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STATUE METALS IN TIBET AND THE HIMALAYAS: HISTORY, TRADITION AND MODERN USE

E. Lo bue

One fact which has emerged from six field-trips (1972-1978) which I devoted to the study of traditional Tibetan and Himalayan metal statuary (in Bue, 1978 and 1981) as carried out today in the workshops of Patan, in the Nepal Valley, was that few sculptors use copper and brass for casting their images by the lost-wax process, almost to the exclusion of bronze. This observation prompted me to establish whether the term "bronze", as frequently used by western art historians to describe Tibetan and Himalayan metal statues, is correct, and, if so, to ascertain the extent to which true bronze images were produced in the past, not only in Tibet and the Himalayas, but also in northern India. In November 1975 Jim Black kindly analysed for me a 20 cm. high Tibetan image of Gajewari (Christie's sale catalogue of July 2nd, 1980, p.16, No.67 and Sotheby's sale catalogue of June 29th, 1981, p.14, No.11) attributed by von Sormbeke to the 12th century, and this was found to be made of brass. Since then (Bue 1979) has published a number of analyses of Tibetan and Himalayan images (black) which have been confirmed by Paul C. Craddock of images and other ritual objects from the British Museum collection and elsewhere.

The following discussion serves as an introduction to the study of the various statue metals in the context of the economic history of Tibet and Nepal (for a fuller treatment see Bue, 1981, Ph.D. thesis).

There is a persistent myth among art historians that northern Indian statuary is made in bronze which has been termed "copper-loy" (ajjup-chho), a compound containing copper, tin, lead, antimony, zinc, iron, gold and silver in varying proportions (Spooner, 1955: 157; Bhattaseh, 1972 repr.: xx; Saksawat, 1965: 20; Sahai, 1977: 233; Bhattacharya, 1979: 146). This belief has not been supported by any serious study of the results of metallographic analysis, (see 1967: 47), commenting on the metallographic analyses of one Karimjee and one Indo-Tibetan image notes that the parts of the six are radically at variance with those preferred by various ancient holy texts for the guidance of artisans. In these, unfounded theory takes precedence and we are given imaginary formulae for particularly auspicious combinations of metals based on numerical magic but certainly incapable of producing the desired effect. The ajjup-chho is not the only instance of the Indian alchemical fascination with magical numerals. Mahavira (1826: 462) also mentions sarsipi, xoglalha and pachanubha.

One of the most striking features about Tibetan and Himalayan statuary, which becomes apparent when studying its materials and techniques, including the use of the lost-wax process and fire-glazing, is that descriptions of these contrivances appear to belong entirely to an oral tradition, as attested by the artisans and sculptors, as opposed to a religious and academic tradition of the written. The latter did not always have a clear picture of the technicalities faced by artists and, as he is the rule in Buddhist literature, in order to accommodate personal religious merit rather than to give precise instructions on technical problems. Thus few Tibetan or Newar manuals written in the vein of Gimenes Cominelli's Il Libro dell'Arte, have ever come to light. The suggested existence of these allegedly used by few sculptors (Kershman, 1976: 29 and Bhattacharya, 1979: 67) is without foundation and none of the leading Newar metal sculptors who were repeatedly interviewed during my fieldwork in Nepal had ever heard of such a manual. Attempts to trace Tibetan and Himalayan statuary traditions to literary sources are doomed to failure as the sculptors are sometimes illiterate and certainly ignorant of Sanskrit and do not need to refer to handbooks in order to carry out their work, any more than their western counterparts.
In the light of the above considerations, a study of Tibetan and Himalayan metal statuary has been attempted from a scientific angle, though without neglecting the literary and oral sources. This kind of interdisciplinary approach requires not only the study of the language and literature, but also fieldwork and close collaboration with scientists, so that the evolution of style and iconography in art can be related to the material culture and economic history of the people who adorned it.

The traditional attitude of archaeologists and art historians towards the study of northern Indian metal statuary and its technology has not shed much light on the production of the objects used in the past. In his study on Taxila Marshall (1931, II: 564) uses the word "bronze" to include alloys other than those of copper and tin, and Geiss (1949: 159), while accepting the fiction of agni-thātu, adds to the confusion by equating it with bronze. The latter appears to regard bronze as a "cheap metal", and his prejudice against the term "bronze" is derived from the Western classical tradition wherein "bronze" is equated with the statuary metal par excellence and bronze as a cheap "substitute".

A detailed study of the metalurgical data reported by Spooner (1911: 157), Marshall (1931, II: 566-569), Ial (1990: 55-56), Lee (1967: 11, n.22), Sahai (1977: 234-236), Werner (1972: 184-187 and 190-191) and Uhlig (1979: 66-67) shows that in northern Indian metal statuary unalloyed copper was used from the times of Taxila, and that bronze tends to replace bronze as one proceeds westward from Bengal (an area close to tin-producing countries such as Burma and Melanesia) to Rajasthan (where zinc ores were exploited in ancient times). Brown and Dey, 1999: 163 and Werner, 1972: 161-162) and Kashmir. This is of great importance for the study of Tibetan and Himalayan statuary which was, and is, almost exclusively cast or embossed in copper or bronze, copper and zinc ores are found in both Tibet and Nepal, whereas tin is absent from both countries.

Indian statuary was introduced into Tibet from the west (Kashmir) and from the south (northern India via the Nepal Valley) concurrently with Buddhism. During the 5th and 7th centuries western Tibetan Buddhist kings were in contact with Kashmir and other Buddhist centres in North India. At their request the Tibet scholars Rin-chen-bas-po (4. A.D. 918-1055) travelled three times to Kathmandu and once to eastern India (Sraling and Skrong-pa, 1980: 91 and 94) and, having brought back to western Tibet thirty-two artists in 1. A.D. 1019 (Appendix II: calculations; see Sraling and Skrong-pa, 1980: 91, n.21 and 22) and 12th century (Tucci, 1933, II: 67 and 121), he had chapels and temples built in twenty-four different places. All of these temples, he erected forty-five metal images, some in copper and some in bronze (Tucci, 1933, II: 69; cf. Sraling and Skrong-pa, 1980: 91 and 107)

Previous to that, Rin-chen-bas-po commissioned the Kashmiri artist Goldschen to make an image of Avalokitesvara to his father's wish; with bronze he was forged for in Kashmir (Sraling and Skrong-pa, 1980: 32). It is possible that, being an alloy commonly used in Kashmiri metal statuary, bronze was preferred for casting images in western Tibet, although another text unequivocally indicates that copper was also used there (Padma-ke-cch-o, 1973, I: 30-31; see below, p.62) at the turn of the 10th century to cast images were for gilding. Copper and brass are also mentioned as the main materials of a number of religious items listed in Rin-chen-bas-po's list ([Sraling and Skrong-pa, 1980: 108]). Thus both bronze and copper were used in western Tibetan metal statuary from an early period.

A starting point for the discussion of western Tibetan metal statuaries and statuaries in the 8th-9th centuries is the high level of skill in the metalwork of the period. Copper alloy used was found to contain around 68-70% copper, 1-2% zinc and 0.5-0.6% lead. This suggests being as being a "red oxide of copper" (red oxide of zinc). Copper and bronze were also used in western Tibetan metal statuaries from an early period.

In the 6th century the population of the region was concentrated in the southern part of the country, with the capital being Lhasa. The region was divided into four main districts: Lhasa, Tsang, and eastern Tibet, and eastern Tibet, which included the area between the Brahmaputra and the Drangme Lhong, was inhabited by the Shang people. The cuisine was dominated by barley, which was grown in the valleys of the river valleys. The area was also known for its rich wildlife, such as yaks, horses, and camels. The region was also home to a number of temples, including the Jokhang Temple in Lhasa, which is considered the most sacred temple in Tibet. The region was also known for its rich natural resources, such as gold, silver, and copper, which were used to create intricate metalwork. The region was also known for its rich historical and cultural heritage, with a number of important texts and artifacts preserved in the region.
thesis) and it is sufficient here to see that, in the light of archaeological evidence, the Cleveland buddha should be attributed to the 11th (Khey, 1975: 29) rather than the 10th (Pal, 1975: 100) century. This master-piece proves once again the persistence and re-creating of style, which I find characteristic of Tibetian and Nugellian art, where copying is the rule, rather than the exception (Khey 1981: 116 and 126 n. 9). It is the earliest datable image from Tibet, for which metallurgical data have been published. Another early 11th-century, see below (p. 79) example of western Tibetian brasse statuette is the 69.3 cm standing Varaha in cast wirh the lost-wax process (Hubei, 1980: 95-38), at the Musée Guimet (M.4.354). Western Tibetian statues belonging to the following period (12th-13th century, nos. 47, 63 and 64 on pp.156-5 and below) are cast in bronze with small percentages of lead, tin and arsenic. An exception is the stand of no. 42, which has no zinc in its alloy.

Central Tibetian brasses were in contact with India and the Nepali Valley from at least the 9th or 8th-9th century (A.D. 827-649), as applicable to the Near Eastern origins. Western sculptors worked in Tibet from 10th century onwards, which may explain why central and southern Tibetian metal images are often cast in copper, a favorite metal for Near Eastern statuary owing to the presence of copper ores in Nepal (see below, pp. 37 & 39) and because of its advantages for fire-casting, which is traditional in the Nepali Valley. However, brass was also used in central and southern Tibetian lost-wax metal statuary (see below, p.48), as well as in the Nepali Valley. Western early 11th-century brasses made during the Mgong-pa period (A.D. 1007-368) were cast in copper (cf. Bhag 1979: 168, fig. 95), central and Sunny-Tibetan metal statue from the Rumpo period (A.D. 1403-1424) and Tibetan-Tibetan period (cf. Bhag 1979: 220, fig. 139) to the Cheren-lung period (A.D. 1738-1795), and afterwards was almost invariably cast in brass, even when it was declared for 'fire-casting'. (see nos. 91, and 57, 27-28, 49-57, 86-86, 111-112 in the list on pp.26-31).

Thus the geographical distribution of the use of metals in Tibetian statuary appears to reflect an increase in the use of copper at the expense of bronze when proceeding from the west and east towards the centre and the north of the country. In the Nepali Valley, where copper was the predominant alloy, there was a general increase in the use of brass from the 11th century onwards, probably in connection with the production of metallic bronze-making and the availability of both zinc and brass from the East India Company (see below, p. 47).

In September and November 1980 (I carried out a survey of Tibetan and Nugellian metal statuary in the major public collections of Britain with the aim of producing statistical data on the types of alloy and manufacturing techniques used in Tibetan metal statuary. In this connection I must acknowledge the help received from the British Academy in the form of a grant which enabled me to gather the following data and prepare this publication in this paper, of the 378 free-standing statues examined, 331 ware of metal, the remaining one being wood, stone, clay, papier-mâché and ivory. As it was not allowed free distinguished by certain characterizing features of Tibetan and Nepali images, owing to the activities of Near Eastern sculptors in all parts of Tibet for many centuries. Some results in Table 1 on the following page are given as maximum and minimum, according to whether a borderline case is included or not. The table only refers to Tibetan metal statues, Near Eastern icons having been left out when positively identified by such.

The general picture which emerges from this survey has been confirmed by the analysis of five Tibetan images in the Victoria and Albert Museum, which were made of bronze or copper, by the analysis published by Bhag (1979) and by those of Craddock (see above, pp.26-31). The results of the metallurgical analysis of one Gandharan and five Tibetan images carried out by A. Martin, of the Victoria and Albert Museum, in September 1980, confirm
<table>
<thead>
<tr>
<th>Museum</th>
<th>Total</th>
<th>Brass</th>
<th>Copper</th>
<th>Silver</th>
<th>Fire-gilded brass</th>
<th>Fire-gilded copper</th>
<th>Cold-gilded</th>
<th>Repousse</th>
<th>Inlaid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ashmolean Museum</td>
<td>30-99</td>
<td>56-59</td>
<td>39-45</td>
<td>5</td>
<td>42</td>
<td>25</td>
<td>5</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Liverpool County Museum</td>
<td>92-71</td>
<td>45-37</td>
<td>32-40</td>
<td>1</td>
<td>15</td>
<td>16-23</td>
<td>5</td>
<td>3.4</td>
<td>-</td>
</tr>
<tr>
<td>Gulbenkian Museum</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Cambridge Museum of</td>
<td>8-11</td>
<td>2</td>
<td>5-1</td>
<td>1</td>
<td>-</td>
<td>4-8</td>
<td>-</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>Anthropology</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RoyalScottish Museum</td>
<td>29-36</td>
<td>18-26</td>
<td>8-9</td>
<td>2-4</td>
<td>6-9</td>
<td>6-7</td>
<td>0-1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
that brass was used throughout all periods in northern Indian metal statuary and that copper and brass must be regarded as the most common and customary metals in Tibet. I take here the opportunity to thank both Mr. Martin and Mr. John Lowy for allowing me to publish these remarks in Table 2. It may be concluded, therefore, that copper and brass have been predominantly used in Tibetan and Himalayan metal statuary almost to the exclusion of bronze, although bronzes were occasionally cast or encased in other metals. The unusual composition of no. 4 in Table 2 is discussed below (p. 45).

Indigenous metals: the literary evidence

Copper

Zangkha, zangkha, and sometimes lI-der and ri-derlyu are the Tibetan terms generally used to define copper. Copper occupies a pre-eminent position in the metallurgy of India, Nepal, and Tibet, where it has been traditionally employed for tools, axes, and encased statuary. lI-der and ri-derlyu is mentioned by Padma-dkar-po as being used in northern Indian statuary along with bronze, in a passage in which he acknowledges the excellence of the Nirav style (1977, 300, ll. 1-2). In view of the initial absence of bronze and white metal and the use of bronze and copper in ancient northern Indian statuary it may be suggested that the term lI-der as used by Padma-dkar-po may often be a term not corresponding to "copper". lI-derlyu is the same as sbrul-don-rtogs ral-don-gyaod-nats - natural copper" (Dongri, 1977, 7: 52). Pure copper (see no. 37 on p. 105), in particular, is very highly thought of by Padma-dkar-po (1977, 1: 298, 1:2). The Mongol lay physician 'jam-ba-don-rtogs (early 15th century) explaining that "native copper from under the earth is as precious as gold. It is rock copper. The native red copper from rock copper is called 'gold copper'. Black copper (seric oxide ??) is called 'iron copper'" (Chandra, 2001, 41). 'Jam-ba-don-rtogs's definition of 'native copper' seems light on an otherwise obscure term used by the dge-lugs-pa encyclopedia Klong- rab-dam-shes (14;3, 1710-1805, Smith, 1969, p. 265) which recurs in Tibetan metallurgical literature (e.g. in Padma-dkar-po, 1: 200, 1:3). "The sea which is dug out like gold is native copper. It has the famous name of 'precious golden king stone'" (Chandra 1977, 1462, ll. 1-2). Klong-rab (Chandra, 1973: 1465, ll. 3-4) also says that 'copper is dug out from parts of Nepal' and makes a distinction between Nepalese copper, not without grooves, and a late production copper of his day, Nangu and with many grooves. Copper is found in small deposits in hilly areas of Nepal and has been extracted and also exported from that country to India at least since the 11th century, for the use of Nepalese copper is mentioned in Carapahdokha's treatise, Cakradatta, written in A.H. 1050 (Ray 1969, 108 and 111). In Book 9, vv. 40 of the late 13th century Khampa-Ratnaguma we read, "there are two varieties of copper: the one brought from Nepal is of superior quality" (Ray, 1969: 182). Ray concludes: "On account of its purity Nepalese copper was highly valued in old days" (1956: 93-4).

According to Ray (1956: 222-3) the best quality copper is also said to come from Nepal to the Esakhel-Midi-straddle, a short treaty included in the Tenjur. During his mission in 1759, Colonel Kirkpatrick (1975 rep., 63) noticed the presence of copper mines in Nepal and reported that, although some of them were nearly exhausted, others were being exploited by a caste called the Birma. Three years later (1762) Ross also noted that the Birma people were working some of their copper mines (Ross, 1963: 247). The government permits from their annual revenue range from three to four lacs of rupees, and in these areas Nepalese metallurgy still have been insufficient in copper, for the Tibet does not appear in Kirkpatrick's list of principal metal commodities (1759 rep., 203) exported from the Nepal India Company's dominions to Nepal, either for use in that country or for the Tibetan market. Furthermore,
<table>
<thead>
<tr>
<th>Inv No.</th>
<th>Description</th>
<th>Origin</th>
<th>Century</th>
<th>%Cu</th>
<th>%Ni</th>
<th>%Sn</th>
<th>%Pb</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>BU 12-1948</td>
<td>Buddha</td>
<td>Gandhara</td>
<td>6th</td>
<td>3.85</td>
<td>70.25</td>
<td>3.06</td>
</tr>
<tr>
<td>2</td>
<td>BU 13-1971</td>
<td>Lama</td>
<td>Tibet</td>
<td>13th</td>
<td>61.27</td>
<td>31.87</td>
<td>0.76</td>
</tr>
</tbody>
</table>

This image is illustrated by Lowry (1973: 34, No. 12) and by Béguin (1977: 262, No. 203), who ascribes it to the 16th-17th century. Results of the analysis of its underside sealing copper sheet:

<table>
<thead>
<tr>
<th>Cu</th>
<th>Ni</th>
<th>Sn</th>
<th>Pb</th>
</tr>
</thead>
<tbody>
<tr>
<td>61.27</td>
<td>31.87</td>
<td>0.76</td>
<td>0.55</td>
</tr>
</tbody>
</table>

(0.01) (0.01) (0.02)

3) BU 121-1910  | Skyamuni | Tibet | 14th | 83.67 | 0.04 | — | 0.01 |

Illustrated by Lowry (1973: 34, No. 2)

4) BU 20-1929  | Lama | Tibet | 14th/15th | 89.28 | 4.98 | 7.32 | 3.10 |

5) BU 61-1929  | Mahākāśāya | Tibet | 10th | 70.67 | 20.80 | 3.99 | 5.41 |

Illustrated by Lowry (1973: 32). This fire-gilded Sino-Tibetan image was originally attributed by Lowry (1973: 33, No. 11) "possibly" to the 16th-17th century.
copper was still being exported from Nepal into Tibet, in the late 19th century (Turner, 1850: 282).

Krong-dol's indication of copper as a metal of Nepalese origin is also confirmed by Gratia della Penna (A.O. 1750, in Mavoumin, 1879: 317) and supported by Buchanan's mention of about forty copper mines and attas in Nepal: of the export of "large quantities" of copper to India (Buchanan, 1819: 272), and of the use of Nepalese copper both in Nepal and in Tibet. Again, Hudson (1872 repr. 170) noted that "Nepal is full of fine copper, and supplying copper currency to the whole tract" and that copper pots and the like were imported from Nepal to India. In the 18th century copper from the northern areas of Nepal was traded in the Terai (Nepal, 1971: 20) but by the end of the century, copper production in Nepal was barely enough for home consumption. From 1800 all existing mines in Nepal were brought under direct governmental management and arrangements were made to purchase copper on a monopoly basis. Indeed, Kirpatrick had already noticed that "European copper was procurable in Calcutta" for one rupee the less than Nepalese copper. Kirpatrick (1875 repr. 176) had a poor opinion of Nepalese mining operations and noticed the "backwardness of the natives in the arts of mineralogy and metallurgy". Buchanan (1818: 76-7) reports that "the ore is dug from trenches entirely below surface, as that the worker cannot act in the rainy season, as they have not even seen to make a drain". Nevertheless, the trade obviously continued in spite of the facts that not only the export of copper but even private trading had been banned and stringent methods adopted by at least 1817 to stop it being smuggled out of the country (Nepal, 1971: 21). Tibetan merchants continued to buy copper utensils in Kathmandu (Buchanan, 1819: 213 and 222).

Copper appears as an import in Nepal only at the turn of the 19th century (Gev, 1928: 1: 312). By the early 20th century Nepal had to import "baset copper and other metals" from British India (Empirical Gazetteer of India, 1908: 12) and there is reason to believe that by the end of the 19th century Nepalese copper mines were exhausted or unproductive to work, and that very little copper is mined in Nepal nowadays.

Copper used by 20th century Newar artists is now bought in sheet form through the London metal exchange and is mixed with any scrap copper they may lay their hands on, such as old wires, faulty castings, spouts from previous images, and so forth. The vast majority of so-called Nepalese "bronze" now in fact fire-gild copper images, made by Newar artists, for the use of almost pure copper in Newar sculpture is very ancient, as has been pointed out by Kraalisch (1964: 50). Copper is still very much in demand amongst Newar sculptors for the castings of good quality statues (loc. cit. 1964), in spite of the problems that its high melting point (1085°C) poses for the comparatively primitive Newar metalurgy. The soft surface of pure copper is easier to chisel than the hard and brittle surface of brass, and it does not present any problems for fire-gilding.

Although Tibetan sculptors had alternative supplies of copper to those from Nepal, it is likely that Nepalese copper continued to reach Tibetan in one way or another during the 19th century for, as a rule, Tibetans themselves did not get involved in mining on a large scale. They feared upsetting the local gods of the earth, and preferred to import metals from India, China, Nepal, and East Turkestan. To that effect Indian sections of the Khomeyn's active source on the matter, dating from a few years before 1841:

Mines are freely excavated in Tibet. In the northern part of Khomeyn (sic), and in Yungs, new gold dust is gathered, as also in Szechuan and Baltistan (sic); it is washed from the rivers. If they knew how to work mines, they might find in easy places gold, copper, iron and lead.

(Fedin, 1922, VII: 185).

13
Ordinary Tibetans have religious and economic objections to the exploitation of mines. In Tibet there is an old-established objection to mining on religious grounds. ‘If minerals are taken out of the ground’, says the ordinary Tibetan, ‘the fertility of the soil will be weakened’. Many times that the minerals were put into the ground by the ‘Precious Teacher’. Padma Sambhava, when he brought Buddhist teachings from India, and that, if they are removed, rain will cease and the crops will be ruined. The religious objection is intensified by an economic one. When a mine is found, the local peasants and others are expected to work it without pay. This work being for the Government, the system of ‘unpaid labour’ is held to apply. So the villagers have every incentive to conceal the existence of mineral wealth, and will sometimes turn out and attack those who try to exploit the mine.

(Sell, 1968 repr.: 110-111).

The Tibetan administration, or the contrary, was interested in developing the mineral wealth of the country (Sell, 1927: 158-9; cf. below, p.50). The presence of copper ores in Tibet was first reported by the Italian Capuchin, Father Giosuè della Penna di Billi (A.D. 1730, in Murano, 1879: 317) who spent twenty years in Tibet and later, in A.D. 1783 by Saunders, who accompanied Captain Turner to Tsatsilphung, near Shigatse (Turner, 1800: 405). Turner (1800: 296) himself mentions ‘mines of lead, copper, cinnabar and gold’ on the roads to Ladakh and Kashmir and specifies that ‘copper mines furnish materials for the manufactures (sic) of Idola, and all the ornaments devised about the monasteries, on which gilding is bestowed’ (Turner, 1800: 372). Copper mines, as well as silver and gold mines, were mentioned also by Redin’s informants (Redin, 1822: IV: 99), and copper is found in Ladakh (Nussbaum, 1877: 43) and in Swat (Marmol, 1901; II: 565 and 570). Deposits of salamchite and aurite (basic copper carbonates) are known to exist in Ama-nu-stang, a site probably in the ‘hills south-west of Lhupa’ (cf. Pal, 1953: 20), though arbitrarily placed by Rouge (1978: map) somewhere between Q思想 and Kho-Yangs. Because of their importance, the ‘Chinese government strictly controlled’ their ‘mining and distribution’, which supplied most of the green and blue pigments used by Tibetan painters (Jackson, 1976: 274). The central Tibetan administration mired the colourful minerals only once a year, apparently so as not to exhaust the supply, but the people of Ama-nu will picked up loose bits on the mining site in order to sell them for their own gain (Rouge, 1978: 168). ‘Nam-dpal-rdo-rje specifically mentions ‘malachite’ (Thim-chung) and ‘aurite’ (Thim-tha’ling) in his section dedicated to copper ores (Chandra, 1971: 57); ‘they appear in the earth which has malachite and aurite [...]’ By selling them there appears copper. It is the one which is called ‘nam-lon copper’.

The existence of copper, besides iron, zinc, lead and a wealth of other minerals, was also reported during the surveys carried out by investigation teams dispatched by Tibet by the Geological Section of the Chinese academy of Science in 1957 and 1964-1965. Upper also occurs in the northern Yushitilla of the Kunlun between Yarkand and Nusuk, and bronze and brass items from east Turkestan dating from the 7th century (Vernier, 1972: 197-198). Table 7.1 lists some. Copper mines in eastern Tibet are mentioned by Copper (1873: 466-468, 468-468, cf. Prasad-Ranita, 1939: 377). For a long time, copper has been extracted to the south of Li-thang (Lung-shu-ch’a-lung; Chinese 246 spells this place name ‘Kungkaling’) and near ‘Sa-thang (le’), in eastern Tibet (Rouge, 1978: 167). It is worth noting that one of the most important areas for metal casting is the province of Kham in eastern Tibet. Three well-known centres in the province are Ser, Chendo, and...
and Ben-ch'ai (Pal, 1963: 29), the coppertone shä of bronze, famous throughout Tibet (Hackhull, 1894: 76), also got their raw material from Song-khim-lan, south of L-chang, Kooles, 1913: 246) and so probably did those of Li-chang (Hackhull, 1891: 207). Copper ore was also found in the area of song-ke itself (cf. Duncan, 1964: 19). At Van-samong-po, a copper mine was opened in 1902 or thereabouts, but has since been closed (Coole, 1919: 246).

Although copper ore was worked in the neighbourhood of Zi-lung, on the Sino-Tibetan border, most of the copper objects in eastern Tibet and Amdo were imported from China. For example, at Lhamon, south of Bum-dung, Hackhull (1894: 344) noticed in use (... a good early Chinese utensile, especially of iron and copper). As the most important copper deposits lie in eastern Tibet, and those in Lower Kho-bo (in this district, see Hackhull, 1906: 46) and 502-3) played no great role, central Tibetans occasionally obtained their copper from Shane (Rudge, 1905: 16). Sometimes between 1951 and 1965, 50-je-je-don-gyi of skyred-stot "was sent to Shane to procure the copper necessary for the repair of 31-ya-pa" (Petech, 1972: 91). However, it is certain (see above p. 39) that the latter continued to be imported into Tibet through its southern borders (Hague, 1919: 147), sometimes for stinking purposes. Although copper ores were apparently worked in Bhutan for the manufacture of large copper ramas (Ferdonc, 1961: repr.: 75), that country too has to import the metal (Reesereton, 1930: repr.: 77).

In Tibet, copper has been used either pure, or to form the various alloys which go under the general term of Ii, 31-ke-ra and shao. The Thung-ga lha-rgyed-po scholar and artist Pasma-deg-po (A.D. 1536-1592) informs us that during the reign of Song-brtan-rgyan-po native copper, Ii-dkar (white Ii) and lii-dkar (red Ii) were used pure, and also in composite metalwork (initial patchwork) Nama-shar-po (1973: 1: 300, 1:1), and that during the reign of Pas-ma-can (A.D. 1536-1586) copper was used not only to inlay the lips of metal images, but also in their alloys, whereby "they gradually turned darker than the early ones" (Pasma-deg-po, 1973: 1: 301-3). From the early 11th century, native copper was used in eastern Tibet either pure (Huc, 1909: 188) or alloyed with zinc to cast metal images (see above, p.34) to cast various ceremonial articles, including alloyed images (no. 46 on p.120 below).

Zi-Bayun

Swat Chandra Das's A Tibetan-English Dictionary with Sanskrit Synonyms (1976 repr.: 1980) contains the following translation and explanation under the Tibetan word mag-Pa, "copper". "Shine polished copper being considered very valuable, images of Buddha and Bodhisattvas made of pure copper are called sun-khor-deg-gyi (sic) also a compound of gold, silver, copper, zinc, of or of silica, quicksilver, tin and lead (..)/...). The most famous statue in Tibet, the 31-xang (north) of Lhasa, portraying a more than life-size [Walsh, 1933: 538] Shakyamuni, is said to be made of such an alloy (Sala, 1955: 165-167) Ogawa, 1977, 7: 571. Although the image is said to have been brought from China by Song-brtan-rgyan-po [Chinese writer], the statue is supposed to have been originally made in India from "gold, silver, zinc, lead, and copper" (Das report cited). In these and stylistic grounds, Walsh (1955: 539) concludes, that "the image is Indian". It is to enthuse this image that king Song-brtan-rgyan-po built the 31-xang during the second quarter of the 7th century. It may be interesting to note that Kho-kha's statement on the tradition that the 31-xang itself was built by Indian craftsmen to house "several valuable Buddhist images" brought to Tibet by Song-brtan-rgyan-po's Newar queen as part of her dowry (Hervieu and Turnbull, 1972: 423) and
that its gilt copper "screen was, perhaps, the work of the famous Nepalese artist and craftsman, Anika (or Aniko) who worked also in China in the latter half of the 13th century" (Richardson, 1977: 105; Richardson does not give any reason to justify his attribution).

On the other hand Pedma-dkar-po (1973, I: 300, 1, 3) states that zi-äbyim was used in Tibetan statuary at the time of Srong-brtan-agam-po, along with "pure" red and white in composite inlaid metalwork (Tib.: skro-mdag-rgyas) translated by Dagag (1977, I: 55 and 57) as: "square patches" and "square pieces". This type of inlay work may perhaps be exemplified by a 17th century brass Sapamde in the British Museum (registration no. 1905.5.19.7). The anonymous text translated by Tucci (1959: 166) confirms that zi-äbyim was used to manufacture statues which were subsequently gilded during a period corresponding to the 10th-11th century in western Tibet, and Padma-dkar-po (1973, I: 301-2) confirms that:

Regarding the varieties (of early Tibetan images) at the time of the two monks-princes, uncle and nephew (Ye-sahe-'od and Rgyang-chub-'od).

They were mixtures of red copper (Tib.: zangs-dmar, i.e.) zi-äbyim thickly coated with gold from Phag-gling (western Tibet). On Phag-gling and its extension see Tucci, 1956: 71ff.)

Their nose is a beautiful and the shape of their body sturdy.

Their dihanchenmo has a graceful aspect. Those which resemble the images of Nepal are called unaorn-tso-gling-ma (perhaps not in the sense of "having their hair raised up and of a blue colour" as suggested by Tucci, 1959: 166 followed by Earmy, 1979: 7, but with reference to the fact that they were made in or for the royal monastery founded by Ye-shes-wat at MtThon-ling, a place-name whose various spellings include that of ornith-nothing, as found in the royal robe gsha-gsal-mthong of Kunstan, 1966: 186, 189, Tupaz, 1935: 66).

Now do the two Tibetan words, dbang-chog and zi-äbyim relate to each other, and in which context do they appear in Tibetan literature? In view of the facts that the Jo-bo itself is said to be made of dbang-chog and that zi-äbyim was used in western Tibet in connection with gilding at the time of the second introduction of Buddhism into the country, an attempt to translate and interpret these two words appears to be useful for the purpose of shedding more light on the use of statuary metals in early Tibetan sculpture:

Das (1975 repr.: 1090) identifies the Tibetan transliteration "Pha-thi-k'ig" (phar-yig in the standard system of transliteration followed by e) with the Sanskrit yamakya, a term which I cannot find in any Sanskrit dictionary, and he does not include the word zi-äbyim in his dictionary. In his work on Tibetan loan-words, Lauffer (1918: 55) only mentions zi-äbyim and postulates a Sanskrit etymology with a question mark, but Tucci (1959: 180 n.2) suggests a Chinese derivation, from the Chinese ch'i-chh ch'iu (Mathew, 1969: 145, 1048) "deep colored gold; copper?" and gives the spellings "ji äbyim" (ji-äbyim, in the transliteration system I follow) and "mäi k'ig" (from Klong-roi who, however, has dbar-yig in the standard transliteration system I follow). Dagag (1977, I: 51-2) only uses the form dge-äbyim to the exclusion of any other, perhaps following his source, ’jigs-med-gling-po (R.O. 1798-1799). As will appear below, each of these words is used to the exclusion of all the others in the Tibetan texts dealing with metals, and they should be regarded as various spellings for the same term. I have chosen to follow the spelling zi-äbyim as consistently used by Padma-dkar-po (A.B. 1526-1592), not only on the grounds that he is the earliest and more detailed of my Tibetan sources, but also because he was a well-known artist himself besides being a literatus, and ’jigs-med-gling-po’s account used by Dagag is in fact largely taken from Padma-dkar-po’s.

According to Padma-dkar-po (1973, I: 264, II: 5-6) zi-äbyim "appears like the gold on the banks of the Sin-du river; it is therefore called
'red gold' and it is recognized precisely by its red colour. It emits the light of a rainbow when touched by acid; it shows the very bow of India', i.e., it becomes iridescent. King-rogló (Chandra, 1973: 490, 13: 1-2) distinguishes two types of zi-ākyam: li-ākra ("iridescent 1") whose ingredients, gold, silver, copper, and with iron, and rock crystal, lead, and black and white (sha-nya dbar nag), and mercury, the right mix of them, when melted and ground, was known as "artiñct 1 Li-ākra-agpa"; and the "pre-μst 1 Do-bu shabi-agpa", which is 'native copper dug out like gold underneath the earth'. The composition of the li-ākra type of zi-ākyam as described by King-rogló differs from that given by Das, for King-rogló does not mention the presence of zinc and tin in the alloy. Elsewhere, in the same dictionary, Das (1976 repr.: 1210) multilating that li-ākra is 'a compound made of gold, silver, zinc and iron cast together', is a most unlikely mixture in which copper is not mentioned, and which again is in disagreement with the definition given by King-rogló, whose text Das generally follows.

Following Yimag-rig-dangtser, Dagny (1977: 1: 51-2) states that pure zi-ākyam 'is obtained from the earth and generally resembles natural copper' and that it turns iridescent when touched by a poisonous "wear" (i.e., acid). He distinguishes it from 'artiñct 1 zi-ākyam, an alloy composed mainly of copper mixed with gold, silver or other precious metals, and nickel silver'. He confirms that Li-ākra is nothing else than artificial zi-ākyam and that the Jo-Bo in the Ju-Kang is made of this alloy. Dagny (1977: 1: 51-2) gives as an identifying new particular image as being made of pure zi-ākyam and even illustrates it. Unfortunately, throughout his work, Dagny never supports his descriptions with metallurgical analysis, thus adding very little to our knowledge of Tibetan statuary metals.

Neither native nor artificial zi-ākyam is mentioned in 'jam-pal-phyin-pa's comprehensive Mngon-Phin-Mon of Ju-Kang, thus making it difficult to postulate a Sanskrit origin for the word and suggesting that Tucci's etymology is more satisfactory. However, it may be interesting to investigate a possible connection between this word (pronounced: Shabki) and the place name Shabki, where copper mines are known to exist (see below, n. 2).

Although it may be assumed that Tibetan scholars writing on the subject of zi-ākyam and li-ākra did not know their chemical composition and were merely following either hearsay information or a slight academic tradition partially traceable to Chinese and Indian sources, all Tibetan authors so far reviewed appear to agree at least in the respect, that both pure and artificial zi-ākyam are copper alloys. None of them mentions Shac (Thib. li-ākra) or the (Thib. ghah-ākra) as the ingredients of artificial zi-ākyam. It should be mentioned, however, that Shac (1972 repr.: 471) equates the Tibetan term sha-aya dbar nag with 'white lead', with ghah-ākra, 'tin', thus allowing another interpretation of King-rogló's formula. The Tibetan metal (li) statues showing an iridescent (ākra) surface are rare. I have come across only one statue with this appearance which has been analysed, a late 14th or early 15th century portrait of the Padma Phung-tsho-rings-rgyal from Tsong (ln. 1306-1365). Its metallographic analysis (see above, p. 142, no. IM 20-1929) shows that copper, zinc and lead are present in significant proportions in the alloy. In fact this is a very rare instance of a Tibetan image actually cast in a kind of bronze alloy, it might be suggested that the Tibetan expressions 'artiñct 1 zi-ākyam' and li-ākra cover was unusual or seldom used Tibetan copper alloys, or else that they are the Tibetan equivalent of the Indian age- 

Dhambha, as suggested by Tucci (1969: 93), and thus a mythical alloy (see above, P. 333). The fact that the Bo-Bo of Shame is said to be made of this alloy by Tibetan sources and the circumstance that no western visitor has ever been able to have a proper look at the material of the lha, which is heavily pierced with clothes and laden with jewellery, should make us cautious, if not suspicious, with regard to the alloy as described by
Tibetan writers. However, it is more likely that 1i-akhir, or artificial zi-khyim, is just a kind of leaded brass. This suggestion is reinforced by Dgyags's statement that at the time of ye-shes-od and rnyang-chub-od (see p. 43) many statues were cast in that material. We know (see p. 34) that western Tibetan statuary of the 10th-11th centuries was cast in brass, besides copper, which is also mentioned by Dgyags as being used at that time. When Dgyags (1977, I: 56) adds that "the 1i-akhir statues of this period were of such fine quality and resembled so closely the Indian statues as to be easily mistaken for them", I cannot help thinking of the Cleveland Buddha, which was cast in leaded brass (see above p. 34) in Kashmiri style, perhaps by Kashmiri sculptors working in western Tibet or by their Tibetan pupils, during the 11th century.

With regard to the "pure" or 'precious' i.e., native type of zi-khyim, we know that Padma-shar-po equates it with zi-akar, red li, which I have suggested to be copper (see above, p. 37) and which Dgyags (1977, I: 62) also describes as "natural copper". The anonymous text translated by Tucci equates it with "red copper, zi khyim" (Tucci, 1959: 186). Klong-rdo defines it as 'native copper'. 'Lings-nga-ding-pon states that it has obtained from the earth and greatly resembles natural copper' (Dgyags, 1977, I: 54); and Das (1976 repr.: 1906) specifies that Buddhist images made of pure unalloyed copper are called prestan zi-khyim. In this connection it may be interesting to note that there is an important copper ore, borotse or khowrte (CuF$_2$ by or Cu$_2$Fe$_2$S$_4$) which, on account of its peculiar colour and iridescence, is known as "peacock ore", "pure copper ore", or "moss-dish ore". The colour of a freshly cut surface of borotse is coppery, but in moist air this rapidly tarnishes to iridescent blue and red colours. According to Millard "It occurs in several parts of India" (Ray, 1963, I: 79), and the presence of sulphur in some of the copper objects found at Tashla was noticed by Ullah (Marshall, 1951, I: 570). In the light of the above literary and metallurgical evidence, there is strong indication that pure zi-khyim is nothing other than native copper, and that red li is yet another one of the many Tibetan expressions used to indicate copper. In connection with the use of these three terms by Tibetan authors to define one western Tibetan statuary metal, it is important to note that Ullah (Marshall, 1951, I: 570) reported the existence of a native copper of a very high degree of purity in Zangskar (literally: "White Copper") a culturally western Tibetan area. The analysis of a specimen of this native copper made by Ullah gave the following result: 99.6% Cu, 0.081% Fe and 0.34% As etc. (S10, etc.). It is unlikely that similar ores of native copper of very great purity (nor-bu zi-khyim) were used by the western Tibetan kings for casting the images mentioned by Padma-shar-po, by the text studied by Tucci, and by Dgyags's sources, and that they were also used in alloy with zinc to cast at least some of the early brass images from western Tibet, at the time of Rin-chen-rabg-po. We have already seen (above p.40) that copper ores are also found in Ladakh, where Rin-chen-bang-po was active during the first half of the 11th century.

Zinc

Zinc (Tib.: 1i-lasba), like tin, is not used as a statuary metal on its own, but is always alloyed with copper. The history of zinc metallurgy is dominated by the fact that its oxide is not reduced by carbon below the boiling point of the metal. If zinc oxide ore is heated to boiling point (above 900°C) without special precautions, it simply evaporates into the atmosphere. In England, it was not until A.D. 1788 that William Champion first obtained patent protection for a furnace fitted with an external condenser for the production of metallic zinc. However, Ray (1956: 130 and 171) provides sufficient literary evidence to conjecture that zinc had been isolated by Indian alchemists from at least the 12th century (see below).
p. 46 and no. 8 and 9).

The problem of deciding the time and place of the recognition and production of metallic zinc is directly connected with the manufacture of brass. Until zinc was isolated and produced on an industrial scale, brass was manufactured by heating zinc ore (calamine) with thin plates of copper, which would absorb the zinc 45%. In zinc pyrometallurgy, Champion's experiments in the 18th Century and Werner's in the 20th showed that brass manufactured by this method would contain more than 30% zinc. Hence, a zinc content above 30% is a sure indication that the brass in question has been obtained from metallic zinc and copper.

This circumstance is important, for ascertaining the period and area of the first production of zinc metal would help to establish a famous pose quem for those brass images with a zinc percentage exceeding 30%. Convincingly, a dated image with more than 50% zinc in the alloy would cast more light on the history of the metallurgy of zinc. Since metalurgical analysis reveals that brass was used traditionally in northern Iran and Kusturistan and was adapted from at least the 11th century in western Tien Shan for casting images, it may be useful to limit for historical evidence of the production of zinc and brass not only to central India but also towards the "Brass Country" (Needham, 1974, V/2: 220). Iran, with which Tibetans traded from at least the 8th century (Backlund, 1980: 35 and al-Yaqūbī, 1977: 4 and 234-6).

During his stay in Iran, Marco Polo (A.D. 1254-1294) witnessed the process of making "uzala" (tufety, impure zinc oxide) from ore which he described as "ardesico" and which we can reasonably assume was calamine. "Uzala" is the Middle Persian word for calamine, which spread into Arabic and into Western languages (Needham, 1974, V/2: 203). They take the crude ore from a vein that is known to yield such material, and cut it into a proper furnace. Over the furnace they place an iron grating forced or small bars set close together. The smoke of vapour ascending from the ore in burning attaches itself to the bars, and as it cools it becomes hard. This is the tufety; whilst the gross and heavy part, which does not ascend, but remains as a cinder in the furnace, becomes the calamine.

(Masfeld, 1828: 71).

In his Cosmography (c.1200) the Persian al-Kasimī describes the smelting of tufety from the sides of the furnace (Dawkins, 1950: 5). Again, Marco Polo mentions "a mountain where the mines produce steel and also calamine" in the district of "Chinghitshān" (Pounchriel, ed., 1971: 49) in Tien Shan, zinc deposits have been located in the Khotan district, and references "found in sixth century texts" as well as "archaeological finds at Kucha in Khotan show the way" by which knowledge of brass-making with zinc ore "penetrated from Persia" (Krosher, 1973, XIII: 211). We have seen above, p.60 that copper ore exist between Khotan and Yarkand. It is quite significant that Needham (1974, V/2: 220, n.4) should conclude his section "The origins of zinc" by stating that Chinese mention of brass as a Persian export would point to the Iranian culture-area as the place where we ought to look, but unfortunately the early history of science and technology in that region is still (....) poorly documented (....). All in all, we are disposed to favour the view that brass-making began in the Persian culture-area and spread both west to Europe and east China.

(Needham, 1974, V/2: 220 and n.c.).

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In any case, it would seem that the recognition and production of metallic zinc had started in India by the 13th and in China by the 15th centuries (Needham, 1974, V/2: 211 and 212, table 98). In 1597 Lamiusus (c. A.D. 1545-1616) received Indian zinc, which he called "Indian or Malabar lead" or "Malabar tin" from Holland. He was uncertain what it was but ancient lead-zinc deposits "which according to the information of Curas must have already been exploited around 1362" (Werner, 1972: 127) exist near Zawar (or Zawar) "15 miles due south of Udaipur, Rajasthan" (Brown and Dey, 1956: 163). There are also remains of zinc furnaces at Sojat in Jodhpur and in connection with the manufacture of brass alloys it is interesting to note that important ancient copper mines existed in Jaipur (Imperial Gazetteer of India, 1908, XII: 128). The zinc mines at Zawar were active through the 18th century until 1812. According to Somalettie, "very many small clay retorts are found in the ruins of Zawar, which may possibly have been used for zinc production in ancient times" (Werner, 1972: 127). Indeed, it has been suggested that the term "calamine" may derive from its place of extraction, Calamina, at the mouth of the Indus (Beal, Si-yu-ki, 1884, II: 174, n. 103). Small zinc deposits also exist in Kasmir. In this connection, it may be interesting to note that Ponchrezi (1979: 29) explains Ambicino as "(ferrous) indium, "Indian iron", though he translates the term as "antimony" instead of calamine. Details of the extraction of metallic zinc from calamine are to be found in the Rasamara-Manacayang, as translated by Ray (1956: 171). That treatise, which starts with a Buddhist invocation, and is attributed by Ray (1903: 222) and Bala to "Huen 1300 A.D." merely borrowed the description of calamine and the coupling concerning the extraction of zinc almost word for word from the Rasamara-Mauananacayang, a comprehensive work by Yaphobhara who, according to Ray, lived in the 13th century and was used as one of his authorities by Bala. It is interesting to note that by the 15th century, perhaps in connection with the Musulim conquest, alchemy had become so neglected in India that one alchemist, Govinda-bhuja, declared that for the knowledge of certain processes he was indebted to the Buddhists of Tibet (Ray, 1909: 106). In this connection, and on the basis of the attribution to the 15th and 16th century of two Tibetan metal images at the British Museum (nos.110 and 98 on pp.108 and 107) it may be tempting to surmise that by the 15th century Tibetans had the knowledge of the art of an external condenser for the extraction of metallic zinc, whether derived from iron, from Indian alchemical treatises, or from China. However, their very poor mining and technological ability strongly suggests that they either imported the unalloyed metal already smelted (Kingpatrick, 1975 rep. 209), or else used local zinc ores, and alloyed them with copper, to manufacture brass. In fact we know from della Pensa (A.D. 1730, in Marabès, 1937, cf. Gorgi, 1972: 45) that Tibetans used the casseriter process to manufacture brass from local zinc ores. Della Pensa wrote in 1730, at a time when zinc metal had not yet been isolated in Europe, and although he could only recognize its ore, he is quite clear that he refers to zinc when describing a "mineral, of a white colour, like tin, which is called fikse, and is worked into a sort of brass by being mixed with copper". As we know, ti-taæ is the Tibetan word for zinc. Also 'Jen-apo-ro-po' describes the ore used to make brass: "the one having bluish-white lustre or the cloudy one, with specks [Tib.: sha-bzhag, not in the dictionaries, as translated by Phuntshog Wangyal] is like a-reg. It has hair-like. After having been finely ground, it is thrown into molten copper and there appears light-coloured brass. Brass is not produced from the ore alone" (Gorgi, 1972: 57). In that passage, not only is calamine (metalsiinite, sometimes blue but white when pure) recognized as zinc ore, but the cassiterite process is mentioned too.

The presence of lead and zinc deposits in Tibet was also reported by investigation teams of the Chinese Academy of Science (see above, p. 60).
and zinc oxide is mentioned by 'Jan-gal-dr-je' as ti-lha dgav-po ("white zinc") in his description of bronzeware manufacture (Chandra, 1971: 43). In the work Abcera Midda, 'Jan-gal-dr-pa describes metallic zinc in the following terms: "as for zinc, it is blue and is like the Tibus silver appearing from both red and green stones. If you rub it with fossil barite it produces a sharp sound. If you break it, its edge is like so-gr-mh." If it is mixed with copper it forms into bronze" (Chandra, 1971: 43). Zinc ores, probably galenite and calamine of various colours, are described by 'Jan-gal-dr-je' (Chandra, 1971: 56) under the title of "yellow zinc" and associated with lead and silver. The phonetic use of tussy from melting of zinc ore area is mentioned by 'Jan-gal-dr-je'.

The presence of zinc ores and mines in Nepal was reported by Buchanan (1819: 76, 94, 195, 264, 272) and Hodgson (1874: 1091: 'Nepal') produced plenty of zinc, but no skill to work the mines. Furthermore, "little is known of the deposits near Nagpur in Nepal" (Brown and Dew, 1865: 624). Ullah follows Latouche in mentioning that 'copper are associated with that of zinc in common in Sikkim'. Marshall, 1951: 1: 571: Hodgson (1874: 19) specifies that there are lead and zinc mines in Nepal, but no skill to work them profitably. A deal of lead is imported from the plains, and also of tin, with which last, and with the zinc from us, the Nepalese make their own copper, and make a great variety of mixed metals in a superior style'. Ellis-Patrick (1979: Feb.: 290) mentions zinc in his list of principal commodities exported by the East India Company to Nepal either for use in that country or for the Tibetan market in the late 18th century and the circumstance is not surprising when we know that by then Europe had started to produce metallic zinc as a separate commodity in commercial quantities.

Brass

Brass (Tib.: rgs, rd-ga, and some types of lli) is described in a number of Indian and Tibetan texts for its external properties. Different proportions of copper and zinc give rise in alloys of varying ductility and brittleness and having a range of colours, of which the most notable is that with about 80% copper that resembles gold. Kama-vid (Chandra, 1973: 1467, li. 4-5) distinguishes various types of brass: 'female brass' and 'male brass', which are yellow, (and) have a good ductility; 'male brass' is the brass which makes the 'light yellow' type of brass and is poor.' 'Jan-gal-dr-je' (Chandra, 1971: 43) tells us that 'red, yellow and bright types of brass come from China, one or three parts of copper have been mixed to five of zinc. Also, the white one is richer than silver'. Padma-basgo (1973: 2: 200, li) mentions that in northern India leathers were made of 'white lli, brass; and, being mixed, it was like the yellow types of brass'. Regarding the materials of the 'gold images', by which he means the statues cast from the advent of the king's dynasty (6-6, 1068), 'those which are known as khu-rimma and sampar in Chintill brass or in light yellow brass are superior in inspection' (Padma- dzon-po, 1973: 2: 304, li-5). In Tibet itself the images of the period of the first religious king Shrong-btsan-sgam-po when black from brass or lead are similar (Padma-dzon-po, 1973: 2: 364, 1-5), and the composite brass, made with different metals (Tib.: rga-ga-ga) during the reign of Khri-chab-je-og-la Hروح-lha (see above, p. 41) were not as good as those made of brass' (Padma-dzon-po, 1973: 2: 34-35).

'From the 11th century onwards, brass was constantly used in Tibetan statues, though described by Western scholars as 'bronze'. Puugga in Padma-dzon-po (see below, p. 50) suggests that the metal images made by Indian artists in central Tibet during the early 13th century were cast in brass and inlaid with copper and silver. In the context of the Indo-Tibetan derivative style which may have resulted from the initiation of
In central and southern Tibet, we should perhaps situate nos. 82, 108 and 105-108 which were all cast in brass with 65.5-71.0% Cu and 24.2-28.0% Sn. Their alloys show copper and zinc percentages very close to the proportions in one of the types of brass described by "Zem-Phap-rdo-Byin" (see above, p.47) and nos.106-108 are tibetan with silver and copper. We have also seen (above, pp.34-35) how brass was used in western Tibetan statury from the 11th century. The first names of Tibetan artists known to have used brass and mentioned as "most accomplished in the art of sculpting" images in Tibet, are those of the guru ‘Pha-ma-dasa-apa and Stie-u-chung-pa (Kon-sadrag, in Chandral, 1970: 972, 1:5; and Tucci, 1959: 180). Dagyab (1977: l: 38-39) regards them as contemporaries of Sen-gipe-ga-apa (A.D. 1357-1419), but gzhou- nu-dpal (A.D. 1392-1465). Roesler, 1976 repr., 878 mentions one Stie-u-chung-pa as a disciple of the great translator Dus-ma-nams-rgya-stambh (A.D. 1424-1482) in western Lho-bri, a southern Tibetan area bordering with eastern western Bhutan. Both sculptors were probably active in the mid-15th century. According to Dagyab (1977: l: 56) of his sources, the statury made by Stie-u-chung-pa closely resembled the "new" Chinese Ming (A.D. 1368-1644) ones, a remark which can be traced also to the anonymous author of the text studied by Tucci, who tells us that the lkhams made of brass or the gilded images45 by Pha-ma-dasa-apa and Stie-u-chung and other clover artists may be mistaken for the Chinese ones (Tucci, 1959: 186). Both Tucci's and Dagyab's sources describe the style specific to Stie-u-chung-pa, and mention that the "cushion-seat was formed from a double row of lotus flowers completely encircling the seat" (Dagyab, 1977: l: 56), a characteristic to be found, for example, on a gilded seated Shakyamurti published in Christie's sale (Malague of July 3rd, 1980, p.16, no. 69), which may be attributed to the 15th century.

Brass continued to be widely used in Tibetan statury until the present century and Tung (1800: 274) was well aware of the types of metals used in the workshops and in the collection of images studied by him in a "gallery" of Tashilhunpo monastery. After mentioning the manufacture of a brass portrait of a deceased dpal-lhing, he goes on to say that "most of those images were cast of that metallic mixture, which in appearance resembles Welswood's black wax, but the greater part were of brass or copper gilt." He concludes: "the manufacture of images, is as art for which they are famous in this country. Thebes Sothoo has an extensive board of work, established under the direction of the monastery, and constantly employed in this manufacture." Some of the images shown to Tung were brought from China, Lhasa and Nepal. Although we know from della Penna that brass was manufactured in Tibet with local zinc ores, from at least the 15th century brass and brass were also imported into central Tibet from Nepal (della Penna, 1730, in Marbach, 1878: 317; Népia, 1961: 247; Buchman, 1959: 213 and 233; and Sandberg, 1959: 160), whereas eastern Tibet supplied to merchants bringing in broc from Kham (Teichman, 1932: 86).

In Nepal, brass must have been known and used for various purposes from a very early date. During the administrative organization of Tibet under Phri-arong-dog-rtsulan (A.D. 754-797), one of the four kings paying tribute was the king of Nepal, with the appellation of "king of brass" (Teich, 1962: 20, from dpal-bo &tso-lag-lng-le-pa's chronicle, written between A.D. 1345 and 1365). However, the preference for copper in early Newar statuary may be explained by its relative abundance since the 15th century, by its prestige, and by its advantages for mercury gilding. The production of brass statuary seems to have flourished particularly after the Gompa conquest, perhaps for economic reasons following the diminished wealth of the Khampa monasteries and lack of royal patronage, and certainly in connection with the availability of zinc metal from British India (see above, p.47) coupled with the degressive use of lead as solder. Rodgson (1919, repr.: 114-119, see also Népia, 1971: 20) mentions the manufacture of brass with
zinc, reported from India and, in his day, not only copper but also bronze vessels were imported from Nepal. The composition of Indian bronze ('yellow metal') exported to Nepal seems to have a high zinc percentage: 65% copper and 35% zinc (Brown and Day, 1953: 101). The late Saka bronze images analyzed by Brown (1968: 795) reflect similar percentages: 60.5% copper and 39.5% zinc. The increased use of brass in the second 700 BC is witnessed by a number of dated images of deities now devoted with zinc percentage sometimes higher than 60%. This, too, is in line with pp. 103a, 103b and 104b in nos. 109 and 110 below, but lower (no. 125) when associated with fire-gilding (see below, p. 103).

Finally mention should be made of the age of brass for the casting of metal reliquary stupas (Th.: 'srok-chen' from at least the 13th century (see Hatt, 1982: 210 and 214, if, nos. 29 and 45 on p. 104 and 105 below in Tibet, where brass was commonly used to manufacture all kinds of ceremonial articles from at least the 11th century see above, p. 34 and below, nos. 22, 79, 79).

Tin

Like zinc and lead, tin (Th.: 'tshogs-gsang') has been imported into Nepal since at least the 16th century (Kerpatrik, 1979: repr. p. 297 and Holm, 1972 repr. p. 102) and only used along with copper in Tibetan and Himalayan statuary. The general presence of tin objects from the Himalaya, India and Tibet partially supports the variety of its use in Newar and Tibetan statuary. 'Jam-dpal-don-je (Chandra, 1971: 43) regards 'tibetan' and 'lowen', Chinese tin as the best. His mention of average poor quality Tibetan tin is not supported by geological evidence. Tin is apparently not even found in eastern Tibet, 'in no mention of it is ever made. The white alloy of tin used in Newar for statuary was imported from China' (Chulise, 1910: 494). Although Tibetans did use bronze scrap, it appears that they added manufactured bronze for statuary purposes. The additional data provided by Crackendon (pp. 30-32 indicates that tin was almost never used in Tibetan statuary alloys, a fact which may be explained by the virtual absence of tin ores from Tibet as opposed to the presence of and ores. The low tin percentages to be found in many Tibetian metal images analyzed by Crackendon (1967) betray the use by Tibetan artisans of bronze scraps from wells or other bronze items.

Bronze

Bronze and bell metal are both mentioned in Book V of the late 13th century Khlebi granthamangala, and the latter is described as being made by melting together eight parts of copper and two parts of tin. 'Rag, 1952: 14.' 'Jam-dpal-don-je (Chandra, 1971: 43) regards 'tibetan' and 'lowen', Chinese tin as the best. His mention of average poor quality Tibetan tin is not supported by geological evidence. Tin is apparently not even found in eastern Tibet, 'in no mention of it is ever made. The white alloy of tin used in Newar for statuary was imported from China' (Chulise, 1910: 494). Although Tibetans did use bronze scrap, it appears that they added manufactured bronze for statuary purposes. The additional data provided by Crackendon (pp. 30-32 indicates that tin was almost never used in Tibetan statuary alloys, a fact which may be explained by the virtual absence of tin ores from Tibet as opposed to the presence of and ores. The low tin percentages to be found in many Tibetian metal images analyzed by Crackendon (1967) betray the use by Tibetan artisans of bronze scraps from wells or other bronze items.

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dpal-rdo-rje had in mind. It is interesting to note, however, that copper occurs in the northern foothills of the Kunlun, between Yarkand and Khotan, and that zinc deposits have been located in the Khotan district, but no tin. Although the manufacture of bronze objects in East Turkistan is demonstrated by Werner’s analyses (1972: 100-1), the same author (1972: 141) ventures to say that for the period from the 12th to the 15th centuries the zinc content among the analyzed objects from Chinese Turkistan and China “rises sharply to 30% Zn”! Indeed one standing goddess from Turfan “dated to the 8th century, yielded a zinc content of 26% Zn” (Werner, 1972: 123). These circumstances (see also Marco Polo’s information on p.35 and n.7) suggests that bronze manufactured from Khotanese ores was exported to Tibet.

It is unlikely that Pade-dkar-po and his dpal-rdo-rje had first-hand knowledge of the components of the two li statuary metals whose exterior aspect they describe in identical terms, a circumstance which may be due to the fact that both white and red li were often of foreign provenance. Since metallographic analysis and careful inspection of Tibetan and Himalayan metal images show that the vast majority are cast either in brass or copper – and the same goes for northern Indian and Kashmiri statuary, whose alloys are again often described by Pade-dkar-po in terms of li – it may be concluded that Tibetan writers used the term li in the same loose and incorrect manner in which the term "bronze" is used nowadays in the West when referring to objects made of copper or its alloys. It may be further suggested that the terms "white" and "red" li used by Tibetan writers in connection with Tibetan and Indian statuary more often than not indicate in fact brass and copper, which are indeed by and large the most common statuary metals used in the area with which we are concerned. The general confusion among Tibetan writers about the term li and its composition may be explained by the fact that they were virtually unacquainted with the manufacture of bronze for statuary purposes and were rather out of their depth with the word, which betrays foreign origin. This contrasts with the relative precision of the words they use for copper, gold, silver, lead, tin, zinc, iron and, significantly, brass. This suggestion is strongly supported by the metallographic analysis of an Indo-Tibetan metal image of Mulasara style (p.108, no.105) and inscribed: Be-rlo li-dam, "li object of the Be-po." That statuette was cast in brass and no tin is detectable in the alloy. It is described by Béguin (1977: 701) as a northern Indian "replica of an original of the 12th century" and included in a group of Tibetan images betraying very strong Sillian stylistic features (Béguin, li-12). It shows Shiva sitting on Siddha’s left leg, with the latter caressing her chin. The donor at the bottom of the pedestal wears a semi-ling Tigris girdle and chignon. In connection with the group of Indo-Tibetan images in which Béguin identifies this statuette, it is quite interesting to report Pade-dkar-po’s verses on statuary in Tibet during the kingdom of mnga’-dodag (king) Khor-lal (Rin-pa-can; see above, p. 41). He explains that as for

The images manufactured by Indian artists (in Tibet),
Their kind is similar to the images of Mulasara,” made out of white li (of the quality called) "indisputable."
As for the dissimilarities setting them at variance,
Their face is a little plump
Their abhaya gesture has a great share of grace;
And the silver and copper openings of their eyes are perfect.
Zangs-thang-drung (images also) occur; they are (with) copper lips and silver eyes.


The description given by Pade-dkar-po in the first four verses above fits remarkably well the group of images studied by Béguin (see above, p.88),

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which are often inlaid with copper and silver. Is it possible that this kind of statuary was produced by Pala and Lasa artists in Tibet perhaps as early as the 8th century? The latter suggestion is confirmed by the metallurgical analysis of the Umshafigure mentioned above, and also by the circumstance that a Tibetan inscription was found inside the base of an 11th century silver inlaid bronze Maitreya in Pala style (Chdl, 1979: 116-20, fig. 4b). Although seven (1979: 36, no. 37) has implied that while it is to be understood as a kind of silver, there would have been little point in inlaying silver statues with silver. All the images belonging to this group are cast in brass and never of them inlaid with silver and copper.

The fact that the term li has not been understood in a looser manner as merely indicating any copper alloy is again suggested by the several kinds of uses attributed to the various types of li which he describes in the same passage (Chandra, 1971: 4). After specifying that white li, slightly yellow with white brilliance, and red li, slightly yellow with red brilliance are both made from Khamtse ore and used to manufacture metal images (which we know to be cast almost exclusively in copper tin bronze), he mentions "coloured li" or "coloured red li" as the metal used for fashioning the metal circles for manjus, although copper is a metal often employed for these. He then states that the "real" li alloy is used for the manufacture of various musical instruments, such as symbols, but the term must here indicate "bronze" or "bell metal" (see io. 47 on p. 205). For all these reasons, dictionary translations of the term li as "bell metal" or "bronze" and of 1-10 as "metallic 100" concerned containing more gold and silver with which images are generally made (Gos, 1976: n.p. 1221. From jiggan ran li is the bronze 100) are either inadequate or as fantastic as the agnadhifu alloy mentioned once (p. 38).

Jig-chu (or Jig-chu) is another term which has been variously translated as "bronze" and "bell metal". Long-rdo (1973: 1462, ll. 1-1) explains that:

apart from black kham, (which is a iron, the alloys known as) 'thousand lius', like silver, 'poor', like neba-li, 'red shadnase', like copper, 'clear white', like white iron. As called sager-ba, lately, all these were made with dog-rose-'copper coin'. cf. Lauffer, 1958: 106. After being perforated in the middle it is easy to carry them. It is reckoned that China and India enjoyed the use of copper coins as extensive trading currency.

The fact that copper enters into the composition of Jig-chu alloys is confirmed by the Jig-dpal-po-daramel (Chandra, 1971: 43), who shows that the word Jig-chu gives us a positive definition of it as "bronze": "as for 'Jig-chu', by mixing seven parts of copper to one of tin from Kham and one of tin from the Brahmaputra (in eastern Tibet)." cf. Douglas, 1977: 56. It turns the white and red 'silver, which is used to make mirrors and gongs.', -Jig-dpal-po-daramel's proportion of tin to copper corresponds to the same value of tin percentage found in the Chinese mirrors analyzed by Chaloupka (1920: 919), or suggested by Craddock (1972: 77) in his discussion of the Kham-sag ("Chinese bronze"). An alloy used in Islamic metalwork (see also Allan, 1969: 435f.). Kham-sag may have been a bronze alloy manufactured not only in China, but also in eastern Tibet, perhaps with Chinese or Bhutanese tin. Since bell metal varies considerably in composition from about three to five parts of copper to one of tin, and the composition given by 'Jig-dpal-po-daramel falls within such percentages, we may well accept 'bell metal' as a suitable term for translating 'Jig-chu', at least when translated by metallurgical analysis.

InMetal, according to my news informant, the owner of a metalwork staller at Sham, tin is present in three types of bronze made in the
casting of various domestic and ritual items:

i) Newar "bell metal" with two parts of copper to one of tin, used for example, in the manufacture of water-pots and wine jars;

ii) Newar "bell metal" with three parts of copper to two of tin used, for example, in the manufacture of traditional plates. Neither appellation of "bell metal" by my informant,14 corresponds to the use of the word in Western metalurgy, where it may indicate any type of bronze in which the parts of copper may vary from three to five, to one of tin (75% to 63% in the alloy);

(iii) "bronze", made with two parts of white metal to one of tin, mostly imported from India. The very low percentage of copper from the melt makes it preferable to regard it as a variety of white metal;

(iv) white metal, imported from India. In Western metalurgy the term white metal designates three different alloys with high (more than 60%) tin, lead and cadmium percentages respectively.

Images cast in white metal are rare and, because of their weight, I tend to believe that they are made of lead-based alloys, which are cheaper than tin and cadmium alloys. The low melting point of lead and its relative freedom from contraction when solidifying makes it particularly suitable for casting. Alloys ii, ii) and iii) have not been mentioned as being used for common statutory purposes by any of my Newar informants. This circumstance confirms my suggestion that the term "bell metal" and "bronze" as translations of names of Tibetan and Malaya metal alloys and compounds may be used only in a rather vague and approximate way with regard to "ritual and domestic implements and should be used hardly at all in connection with the metal statutory from that part of the world. Buchanan's following remarks also seem to confirm that in the past too the use of bronze by Newar craftsmen was limited to the manufacture of domestic or ritual implements (Buchanan, 1819: 72)23: "In Lalita Petan and Phatang there is a very considerable manufacture of copper, brass, and Phul, which is a kind of brass-metal."

The bells of Tibet are superior to those of Nepal, but a great many vessels of Phul are made by the Newars, and imported to Tibet, along with those of brass and copper. Iron vessels and lamps are also manufactured for the same market." (cf. Buchanan, 1819: 213).

Silver

The earliest known silver (Tib.: dgyud) item from Tibet was apparently manufactured in Bactria and has been studied at some length by Denwood (1977: 121-7). Authentic survivals of silver metalwork from the monarchical period are extremely rare and no serious archaeological or metallographic research has been carried out on the silver jug kept in the Jo-khang at Lhasa and "said to be a recent outer covering, made in replica and containing an original piece dating from the time of Khri-srong-lde-brtan" (Ivey 1968: 90).24 It is possible that Irnian silverwork was known in Tibet from a very early period and that its revival lasted until the 15th century. In fact 'lam-dpal-dro-drje mentions that silver, if "roasted in the ni-ba-da wood of the country of Khurasan, thuved" (Chandra, 1971: 41), and Das (1975 repr.: 358) maintains that "the kind of silver called mchog-dam is imported into Tibet from Khurasan". Whereas no silver mining occurs in Khurasan and during the Islamic period silver was used mostly for inlay or for jewellery and coinage, it is a fact that the zenith of the old Islamic silverwork tradition was reached during the Samanid period (A.D. 224-651) and that Tibet came into contact with
Iranian civilization by at least the 7th century A.D., and with Karapinar in particular by the beginning of the following century (see al-Fa‘lI, 1937: 124). The Tibetan tradition associating silver with the Iranian yari is contrasted by Jhan-spal-rdo-rje (Chandra, 1971: 41) with the types of silver available in his day, which included Indian tankas, Chinese ingots and Tibetan coins.10 Long-cho (Chandra, 1971: 146, 1.31) also mentions silver from Hor (Turkestan) and from Shensi. The presence of silver ores in eastern Tibet was first reported by the famous Italian Jesuit Ippolito Desideri (De Filippi, 1937: 123) and by Dela Pena (1750), in Marques 1789: 316. In the end of the 18th century silver continued to be worked in eastern Tibet (cf. Cooper, 1871: 43) in small quantities at Der-ri-te-mo (Cookes, 1919: 260) and the trend continued in the following centuries. France(Combes 1939: 77) mentions that silver is obtained in eastern Tibet and Waddell (1901: 475) specifies that it comes from Bal-lhang and Be-lhang. Giorgi (1962: 456) refers to the presence of silver ores in Chang and Waddell (1901: 475) reports that small quantities of silver were said to be found in the valley west of Sera. "One day's journey off the Pamba Pass" north of Lhasa. Range (1975: 145) mentions the presence of silver ore in lower Mo-nag. However, the output of these deposits was negligible and Tibet continued to import silver from China (Rhodes, 1980: 261; Spurll, 1980: 261; Olson, 1975: 54; cf. Turner, 1980: 351), Mongolia (Beil, 1968: repr.: 222; Rhodes, 1980: 261), and from Siberia (Brog, in Marques, 1979: 126-8). Chinese silver bullion was available in Der-ri-te-mo in 1889 (Sampaolin, 1891: 208). Tibet imported its silver requirements for minting from China (Rhodes, 1980: 261) and from India (Range, 1975: 145). In the 16th century the latter was in turn supplied with large quantities of Mexican silver by the Portuguese, who used to trade it for spices. The great Mogul emperor Shah (who even had a Tibetan wife in his harem) uses surplus silver in trade with Tibet (Rhodes, 1980: 261).

Silver was seldom used in cast images by Tibetan and Newar sculptors (but see no. 30), though its use in statuary does survive even to this day (Alap and Chariton, 1973: 43).11 Like copper and brass, silver has been widely employed for repousse work by Newars in Nepal and Tibet and by Tibetans themselves. Three ancient gilded silver images made by a Newar and a Kasmini sculptor at Khajuri, in western Tibet, are mentioned by Tucci (1939: 40 and 1956: 61-3). cf. Franzenmann, 1939: 52 and 161. A good example of a 20th century repousse silver 'Tibetan status is the 11 ft. high image of an eleven-headed Avalokiteshvara erected in 1970 in the main chapel of the newly built Tibetan Cathedral in Dharamsala (Dalai Lama 1970: 12). This statue includes faces from the eleven-headed Tsunam-pa-image from the Jiu-shang in Lhasa, which was destroyed by the Cultural Revolution in 1966. Parts of the heads were somehow rescued by Tibetans and conveyed to India in 1967 and 1968 (Dalai Lama, 1970: 13, and Richardson, 1977: 74). The use of silver inlay in white 11 and in composite copper and white 11 Tibetan statues is attested by Padma-Sambho-pa from the reign of Pal-pa- tan (see also above p. 50). Silver has been consistently used in inlay work in brass and copper statuary in Tibet, and was a traditional material, available to Pho-lha, Sera and Kangyur origins, is still followed by leading Newar sculptors such as Ndrch Ny-Sakya and Jampan-Ny-Sakya. However, nowadays in the Nepal valley silver inlay is more often applied to copper than to brass images. Although, according to Abdul Akbar's report of January 6th, 1979, silver mines existed in Nepal and "the natives do not understand working them" (Rae, 1961: 267), his suggestion is not supported by geological evidence and the yield of silver from lead ores in Nepal must have been negligible. Shuten imported silver from Tibet and exported it to Bengal (Kerbent, 1961 repr.: 8, 75-7 and 79), but it is likely that the item did not originate from Tibetan or to and was ultimately of Chinese origin.

10
Deposits of kuviuid gold (Tib.: gsar) in Nepal are mentioned by Buchanan (1819: 76 and 251; cf. Negri, 1971: 18), but their importance is minor and greatly contrasts with the reputation of Tibet as a gold-mining country. De La Pena (1733), in Marquet, 1879: 310 reports the presence of gold mines in the provinces of Kham, Kang-po (central Tibet), Lang-der-po (southern Tibet), Byang-chang (northern Tibet) and Khams (eastern Tibet, cf. Hurgd, 1972: 456). Saunders (Turner, 1900: 404-5) mentions "large quantities" of gold in the area of gold mines in Tibet. In 1967 the Indian Pandit Nais Singh explored the gold mines of Tshok-jag-lung, in western Tibet, reaching the main gold-field at 15,200 feet, in N. lat. 27°24'.26" and E. long. 81°37'.88", where the core of the Tibetan gold diggers was placed. The master of gold diggers was a native of Ghansu, a skilled and well-informed man. The Pandit describes the method of working of the gold and the habits of the diggers. (Marquet, 1879: 614 and niv: see also Trotter, 1877: 112-3). Intensive goldfields in the district of Sambor, western Tibet, were discovered by Swami Pranavamsa, an Indian who made surveys in the 1930s and 1940s in the Mount Kailash and Lake Namtso districts. Pranavamsa (1939: 36) mentions the existence of a vein of gold deposits running about a mile south of the Lang Chu, a discharge stream connecting the Namtso to the Tang-ga Tal. Mining had been abandoned there around 1935, because an outbreak of smallpox was attributed by the Tibetans to the wrath of the presiding deity of the mines and consequently the mining was stopped by the Government. Besides the goldfields at Tshok-jag-lung, Pranavamsa mentions those at Kugathok and Hunggar "loose 20 days march northwards from the shores of the Namtso". Those and other extensive and rich deposits were then mined by primitive methods. The mineral specimens collected by Pranavamsa were analyzed at the Banaras Hindu University. Gold mines were also mentioned by Helin's informants (Helin, 1922: 499) and gold was used by the 11th century kings of western Tibet not only to gold statues, but also to pay Amdo for his visit to Tibet in A.D. 1042. In central Tibet Atide was presented by a nun with "the image of a horse made of gold on which a small boy made of turquoise was riding" (Hoffich, 1975: rep. 298).

The gold mines at Tshok-jag-lung are again mentioned by Kedem (1905: 474), Kuchelt (1924: 25), and Tsul (1926: 114-5) and illustrated by a picture of a pit in the Ng'i-rin-ke-nag area (Tsul, 1937: opp. p. 65) where, by order of the Chinese Government, it was then forbidden to mine gold, "because the mines are too close to the border (...). People say because they are convinced that by extracting from the earth the treasures contained in it, its fecundating power to make barren and its crops impoverished" (Tsul, 1937: 61-2). However, besides the use of common placer techniques, diggings occurred in Tibet: "there are left the traces of the ancient excavation works: deep and narrow pits, like many ant-hills" (Tsul, 1937: 62). Commenting upon Filippo's and other historians' mention of the presence of gold in the area, Pesenti (1977: 4) states that the "most detailed treatment of the question is still that of Herrmann, who brings arguments to show that the tale of the "Gangs" gold-digging ants goes back to a deep knowledge of gold-washing in Ladakh and Baltistan, and chiefly at Tangtse" (see also Webb, 1966: 474). Although "gold is found in the sandy banks of the Indus and its tributaries right from Sapsay to Chilam on the Gangs" (Franche, 1971: 4) and "was found from the waters of the river Bum" (Hassanain, 1977: 43), it is more likely that Herodotus' tale is connected with the western Tibetan areas visited by Tsul (1937: 62), than with Ladakh or Baltistan, as for the Gerde, Clarke (1977), in Philip Denwood's words, "has relegated them to the status of a ghost people invented by Schopenhauer.

Gold excavations "in the Lo-chung country" are mentioned by Helin (1910, i: 174 and 175), who quoted many trails of gold-diggers in western
Tibet. Most of the Tibetans digging gold in western Tibet came from Shigatse and Lhasa (Nedin, 1910: I: 194) for a period of two or three months and combined their mining activities with the trade of various goods carried during their journeys (Nedin, 1910: I: 171 and 174). On the other hand, in the 12th century, western Tibetans were brought in by the governor of Ila-yang-drang, near Shoton, to dig gold from an old river bed in that area (White, 1971: 201). During the early 12th century Besideri reported that more gold is found in I “than in other parts of Tibet, and in rather larger nuggets.” (De Filippi, 1937: 140. see also Karsten, 1985: 153). In parts of central Tibet gold seekers had to buy the rights to prospect for gold (Ronge, 1974: 14d; Bailey, 1957: 186; and Karsten, 1985: 165). Gold is found in lower Abo-ba (Ronge, 1978: 44d) and Drag-po (Waddell, 1906: 437 and Bell, 1968 rep.: 110) and Bailey 1957: 185, see also ibid. 193) describes the placer techniques used by labourers in the latter district:

"The way they did it was this, They dug a channel beside the stream about a yard and a half wide, with what they removed they made a dam across the exit of the channel. On this dam they placed five pieces of very short turf about 15 x 8 x 1 inches. These made a weir-top, when the stream was diverted into the channel. Then they dug the soil from the stream-bed up stream and placed it on top of the turf, letting the toe get gradually washed away. The mud in this way was removed and the gold dust fell and was caught in the turf. As they worked, they moved slowly down stream, repeating the process over and over again. Twice a day, at noon and in the evening, the sods were removed and the dust washed out of the same. The dust went through three stages, being washed first in a wooden pan three feet by one with a hollow in the middle. The contents of the hollow were washed finer in a small wooden bowl and finally these were washed more finely still in a tin. By the second stage I could detect grains of gold. But the deposits were obviously not very rich ( ) and ( ) if a nugget was ever found, it was replanted because the people believed that the nuggets would breed more dust."

However, gold mines existed in Drag-po at Mani Serkha and Richung (Waddell, 1906: 47 and map) and the monastery of Kham-yas contained "the State treasure and gold" from those mines (Waddell, 1906: 440, n. 1). South of the Ghang-po river, the nomads of Shigatse mined gold because they were required to pay their taxes in gold dust (Evans, 1968: 55). An episode illustrating the Tibetans' religious attitude towards mining is reported by Macdonald (1832: 230-1): wishing to be self-sufficient in gold supplies, the Tibetan administration sent a monk who had been trained in England as a mining engineer to prospect for gold to the north of Lhasa; however, the returns of the local monastery towards such irreligious activities was such that, although the prospecting had been successful, the monk was "recalled to Lhasa, and placed on duty as a police officer, with the title of Kenchung, of the lowest rank of monk officials" (see also Thomas, 1951: 130). According to the Nepalese consul in Lhasa in 1904, the best gold came from a reef "a few days' journey due east of Lhasa" (Waddell, 1906: 474).

The presence of gold in eastern Tibet did not escape the notice of Besideri, who first described the placer technique used by Tibetans as observed by him in the early 18th century:

Gold and silver of good quality exist in the province of Khan, indeed gold is to be found everywhere in Tibet, but there were no mines as in other countries, the people simply separate it from the earth and sand in the following manner. Near the rivers, with great labour, Tibetans move large blocks of stone and dig

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out the earth and sand underneath, which they throw into a trough. Into this, after placing therein large square sods, they pour much water, which running down carried off the earth, the coarser sand and the small stones. The gold and fine sand is caught in the rough grass of the sods, which are washed over and over again until none remains. The gold is generally like sand and not in nuggets. It is usually found in flat land at the foot of mountains, because the rain washes the earth and with it the gold. It is therefore manifest that if the Tibetans knew how to tunnel mines in these sterile, bare mountains they would find much gold.

(De Filippi, 1937: 121-2).

Rockhill [1384: 360-1] left a brief description of an extremely simple method of extraction used in eastern Tibet, as he observed it in 1922. Alluvial gold is widely distributed in the sands of the great eastern Tibetan rivers (Ronge, 1978: 143), where "the usual method of crude washing is employed, the concentrates being finished off with quicksilver" (Coales, 1919: 246). Similar mining techniques were used in eastern and western Tibet (Ronge, 1978: 144). It is possible that placer mining was favoured because "it can be operated without undue damage to prejudice against digging", which comes from the religious belief that delving into the earth was "to disturb the subterranean demons and destroy the crops and the people" (McGovern, 1924: 363). Centres of gold exploitation in Kham were at some distance from Li-thang (Waddell, 1906: 474), for gold washing was forbidden by the monks in the neighbourhood of the town, although its trade was allowed in Dar-ri-sne-md (Ronge, 1978: 143). Gold dust was traded also at Jyekundo (Rockhill, 1891: 206). An indication of the relative abundance of gold in eastern Tibet is provided by Rockhill (1891: 206), who mentions that the same gold purchased by him in Peking for 20 taels an ounce was worth only 12½ to 13 taels in Dar-ri-sne-md. He notes that "gold-washing is one of the commonest occupations throughout the country, as every stream seems to contain in its sandy particles of the precious metals; and, though the quantity collected by any individual washer is undoubtedly small, the total amount procured annually cannot fail to be of great value." Rockhill [1391: 208-9] was probably one of the first western travellers in Tibet to report that "mining is not allowed in Tibet, as there exists a deep-rooted superstition, carefully fostered by the lamas, that if nuggets of gold are removed from the earth no more gold will be found in the river gravels, the nuggets being the roots of plants wherefrom the gold dust is the grains of flowers." Tawing, a locality north of Dar-ri-sne-md was an active gold-mining centre in 1908 (see Ferguson, 1911: 232) but the goldfields in its neighbourhood had been worked out by 1919 and everywhere "abandoned workings, in the shape of little gravelly soil by the streams" were noticed by Teichman (1922: 61). The most productive gold mines on the frontier in 1919 were in Bhutan, in "Sial-rong and Nyag-rong (Teichman, 1922: 65-6 and 70). Information on gold deposits in eastern Tibet through "large parties of Chinese" into the country (Ferguson, 1911: 214 and Duncan, 1964. 19), but the Chinese prospec-tors who appeared in the 1940s could operate only under military authorization and protection (cf. Ghubat, 1949: 59 and 174-5).

Gold mines in eastern Tibet are also mentioned by Goff (1923: 324) and Cooper (1871: 474). The eastern Tibetan gold deposits were exploited by natives and could only be exploited by the local rulers, "to whom a small quantity of the gold found in dust" (Desideri, in De Filippi, 1937: 122). Although "the yield of gold" was "generally poor", in 1926-7 "several thousands" of Chinese labourers were engaged in exploiting the gold field 50 miles north-east of Yunn, in Yar (Coales, 1919: 246). This gold reached the market of Yunnan (Ronge, 1978: 143).

Mining gold by placer techniques is a subsidiary activity of northern
Tibetan gold is also very rare in Siberia. The Chinese received the "gold domes" from Tibet through the Kham region.

The Tibetan gold is also very rare in Tibet and is considered extremely valuable. The Chinese received the "gold domes" from Tibet through the Kham region.

The Tibetan gold is also very rare in Siberia. The Chinese received the "gold domes" from Tibet through the Kham region.

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Pada-śren-po (1973; i: 200, l.3) mentions that gold was used for
statutory purposes during the reign of the first "religious" king, Song-pan-
brittan-śren-po. It is very difficult to ascertain whether the Chinese
envoys saw in Tibet were gilded rather than golden images. Significantly,
Pada-śren-po (1977; i: 200, l.6 and 301, l.7) mentions that gold was
used during the first and third period of the religious kings (7th and 9th
centuries) for the true-gilding process (Śrāsā-pa), which consists in
applying a gold wash to the metal and driving off the mercury with heat,
leaving a coating of gold on the metal surface (see p. 87). Further
confirmation of the gilding of metal images during the 9th century is
provided by div-śen-śren-śgrub-pa see Kusay, 1975: 55). By the 9th
century it appears that Tibetans had also started to inlay stones in their
statuary, since we know from 654 that the Tibetan governor of
Turistan presented "a statue made of gold and precious stones" to a Ra-
myo (Paksch, as reported by Sagsby, 1967: 43) during the reign of the
Tibetan king Rbi-lod-rgyal-brtsun (c. A.D. 800-857). It is likely that the
Tibetans derived the idea of inlaying stones with precious stones from the
Chinese, whose statues were decorated with stones and pearls at the time
when the Chinese missions visited the Nepal valley in the 7th century (see
below, p. 80).

Iron

Though thought to be a component of the artificial alloy zhi-thyin, iron
(Tib.: rags, though in other contexts is kha- means metal" and,
rhro-bzang) hardly appears in any significant amount in Tibetan and Himalayan
statuary alloys (ma. 44, 45, 82 on 06.105-71). I understand that the Newar artist Zang Ma Saky has cast a few
images in iron. Allop and Charlton (1973: 43) confirm the use of iron by
sculpture for occasional casting in Pātan. Iron statuary is comparatively
rare in Tibetan and Himalayan statuary, notwithstanding the presence of ores
is "Full of iron ore" (McGowan, 1924: 366) and Della Penna (c.0.
1750, i: Marshall, 1979: 316) cf. Giorgi, 1972: 454) first noted the
presence of "mines of iron" in the country. /a-ba-lus-je snyed
extravagantly on the subject and Klima (1977) ponders, 196: 125-2) mentions
that "the soft Tibetans white iron is a good material for the waving bowl"
(wes, into which robes are thrown by lamas-givers where as in China
"sogor" iron, notsuspected, is ideal for various arts and crafts [...].
Farming tools are of iron" (Klima and Spiegel, 1975) cited. Iron must
have been aware of the fact that, besides its mere traditional uses, iron
sometimes replaced bronze in Chinese statuary, and that it was used in
China not only for temple furniture (hospitable, canons, caddrians and even
helmets), but also to build pagodas. Though many iron items were imported
from China to eastern Tibet (Rockhill, 1904; 368), cf. Rockhill (1901: 207) that "the few pieces of ironware recalled from Tibet came
from Lha-gang and that iron deposits exist at Chak-lo, in Kham (Rockhill,
1904: 300-4). The existence of iron mines in eastern Tibet is also reported
by Cooper (1871: 463-4), Frey (1839: 37) and Duncan (1864: 19),
the existence of iron deposits in Chak-lo, in Kham, and the discovery of gold was credited to the findings of the geological section of the Chinese Academy of Science (see above, p. 40).

From 1901, 11: 149-51) mentions a forge at Lhagong, which was probably
supplied by local iron ores (cf. Rockhill, 1894: 303-4). Rockhill (1894:
330 and 333) reports the presence of smallsmiths at Nyewa and Li-thang but
none of the work he saw was "of a high order, all is very inferior to that
done in Persia". Iron deposits were also located in the Huang-ho Range on
the border of Tibet and the province of Tsinhsu. Iron also in the Way-chu-kha
area were reported in production in the late 1950s. Iron is to be found all
along the eastern shores of
the lakes Wannarav and Ribesa Tui. It is very likely that Tibet was self-sufficient in iron and the site does not appear in Kiphotheron's list of exports from India to Nepal and Tibet. Some wrought iron was exported to Tibet from Bhutan (Pemberton, 1961 repr.: 76), where iron was "procured in the hills" during the first half of the 17th century (Pemberton, 1961 repr.: 76). Kiphotheron (1775 repr.: 76) maintains that "the iron of Nepal is not, perhaps, surpassed by that of any other country" and in A.D. 1791 Abdul Kazir noted that Nepalese worked some of their iron mines (Rgnyi, 1961: 247). Iron utensils were imported from Nepal to Tibet (Buchanan, 1859: 213 and 232).

Lead

Lead (Tib.: shs-nye) is not used on its own for Tibetan and Himalayan statuary, although it is often found in brass and sometimes in copper statutaries, where it is added to improve the fluidity of the alloy. Lead deposits are located in Tibet by the Chinese Academy of Science after the Chinese occupation of the country (see above, p. 40) and the existence of a lead mine two dozen years later from Tshanglha is reported by Saunders (Turner, 1860: 40; see above, p. 40) who adds that the ore was "mineralized by sulphur, and the metal obtained by the simple operation of fusion alone". The lead mines noted by Bailey (1897: 167) at Nyenlong Tsang, in Drags-ku, were probably the same mine, and are exhausted at the time of his expedition in 1912. The lead was extracted there "by heating the ore with charcoal". Lead is found in eastern Tibet, between Ta-chang and Phur-ma (Cooper, 1971: 467) and in Tsu-tong (Goy, 1923: 328). "Jen-dal-bshis-je (Chandra, 1971: 43) was aware of the circumstance that lead can be associated with silver ores (cf. Saunders in Turner, 1860: 40) and observes that "it flows out of the place of the ashes (residue) of silver." He also mentions Indian, Chinese and Nepalese red lead (Chandra, 1971: 61) and explains that: "If you roast it, lead will flow. We know from Hodgson that there were lead "mines" in Nepal, but there was "no skill to work them profitably" (see also Kadir's report in Rgnyi, 1961: 247) and the metal was "imported from the plains" (Hodgson, 1972 repr.: 119. cf. Judd: 109). Lead, "China red lead" and white lead were imported into Nepal from India (Hodgson, 1972 repr.: 109). According to Jackson (1976: 282) the red lead used by Tibetan painters was imported "as an already powdered pigment from Nepal, India and China". From the study of Werner's data (Werner, 1972: 284-7, table 4.1) and the analytical data reported by Riedel and Willhaber (1975: 64-67), it appears that the main source of the Tibetan metal is the Greek variety analysed by Crudkite (pp. 26-31 above). The presence of lead in Tibetan and Himalayan statuary dates from at least the 7th century and the Cleveland Buddha (see above, p. 34) contains as much as 11% in its brass alloy. It is very likely that we find the first Tibetan development of the advantages of using lead to brass for casting purposes (nos. 42, 63 and 64 on pp. 105-6) in artefacts even higher than 10%. These varying percentages reflect the proportions of brass artefacts to be found in Khamsi statuary: 2.75% lead in the brass Shing-a-wa by Lee (1987) containing 78.1% copper and 18.7% zinc (personal communication from Shumval-Cheema, September 5th, 1976) and 10.37% lead in the bodhisattva illustrated by Uehlinger (1979: 122, fig. 56) containing 70.1% copper and 13.1% zinc. New discoveries only add lead in very small amounts when casting brass images (nos. 114, 115 and 121 on pp. 108-9). Although the addition of lead reduces the strength of brass, it makes it easier to cast and more suitable for engraving.

Mercury

The importance of mercury in metal statuary is connected with its role in the traditional fire-gilding process (see pp. 80-83).
Mercury (Tib.: rgyu-lugs) enjoys a great reputation in Indian and Tibetan medical and alchemical literature and occupies the first place in the list of precious substances which can be melted, as examined by "Jad-rol-rdo-rgyud" (Chandra, 1971: 40), thus preceding gold, silver, and copper. "Jad-rol-rdo-rgyud" (Chandra, 1971: 39) quotes the "Phyi-rug-pa". The fourth buyok in the medical tantra, the rgyu-gshi, to say mercury is "as manufactured by boiling clinober". He further distinguishes four varieties (mthal) from cinnaubar (rga-la-ma) and again mentions that if one roasts the former "quicksilver flour" (Chandra, 1971: 11, 2-3). As to the latter, "it is called mthal-rgyud ("wild varietal") and also rgya-mthal on account of its appearing in India (Tib.: rgya-sad) and China (Tib.: rgya-sad). In the native red stone there is a great deal of purple. It is like an arrangement of wide needles. By melting it there appears mercury" (Chandra, 1971: 59, 11, 1-3). The Tibetan rgya is an adjectival prefix which may indicate India or China. Chinese vermillion was occasionally exported to Europe during the first half of the eighteenth century and its reputation for high quality became firmly established from the second half of that century (Harley, 1970: 118). Vermilion, a synthetic mercury sulphide, was probably imported into Tibet "from India or China, both of which had the technology for synthesising it since ancient times" (Jackson, 1976: 277). There is evidence that both "kingfisher or vermillion (rdo) cinnaubar" and mercury were exported from India to Nepal and Tibet (Klima-zhitriz, 1975 repr.: 209 and Hodgson, 1972 repr.: 109) during the 18th and 19th centuries and it seems unlikely that either country had the technology to manufacture vermillion before then. Clinober, the native mercury sulphide, "occurs naturally in some parts of South-East Tibet. It is easily recognisable by its reddish metallic appearance and extremely heavy weight" (Jackson, 1976: 277). However, vermilion made by the sublimation method is pretty well indistinguishable from the best native ores (personal communication from Davis Bristol). Native Tibetan cinnaubar ores "exported to the lov country for sale" are mentioned by Turner (1800: 78 and 299) and "cinnaubar, containing a large portion of quicksilver" by Saunders (Turner, 1800: 495) who travelled through southern Tibet to Tashili-n'-pu. Saunders, who was a surgeon, only mentions mercury in connection with its preparation for medical uses (Turner, 1800: 410-11). Mercury ores are found in lower af-so-bo (Ronga, 1978: 125) and according to a Tibetan informant (Margile, 1980: 44 and 40) cinnaubar is found at Mount Tang-jo, in central Tibet, and in a place near Mount Khalka. Tibetans knew how to extract mercury from the cinnaubar deposits near Bangthang and used it specifically for fire-gilding purposes (Song, 1978: 145). The earliest reference to clinober ore in Roman (eastern Tibetan) is to be found in della Penna (a.d. 1730), in Marbach, 1879: 317, cf. Dinger, 1976: 317). Also Cooper (1871: 40-41) and Richd. Simons (1590: 37) mention the existence of mercury ore in eastern Tibet. However, both quicksilver and clinober appear in Turner's list of "Chinese imports to Tibet". Turner (1800: 372) maintains that Tibetans did not know how to extract mercury from cinnaubar, though he mentions the existence of mines of clinober, containing a great proportion of mercury and used "for colouring, in paint". In the same work, however, Saunders (Turner, 1800: 410-11) observes:

Nor could I allow myself to think that they were acquainted with the method of preparing quicksilver, so as to render it a safe and efficacious medicine. In this, however, I was mistaken [...]. There is one preparation of mercury by means of which has been made after the following manner. A portion of alum, nitre, vermillion, and quicksilver, are placed at the bottom of a water pot, with a smaller one inverted, put over the materials, and well luted to the bottom of the larger pot. Over the small one, and within the large one the fuel is placed and the fire continued for about forty minutes. A certain quantity of fuel, carefully weighed out, is what regulates...
then with respect to the degree of heat, as they cannot see the materials during the operation. When the vessel is cool, the small inverted pot is taken off, and the materials are collected for use. I attended the whole of the process, and afterwards examined the materials. The quicksilver had mixed on, by the other ingredients, deprived of its metallic form, and rendered a safe and efficacious remedy.

This passage, along with 'Jam-dup-ruo-ri's observation, suggests that Tibetans were aware of the property of heated mercury and cloumba to coalesce and use techniques of collecting mercury during the heating process. According to Naskari (1964, III: 72), cloumba was also 'found in Nepal', and Buchmann (1919; 264 and 272) confers the existence of cloumba mines in Nepal. Such mines were 'used to some extent' (Regel, 1971: 18). However, as we know from Buchmann (1919: 212; see also Imperial Gazetteer of India, 1909: 121), that Chinese quicksilver found its way to Nepal and as cloumba appears in Kirpatrik and Hodgson's 1615s of Indian exports to the country, it is very unlikely that Nepal was self-sufficient in mercury in the 18th and 19th centuries. The metal was much needed in the filigree technique commonly used in Nepalese jewelry. It is possible that the Nepalese were also acquainted with the technology necessary to synthesize mercury and that vermilion was manufactured in both Nepal and Tibet (cf. Regel, 1971: 23 and 67). However, it is not clear whether Regel, who mentions the casting manufacturing "vermilion", distinguishes between red lead and vermillon, when using the latter here: the Nepalese word and/or translates into "vermilion" and 'red lead'. It may be noted here that all the mercury and cloumba exported from India to Nepal and Tibet was of Indian origin, since there is no evidence for the existence of either in Nepal. (Brown and Sey, 1955: 29).

Notes

1. The brasse Augustine described by Ulig (1979) as "western Tibet" often include a floating scar, the shape of which compels one to expect the outline of a cloth worn. However, this characteristic, as well as their general aesthetic features, is not to be found in any statue or statuette, whether Kashmiri, Ladhaki or actually western Tibetan, to be seen in the shrines illustrated in relevant books by April (1973, III), Shambhun and Skvupak (1977 and 1980) and Gotthleb (1979, III: 151-161 and 201). Because this mentioned scarf motif is conspicuous by its absence from all western Tibetan images, whether made of clay or of metal, to be found in situ and because of attitudinal differences, there is in fact no evidence to support the description of that group of brasse statuettes as "western Tibetan", of which I have never come across one single example during my visits to various monasteries in Ladakh. Thus the attribution by Ulig (1979) of a large number of brasse images to Tibet should be treated with caution. An interesting technical feature of this group of images is that they often have a very thin cast (cf. Brown, 1955: 95).

2. On the location and mining from ancient times of copper ores in northern India, see Brown and Sey (1955: 146-154); "there are many occurrences of copper ores in the outer ranges of the Himalayas at intervals from Sikka in the east to Kashmir in the west. In Sikka they were worked extensively in the past by Nepalese miners. A copper mine in Kuras (Kashmir) is mentioned in Bahan's Ajyārajagrma (Book IV, vv. 214, in Steff., 1900, I: 179). Ray (1956: 202) states that "mining of copper ores and the extraction of the metal had been carried out on a large scale in the various states of Rajputana."
(Rajasthan) from a very early time till towards the end of the 10th century." On copper ores see also Dattatraya (1894): 447-9.

3. Again, the land of the Khotan (western Tsin-Kayla) is mentioned in connection with the production of copper pottery in Shih (5), 77. The same area occurs in Nagārjuna's Rasaratnākara, v. 29-30 (cf. Bay, 1906: 130 and 1681). Nepal is mentioned as a copper-bearing country also in the Dharmakīrī (complete 14-5 in Bay, 1906: 260). The earliest mention of Manipur copper in Chinese literature is probably made by Hui Shih, who travelled to India from 4. 629 to 645 and reports that Nepal "produces red copper [. . .] in commerce they use gold coins of red copper." (Bay, 1894, 17: 60. Cf. Wharton, 1900, II: 83. Since Hui Shih obtained his information in India, it appears that by the 7th century India already looked on Nepal as a copper-bearing country.

4. Buchanan, 1819: 76-7. 203, 242, 264, 267, 269, 272, 275, 397 and 301. In Farnell (for Malehak) alone "the mines of copper are said to be twenty-five in number and produce a great revenue." (ibid.: 270).


6. For the term amāniko, see Olivieri, ed., II Milione, Hari (1912): 28 and 341. The same word appears also in C. Steinor, ed., Cocco Angiolieri, II Casanzone, Turin, 1929, 499: no. 109. v. 2. Cocco Angiolieri (1260-1311/13) uses the term in connection with the word "metal" and Marco Polo with the words "iron" and "steel." From Marco Polo's description of the process, I should think that the translation of amāniko as "zinc carbonate" or "zinc ore" would be more appropriate than the current Italian dictionary definitions of it as "very hard metal, akin to iron and steel." I do not regard the leading Italian comic poet of the Middle Ages as an authority in mineralogy. On the same process, see the reference given by Crabtree (1979: 69). Cf. also Forbes 1961, VIII: 205f. Zinc oxide has a pigmented strength some what superior to white lead, and having the added advantage of being non-polariser, is used in cosmetics. Marco Polo says that "excellent" collyrium was made from the coby by the inhabitants of Khuban. However, Ponchiroli (1979: 299) translates amāniko as "antimony" (arsene indiastium, "Indian iron"). Antimony is highly toxic to the human body and irritates both internally and externally.

7. Among the objects from East Turkestan analysed by Werner, there is one from Ko-cho (Turfan oasis) with 31% zinc (Werner, 1975: 201-1, no. 24). If its dating is correct, it would seem that the manufacture of metallic zinc in that area began in the 13th-14th century, some a zinc percentage in excess of .3 is evidence of the use of the complicated method to extract zinc from zinc ores by means of an external condenser.

8. Cf. Forbes (1971, VIII: 201): "Though the value of the old Indian alchemists and their modern commentators is very doubtful it seems that zinc was prepared by Indian chemists since the twelve century, but that this remained a laboratory experiment and was never applied to industrial production. This stands for the essence of tin as it is sometimes called was prepared by distilling calamine with organic substances in an apparatus suitable for distillation per descensum, where a s-stance could be heated in an upper flask and the drippings could be collected in a lower one."
9. Cf. Ray (1956: 122). Ray (1907: vii) uses a copy of the ms. preserved in the Rumih Library, Kashmir, of which the "readings are on the whole accurate" (ib. footnote). A fuller discussion of the use of metallic zinc in medieval India is contained in vol. 1, pp. 155ff., where Ray concludes: "In the medical lexicon ascribed to king Mahendravala and written about the year 1374 A.D., zinc is (…) distinctly recognised as a metal under the designation of Jasada". The extraction of zinc is also mentioned in the 12th century Rasāranga which is believed to be a Tantric work of the 12th century A.D. (Ray, 1956: 119). Section VII, vv. 37-8, states that calamine mixed with various ingredients and "roasted in a covered vessel yields an essence of the appearance of tin" (Ray, 1956: 128).

10. Also: cong-shi. This word has been inadequately translated as "a kind of white stone" (Skeat, 1972: repr. 191), "a medicinal white stone alleged to cure diarrhoea" (Bos, 1970: 383), and "calcite" (Schottner, 1975: 125). 'Aam-dpal-drdo-khrug (Chhabra, 1971: 46) lists five types of cong-shi, with colours varying from that of rock-salt, to white, bright purple, yellow and even blue and black, and says that the first two are found in hot springs. It may be suggested that the word indicates a range of minerals from sodium carbonate to calcium carbonate (calcite, calccareous spar).

11. Sphalerite, a sulphide of zinc, is the chief ore of that metal. The colour varies widely. Generally, it is a shade of reddish-brown to black, but some sphalerite is green, yellow/or, in crystals of high purity, almost colourless transparent to translucent. Calamine is usually coloured green, blue, yellow, grey or brown by impurities (cf. Forbes, 1964: 261).

12. In view of the above considerations (p.37 on red ii) and of the composition of northern Indian alloys, I suggest that Padma-dkar-po is here equating white ii with brass.


14. Padma-dkar-po (1973, i: 295, 1, 2) explains that "those images which are made with white ii for the body and red ii for the garments are called dangs-rhang-nga" see also Tucci (1959: 191, n. 6) and Daglay (1977, ii: 52 and 571).

15. It is possible that during the early 13th-century period Tibet imported brass from Iran. Close connections between Tibet and Iran at that time are confirmed by a number of historical sources.

16. See also Daglay (1977, i: 56-7). Gilded brass images are increasingly encountered in Sino-Tibetan statuary from the 15th century onwards (see above, p.25).

17. This kind of Sa-skya-pa portraiture may have reached its climax before the rise of the 13th-lug-pa power in Tibet, at a time when the Sa-skya-pa enjoyed the patronage of the Mongols, and continued during the reign of the Yung-lo emperor, only to diminish from the triumph of the Yellow Hats in the 17th century. Describing the "new Chinese" statues, Padma-dkar-po specifies that "the two coronals (Tib.: a-kha-skya) of the lotus divide one above the other and adhere at the front and back" of the base (1973, i: 301, 1.4). Karmay (1976: 95) notices that "in many
respectors, Padma-khar-po’s account, although describing King bronze in general, concords with her description of the tuglu-lo bronzes in particular.

18. "Upper" and "lower", as used by Tibetans in a geographical context, mean respectively "upstream" and "downstream" and here, as is often the case, they stand for "west" and "east" of the Yarlung-po river, namely Western Asia and China respectively. Although no one would question the presence of important tin deposits in China, the picture is quite different for India, a country which has traditionally imported tin ore, at least since the 3rd-2nd centuries B.C. "The oxide of tin cassiterite, has been found at a number of places in the Hazaribagh, Ranchi and Gaya districts of Bihar, but none of the occurrences appear to possess economic importance, though as long ago as 1589 tin ore was being smelted in village nce furnaces at Purgo, in the Paljgar estate near Farsabad" (Brown and Day, 1955: 167). "Outside Bihar, cassiterite has been found, but again only in insignificant amounts ( ... ) there are no recorded instances of the occurrence of tin ore in Pakistan" (Brown and Day, 1955: 168). Discussing the use of metals at Taxila, Marshall (1951, II: 563) acknowledges that "even if these deposits were worked in ancient days (which is uncertain), they would not have been adequate to meet the needs of the country". Marshall infers that tin was then imported from the west, to which may be added Finch’s observation (1959), as reported by Brown and Day (1955: 168), that Burnese tin served all India. A detailed study of the history of Indian statuary metals is outside the scope of the present paper and I am satisfied with bringing circumstantial evidence to my suggestion that bronze was not the obvious alloy to use for statuary purposes in India, owing to its lack of tin ore. Significantly, Marshall (1951, II: 565) states that the Sanskrit kastira derives from the Greek word for tin, kassiteros, and "not vice versa". Indeed, we understand from Pline that the coastal districts of western and southern India "possessed neither bronze (les) nor lead, but exchanged precious stones and pearls for them." (Marshall, 1951, II: 566-567). Pline (1958: 57) confirms that, "silver, tin and mercury ores ( ... ) are still now not known to occur in India". The "upper Indian" tin mentioned by "Jan-dpal-rdo-rje may have been Western or Burnese. As I cannot find any trace of Burmese tin in Persian or geographical distinction in the Indian subcontinent. Similarly, Arab writers did not regard Lower Burma as a separate geographical entity from Bengal (Ogpal, 1950: 51-2). The suggestion that Burnese or Western tin was exported to Tibet via north-western India and western Tibet may answer "Jan-dpal-rdo-rje’s apparent contradiction of "upper", Indian" tin.

19. It has been suggested that white tli is an alloy of silver and bronze (cf. Nevin, 1975: 30, no. 6), although such a statement has not been supported by metallurgical evidence and is challenged by its accurate definition as given here by "Jan-dpal-rdo-rje’s Padma-khar-po’s recurrent use of the term for various periods and school of statuary and the rarity of images cast in any kind of "white" metal point to the suggestion that white tli must have been some other kind of alloy. On the evidence provided by the results of the analyses discussed above, Crocco suggests that white tli is a high zinc brass (above, p.24), although the zinc percentage could not be higher than 30 in Padma-khar-po’s day. However, "Jan-dpal-rdo-rje’s definition, coupled with Khong-
rbo'l's statement that both red and white li as well as yellow li, iridescent li, and dark reddish-brown li are used to make musical instruments suggests that in this particular instance those names of alloys actually indicate bronze (see the analyses of nos. 47 and 60 and Craddock above p.26). On iridescent li, see above, p.36. Neither the yellow nor the reddish-brown varieties of li are mentioned by rong-rab in connection with statutory purposes (Chamdo, 1973: 1962, 2-1).

20. See note above. Symbols "and other musical instruments" were also exported to Tibet from China (Turner, 1980: 381). Nor was the best source of bronze products and in Kedo Tibetans would receive bronze items from Peking and Dolonor (Sauge, 1978: 166-7). On the metal workshops of Peking see Montell (1954); on those in Dolonor see Huc (1904, I: 801) and also Hochuli (1901: 131).

21. Tib.: "Li-yi", This name is sometimes also used to designate Nepal. The Tibetan yI means "country".

22. It may be mentioned here that in upper Nor (East Turkestan) a mixture of white and red (ir) was used to manufacture "dark Arkho" (Yadma-dekar-nu, 1975: 3) and, 11, 1-21) is here not to be found in Jqem-dpal-rdo-ser's Rsera Medra, but for which the word "bronze" might be suggested if only the bronze objects from that area analyzed by Werner did not belong mainly to one branch of three centuries (7th-9th centuries) and come mostly from one site (cf. Werner, 1972: 190-2). On Áhro see below. On Áhro-li see Degrug, 1977, I: 52, no. 7.

23. A brass Green Tárü studied by me at Musaeum, Spurk of London in 1979 and a brass White Tárü studied by me at Bombay's in 1900 bear identical inscriptions. Karoo (1975: 30) mentions a standing Yarцевайtaa bearing the same inscription in a private collection in London. I have never come across the description of a "De-mo" 254 of li-chu in any of the Tibetan texts dealing with the subject and I am rather inclined to follow the suggestion that the inscription was the owner's mark. From Ferrari, we know that De-mo (Raguy-tu) was the name of three important regents of Tibet: the first incumbent, an important figure in the history of Tibet, was regent for the VIIth Dalai-Lama from 1757 to 1777; the second was regent for the 9th and 7th Dalai-Lama from 1810 to 1815; and the third was regent for the XIIIth Dalai-Lama from 1866 till 1869. In 1865 he was in 1865 deposed and thrown into prison by the young Palkhi-Lama, who took the government in his own hands. Their residence was han-rgym-gleng, the most important monastery in Lhasa, in the northern part of the city. In 1912 the monastery was destroyed by the Tibetan government because it had ties with the Chinese. Afterwards, the Post Office of Lhasa was installed on its premises. We know that at the time of R. Richardson's mandate in Tibet the De-mo lived in the gdi-bal college in Lhasa. Ben-rgung-gleng was apparently built by the regent of Tibet, which ceased later than 1667 (Ferrari, 1958: 93). It is possible that due to the vicissitudes of the De-mo and their men, their collection of metal images started being scattered even before the Chinese occupation of Tibet in 1959.

24. In this connection it may be interesting to note that according to dge-lugs-pa Zang-dan-rgyal-rwa, who compiled his History in A.D. 1566, all statues in the temple of "A-bang-bu, erected by Bal-gyam-nu south of Lhasa, "were modelled on the god of Magadia in India, cast in white and red li and gilt with gold from the river Dzompu" (Sherpa, 1975: 5 and 7)). Direct connections between Tibet and Bengal started at the latest in the mid-8th century, when the Pala kings had to pay tributes.
to King Khri-arong-lde-Ordzam in A.D. 755-6 (see Stein, 1962: 39 and 43).

26. For a different type of zungzhang-ma, see above, n. 14.

26. It may be suggested, as Séguier notes, that these images are replicas of more ancient Pala and Sena statues. A few of these statues, however, may have been made by Indian artists working in Tibet (see p.34). Others were produced by Newari and Tibetan artists working from Indian models. Indian statuary styles were in fashion in Tibet for centuries as illustrated by the fact that the Tibetan Scholar Rgya’bras (n. A.D. 1675) commissioned Never sculptors to make a statue of Jamyang “in the Indian style” (Gucci, 1969, I: 276). Tibetan images in Indian style are difficult to date because they were produced at various times. The ability of Never sculptors to imitate alien schools is witnessed by the occasional appearance of 15th century artificially aged copper and brass statues on the international antiques market. What appears to me to be a copy of no. 119 on p.109, for example, was sold as an “antique” in London eight years ago.

27. Elsewhere, Den (1975: 12) describes lji-drab as “a rarely encountered alloy, characterized by a whitish tinge (drab), differing from silver in its lack of oxidation”. The term is of very frequent occurrence in Tibetan literature describing Tibetan and Indian statuary alloys which, however, are seldom made of silver or bronze. See also note 19.

28. These items are described and illustrated by Daggag (1977, I: 34 and II: 17, Fig. 19).

29. Cf. Des (1976 repr.: 115): “The kind of bronze called Abhro-mag or dark bronze is also called zungzhang-ma on account of the predilection of iron in the compound,” the analyses reported above (pp.26-31) exclude the likelihood of such an alloy being used for statuary purposes. Des never mentions tin but rather speaks of zinc – to justify his translation of abhar-ba as “bronze”. In fact, Krong-ral seeks to take great care to exclude abhar from the various types of abhar-ba (bronze) he mentions. If we had to follow Des’s own explanations, we should suggest translating the term as “bronze” rather than any kind of bronze, at least as far as abhar-khor is concerned (cf. Daggag, 1977, I: 50). ’Jam-dpal-dro-je (Chandra, 1973: 64) qualifies abhar-mag as “iron” and mentions that the Chinese one is made to look like gold and silver and coated with gold (those used for paining backs), then confining that we are in the presence of an iron compound, not quite of “bronze”. Foreign terms are specifically said by the Krong-ral (Chandra, 1973: 166-2) to be made of iron from Khams and Kham. It is likely that, as in the case of gi-phyon, which represents the lozengy-copper – and possibly of non-Tibetan origin – Tibetan reported abhar-mag and did not know its constituents, or that the manufacture was lent to eastern Tibet (Daggag, 1977, I: 50). Even Des (1976 repr.: 175) acknowledges that the alloy is largely manufactured in Chana”. Daggag’s definition of abhar-mag as “an alloy of iron and abhar-ba” (1977: I: 50) does not cast much light on the issue, for he fails to define abhar-ba with any certainty and, generally, to provide any kind of metallurgical evidence in his study of Tibetan statuary metals.

30. On the white tin alloy used by the Newari metalworkers, see above, p.49.

31. It is possible that this eastern “Tibetan” tin came from some near the
border with Ruman. A region with the name of ‘Rud’ is placed precisely in the proximity of the Tibet-Burmease border on Wylie’s map of Tibet according to the ‘Dram-gling-rgya-bshad’ (Wylie, 1962: opp. p.266). However, it is more likely that this eastern Tibetan tin was in fact imported from China and Ruman. (see above, n. 18).

32. My informant, Jagat Man Sakyu, uses an English word either found in dictionaries or heard from foreigners. His descriptions should be taken very cautiously until they are substantiated by numismatic analyses of actual samples of the objects he mentions.

33. Cf. Klong-drol’s text on “the manner to recognize precious substances”: “there appear various counterfeit types of li in Nepal, Ruman and Tibet, soundless and of a black colour.” (Chandra, 1973: 1462, 1.3).

34. The “pottery drinking vessel, said to have been used by Strong-britsang-gam-po and now enclosed in silver” as mentioned by Smilliegrove and Richardson (1966: 50-1), appears to correspond to Strong-britsang-gam-po’s bowl described by Tucci (1952: 77) as being encased in a silver vessel on which he could read a date corresponding to A.D. 1864. However, Richardson (1977: 181) maintains that the “round-bellied silver jar with a long neck surmounted by a horse’s head” bears a date corresponding to 1945, “a new covering in exact replica having been put over the original jar for its protection” and mentions Strong-britsang-gam-po’s “earthenware beaker, now protected by a silver case”, without giving a date for the latter. A silver portrait of Khri-strong-lde-brtson is mentioned by dpal-’bo gTum-mcap-rgyong-ba (Karmay, 1975: 4 and 31, n. 26). From Chinese sources we also know that in A.D. 824 Tibet presented China with a pok, sheep and a deer “all cast in silver” (Deméville, 1952: 203, footnote): “Gold and silver objects are often mentioned among the presents offered by Tibet to the Chinese court.”

35. Klong-drol (Chandra, 1973: 1461, 1.3) seems to have a high opinion of Chinese silver, but not to extend it to Indian silver: “The ‘Indian yellow’ one is the faulty one from India and Nepal”. It is true that Indians sometimes use a poor type of silver, with a yellow tinge, to cast jewellery items. As a rule, however, Indians use almost pure silver for their jewellery.

36. In the shrine of Mr. Ravji Baj Farnikar, the keeper of the main teashop in the Durbar Square of Patan, there are two splendid cast silver images of a six-armed Maitreya and of an eight-armed Mahakala standing on two lions. Unusually they are displayed for public veneration only once a year, on Tihar. As I missed the opportunity of studying them on September 10, 1978, because of the compact crowd of tourists, I could not examine their interiors and can only provisionally assign them to the early 20th century. They both measure 22 cm x 15 cm.

37. Main Singh gives the location of a few goldfields between N. 1st and 31st and 33rd and 41st, and describes their organization and methods of extraction (Trotter, 1877: 505-5 and map). These fields were not as rich as the western Tibetan ones and their exploitation was not very lucrative.
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CASTING OF DEVOTIONAL IMAGES IN THE NEPALI/AVASI HISTORY, TRADITION AND MODERN TECHNIQUES

E. Co Bee

Both voided and hollow-casting by the lost wax process have a long history in Nepal. According to Sivert (1982:25), the earliest literary evidence for the process is the description contained in the Neubuch (Bhairavi-Abhors, as recorded in chapter 68 of the Mahabharata, which is believed to have been compiled in the Gupta period (Brihaspati, 1968: II:108). Unfortunately, surviving cast metal statuary from this period is rare. And Shakti Bhuyan (1979:62) suggests that the extensive use of metal for sculpture in northern India may not be earlier than the late Gupta period. From the early medieval period (7th to 12th century AD), terra cotta is found containing references to metal-casting techniques. Of particular importance is the Visnupramanisu- Sarasvati (II:43)-4, which mentions both hollow- and solid-casting by the chha-panche method (Sivert 1982:32). This text is well-known in Nepal (Pat, 1970:1); Levis, 1992, (I:3:33). However, the first medieval description which gives detailed instructions is contained in the Abhijatavahini (a text also known as Mappali/Sivapali or Murali/Mylapalli) which was written in c. AD 1113 by king Dineshvar Bhuvanesvaral of the late Kalinga dynasty of the Pala (Ehrenwein, 1936:129). Sivert, 1982:32; Hettler, 1974:2-2. The verses on the lost-wax process, as translated by Saratwati (1936:167), also specify that the ratio of brass to copper should be 1:1 (i.e., according to a variant reading, 2:1). By this time, hollow-casting had reached a degree of perfection which enabled sculptors to attempt very large images, for which the repoussé technique is otherwise generally preferred. The 2.6 m. high Bhairavya copper Buddha in Biramganj City Museum was cast in more than one piece by the hollow-casting method and it is very likely that the 1.16 m. high copper Buddha in Biramganj City Museum was cast by the same method.

The History of Buddhism in India, written in AD 650 by the Tibetan scholar Mokshita(?)(1576) states that during the Buddha's rule (c. AD 454-486) the work of two outstanding Bhamali painters and sculptors, Vasum and Bhupala respectively, gave rise to new schools of painting and metal statuary (Chithokshapuris, 1967:361). Sivert (1982:25) suggests that the result widespread use of the chha-panche process was to influence the manufacture of copper images in Nepal, and Tibet at the turn of the 10th century AD, particularly with respect to copper gilt images which are still produced there today. As in the past (manadhara, 1965:2), both solid and hollow lost-wax casting methods are still used by Nepali sculptors. The former is often used for medium-size images (from 12 ft 30 cm) to large (from 30 cm) images, the latter for small (15 cm) and sometimes medium-size images. The use of the two methods overlaps for medium-size images ranging from 30 to 120 cm. There is no evidence to support Degrade's claim that in Tibet permanent molds for solid-casting were more widely used than the method of lost-wax casting (Degrade, 1927:12). However, this claim appears to overlook the use of the lost-wax process in Tibetan statuary: "in Tibet halls as well as statues were made by the sand-casting method which required the same process to be used after casting. However, Pat (1909:24) accepts that the "bronzes in Tibet were usually cast by the copper-gilt method", a careful visual examination by Treadwell (personal communication of the 121 objects or flash lines, failed to show any evidence especially in the underside of the bases. It seems probable that both techniques of casting were used in Tibet, the earliest evidence for the introduction of the lost-wax process into Tibet is probably provided by a western Tibetan Vajradhara at the Musee Guimet in Paris (K.3548). This statue was hollow cast in brass (11,7% zinc and 8% lead) by the lost-wax process, as shown by Treadwell which
revealed the presence of a core held together by a metal armature (Hours, p.619-95-96). This image, attributed to Fall(1969:22, Figure 6) to the 11th-12th century and regarded by Regn turbulent evidence for the introduction of the lost-wax process to western Tibet.

The continuous presence of Newar sculptors in Tibet is attested in Tibetan and Western sources from the 7th (Norbuling and Tschudi, 1979:143) to the 20th century (Cru, 1924, II:284; Blau, 1978:196 and 202-3). The career of Aniko, a Newar artist who was sent to Tibet at the head of a team of eighty artisans in AD 1250 (Lévi, 1905, III:187; Petteg, 1958:59; but see Tucci and others who give the figure twenty-four, probably mistranslating Lévi's French "quarante-trois") is only one example. Aniko was subsequently invited to the Nongro court in China, where he was put in charge of the imperial metal-works, and received unflinching honours. Byzantine and copper are listed by the Maunakasi (see below, p.601) amongst the materials used by Aniko (Kosay, 1976:71). For every subsequent century, the presence of Newar sculptors is de-tailed in various parts of Tibet. Newar communities existed at Lhasa, Shigatse, Gyantse, and Saga on the Tibetan plateau. Although the figure of 20,000 Nepalese residents in Tibet (Nepal, 1965:23) is certainly exaggerated, what matters rather than their numbers are their social and anthropological contexts. They all belonged to the three Newar castes among which metal sculptures are still to be found: Vajrakilaya, Saga and Uda. During the early 17th century in particular, their activities extended from Guga to Puri (1786-95; see Lévi, 1905, I:79-80) to Buxton (Ardou, 1971:100-6), which is still supplied by the Newar metal sculptors of Katmandu. The number of Nepalese metal images in Tibetan temples was legion and Newar sculptors have also been active producing statues in Tibetan style (Le Rue, 1978 and 1980). There is, however, no historical evidence that Tibetan metal sculptors ever worked in Nepal. Furthermore, the current absence of local lost-wax statutory manufacture from Buxton, Lalakha, and the Tibetan areas of Nepal, including the Tibetan refugee settlements where there are quite a few outstanding painters, suggests that Tibetan lost-wax metal statuary depended heavily upon Newar sculptors well into the 20th century (Le Rue, 1978 and 1980). For these reasons, and in the absence of living Tibetan lost-wax metal sculptors to act as informants, I have thought it acceptable to base the following sections on the work which I carried out in 1977 and 1978 among Newar sculptors working for Buxton in Nepal.

A pioneering study by W. de Labriasse (An Anthony Article on lost-wax metal casting in the workshop of Jampa Lekpa in Saga on Olo Nahi). Katmandu, was published in Kaifush in 1973. Another study by Alois and Charlotte was published in Contributions to Nepalese Studies later the same year. The following sections are intended to sum up the knowledge of the contemporary technique of Newar lost-wax casting and are chiefly at supplementing three earlier studies with more detailed information, especially with regard to the timing of investing and casting.

Wax model

The composition of the wax model is approximately as follows in the Nepalese Valley. The light "summer" wax is made with a mixture of 10% bees-
wax, bought from Tawang in the hills surrounding the Nepal Valley, and 90% maha, a tree resin imported from India. Beesxes (1962:30) states that, perhaps with the aid of a Tamil translation, the defective (Sarasvat, 1938: 199) states that the 68th chapter of the Mahabharata defines the damar used to manufacture statutory wax as the resinous sap of the sadi tree. The wax used in the manufacture of artefacts is usually the same as that used for making statues, and is also used for making ghee, including the Nepalese Terai. The dark "winter" wax is made with a mixture of one dhami (-2.0% folia, one folia = 1.463 gm. Nepal, 1941:211) of
beeswax, 1.5 to 2 pans (27 to 36 tāla) of oil and about 0.5 pan (9 tāla) of vegetable glue extracted from the seeds of the tree Madhuca longiflora (Roxb.) Wood in small pieces of paper. It is mixed with vegetable glue and gives the following proportions: sixteen parts of beeswax, eight parts of resin and one part of oil. To manufacture the modelling wax, small pieces of beeswax are first melted in a brass or aluminum pan over a low flame on a charcoal burner and then poured into a mold and stirred well. Finally, the vegetable fat is added and stirred vigorously.

The round wax models (Plate 1) used for sculpting the forms of the image are prepared by heating a cake of wax with a mat and by spreading it uniformly on a stone slab with a roller. The thickness of the wax used varies according to the size of the statue to be cast and the type of metal to be used. Hollow copper models require a thicker wax model than brass ones. The chief tool used in wax-modelling in the sālūpa, a buffalo-horn spatula oriented at both ends, one end being wider than the other, and with one side slightly rounded and the other almost flat, so that its edges are not sharp (Plate 2a). Labriffe gives the spelling sālūnu. The outline of this spatula is reminiscent of the shape of a fountain pen, Sūnu varies slightly in size, but they usually measure between 10 and 16 cm in length and are about 8 mm thick. A larger type of sālūnu, keeping the shape of the horn, from which it is made, but cut at both ends (Plate 2a), is used to roll wax rods, which are employed to make attributes, necklaces, etc. The importance of the smaller spatula in modelling the wax is such that Khul Kuna, one of the leading sculptors in Pāla who specializes in the manufacture of tantric deities in Tibetan style, regards it as a sixth "finger." Other tools, such as the scissors (Plate 2d) used to cut wax, are made of metal or wood.

The sculptor models the parts of the body, whether hollow or solid, without a core, by skilful manipulation of portions of wax sheet and use of the spatula (which is frequently moistened with saliva to avoid sticking) near a portable charcoal stove (Plate 1), (ou chū) Labriffe, (1973): caption opp. p. 187 has marked off of clay called ghota chā (Labriffe, 1973:188, has ghota) and, provided with a core to absorb the heat in the lower section and a perforated fuel reticule in the upper. The stove used by Khul Kuna measures 16 in height and has an external diameter of 28 cm. The various sections of a wax figure or of its component parts are joined by rolling out wax and heating their edges before attaching them (Plate 3). Once the wax model is completed, the artist sets the surface with water and pressures on pieces of slightly heated thick wax in order to obtain the (Nādā 'nghri' (Plate 4) or 'treme' sections of a mold which will allow him to duplicate the same image, or parts of it, in future. The Nādā also ensures that in case of miscasting the two employed to remold the image will be refined. In order to model a nādā the sculptor or his apprentices set the inside of the sections and press the slightly heated thinner sheet of modelling wax against them. No various sections obtained from the Nādā nor then joined together following the original model to form a complete figure or parts of it. The method of casting images in several parts with separate attributes which are subsequently joined together is a traditional feature of Tibetan and Himalayan sculpture (see below, p.78, and Khandalava, 1950:22).

Although appendages may be involved in all modelling operations connect with the Nādā, the modelling of the postures is carried out by the Sculptor alone. Fibulae, ornaments, and attributes in brass and gold to which the figure is modelled and fitted to the assembled wax figure. Khul Kuna notes that use of a black stone obtained from Tibet, carved in low relief, with the "insane" mould of a number of religious attributes and ornaments which
are part of the accoutrements of his tantric deities. Once a wax model or its parts are complete, a wax tripod is filled to their bottom edge: the rod will hence burn away when the wax is melted away.

During the whole process, the artist makes use of a basin filled with water to cool and harden the wax as necessary, and of a small pot filled with rotten wax for retouching and joining. It should be noted that he does not use ceres at any stage of the modelling, although a core is automatically formed when inserting the wax of hollow models.

Investing the Wax

The investment of the wax is carried out by the sculptor or his apprentice, or by a specially hired clay worker, as was the case with the investing of a number of small and medium sized wax figures which I observed in one of Kalu Kumār's workshops in the summer of 1976. The investing of Kalu Kumār's models by this artisan was carried out during four days of sunshine. This account follows a chronological sequence to give an idea of the time involved in the various operations.

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A paste made of fine clay (Rep. pahāra) and water and cow dung in equal proportions is applied to all the inaccessible parts of the model. Immediately afterwards, a more liquid, cream solution of the same composition is applied and poured over and, where appropriate, inside the wax model or its parts (Plate 5). To improve access to the interior of a hollow model, a small window may be cut in the wax and the paste plugged through it from the core. The window must be replaced before allowing the outer surface with subsequent layers, or may be filled with clay and only closed with a piece of copper sheet after casting is complete. The excess investment solution is then shaken off and the clay left to dry in the workshop for about twenty-four hours.

6 September 1976

A thick paste made of yellow clay (Rep. pahāra) and water and rice husks is applied on top of the first layer. The resulting moulds are then put on a roof terrace to dry in the sun for a couple of days. Clay and rice husks are kept separately and mixed with water in a large clay pot as required.

8 September 1978

One or more iron nails are driven through the outer layers into the wax and the inner layers of clay to act as centres, so that during the melting of the wax the core of hollow models will not be displaced and thus hinder the molten metal from reaching all parts of the voids. A thicker layer of thick clay paste is subsequently putted onto the moulds, which are finally left to dry completely (Plate 6).

Removing the Wax

Delevelling and the subsequent operations will be described here in a time sequence referring to the casting in copper of the Shapas whose investment has been described above. They took place in the small courtyard (30 ca x 210 ca) and porch of Kalu Kumār's old house, on the evening of 13 September, 1976. The evening was chosen because casting is obviously more bearable in cooler conditions. Kalu's son, Rajesh, directed the operations, which involved three other workers, including his own brother-in-law, two other assisting
of kiln, and one of another sculptor's apprentices.

Although some workshops are provided with a dewaxing stove (Plate 7) and firing kiln (Plate 8) besides the furnace for melting the metal (Plate 9), one Great use a dual-purpose yellow clay kiln measuring 68 cm x 48 cm x 74 cm and built on a similar principle to the stove described above (p.72). Here, however, the lower compartment has a larger door for admitting the draught, and the top compartment is a chamber built with a temporary front wall of loose bricks. The kiln is not moveable, being built against one of the walls of the courtyard.

5.00 p.m. The moulds are placed on a charcoal fire resting on the receptacle separating the lower from the upper compartment of the kiln. They are turned with tongs until thoroughly heated, but not fanned, for a period varying from 2 to 5 minutes according to the size of the mould. They are then removed, the head of the tripod is pierced and the air flows out through the spouts into an earthenware bowl. It takes a few minutes for all the air to escape, and eventually the spouts are cleared with metal tools in order to ensure a passage for the molten metal to be poured in later. The wax will be re-used for modelling, after replacement of its vegetable glue.

5.15 p.m. Copper sheets and scraps (including wire and a variety of bits and pieces) are harnessed to the smallest possible size and jammed into an open glazed ceramic crucible 20 cm high and 16 cm in external diameter. These crucibles are imported from India and are used especially for casting copper.

Firing the mould and melting the copper

5.45 p.m. The fire in the kiln is reactivated with paper, dry corn-cobs and small bits of wood, and then the draught from an electric fan is directed into the door. Charcoal is added and once it is burning well the fan is switched off.

5.45 p.m. Coal is placed in the hearth of a furnace built like the stove and the kiln from bricks and yellow clay, and located in the corner opposite the kiln. Its measurements are 72 cm x 72 cm x 60 cm. Coal is not found in Nepal (Imperial Gazetteer of India, 1908:119) and is now imported from India, but it does not appear to have been imported in the past. As a fuel it has probably replaced charcoal for casting, whereas wood is still used for firing moulds (Aisop and Charlton, 1973:30). In Tibet, coal was available in the eastern part of the country (Cowper, 1947:463; Saunders, in Turner, 1930-405; Duncan, 1964:117). Combustion is aided by directing an electric blower into a pipe protruding 15 cm from an opening in the lower compartment of the furnace. The blower is linked to the pipe with clay.

5.50 p.m. Cross-armed crucible tongs are brought into the courtyard (Plate 10). Their length varies from 170 cm to 182 cm and their followers is located so as to allow maximum grip when holding the crucible. Their ends are semi-circular so as to fit almost all the way round the crucible. Slowing coal is transferred from the furnace to the kiln in order to reach a higher firing temperature.

5.55 p.m. The coal in the furnace is burning with a flame 60 cm high, undisturbed because of the draught from the electric blower.

6.00 p.m. The crucible containing the metal is placed directly on the coal in the furnace and a brick chamber is built around it. The chamber is one brick thick and leaves the upper portion of the crucible visible. Pliers of copper stick out of the crucible to a length of 15 cm. The crucible is not fixed in position, but rests on two04900s which are continually tapped up.

6.10 p.m. A convex iron lid is placed over the furnace chamber. Charcoal is added to the receptacle of the kiln and moulds are placed on it for firing. They will have to be brought to a temperature close enough to the melting point of copper (1083°C) to prevent the metal from starting to solidify before the mould is completely filled, and the mould itself from cracking.
during pouring. No thermometer or other form of temperature control or measurement is used by Hawaiian sculptors even today.

0:17 p.m. The lid is red hot and four sheets of scrap copper hammered to equal size are put around it, leaning partly on the temporary brickwork of the chamber. More copper scraps, mostly scraps recovered from previous castings, are beaten, and coal is hammered into fragments.

0:30 p.m. The kiln receptacle is filled with coal and a stone is put as a roof over its three walls, while a temporary wall of bricks and clay is raised in front of it to seal off the mould in a chamber. The scrap copper sheets which were being heated on the top of the furnace are hammered while hot to a size to fit the crucible.

0:38 p.m. The furnace lid is so red as to appear almost transparent. A large ceramic bowl measuring 18 in. in height and 27 in. in diameter, is filled with water in preparation for cooling the moulds after casting.

0:35 p.m. The position of the crucible is adjusted with a long iron bar through an opening in the temporary chamber wall, and the lid lifted. The crucible in the bottom of the crucible must have started melting because the level of the red hot copper scrap visible above the rim has dropped. They are further pressed down with an iron bar. Small copper scraps are jumbled into the crucible from a ladle, 9 cm in diameter and 27 cm long, provided with a wooden handle.

0:37 p.m. The crucible is red hot and more coal is added to the chamber by hand. Both coal and scrap copper are carried in metal buckets.

0:45 p.m. The furnace lid is lifted to add more scrap copper to the crucible. After raising part of the temporary front wall, Rajah puts five more moulds into the kiln chamber and adds charcoal.

0:50 p.m. The bricks are put back and the flues in the kiln chamber are fanned with a piece of straw casting.

0:50 p.m. The wall two bricks high is built on the ground in the porch to support the moulds during casting.

0:55 p.m. The temporary front brick wall of the kiln chamber is dismantled and the fired clay moulds are placed on the ground, leaning against the two-layer brick wall. They are red hot and stand upright down with the opening (i.e., the head of the tripod) pointing upward, ready to receive the molten metal.

1:00 p.m. The copper is molten and casting begins. Rajah sits in the molten copper with an iron bar to check that melting is complete before pouring it into the opening of the mould. A certain amount of spilling occurs, probably because the open gabled crucibles are difficult to handle. No precaution is taken to ensure that air escapes from the moulds. Consequently air-castings are not rare, as I saw the following day, when the tripod-shaped vessels were sawn off the bottom of the copper slabs and parts of statues.

The above table shows that it took one hour and fifty minutes for the copper in the crucible to melt and one hour and thirty-five minutes for the clay moulds to be fired. The copper castings are allowed to cool and harden for about fifteen to thirty minutes. The cooling is speeded by pouring cold water over the mould, which creates huge amounts of steam. Finally, the entire mould is placed in a large jug of water to complete the cooling process (Alday and Charlton, 1973-75).

The castings operations for copper were not very different from those for casting bone, as I had observed them in the house of the sculptor Naku Kalai Naka on 12 September, 1978. Preparations started there at 9 a.m. Both his kiln (71 cm x 71 cm x 130 cm) and his furnace (94 cm x 81 cm x 132 cm)

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are located in the porch adjacent to the courtyard. Sanu Kaji’s furnace is larger than Kulu Koma’s and has a 14 cm x 14 cm window to admit the draught located 25 cm from the floor. The sculptor and his assistants were casting medium size images of Vajrajapal, Amsayus, and a Buddhist style Sakyanum. Lotus bases, bodies and head-dresses were cast separately. The crucibles were 24 cm high with a short spout near the bottom. They were completely sealed to prevent loss of zinc from the alloy. These crucibles are made by the artists themselves and, according to Krishnan (1976:31), withstand only one melting operation. After the crucibles had been sufficiently heated for the brass to melt, they were removed from the furnace and their spouts perforated with an iron rod. Brass solids at a lower temperature than copper and appears more fluid and easier to cast; the molten alloy was poured into the moulds without the spilling noticed in Rajen’s workshop.

After casting, Sanu Kaji dropped each hot clay mould into a brass basin full of water, with considerable steaming and bubbling. The moulds remained in the water for a few minutes and were then taken out to be broken with an iron bar (Plate II). The fired clay came off the metal statues easily and, as is to be expected with brass, Sanu Kaji’s casting had a higher rate of success than Rajen’s in copper.

Cleaning up and assembling the cast

After removing the clay from the casts, the spouts are sawn off and the statues are then cleaned and polished for hours with the help of files (Plate 12), sandpaper and rags. None of the operations described above has to be performed by the artist, although most sculptors do their own casting. Finally the statues are assembled, mostly by means of creeping and riveting although in the past split pins were also occasionally used. The backs of the neck, shoulders and wing attachments of Kulu Koma’s 44 cm high copper Garuda, made in c. 1971, provide a good example of creeping combined with riveting and dovetailing; the head is held in place by fitting it between the shoulders and driving a rivet between the shoulder-blades into the neck. The neck ornaments conceal the junction and the continuation of the neck into the shoulders so that the rivet is hardly noticeable. A crack in the dovetail joining the right wing and shoulder-blade of the Aniko Collection Garuda (inv. no. 119; 44 in the Victoria and Albert Museum) reveals that the wing is also provided with a tenon inserted into a corresponding hole in the shoulder-blade (Plate 13). The latter type of fitting is always used to join medium or large size figures to their base or vehicle. The bottom of the figures and their bases are provided with tenons which fit into corresponding sockets in the base or vehicle (Plate 14 a-c).

The casting of an image in several parts has the advantage of reducing a minimum wastage due to off-casting, besides allowing the sculptor to model wax surfaces which, being softer, are relatively easy to handle. Newar and Tibetan sculptors adopted this technique from an early date, as may be seen from a c. 13th century gilted copper image of Maitreya, cast in four pieces by the lost-wax process and regarded by Schroeder as an example of the Sino-Newar school of Aniko (Ellings, 1979:166-7, p. 95). Separate casting is favoured for both medium size and larger images, but is also frequently used to cast components such as the base, backplate and attributes of smaller statues, sometimes in different alloys or metals, according to circumstances and taste. Although specialists in Tibetan and Himalayan tend to be suspicious of figures where analysis has revealed a different composition from that of the base, backplate or halo, it should be noted that such differences are not necessarily evidence of forgery or restoration work. Bases and backplates may be cast, or even hammered, several weeks after the figure to which they belong, for a number of reasons, such as division of labour, availability of metal. Delays due to weather conditions, time of year (newar metalworkers are extremely reluctant
to work during the numerous festivals of the Buddhist calendar, and mixing. Because the use of scrap in the alloy is not surprising that the castings of different parts of this material, and not just in the case of the same material, and for the use of different alloys for different parts of the same material, and for the case of a 17th century Tibetan copper image of Vīra-kālakāra - again - when dancing on a brass base (British Museum: 1935.5-19.11.: p.106, no.28) and for an 18th-century example (Lázzeri: Werner, 1972: Figure 31). The case applied to other pieces, like a Tibetan copper statue of Sitatāra sitting on a brass base (British Museum: 1909.10.23, p.101, no.41, the 15th century 25 cm high Tibetan statue of Padmasambhava illustrated in Christie's catalogue of their sale on 12 February, 1980 (p. 19, no. 78), and various other pieces. Although the possibility of later restoration work cannot be excluded as an alternative, the use of different metals in the same image, it is important to stress the role played by chance and taste in composite metal statuary from Tibet and the Himalayas. The same observations apply to original restoration work, where different metallurgical data from the same statue only prove that time has elapsed between the first and second casting, but cannot quantify it - whether in terms of days or centuries, unless other evidence is available.

With the polishing of the casting, the task of the sculptor is completed; for chasing, engraving and inlaying are carried out by the chase, and we also seals the sides of the statue with a sheet of hammer copper after the concretion of the image, and may inlay semi-precious stones where necessary. Although the first two operations are decisive for the final appearance of the image, the technique and tools of the chasing (Bagg: 1977, II:1-2, pls. 67-69 and 71) are rather different from those of the sculptor, and chasing, engraving and inlaying, as well as statuary enamelling, deserve separate treatment. Sufficient to say that the chase gently beats the surface of the casting with the aid of a little hammer and punch, before engraving it with a hammer and chisel. Copper is soft and relatively easy to chase and engrave, whereas brass is hard and brittle and few chasers challenge to metal with more than an average performance. Although such was the case for a bronze Buddha (Victoria and Albert Museum, 1.2.21-1900; no. 121 on p.109 below), copper is also more suitable for mercury-gilding than brass, particularly the leaded brass commonly used by Nepalese workers (see p. 59). The materials used for inlay work in copper are usually silver and gold, but copper is used for inlaying brass. Gilding is seldom associated with inlay work, although I have seen one example of gold and silver inlay in a partially gilded copper statue of Dīpadhaka. This combination of techniques finds an antecedent in at least one example of a post-Gupta gilded metal image, whose eyes are inlaid with silver (Majumdar, 1936:425). According to Khandelwal (1950: 24-25) "the practice in Nepal of setting ornaments and crowns of images with semi-precious stones was ... derived from late Pala art ... the practice of gilding Nepalese copper images is also borrowed from Pala metal sculpture where gilded images are frequency set with semi-precious "stones and pearls" are reported to have decorated statues in the four parapets of a gifting in the ancient capital of the Nepal Valley at the time of the dynasties of Wang Rinpoche’s in AD 647/8 and 657 (Lévi, 1905, i:157 and 159 and II:116-18). Tibetans traditionally prefer turquoise and coral for inlaying their metal images.

Gilding

Tire-gilding or mercury-gilding, that is gilding by means of a mixture of mercury and gold, is mentioned by Padma-skor-po as being used in Tibet from the 7th century (see p. 58). However, textual sources are scarce and this technique is not described in detail by any of the Tibetan sources used for this introductory study. Rip (1986:115) refers to a text of the Kadampa Sect in
"In the valuable manuscript collections of the Maharaja of Nepal, this was written in Gupta character and copied about the 6th century AD. In this Tusita we find allusions to the transmutation of copper into gold with the addition of mercury. It is probable that sections of such a transmission in Indian and Tibetan alchemical literature are merely descriptive of fire-gilding. Mercury is referred to in connection with copper in the Bhdvyapäramoody, a text which was translated and included in the Tusita, and is therefore earlier than AD 1136. The translation by Sunshi Kusako (Toy, 1898: 469) of the Tibetan version of verses 17 and 19 concerning copper and mercury, interprets the latter as referring to fire-gilding on copper, but is, as usual, excessively free. The word for "gold" does not appear once in the corresponding Tibetan verses. On p. 50 of the Namkhai Nadjö, a record of the materials used by artists of the Mongol court between AD 1295 and 1320 at a time when they were active there, mention is made of an image being "polished with Tibetan liquid gilding" (Karmay, 1975:23), which is perhaps a reference to mercury-gilding. In the Nepal Valley, mercury-gilding has been used from the 15th century (see p.86) and Nepalese artists have always preferred this gilding technique on metal statues almost to the exclusion of any other, even after 1970 when electro-gilding was first introduced. The Nepalese probably derive that gilding technique from India, although a few examples, gilded in India, are known (Nyarjü). Indian statuary have survivals. Wyanjö (1820-427) assumes that the 84 on (that) standing Wyanjö from the ancient city at Mathan (Nagra District, Bangladesh) was mercury-gilded. However, he contrasts himself in regarding the image as not earlier than the 1st period (Wyanjö, 1926-427), thus attributing it to the Gupta period [Eggi, 1107]. R. Saraswat, who knew the piece well, calls it "of definitely Gupta workmanship" and "gilded-plated" (Saraswat, 1962:26), by which he means to have understood fire-gilding. He describes its "fire-gilding" as having an eggshell, and in explanation, briefly quotes an account of contemporary Nepalese fire-gilding (Saraswat, 1962:30). Antiquity found at Mathan shows that the city continued to flourish after the Gupta period and, since very few surviving metal images can be unquestionably given a Gupta date, it may be safer to assign the statue to the post-Gupta period. This view finds support in Den (1959) and Aker (1980:45).

Although the method of fire-gilding became very popular in the Nepal Valley for the gilding of cast or repoussé Buddhist and Hindu copper images (1000-1150), there is no evidence that all copper statues from Nepal were gilded or were left to be gilded. Fire-gilding appears in Nepalese statue from at least the 17th century, perhaps later for aesthetic reasons than as an economic measure, as the back of the image often remained ungilded (Kandakar, 1930:22) and was painted red. This kind of parcel-gilding became very common in Nepal in subsequent centuries. The front of the statues, with the exception of the hair, was always distinctly gilded and polished. Sometimes the main figures were gilded and its accessories left ungilded, Walscheidt (1886: no. 35) and Worner (1972:21), figures 31 illustrate an 18th-19th century Nepalese gilded image of Jagadhar seated on an ungilded throne with an unified ornamental saucer and canopy. This statue and all its parts were cast in brass (Korm, 1972:364, no. 177 ac). Examples of mercury-gilded bronze from an early period are less common, but bronze was being used in Nepalese statue from the 15th-16th century onwards. Parcel-gilding for aesthetic purposes has occasionally been carried out on copper statues front from the Western and Tibetan styles. This was also a common method in eastern Tibetan and Sino-Tibetan bronze statue from at least the 19th century onwards. Usually the hair or the back and front of a figure, except the exception of the hair, were gilded, and the garments, or parts of them, were left ungilded, or vice versa. Gold was also applied to both the front and back of the statue. Parcel-gilding has also been used on repoussé work from at least the 18th century and is still very common, particularly on domestic and ritual objects such as bowls for Tibetan Outliers."
Newar artists are aware nowadays of the difficulty of fire-gilding brass and of the impossibility of fire-gilding leaded brass (pp. 82-83), but it is uncertain how they approached the problem from the 9th to 12th centuries. Tibetans probably learned from them, as is suggested by a fire-gilded image of a king dated 12th century AD in the National Museum of Korea. The alloy of this image contains only 0.6% lead and 4.0% zinc, the percentage of these two elements probably having been kept low in order to avoid any adverse behaviour of the alloy when exposed to heat during the fire-gilding process.

Cold gilding is mentioned by Padma-skhor-po as being used to gild the statues of Tibetan kings during the 8th century (Padma-skhor-po, 1973, 1:130, 1, 13). Cold gilding may also be done by the application of gold leaf to the surface of the statue, either by burning it on, or by using an adhesive. It seems, however, that the most common technique for cold gilding statues is painting. Traditionally, gold paint is prepared by mixing ready-made linseed-oil shaped drops of gold dust with gum. The exact method of preparation of these drops is still a secret known only to the Newars, and in Tibet only a few Newars know the following recipe: Add gold dust; mix well; add gum; mix well and apply. The pigment must be ground in a mortar and pestle.

Cold gilding is particularly suitable for statues made of materials other than metal, and the 14th century clay groups of Shrig-dzang-nag-po and his two sons preserved in the Pushkar (Snellgrove and Richardson, 1968: 154; Stein 1962: 147 and pl. opp. p. 248) and the Jwa-nang (Sadak and Vaid, 1957: 13 and 147-9) are certainly gilded by this technique. Cold paint is still used today by Newar and Newar artists to give the faces and necks of Tibetan images their characteristically matt golden colour. This practice is very common in Tibetan metal statuary, whether fire-gilded or not, and in the former case the gold paint is applied over the mercury-gilded surface of the face.

Finally, mention should be made of the use of gold as an offering in the alloy of statutory materials, as is revealed by Himalayan copper and brass images with a gold percentage higher than about 0.02%, although Werner suggests a lower limit of 0.05% (Werner, 1972: 146-7, table 9, nos. 167, 173). The 25 high brass statues of Sadak (Werner, 1972: 146-7, table 9, no. 173 a-c; see above p. 82) has a gold content of 0.12%, although it is not clear whether the result of the analysis has been biased by the fact that the main image is actually gilt, because its backplate and base have only 0.012% and 0.0006% of gold in the alloy. However, the detection of pieces of gold leaf beneath the surface of a few tshang-dzas (Bruce-Gardner, 1970) by means of an infra-red viewer, suggests that gold may have been similarly added to statutory metals for purely religious reasons. It is possible that this circumstance contributed to the creation of the myth of the "octo-alloy" (see above, p. 32).

The surfaces of unalloyed copper images made nowadays by Newar sculptors are often finished by covering them with moderately polished or even rubbied shellac in order to give them a patina. The aim of this is not necessary to make them look antique. The tradition of using gold leaf on metal images is very ancient in Tibet and may be due to aesthetic reasons or to the realization that it was a good method of preventing oxidation of fire-gilded images made at the time of king Shrig-dzang-nag-po were surrounded by bhupa ritsu (for "bupa ritsu") (Padma-skhor-po, 1973, 1:290-1) a term translated by Brou (1908: 185) as "resin or gesso material". Similarly, the statues made during the reign of Khyi-arong-lam-dreqen were surrounded by bhupa ritsu (Padma-skhor-po, 1973, 1: 301.1), and Chinese statues made during the Ming dynasty were actually surrounded with this ritsu (Padma-skhor-po, 1973, 1:304.1.5). This literally means
"card Version", although Tucci (1959:106-7) translates the corresponding expression from his anonymus manuscript as "red".

Antiquing

The antiquing of images in the Nepal Valley started in the nineteenth centuries as a result of the growing demand for Tibetan and Himalayan antiquities in the Western art market, and it is now carried out by a few specialists in Nepal and Bhutan. The artificial aging of works of art is forbidden in Nepal and this makes it very difficult for the researcher to get in touch with professional forgers who, in any case, are not ready to disclose their trade secrets. Some artists, like Kam Kun, earn their living in order to avoid trouble with the Department of Archaeology of Nepal, which issues the permits and seals necessary for the legal export of all works of art. The export of items over one hundred years old being now forbidden. However, that does not prevent some Nepali and Western dealers from having artificially aged a large number of the statues bought from modern artificers. Various methods of antiquing have evolved during the last two decades. In the nineteenth-sixties, dealers were generally happy with darkening bronze images by heating them at a high temperature, thus obtaining a thin patina on the metal surface. Likhut (1951:182) mentions heating over oil lamps, but it is doubtful whether such a method was ever popular, for the metal would come off the metal surface easily and stain the hands of any potential customer, thus defeating its purpose. I have used, however, that a similar method was used to new paintings. Occasionally imitation is induced by covering the statue with earth and liquid (1973:IX) says that some statues were covered with a mixture of lemon and soil and kept in a damp place surrounded by cloth for a period varying from six to twelve months. She also mentions another method, consisting of covering the statue with liquid plaster, stone and cow-dung and burying it in the ground for a year, in order to retain a corroded surface. However, such relatively primitive methods of oxidation are now seldom used, perhaps because collectors have realized that ancient Chinese and Tibetan metal images are never encrusted from archaeological sites, but come from temples and shrines where they are reasonably well protected and corrosion is minimal.

A green patina on any Himalayan statue is almost certainly the result of forgeries (Pal, 1974:12-23).

During my visit to the Nepal Valley in the nineteen-sixties, I made several cautious attempts to get in touch with professional forgers, but only manages to create suspicion and fear amongst my informants, although intriguing methods vary, they can be reduced to two basic techniques: rubbing and heating with a chemical agent. Rubbing is carried out for many days with cloth which may be dampened with liquid plaster or powdered coke, and the effect is very intense. The heating of most photos of images coated with sal-ammoniac (lemonium chloride, which was, according to Rothmann Halston (1965:212) an idea imported from China to Nepal in the thirteenth century) partially destroys the glazing, but gives the effect of wild corrosion which successfully dupe collectors. Layers of Tibetan and Himalayan images. Finally vermillion and ritual substances may be smeared on the forehead or other sacred parts of the statue to add the final touch of 'authenticity' to the image. As if it had just been snatched from the altar. In some cases forgeries are left incomplete by simulating less day to day weathering. The more sophisticated method of antiquing are used for statues which are especially commissioned from sculptors by Western dealers, on the understanding that no other images will be produced from the same slab. A model produced in only one or two copies is obviously more expensive and I understand that the professional artificial aging of a statue may cost up to 100 U.S. dollars, but the investment must be worthwhile for some dealers are ready to pay.

Western collectors should be particularly suspicious of black or green corroded "Tibetan" metal images, for anyone who is familiar with the way
they are kept ought to be aware of the generally good state of preservation of their works. Tibetans have a less physical contact with their images than Newars and seem to regard the direct application of offerings to their surface as not far short of sacrilege. A good example of the contrasting Tibetan and Newar attitudes towards Buddhist images kept in Tibetan monasteries of the Nepal Valley is provided by Kuber Singh Saka's SDO on high fire-gilded copper repoussé Skya-thub-pa (plate 15) which in about 1875 had to be protected by glass panels from the offerings thrown at it by Newar devotees. Drier climatic conditions in Tibet, where precipitation is generally less than 25 cm per year, also contribute to the better preservation of metal images there than in the case in the Nepal Valley, where they are exposed to the intense dampness of the monsoon; from July to September the Valley receives most of the annual rainfall of 127 cm to 140 cm. Thus, as a rule, Tibetan antiques are in a better state of preservation than forgers would have us believe.

The problem of establishing whether Newar metal images are ancient or modern is sometimes difficult. Newar statues are quickly worn by worshiping and the organic ritual substances deposited on them do not provide a clue to dating by chemical or carbon-14 analysis because their application is perfectly compatible with contemporary worship. Furthermore, it is doubtful whether antiqued gilded images will retain sufficient traces of ammonium chloride on their surface to be detected by chemical analysis. It is likely that the considerable demand for Himalayan antiques will lead to the perfecting of artificial ageing methods, particularly as far as Newar statuary is concerned, and especially where those methods are encouraged and supervised, if not actually practised, by Western dealers.

Conclusions

Apart from the methods of forging, it appears that very few technological innovations have occurred in the statuary techniques used by Tibetan and Himalayan sculptors to this day. They still manufacture their own modelling tools and they model clay and wax in a traditional manner. Their investment techniques find a parallel in the use of different grades of clay as described in various Indian texts (Reeves, 1962:31), including the Materia Prasa. Apart from the use of coal, the only improvement made in firing the mould and setting the metal is the modern use of electric fans and blowers by some sculptors, instead of hand-operated bellows. No innovation has been applied to the seemingly difficult problem of measuring the temperature of the clay mould before pouring the molten metal into it. Artists obviously feel confident enough to rely exclusively on their own experience.

Casting of separate parts of the same image is not a novelty, as is shown by the instance of the Sultanganj Buddha, occasionally medium-sized statues, whether hollow or solid, may still be cast in one piece (Alsop and Charlton, 1973:38). A few minor changes have occurred in the fitting techniques; tenons tend to be thicker than in the past and can no longer be bent, and split-pines are no longer used. However, examples of unsecured base in ancient statues are not rare. Braiding and silver-soldering are nowadays used to repair minor nose-castings and both techniques appear to have been introduced in Newar statuary after 1875. However, chasing, engraving, inlaying and gilding are still carried out with the traditional techniques, and it may thus be concluded that Himalayan metal statuary has undergone few technical changes since it was introduced into Tibet from India and Nepal and that it is still practised by ancient methods by Newar sculptors in Nepal.
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MARJUNŚRI
Western Tibet, 11th-12th century

By the courtesy of the Trustees of the British Museum
MAITREYA (♀)
18th-19th century A.D. Brass with red pigment on lips, imitation gold paint on front of figure. Ht. 8.0 cm. O.A. 1984.6-20.10.

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NOTES AND TOPICS
WITH
ACKNOWLEDGEMENT

In this issue of Bulletin of Tibetology, we are reproducing two articles of Dr. Roberto Lo Bao. The first article deals with the history, tradition and modern use of metallurgy in Tibet and the Himalayas. The second article deals with the history, tradition and modern techniques in casting of devotional images in the Himalayas.

Only three illustrations with their descriptions are reproduced in the article:
1. Illustration No. 42 (Mañjuśrī).
2. Illustration No. 66 (Maitreya), and
3. Illustration No. 121 (Tara).

We are grateful to the British Museum for their kind permission to reproduce the above illustrations which we hope will benefit the traditional and modern scholars in their research into this field of study.

We owe much to Miss Marianne Winder for her kind co-operation and help.

J. K. Rechnitz
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