The Beginnings of Chinese Bronze

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I. BRONZE IN ANCIENT CHINESE LITERATURE

Ancient Chinese literature takes for granted that bronze was in use in China right from the beginning of her history. The knowledge was known to Huang-ti 黃帝, the earliest ancestor of the Chinese people. According to *Shih-chi*, 史記 (*Record of the Historian*) the first general history of China, "Huang-ti (2697-2596, traditional dating) made three precious *ting* tripods, representing Heaven, Earth and Man, and Yü (2205-2198) received *chin* 金 metals from nine regional governors to cast nine *ting* tripods." 黃帝作寶鼎三，象天地人。禹收九牧之金，鑄九鼎(23, 28.29a).* To the ancient people the metal was known as *chin*, not *ch'ing-tung* 青銅 or bronze.

The purpose and significance of such precious vessels were fully described in *Tso-chuan* 左傳, a commentary on the *Ch'un-ch'iu* 春秋 (25) (*Spring and Autumn Annals*), centuries before the *Shih-chi*, as follows:

> "Anciently, when Hsia was distinguished for its virtue, the distant regions sent pictures of the [remarkable] objects in them. The nine pastors sent in the metal of their provinces, and the tripods were cast with representations on them of those objects. All the objects were represented, and [instructions were given] of the preparations to be made in reference to them, so that people might know the sprites and evil things. Thus the people, when they went among the rivers, marshes, hills and forests, did not meet with the injurious things, and the hill-sprites, monstrous things and water-sprites, did not meet with them [to do them injury]. Hereby a harmony was secured between the high and the low, and all enjoyed the blessing of Heaven. When the virtue of Chieh was all obscured, the tripods were transferred to Shang for 600 years. Chou of Shang proved cruel and oppressive, and they were transferred to Chou. . . . King Ch'eng fixed the tripods in Chia-ju, and divined that the dynasty should extend through 30 reigns, over 700 years." (23, 21.8b)
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> 昔夏之方有德也，遠方圖物，貢金九牧，鑄鼎象物，百物而爲之備，使民知神姦。故民入川澤山林，不逢不若螭魅罔兩，莫能逢之，用能協於上下，以承天休。桀有昏德，鼎遷於商，載祀六百，商紂暴虐，鼎遷於周……成王定鼎於郟鄏，卜世三十，卜年七百。

To the ancients, these auspicious objects were symbols of dynastic legitimacy. They signified actual political power.

Accounts of bronze industry, including the search for the relevant minerals in ancient China have also been handed down in the Chou literature. 467 mountains which produced metal ores were recorded in a chapter on "geology" in *Kuan-tzu*

*All references in the text are in parentheses. The numbers or letters in bold face refer to the book or journal under those letters in the Bibliography that follows the text. In most cases the page reference is given.

管子·地數篇 (17). It proceeds to note that deposits of *t'ung* 銅 copper and *chin* 金 gold are to be found in those that yield *tz'u-shih* 磁石 magnetic stones on the surface, while *ch'ien* 鉛 lead, *hsi* 錫 tin and *ch'ih-t'ung* 赤銅 copper are to be unearthed in those that possess *ling-shih* 陵石 green mineral (malachite) on the surface. 出銅之山四百六十七……上有慈石者下有銅、金；上有陵石者下有鉛、錫、赤銅。Many of these may be identified in the landscape of the Central Plain in China. (18)

The technique of bronze manufacture was briefly mentioned by Mo-tzu 墨子 in his chapter entitled *Keng-chu-p'ien* 耕柱篇 (22):

> "In the old days, Hsia-hou K'ai (2197-2189) despatched Fei Lien to quarry (extract) metal from the hills and streams, and then have it smelted and cast at K'un-wu."
> 昔者夏后開〔啟〕使蜚廉折〔或作採〕金於山山，而陶鑄之於昆吾。

K'un-wu, famous as the centre of ceramic industry in the Hsia period, may be identified as a locality to the east of P'u-yang 濮陽 in modern Hopei. As pottery-making was already a well-established technology in the prehistoric days, it may be presumed that the new industry was developed from the practising tradition with fire as the main source of power and smelting and casting as the basic techniques of manufacture. Hence, *t'ao* 陶 pottery making, *yeh* 冶 smelting, *chu* 鑄 casting, *lu* 爐 kiln furnace in all sorts of combinations were common in both traditions throughout the ages. The new industry began to flourish with the progress of time and its products such as *K'un-wu tao* 刀 knives, *K'un-wu chien* 劍 swords, *K'un-wu ting* 鼎 tripods, *K'un-wu wa* 瓦 tiles have been recorded in Chou literature. Other legends claimed that the bronze industry was so successful that the enterpreneur was enfeoffed there as a *Po* 伯 Earl of the Hsia dynasty.

The development of bronze industry reached its height in the Shang and Chou dynasties (1766-220). Apart from the improvements in the methods of casting, the Chou bronze masters experimented in producing all sorts of alloy for the manufacture of various types of vessels and artifacts. Six standard formulae are recorded in another Chou writing, the *K'ao-kung-chi* 考工記 (12, 40.6a) as follows:

1. Five parts of copper and one part of tin: this is for the casting of *chung* bells and *ting* tripods;
2. Four parts of copper and one part of tin: this is for the casting of *fu* and *chin* axes;
3. Three parts of copper and one part of tin: this is for the casting of *ko* dagger-axes and *chi* battle axes;
4. Two parts of copper and one part of tin: this is for the casting of *ta-jen* big knives;
5. Three parts of copper and two parts of tin: this is for the casting of *hsueh-sha* scrapers and *shih* arrow-heads;
6. Half portions of copper and tin each, this is for the casting of *ching* mirrors and *sui* fire-makers.

金有六齊。六分其金而錫居一，謂之鐘鼎之齊；
五分其金而錫居一，謂之斧斤之齊；
四分其金而錫居一，謂之戈戟之齊；

三分其金而錫居一，謂之大刃之齊；
五分其金而錫居二，謂之削殺矢之齊；
金錫半，謂之鑑燧之齊。

While the Chou bronze-masters were busy developing their arts and craft, another Chou scholar, *Feng-hu Tzu* 風胡子 was attracted by the part in which bronze weapons had played in the progress of material culture. As a result of careful observation and study, he arrived at the conclusion that there were four successive stages in the development of Chinese culture, characterized by the use of stone, jade, bronze and iron. This is recorded by Yuan K'ang 袁康 in his *Yüeh-chüeh shu* 越絕書 (30) in the following dynasty. The text reads:

> "In the time of Hsüan-yüan, Shen-nung and Ho-hsü, weapons were made of stone for cutting trees in order to build houses. . . . In the time of Huang-ti, weapons were made of jade, for cutting trees in order to build houses and to dig the ground. . . .
>
> In the time of Yü, weapons were made of bronze for cutting the passage for River Yi in order to make a passage through the Lung-men gateway, and for dredging the beds of Huang-ho and its fellow rivers, channelling them into the Eastern Sea. All the lands were accessible and level for the building of houses. At this time, weapons are made of iron, thus putting the three Armies in awe, and no country dare not to obey."
>
> 軒轅、神農、赫胥之時，以石爲兵，斷樹本爲宮室……。至黃帝之時，以玉爲兵，以伐樹木爲宮室，鑿地……。禹穴之時，以銅爲兵，以鑿伊闕，通龍門，決江導河，東注於東海，天下通平，治爲宮室。……當此之時，作鐵兵，威服三軍，天下聞之，莫敢不服。（記寶劍）

It proceeds to take note that in some cases the ancient weapons were buried with the dead.

To a modern archaeologist who is familiar with the three-age system advanced by Thomsen at the beginning of the last century, it is fascinating to find that Feng-hu-tzu had actually conceived the idea of four stages in the development of Chinese civilization by taking note of the ancient weapons which had been buried with the dead. The results of recent archaeological investigations in China have also confirmed the wide usage of jade artifacts in the pre-Hsia days and it continued to be in fashion in the Shang and Chou periods.

The tradition of studying the ancient relics which subsequently came to light has been faithfully upheld by later scholars and by the time of the Sung dynasty (960-1278) it had become a systematized academic discipline known in Chinese as *Chin-shih-hsüeh* 金石學. (10) The term means literally the study of ancient bronzes and stones, but in fact it covers all archaeological specimens including pottery, seals, costumes and architecture. The main emphasis of the subject, however, has been placed on epigraphy, dealing with the inscriptions on these ancient objects. As a result books on the subject enough to fill a library has come down to us. One of the early catalogues *K'ao-ku-t'u* 考古圖, (21) compiled by Lü Ta-lin 呂大臨 recorded 211 bronzes and 13 jade objects in the palace and private collections of his time, giving illustrations, place of origin if known and dimensions and weight. Many intensive studies of Chinese bronzes have been accumulated in the following dynasties. It is evident that China has had an indigeneous tradition in archaeology.

II. THE ORIGIN OF CHINESE BRONZE

The collection of Chinese bronzes in the West and the introduction of modern archaeology at the turn of the century in China brought forth an intriguing issue with regards to the origin of bronze in China. The magnificent art became a puzzling problem in scholarship. Superb in manufacturing skill, unique in structural form, characteristic in decorative treatment and in some cases documented with inscriptions, they stand unrivalled throughout the world. The earliest examples were known then from the ruins of the Late Shang capital at An-yang, Honan, traditionally dated to 1766–1122 B.C. As the technique of manufacture was already fully matured, the art seems to have dropped down suddenly from heaven. In search of its origin some traced it to Mesopotamia in the west and others to Siberia in the north, and more recently Thailand in the south has also been proposed. The results of these academic exercises are indeed facinating and sensational and have attracted much attention especially in the West, but they are far from being able to produce any concrete evidence of cultural diffusion. On the contrary, however, the efforts of the Chinese archaeologists in the field have brought to light in recent decades enough data to show that the use of bronze in China can be pushed back to at least 3,000 B.C. in the Huangho basin. The industry has its roots in the prehistoric past and its beginnings may now be told. Let us have a review first of all of the evolution of the Late Neolithic culture in the Huangho basin revealed by the Chinese archaeologists so far. (2, 4, 5, 7, 8, 9, 11, 13, 14, 15, 26)

Middle Huangho

It is generally accepted that the Central Plain of China, which occupies the valleys of Middle Huangho was the cradle of Chinese civilization. In the course of time it expanded along the river eastward into Hopei and Shantung and westward into Kansu and Chinghai. Throughout the river basin thousands of Late Neolithic sites have been investigated. For the early Late Neolithic stage three distinctive cultures have been recognized, namely P'ei-li-kang 裴李崗 in central Honan, Tz'u-shan 磁山 in Hopei and Ta-ti-wan 大池灣 in Shensi and Kansu. They have all been found under the typical Late Neolithic Yang-shao 仰韶 cultural deposits in stratified order and the results of C14 tests have ascribed them to around 5,000 B.C.

The pre-Yang-shao sites may be represented by some village ruins which occupy usually rather limited areas with thin layers of cultural debris. The structural remains are invariably ruins of round or square subterranean dwellings and storage pits and in some cases, pottery kilns. They were apparently permanent settlements with a common cemetery beyond the village limit nearby.

The Yang-shao culture, with its centre in and around the Central Plain, has a wide distribution. The results of C14 tests produced by dozens of excavated sites give a date of roughly 4500-2500 B.C., a period of no less than two thousand years. The long development in various regions and in different stages produced some varying types of cultural elements showing that they belong to the same basic culture but in various stages of admixture and development.

The Yang-shao people lived in villages. Some of their settlements were systematically laid out covering a considerable extent in area. The site of Pan-p'o-tsun半坡村 near Sian, for example, is estimated to be about 50,000 square metres in size. In the centre of the village plaza in a huge long house, which served as a communal hall and around it clustered smaller dwellings, storage pits and animal pens. Apart from husbandry and agriculture the people practised various types of handicrafts, especially ceramic works which set the foundation for bronze industry later on. It was succeeded stratigraphically by a more advanced stage known as the Lung-shan 龍山 culture.

The developmental sequence in the Central Plain shows that Lung-shan evolved directly from Yang-shao and as a result of cultural mixing and social and economic changes new elements and institutions were introduced. It existed in this region for a period of at least 500 years roughly 2,500-2,000 B.C., but elsewhere it continued to develop into the historical period.

The Lung-shan people were basically farmers living in a more permanent settlement than the preceding stage. Their farming implements, working tools and military weapons were all better developed and in architecture woodwork was supplemented with *hang-t'u* stamped-earth for wall building and man-made lime for surfacing the floor. Some of the villages were surrounded with city walls while communal cemetery and ceramic kilns were located outside the village compound.

The ceramic industry of Lung-shan was very inventive. With the Yang-shao tradition behind it, the aim of the art was to produce a ware with two essential qualities, thinness and hardness. In achieving the latter the use of fire was greatly improved setting the foundation for the invention of bronze. Remains of the new industry and fragments of its products will be mentioned in due course.

In the course of its development the Lung-shan community grew into city states characterized by the establishment of a dynastic form of government and all sorts of handicrafts and industries flourished including the firing of hard stoneware and casting of bronze. Archaeologically, the abundance of Erh-li-t'ou 二里頭 (2,200-1,800 B.C.) remains in Honan and Shansi are enough to present an adequate picture of this stage, which has been recognized as Erh-li-t'ou-Hsia culture. It links the prehistoric Lung-shan to the historic Shang in stratified order. Thus the cultural development in the Central Plain substantiates the sequence recorded in the traditional history.

Upper Huangho

The prevailing culture in the Late Neolithic Upper Huangho may be closely linked with Yang-shao of the Central Plain. Represented by the remains of the Ma-chia-yao 馬家窯 and Ma-ch'ang馬廠, they form a western branch of Yang-shao. Hence it is sometimes known as the Kansu Yang-shao. Relations between them have been noted not only in the stratigraphic sequence but also in their respective cultural elements. The results of C14 tests ascribe the Ma-chia-yao and Ma-ch'ang deposits to 3400-1700 B.C., evidently a distant offshoot of Yang-shao. It was followed by the Ch'i-chia 齊家 (2,200-1,600 B.C.) and Huo-shao-kou 火燒溝 (1,770-1,630 B.C.) cultures into the historical period. The chronological sequence in Kansu has also been established by stratigraphic evidence.

Lower Huangho

The Late Neolithic Lower Huangho presents a different picture. The earliest stage of the culture here was dominated by the Ch'ing-lien-kang 青蓮崗 (roughly 4,800-3,700 B.C.) which held sway also in the Lower Yangtse, where a series of prehistoric cultures developed in an independent chronological sequence. Ch'ing-lien-kang was followed by Ma-chia-pin 馬家濱, (roughtly 3,700-3,000 B.C.). Sung-tse 崧澤 (roughly 2,900-2,700 B.C.) and Liang-chu 良渚 (roughly 2,800-1,900 B.C.) in chronological order into the historical period. But under the influence from the Central Plain, Ch'ing-lien-kang in Lower Huangho developed as Ta-wen-k'ou 大汶口 (roughly 3,900-2,200 B.C.) and it was followed by Lung-shan and on account of a number of unique elements it is sometimes labelled as Shantung Lung-shan. Subsequently, cultural mixing brought forth the Yüeh-shih 岳石 culture which flourished in southern Shantung and northern Kiangsu. (roughly 1,800-1,600 B.C.)

The archaeological data of Late Neolithic Huangho Basin may be tabulated as follows:

Late Neolithic Huangho Basin

<table>
<tr><th>Regions / Periods</th><th>Upper Huangho</th><th>Middle Huangho</th><th>Lower Huangho</th><th>Dating</th></tr>
<tr><td rowspan="2">BRONZE AGE</td><td>Ssu-pa (Huo-shao-kou)</td><td colspan="2">Shang</td><td>1000 B.C.</td></tr>
<tr><td>Ch'i-chia</td><td>Erh-li-tou-Hsia</td><td>Yueh-shih
Hsia-chia-tien
Lung-shan</td><td>2000 B.C.</td></tr>
<tr><td rowspan="5">LATE NEOLITHIC AGE</td><td>Ma-ch'ang</td><td>Lung-shan</td><td rowspan="2">Ta-wen-k'ou</td><td></td></tr>
<tr><td>Ma-chia-yao</td><td rowspan="3">Yang-shao</td><td></td><td>3000 B.C.</td></tr>
<tr><td rowspan="2">Ta-ti-wan</td><td rowspan="2">P'ei-li kang</td><td rowspan="2">Ch'ing-lien-kang</td><td></td></tr>
<tr><td>Tz'u-shan</td><td>4000 B.C.</td></tr>
<tr><td></td><td></td><td></td><td></td><td>5000 B.C.</td></tr>
</table>

It remains to be noted that the expansion of Lung-shan northward gave rise to the Hsia-chia-tien 夏家店 culture, which enjoyed a wide distribution in northern Hopei, Inner Mongolia and Liaoning. It was the result of cultural contacts between the Huang-ho Neolithic and the Inner Mongolian Microlithic along the Hsi-la-mu-lun-ho 西喇木倫河 and the Liao-ho 遼河 regions. Radio carbon tests of the contents from the lower level of the cultural deposits ascribe the date to around 1,900-1,700 B.C. almost contemporaneous to that of Lung-shan in Shantung.

The archaeological data summarized above demonstrates beyond the shadow of a doubt that the culture of historic China had its roots in the Neolithic past. The population was native in origin and the culture they created was characteristically their own. By the end of the Lung-shan stage, the Central Plain and the Lower Huangho were teaming with various groups of tribal states and one of them rose in dominance and founded eventually a centralized government, recorded in the traditional history as the Hsia dynasty, the first of the Three Dynasties. (**11**; **26**, 93-294; **KG**, 79, 5, 393-403; 84, 3, 271-277)

With the establishment of the Late Neolithic sequence in the Huangho Basin as the background, remains of bronze artifacts of this stage may now be introduced.

III. PREHISTORIC BRONZE IN CHINA

The search and study of bronze artifacts in the Neolithic remains in China was probably started by Professor T'ang Lan 唐蘭 of the Peking Palace Museum. A posthumus paper of the celebrated scholar on the beginning of Chinese bronze was published in 1979. (**24**) It declared that the art was in service in the Late Neolithic Yang-shao period around 5,000 B.C. He cited a broken nickel-copper hairpin from Pan-p'o 半坡, Sian, a fragment of a brass tube from Chiang-chai 姜寨, Lin-t'ung 臨潼 in Shensi and a bronze knife from a Ma-chia-yao 馬家窯 level in Kansu as evidence of his declaration. In the same year, the Kansu Provincial Museum announced the discovery of another bronze knife from a Ma-ch'ang 馬廠 deposit in the same province (**16**), and took the two specimens as evidence of a transitional stage between the Stone and the Bronze Ages in China.

In reviewing these proposals two years later, An Chih-min 安志敏 of the Institute of Archaeology pointed out that the first two specimens were probably intrusive articles in the ancient deposits and they cannot be taken as evidence in the study. The two bronze knives which were found at Chiang-chia-p'ing 蔣家坪, Yung-teng 永登 and at Lin-chia 林家, Tung-hsiang 東鄉 respectively are both well manufactured by mould-casting and radiocarbon dating has ascribed the Ma-chia-yao to 2575-2500 B.C. (calibrated: 3100-3010 B.C.) and the Ma-ch'ang remains to 2020-1715 B.C. (calibrated: 2680-2355 B.C.). To the reviewer the former seems chronological a bit too early, while the latter sound more reasonable. He held the opinion that more examples would be required to support a definite conclusion. (**3**) Now, new discoveries of bronze articles in China in the last few years have begun to set the proposal on a more solid foundation.

Up to the spring of 1984, more than 300 pre-Shang bronze artifacts have been

reported. The new materials were unearthed in a very wide area, covering the entire Huangho basin. They were found invariably in association with the successive cultural deposits in their respective regions as follows:

Middle Huangho

1. Yang-shao
   (a) Pan-p'o 半坡, Sian: A fragment of bronze ornament, which contains some 20% of nickel, an alloy of copper and nickel. (3, 270)
   (b) Chiang-chai 姜寨, Lin-t'ung 臨潼, Shensi: a fragment of bronze article which is composed of 65% of copper, 25% of zinc, 2% of tin and 6% of lead, recognized as a brass object. (3, 270)
   (c) Yuan-wo-chen 源渦鎮, Yü-t'zu 榆次, Shansi: A fragment of a pottery *k'an-kuo* 坩堝 crucible with some metallic slags which have been found to consist of copper (47.67%), silicon (26.81%), calcium (12.39%) and iron (8.00%). (3, 272)

   As these three specimens are neither copper nor bronze, their authenticity as a genuine Yang-shao remains has been questioned by An Chih-min mentioned above. However, if the flourishing ceramic traditions of the Yang-shao potter who was capable of maintaining a kiln at no less than 1050 ℃ was taken into consideration there seems no reason to doubt that he could have accidentally discovered the method of producing metal by smelting. The rough, hard waste left in the crucible after metal was separated from the ores and the impure elements contained in these fragments may be taken to represent some products of early metallurgy. Before the appearance of modern science China was a leader in technological development that resulted from incessant experiments. Naturally, there would not have been standard composition for the production of alloy at the very beginning.
2. Honan Lung-shan
   (a) Mei-shan 煤山, Lin-ju 臨汝, Honan: Ruins of bronze foundries with fragments of pottery crucibles and layers of copper residue. (KX, 82.4.453)
   (b) Tung-chai 董砦, Cheng-chou 鄭州, Honan: A small piece of square bronze fragment about the size of a finger nail has been unearthed by a field team of the Honan Cultural Bureau. (28, 38)
   (c) Niu-chai 牛寨, Cheng-chou, Honan: Fragments of kiln walls and a piece of bronze. (19, 4)
   (d) P'ing-liang-t'ai 平糧台, Huai-yang 淮陽, Honan: Ruins of bronze foundries with remains of smelting copper. (WW, 83.3.36)
   (e) Wang-ch'eng-kang 王城崗, Teng-feng 登封, Honan: A fragment of a bronze vessel. (28, 38)

   The specimen measures 5 × 5.5 × 0.11-0.15 cm. thick in size and 35 grams in weight. The alloy includes 7% of tin and some traces of lead with a layer of green and dark brown patina on the surface. Judging from its size, shape and curvature it may be identified as the bottom part of a

kuei 罍 ewer, which was a characteristic wine container in pottery during the Ta-wen-k'ou and Lung-shan stages. It is interesting to note that such a vessel in bronze was in the collection of Emperor Ch'ien-lung 乾隆 in the 18th century and a line drawing of the vessel may be found in his celebrated catalogue, the *Hsi-ch'ing ku-chien* 西清古鑑. (20)

Among the cultural debris of Wang-ch'eng-kang there are also remains of copper smelting and broken pottery crucibles. It seems reasonable to assume that the bronze fragment was a local product. As the bronze casting in China was an offshoot of ceramic industry, most of early vessels were derived from pottery shapes. (28, 38)

(f) T'ao-ssu 陶寺, Hsiang-fen 襄汾, Shansi: a small bronze *ling* 鈴 bell found associated with two pottery bells of the same type showing that they were produced by the same industry. The alloy is composed of 97.86% copper, 1.54% lead and 0.16% zinc. It may be taken as copper with traces of impure elements. (KG, 84.12.1069-71; 1068).

3. Erh-li-tou-Hsia

(a) Tung-hsia-feng 東下馮, Hsia-hsien 夏縣, Shansi: A copper chisel, a bronze arrowhead, a bronze knife, a bronze fragment and four pieces of stone moulds for casting axes. (KG, 80.2.97-107)

(b) Tung-kan-kou 東乾溝, Lo-yang, Honan: A fragment of a bronze knife. (KG, 59.10.540)

(c) Erh-li-tou 二里頭, Yen-shih 偃師, Honan: More than 30 bronze artifacts in several varieties. (WW, 64.9.33-34; KG, 75.5, 302-309; 83.3.199-216; 84, 1.37-40)

Ritual vessels are represented by ***chüeh*** 爵 wine cups; musical instruments by *ling* 鈴 bells; military weapons by *ko* 戈 dagger-axe, *ch'i* 鉞 battle-axe and *tsu* 鏃 arrowhead; tools by *pen* 鈑 adze, *tso* 鑿 chisel, *tao* knife, *chui* 錐 awl and ***yü-kou*** 魚鉤 fish-hook. There are also some ornamental works in the forms of round and bubble-shaped buttons, discoidal plaque and oval waisted fitting.

The ruins of Erh-li-tou yielded also remains of a bronze foundry. Smelting slags and broken pottery crucibles have often been found in association at the site. The chemical composition of the alloy ranges from 92% copper and 7% tin to 91.66% copper, 7.3% of tin and 1.23% lead. There was already a standard portion of copper in the alloy.

The casting technique of Erh-li-tou reached a high stage of perfection. The *chüeh* wine cup and ***ling*** bell are not large in size, but their shapes of mould parts, which had to be properly assembled, required a rather advanced technique. The perforated inverted bowl around the lower part of the *chüeh* cup was an ingenious idea. Apart from being used in drinking as a wine cup, it was devised with three legs to stand over an open fire and the perforations were aimed at facilitating an easier heating.

The bronze-master of Er-li-tou lost no time in decorating his wares. The designs range from linear, nipple, cloud, and whirligig elements to cruciform

and animal-face patterns. Most of the more complicated patterns are enriched with inlay of turqoise showing that the ancient people were aware that the green semi-precious stone could enhance the brilliance of bronze. The gorgeous animal-face pattern of the waisted oval fitting (Fig. 7.1) serves beautifully as a true masterpiece. The bronze industry was apparently well-established at this stage.

Upper Huangho

1. Ma-chia-yao
   Lin-chia, Tung-hsiang, Kansu: Bronze knife; single mould casting. (18.7)
2. Ma-ch'ang
   (a) Chiang-chia-p'ing, Yung-teng, Kansu: Fragment of a bronze kinfe. (28, 38)
3. Chi-chia
   (a) Ta-ho-chuang 大河莊, Yung-ching 永靖, Kansu: A copper ladle and a fragment of bronze article, composing of 96.96% copper, 0.02% tin and a small trace of lead. (KX, 74.2.53-54)
   (b) Ch'in-wei-chia 秦魏家, Yung-ching, Kansu: One axe, one awl, two finger rings and two ornamental objects. (KX, 75.2.74)
   They are mostly made of copper with some traces of unfused lead and were rendered into shape by casting. The alloy for the ring is composed of 95% copper and 5% tin. Only the copper awl was made by hammering or forging.
   (c) Ch'i-chia-p'ing 齊家坪, Kuang-ho 廣河, Kansu: A socketed axe, 15 cm. long, 3.2 cm. at the blade, 4 cm. at the butt end and 3.1 cm. thick and a mirror, 6 cm. in diameter. (KX, 81.3.277-78)
   The axe has a pair of looped handles on the two sides. It is made of copper, cast with an assemblage of mould parts and decorated with a series of triangular elements. The mirror which still retains its smooth and bright surface is slightly convex giving an image larger than the object itself. It has a curve knot at the back to facilitate easier handling.
   (d) Hsi-p'ing 西坪, Kuang-ho, Kansu: A bronze knife, its total length is 18.3 cm. with 7 cm. for the handle. (28, 39)
   The specimen is quite well preserved with hardly any patina on the surface of the blade.
   (e) Huang-niang-niang-t'ai 皇娘娘台, Wu-wei 武威, Kansu: Some 30 pieces of copper articles including knives, chisels, awl, drill point, finger ring, fragments and slags. (KX, 81.3.287-302)
   They are all made of pure copper by forging, a knife being 99.63-99.87% and an awl, 99.87% of the metal.
   (f) Cha-mu-t'ai 尕馬台, Kuai-nan 貴南, Chinghai: Bubble-shaped buttons, finger-rings and a mirror. (KG, 80.4.365-68)
   The mirror measures 0.4 cm. thick, and 9.0 cm. in diameter, weighing 108 grammes. The knob on the back had broken in use, so a pair of small

holes were drilled along the edge for suspension. The decorative design depicts a seven-beamed star set against a linear background within two concentric rings. The bronze is composed of 91.22% copper, 8.8% of tin and some traces of other impurities. (27, 162)

4. Huo-shao-kou 火燒溝 (Ssu-pa-t'an 四壩灘)
   (a) Ssu-pa-t'an, Shan-tan 山丹, Kansu and (KX, 59.3.12)
   (b) Ch'ing-ch'uan 清泉, Yü-men 玉門, Kansu: More than 200 bronze tools and ornaments, including axes, hoes, sickles chisels, knives, dagger spear-heads, arrowheads, hammers, awls, needles, buttons, earrings, nose-rings, bracelets, tubes and mirror. There are also some stone moulds for casting arrowheads (27, 142-143).

      The majority are made of bronze by casting, but a few copper artifacts are forged. Some of the rings, mostly 5 cm. in diameter are made of pure gold or silver. They were curved into shape from thin metal thread or rod, slightly flattened at the joints. The earring is pointed at one end and flattened at the other by hammering.

      Among the 45 specimens, which have been scientifically examined and analysed, 13 are of pure copper; 7, tin-bronze; 19, lead-bronze and 6 tin-and-lead-bronze (1). Single moulds, valved moulds and multi-moulds were all used in casting. One of the multi-mould products was fashioned with four goat-heads in the four directions, showing the art in its maturity. The culture has sometimes been ascribed to the Late Ch'i-chia stage, dating around 1600 B.C.

Lower Huangho

1. Shantung Lung-shan
   (a) Ta-ch'eng-shan 大城山, T'ang-shan 唐山, Hopei: Two copper pendants (KX, 81.3.274).

      They are both flat, roughly rectangular in shape, plain on the surface but each having a hole near the top for suspension. One of them is made of 99.33% copper while the other is composed of 97.97% copper and 0.17% tin.
   (b) San-li-ho 三里河, Chiao-hsien 膠縣, Shantung: Two fragments of a brass awl. (KG, 77.4.266)

      The alloy contains 20.2-26.4% (averaging 23.2%) zinc.
2. Yüeh-shih 岳石
   (a) Chao-ke-chuang 照格莊, Mu-p'ing 牟平, Shantung: A triangular awl (28, 42).

      The alloy is composed of copper with a small portion of tin and traces of iron, silver, chromium and lead.
   (b) Yin-chia-ch'eng 尹家城, Ssü-shui 泗水, Shantung: a double-barbed arrow-head, a small knife, a nose-ring and several fragments. (29, 82.2.79)
   (c) Ch'eng-tzu 呈子, Chu-ch'eng 諸城, Shantung: A fragment of copper object. (28, 38)

(d) Yang-chia-ch'uan 楊家圈, Ch'i-hsia 栖霞, Shantung: A fragment of copper awl, slags in a bronze foundry and some copper ores. (28, 38)
(e) Ch'ang-tao-tien-tzu 長島店子, Ch'ang-tao 長島, Shantung: Fragment of a copper object. (28, 38)
(f) An-yao-wang-ch'eng 安堯王城, Jih-chao 日照, Shantung: Some copper slags. (28, 38)

3. Hsia-chia-tien 夏家店
(a) Hsüeh-shan 雪山, Ch'ang-p'ing 昌平, Hopei: a bronze knife and a bronze arrowhead. (28, 41)
(b) Liu-li-ho 琉璃河, Fang-shan 房山, Hopei: A bronze earring and a coiled finger ring. (KG, 76.1.60)
(c) Chang-chia-yuan 張家園, Chi-hsien 薊縣, Hopei: One knife, two arrowheads and two earnings. (*Wenwu tzu-liao ch'ung-k'an* 文物資料叢刊, 1 (1977). 163-71; 91)
(d) Ta-t'o-t'ou 大蛇頭, Ta-han 大厂, Hopei: A two-barbed arrowhead. (KG, 66.1.10)
(e) Hsiao-kuan-chuang 小官莊, Tang-shan, Hopei: An earring. (KX, 54.3.81)
(f) Pao-shen-miao 雹神廟, T'ang-shan 唐山, Hopei: 6 pieces of stone valved mould for casting axe, knife and spearhead. (KX, 54, 83-84)
(g) Hsia-chia-tien, Ch'ih-feng 赤峯, Inner Mongolia: Some fragmentary remains of bronze smelting. (KG, 61.2.77-80)
(h) Hsiao-yü-shu-lin-tzu 小榆樹林子, Ning-ch'eng 寧城, Inner Mongolia: A bronze knife, 6.7 cm. long. (KG, 65.12.621)

IV. THE EARLY GROWTH OF CHINESE BRONZE

The archaeological finds of more than 300 prehistoric bronze artifacts and about a dozen foundry ruins in China noted above are enough to show that the art has a history of no less than a thousand years before the founding of the Shang dynasty. It developed slowly and steadily in at least three stages. The seed was sown and germinated in the flourishing ceramic tradition of the Late Neolithic days when all sorts of clay and earth were experimented upon in shaping pottery and building kilns, and fire which had been in use since the Early Palaeolithic time was greatly increased in power. Some of the Yang-shao pottery vessels were hard stoneware, which had been fired at around 1050 °C in temperature. In the course of millennia work in kiln operations, some metals could have been accidentally extracted from the ores which happened to be present in the clay or earth and the hard and tough raw substance readily appreciated and put into use. Pure copper is found in nature and the raw material could be hammered into required shapes but the majority of metals had to be smelted from ores. The early products were naturally alloys of mixed elements. Apart from copper many other substances such as nickel, lead, tin and zinc have been found in producing nickel-bronze, lead-bronze, tin-bronze, tin-and-lead bronze and brass, and when the smelting was not properly conducted, the alloy may also include silicon, calcium,

sulphur, antimony, chromium, silver and iron. The industry was then at its infancy.

In the second stage, as the merit of the true bronze began to be appreciated and valued more than the rest of the mixed metals, there came continuous experiments by trial and error in search of the required proportions of the metals for the alloy to meet various needs or specific purposes. The ancient bronze-smith soon realized that the hardness of bronze was determined by the percentage of tin and lead included in the alloy.

Finally, a proportion of 90-91% copper, 7-10% tin and 1-5% lead was preferred and closely followed. The Cha-ma-t'ai mirror is composed of 90% copper and 10% tin and the Erh-li-t'ou *chüeh* cup and *pen* adze 92% copper, 7% tin and 91.66% copper, 7.03% tin and 1.23% lead respectively. The industry entered then into its stage of maturity. (1)

The same sequence may be observed in the products of the industry. In the beginning the output was limited to tools for piercing and cutting such as awls and knives (Fig. 1) and ornaments in the forms of hairpin and pendants, the latter being plaques of various sizes and shapes and always with a perforation for suspension (Fig. 2). Then came other types of artifacts. Tools and implements began to include axes, adzes and ladles and ornaments, rings buttons and mirrors (Fig. 3). There was also a fragment of *kuei* ewer which could have served as a wine container. And finally, practically every type of tools and implements, utensils and ornaments were manufactured. In Erh-li-t'ou and Huo-shao-kou, for example, the industry produced hoes and sickles for agricultural activities in the field; *ko* dagger-axes, *ch'i* battle axes (Pl. I), spearheads, arrowheads and fish hooks for war and hunting and fishing; (Figs. 3 & 4) points, knives, chisels and awls for household works; rings, bracelets, buttons and mirror for adornment; wine vessels for ceremonial ritual and bells for music making (Figs. 5-6). It is interesting to note that so far Erh-li-t'ou yielded five *chüeh* cups (Pl. II) which are different from each other in shape and design. They are invariably small in size and simple in construction with thin walls and flimsy in texture, representing the art at its early beginning.

The increase in the types of production was matched with the advance in the techniques of manufacture. Copper in its natural state could easily be beaten into shape, especially tools and weapons as well as plaques and pendants. Stone moulds was sometimes employed in the process (Fig. 8). But since the new industry was introduced first by the potter who was able to acquire liquid metal the apparatus might serve also to produce the artifact by casting. He learned by experience that casting was the most suitable method in bronze making. Besides, moulds could also be made in pottery. As single moulds produced only flat artifacts, valve-moulds were soon introduced to make objects in solid form. And finally a multi-mould process was devised to produce complicated objects such as wine cups and bells. In this case, a model of the vessel would have to be made first from which a set of mould-parts accurately created and properly assembled for casting. The multi-mould process was unique in bronze making.

Apart from perfecting his skill in bronze casting the Pre-Shang bronze master was ready to create beautiful objects of art. Complicated patterns composed of linear,

nipple, cloud, animal face and other elements as well as inlays of turquoise flakes served to decorate his work (Fig. 7). Splendid lacquer objects have been reported at Erh-li-t'ou (KG, 83.3.203; 84.1.40) and it seems likely that the adhesive quality of the material was employed in the inlay work. All these set the foundation for the rise of the magnificent bronze art in the following Shang and Chou period.

It may now be concluded that the knowledge of early bronze making in China handed down in the ancient literature cannot be dismissed as merely myths and legends. The magnificent Shang and Chou bronze art was the result of a long development in the Late Neolithic times.

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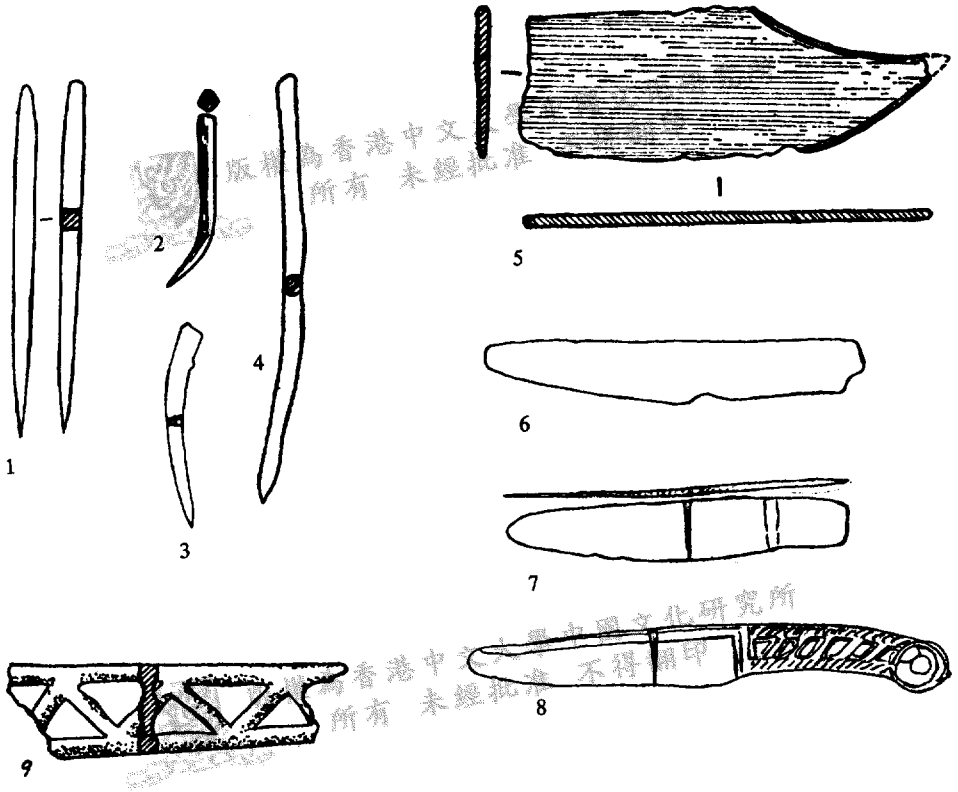


Fig. 1 — Points and knives
1-4. Awls; 5-8. Knives; 9. Knife handle in open work
— after **3**, 278; **27**, 40; **KG**, 83.3.204; 215

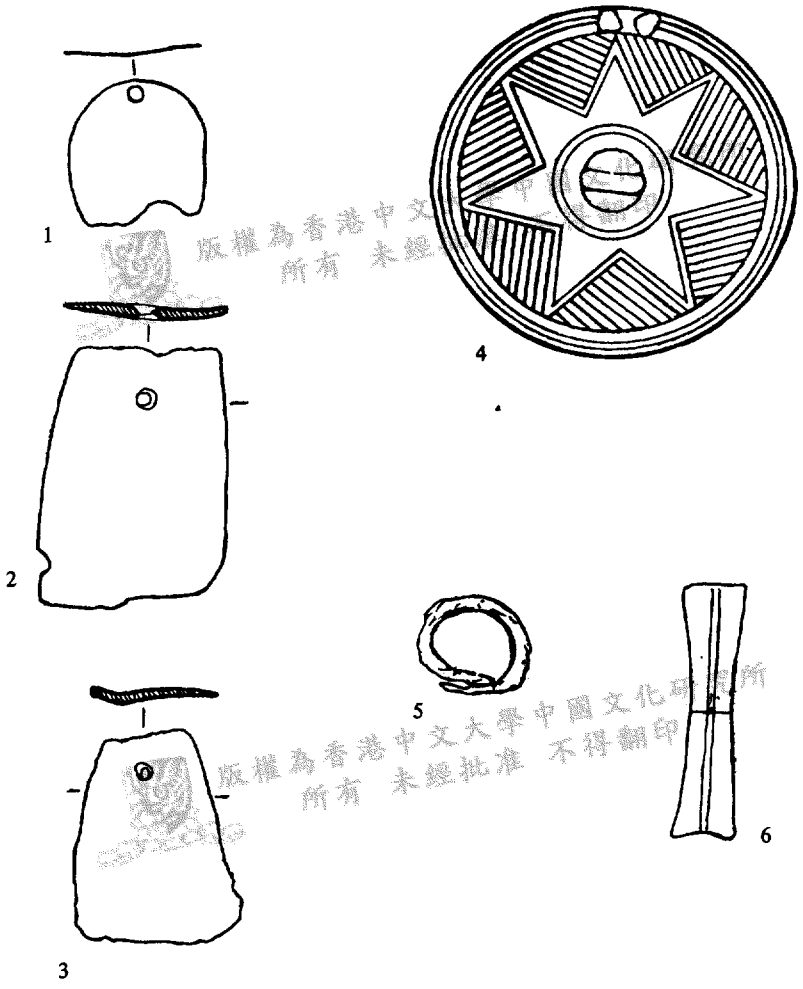


Fig. 2— Ornaments
1-3. Pendants; 4. Mirror; 5. Finger-ring; 6. Pin fragment
— after 3, 270; 19, 4; 27, 40

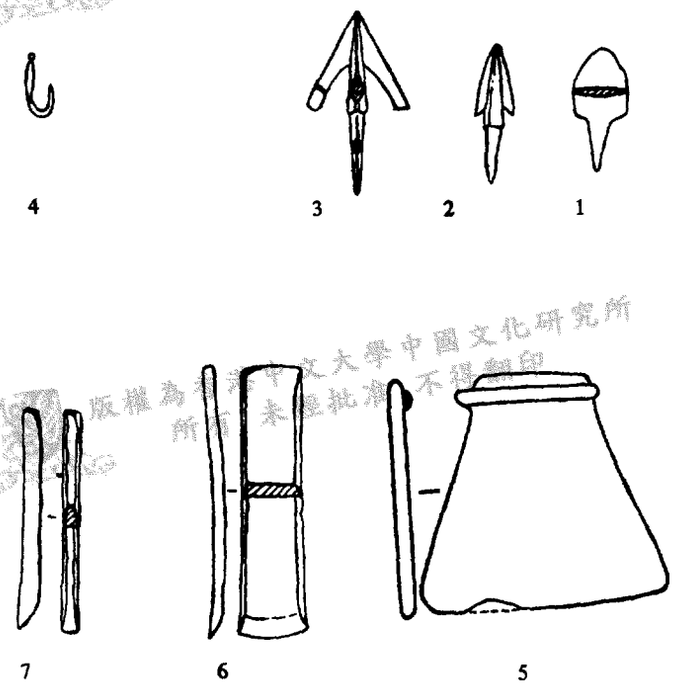


Fig. 3 — Hunting, fishing and working tools
1-3. Arrowheads; 4. Fish hook; 5. Axe; 6. Adze; 7. Chisel
— after 3, 281; 27, 40, 42; KX, 83, 3, 215

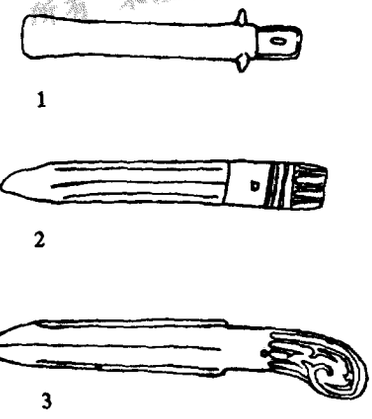


Fig. 4 — Weapons
1. *Ch'i* battle axe;
2-3. *Ko* dagger-axe
— after 19, 7

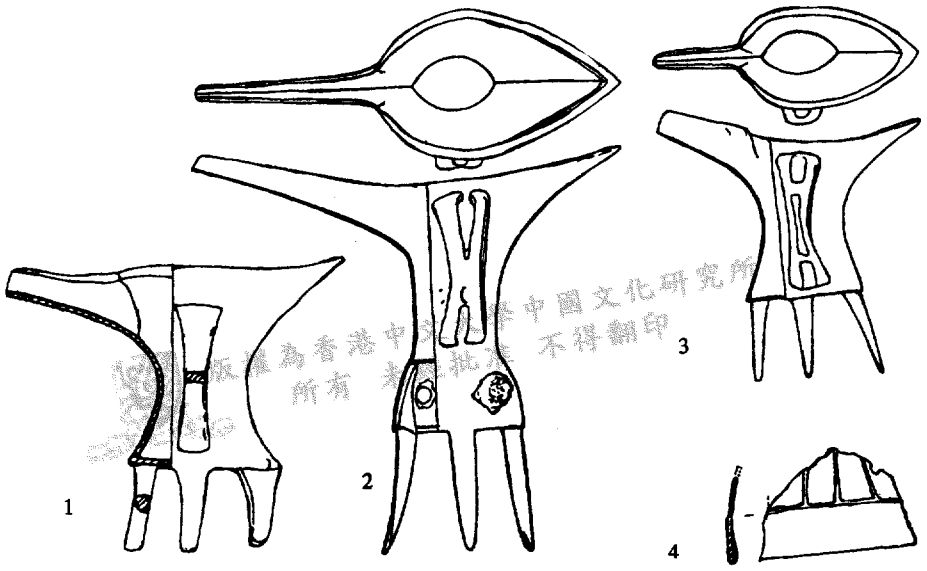


Fig. 5 — Drinking vessels
1-3. *Chüeh* cups; 4. Fragment of a vessel
— after **3**, 281; **KG**, **83.3.203**; 215

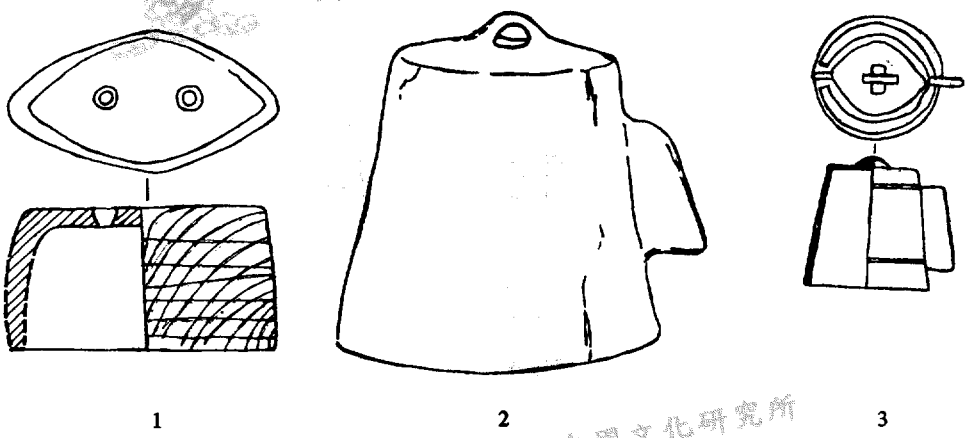


Fig. 6 — Musical instruments, Bells
— after **KG**, **84**, 12, 1069(**1**); **27**, 42(2); **KG**, 84.1.39(3)

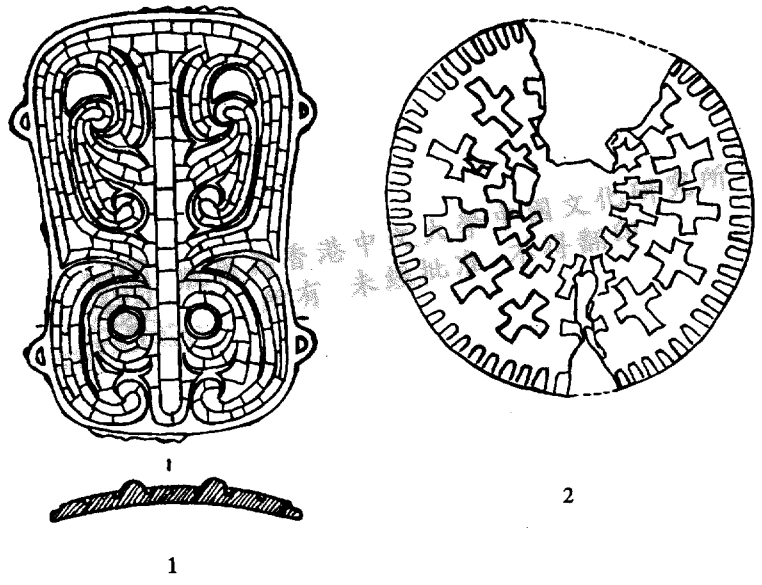


Fig. 7 — Ornamental objects
1. Plaque with turquoise inlaid animal face design; 2. Disc with inlaid cruciform design
— after 19, 7; KG, 84.1.38

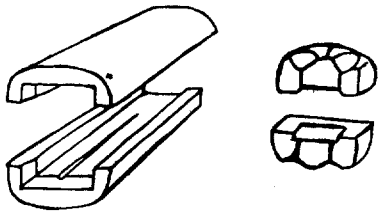
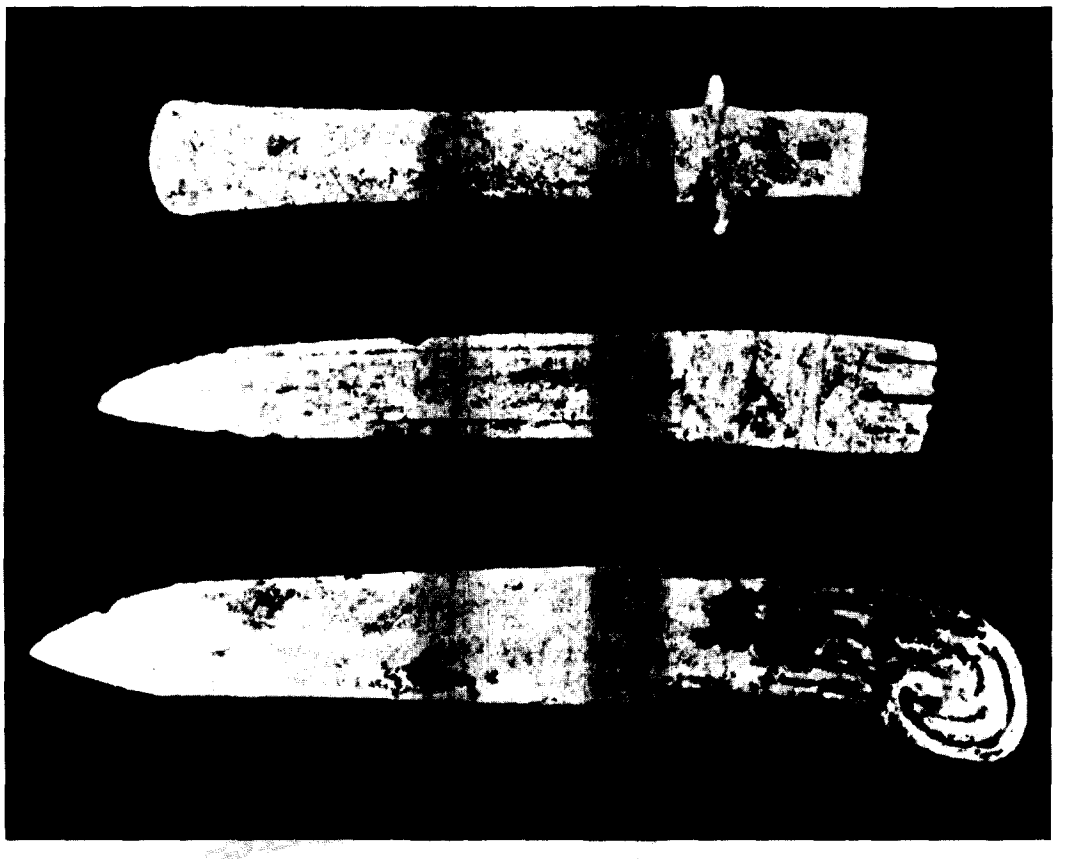
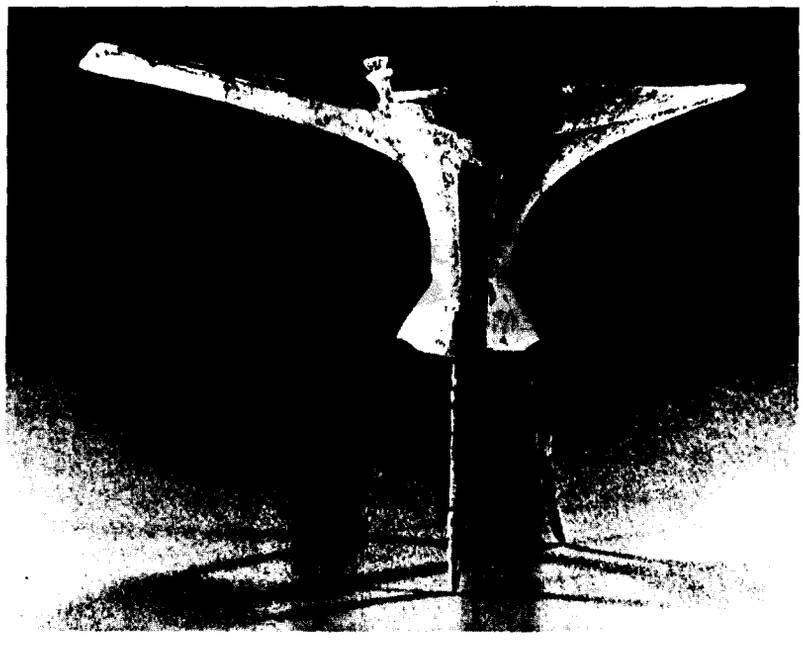


Fig. 8 — Stone mould parts for casting axe
— after 27, 42



Pl. I — Bronze weapons (Erh-li-t'ou culture)
1. *Ch'i* battle axe (23.5 cm)
2-3. *Ko* dagger-axes (27.5, 32.5 cm long)



Pl. II — Bronze vessels (Erh-li-t'ou culture)
Chüeh cups (12, 22 cm high)

中國青銅器的起源

（中文摘要）

鄭 德 坤

青銅器是一種合金，上古文獻叫做「金」，歷史開始就有這類的器物。先秦的《左傳》、《管子》、《墨子》，以至漢代的《周禮》、《越絕書》、《史記》等等就有不少關於青銅器的起源、冶鑄和研究的記錄。

過去著錄古代青銅器多數是商周的遺物，商以前的出品無可考的標本。民國以來疑古風盛，把古史的記載當作神話傳說。西洋學者乘風作浪，以爲商周青銅器冶鑄精巧，形制特殊，紋飾別緻，且附有各種銘文，實代表冶鑄工業全盛時期，應該是外來的技術。不過新近中國田野考古的進展發現中國有一段漫長的史前時代，文化連續演進上下幾十萬年，舊新石器逐步發展，先後井井有序，到了新石器時代晚期，居民已能鑄造銅器，距今約有四五千年。

中國史前文化發源於黃河流域，以中原為中心，然後向東、向西發展。田野發掘所得新石器時代晚期的遺址墓葬，數以萬計。各地文化的演進，層位先後重疊，井然有序，出土金屬器物共計有三百多件，銅廠遺址十餘處，足見這種工業是本土的產物，發源於史前的陶業，經過一兩千年的試驗，技術漸次發展才完成商周燦爛的青銅藝術。本文就利用這些考古資料來敘述中國青銅器的起源。

中國青銅器的起源約可分爲三個階段：仰韶文化時代是萌芽的階段；龍山文化時代是發育的階段；二里頭．夏文化時代是成熟的階段。冶鑄青銅是以燒造陶器的技巧爲基礎。原料是泥土礦苗，能源是火焰。這兩種東西同是本土的產物。以火攻礦，熔取金屬質料，陶人偶然發現金屬原料，進而冶鑄各種器物是很自然的。

初期的合金，冶煉未精，不免有各種襍質。仰韶遺物，純銅參錫，今稱白銅。純銅加錫或鉛，或鉛錫兼用叫青銅。純銅參鋅爲黃銅。（純銅本身叫紅銅。）其他原料還雜有硅、鈣、硫黃、銻、鉻、銀、鐵等等質素。初期冶鑄青銅的幼稚至爲明顯。

在一些合金中青銅色金黃鮮艷，質堅硬强固，且不易生銹，確比其他合金器物效用較大。龍山文化冶人長期多方的試驗；發現各式青銅合金，參配錫鉛的多寡，可以適合各類器物的功用。純銅和錫鉛參配的比例乃漸次確定起來。龍山文化八百年就是這工業發育的階段。

繼起的二里頭．夏的冶人，對青銅器的冶鑄已很精通。合金原料配合的比例已有相當的標準。出土器物多數是純銅百分之九十至九十一，配合百分之七至十的錫和百分一至五的鉛。原料配合有標準應是工業成熟的階段。

新近出土史前青銅器的種類繁雜，簡繁不一，也可以表現其三個階段的演進。萌芽階段的出品限於利用銅質的堅銳來製造刺割的工具和色澤美觀的飾物。發育階段產品種類漸多，且有飲器。成熟階段各類器物已很齊備，工農漁獵工具，飾物、飲器、兵器之外，還有樂器。二里頭出土五件爵杯，形式各異，器體輕薄脆弱，可爲這階段的代表。

史前青銅器的製造起始或直接椎琢成器。但是基於陶業的燒造，遂以冶鑄爲主。出土冶鑄器範可分爲三類。單範及雙範同時並用，但飲器的爵和樂器的鈴卻非用陶塑的內外合範不可。這種獨特的冶鑄法早在史前已經完成應用了。二里頭出土的爵杯五件，形制大小不同。且每套內範外範祇可用一次。冶人創作可自出心裁，自由發展。冶人藝精神通，出品還敷加紋飾，用線條、乳丁、雲紋、回紋以至獸面等母題構成複雜圖案，精巧別緻。商用青銅工業繼承這優秀傳統，終於登峯造極，舉世無雙，實在不是偶然的。

總之，考古發掘所得史前青銅器物數百件，可以證明這種獨特的藝術工業是本土自生自育的。