METALLURGY IN SHANG CHINA

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Introduction

A suitable occasion for a re-examination into the origin and the unique process of bronze casting in Shang China is afforded by the publication of a report on two metal weapons in the Freer Gallery of Art (12) *). It presents the results of a collaborative work of three experts who spent years in the study of these two unique artifacts which are two standard types of Shang and Chou weapons, a ch‘i 錾 broad-axe and a ko 戈 dagger-axe. Reported to have been recovered from an early Chou tomb in Hsun-hsien 淮縣, they can be dated to before 1,000 B.C. As the former has been found so far only in Shang contexts there seems no doubt that it is a hold-over from the Shang dynasty. However, they have one unusual feature in common. The axe consists of a bronze tang and an iron blade, while the dagger has a bronze blade with the remains of an iron point. It shows that iron was used in China in late Shang and early Chou times.

These specimens were subjected to a large number of scientific investigations. Apart from chemical analysis, a variety of instrumental techniques, such as X-radiography, X-ray diffraction, electron-beam micro-spectrometry and emission spectrometry were employed. The results allow us to draw the following conclusions:

1. Both weapons are made of moderately high tin alpha bronze and cast in a two-piece mould which incorporated the iron blade.

2. The bronze used is quite different in the two cases. The alloy for the axe consists mainly of 81.8% copper, 15.8% tin and a trace of lead, while the major constituents of the dagger are 85.5% copper, 12.2% tin and 2.1% lead. In both cases the lead content is low, showing a marked difference from the alloy used in the ritual vessels of the same period. The latter is usually of highly leaded bronze.

*) All references in the text are placed in parentheses. The number in italics refers to the book or article under that number in the Bibliography that follows the text. In most cases the page reference is also given.
3. The iron used in both weapons is of meteoritic origin. The metal was cast individually in the required shape for the blade and then joined to the bronze tang by the casting-on method. The technique used in the casting is again quite different in the two cases. For the broad-axe the iron blade has three perforations along the joining edge. The mould for the bronze tang was built around the wide end of the bit and the tang was cast on to it. The molten bronze ran into the holes in the iron and when solidified, the blade and tang were securely locked together. In the case of the dagger-axe, the iron point terminated in a double notched key by which it was cast-on securely to the bronze blade.

4. The difference between the two weapons both in the bronze alloy and in the technique of manufacture indicates that they were made in two different periods, the broad-axe in late Shang and the dagger-axe in early Chou. The shapes and the designs also support such an assumption.

It may also be noted that Mr R. J. Gettens is the author of the technical studies of the Freer Chinese bronzes (11), published in 1969. These give the results of the laboratory researches carried out to determine the chemical composition, fabrication, metal structure and corrosion products of each individual example. Apart from all the scientific techniques which include microscopy, metallography, analysis by spectrography, X-ray diffraction, wet chemical methods, ultra-violet light and radiography, special emphasis was placed on X-ray examination. Although much new information on the structure, assembly and ancient and modern repairs of the bronzes in the famous collection have been revealed, Dr J. A. Pope, Director of the Freer is obliged to conclude that—

"No amount of laboratory examination and analysis can per se 'date' a Chinese bronze. It is simply a means of adding additional facts not otherwise obtainable to our store of knowledge, the knowledge by which in the last analysis the bronze must be judged." (38, 3)

The technical aspects of Chinese bronze seem to have remained a complicated and puzzling affair.

Ancient Chinese literature takes for granted that metallurgy was known in China right from the very beginning of her history. The knowledge was known to the first emperor. According to the Shih-chi 史記, "Huang-ti (2674-2575: 44) made three precious kíng cauldrons, representing Heaven, Earth and Man" 蒼帝作寶鼎三,