass. Test scrapings on the rim showed no indications of any enrichment of the surface. The weight of the object was found to be 227.8 g., and its specific gravity at 25°C was found to be 16.13. Chemical tests on minute scrapings from the rim showed that the metal was composed mostly of gold and silver with only a small proportion of copper, which was estimated to be about 1 percent of the whole. The gold content of the metal as derived from both its specific gravity and these tests is about 77 percent, which corresponds to 770 fine or 18.5 karats.

According to Rivet and Arsandaux (1946) native gold from Colombia is mostly argentiferous and contains little copper. In their list of assays of 56 specimens of native gold from Antioquia, the principal gold-producing province, the range of gold content is from 63.4 to 96.5 percent with an average of 82.6 percent. The gold content of specimens from certain sites is almost the same as that of the object here discussed. Assays of native gold from other provinces show a range from 73.5 to 98.0 percent, with an average of 85.3 percent. These authors also list quantitative analyses of 23 objects said to have been made from Colombian native gold. The gold content of these objects ranges from 68.3 to 91.4 percent, the silver content from 8.6 to 31.7 percent, and the copper content from 0.0 to 1.9 percent.

Both the appearance of this bowl and its chemical composition are therefore consistent with the report that it was made by hammering out a nugget of Colombian native gold. In contrast with the first object, this second one was made by the most primitive method of gold working.

LITERATURE CITED

- Bowditch, T. E.** 1819. Mission from Cape Coast Castle to Ashantee. London.
Caley, E. R. 1949. Validity of the specific gravity method for the determination of the fineness of gold objects. *Ohio Jour. Sci.*, 49: 73-82.
Zeltner, Fr. de. 1915. Notes sur quelques industries du Soudan Francais. *L'Anthropologie*, 26: 222.
Rivet, P., and H. Arsandaux. 1946. La métallurgie en Amérique précolombienne. Paris.