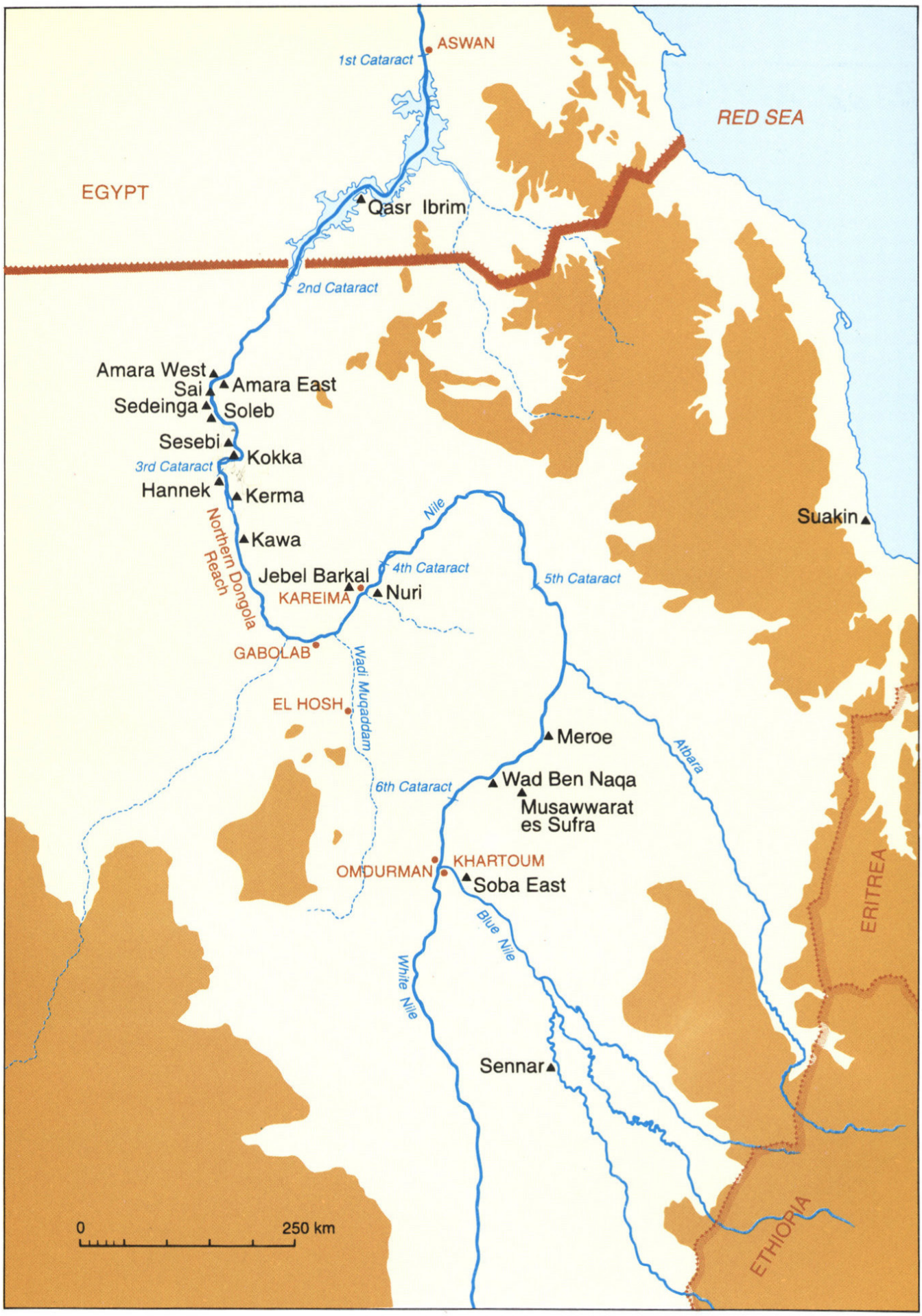
SUDAN & NUBIA

The Sudan Archaeological Research Society *Bulletin No. 1* *1997*


ASWAN
1st Cataract
RED SEA
EGYPT
Qasr Ibrim
2nd Cataract
Amara West
Sai
Amara East
Sedeinga
Soleb
Sesebi
Kokka
3rd Cataract
Hannek
Kerma
Northern Dongola Reach
Kawa
Nile
Suakin
Jebel Barkal
4th Cataract
5th Cataract
KAREIMA
Nuri
GABOLAB
Wadi Muqaddam
EL HOSH
Meroe
Atbara
6th Cataract
Wad Ben Naqa
Musawwarat es Sufra
KHARTOUM
OMDURMAN
Soba East
ERITREA
Blue Nile
White Nile
Sennar
ETHIOPIA
0
250 km

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Front Cover: Relief of the Kushite King Taharqo (690–664 BC) in the Temple of Amun, Jebel Barkal. (Peter Hayman)

Introduction

Vivian Davies

The appearance of *Sudan & Nubia* represents an exciting new development for our Society. Replacing the old *Newsletter*, and incorporating colour illustrations, it is designed to be a more substantial and attractive periodical, and of more lasting value. It will continue to publish reports of our own excavations and other scholarly activities but will also include papers dealing with relevant topics and material from other sources. *Sudan & Nubia* will serve, we hope, to promote interest both in the Society and in the field of Sudanese and Nubian archaeology in general, including that of Egyptian Nubia. It will appear, at least initially, once a year, in the Autumn.

This first issue contains an impressively wide range of subject-matter, covering a time-span of nearly five millennia. In the fieldwork section it will be seen that the Society's project in the Dongola Reach directed by Derek Welsby, comprising in this last season the rescue excavation of sites of the Kerma Period and related palaeohydrological research, continues to yield important new data, while a brand new project initiated by Michael Mallinson – a survey of multi-period sites in the Bayuda desert threatened by road-building – looks to be very promising. Pawel Wolf gives an account of the Humboldt University's fascinating and quite unexpected new discoveries at the great Meroitic temple-site of Musawwarat es Sufra. John Alexander reports on his investigation of an Islamic fortress on Sai Island, a military outpost (similar to Qasr Ibrim) which represents the southernmost point of penetration of the Ottoman Empire in Africa. There are two papers on recent research. Patricia Spencer has been reconstructing from old records the unpublished excavations at Amara West undertaken many years ago by the Egypt Exploration Society. She very usefully summarises the results of her work (recently published in full in an EES Memoir), which has shed valuable new light on this important pharaonic town-site. Finally, Michael Cowell provides an up-date on his programme of scientific examination of Nubian metalwork, a subject sorely neglected in the past. The project has now been extended to include Napatan foundation-deposits, source-material of special value for this kind of research in that the deposits are both well dated and richly endowed with metal objects.

Napatan Period Metalwork: Further Analyses

Michael Cowell

This is a brief report of scientific work on Napatan period metalwork, including further artefacts from Kawa and foundation deposit material from Nuri, which has been investigated in the Department of Scientific Research, British Museum.

Kawa

In a previous issue of the SARS *Newsletter* (Cowell 1995) the scientific examination of metalwork in the British Museum collections from the temple site at Kawa (Macadam 1955) was reported on. The objectives were to investigate the metals and alloys being used and the technology of the artefact production and decoration in Nubia at this time. It was concluded that this region was as active and abreast with metalworking technology as Egypt. Two artefacts were omitted from that study: a small female statuette (EA63597) and a large hollow bronze head (EA63585). These have now been examined and analysed using plasma emission spectrometry (ICPOES), see Table 1. Details of the procedure are given in Cowell (1995).

Female statuette (EA63597, Macadam 0702, Kawa Temple T) (colour plate XX).

Macadam describes this as a statuette of a woman on a thin stand with a piece of different metal attached. The suggested function was a vessel handle or the top of a staff. Preliminary non-destructive analysis by X-ray fluorescence (XRF) and radiography indicates that the statuette is in fact one complete casting, albeit with some casting flaws. The alloy composition is a leaded tin bronze which is typical for this type of cast artefact.

Head of goddess (EA63585, Macadam 0020/1, Kawa Temple A) (colour plate XXI).

The head is hollow and inscribed with cartouches of Arnekhamani. Macadam suggests that it may be from the prow of a minature boat. Radiographic examination showed that it is a single casting. It is quite a complex shape and was almost certainly made by the lost-wax method; there is no evidence of piece moulding on the exterior or the hollow interior. Macadam notes that the eyes were originally inlaid but is not specific about the form of this. At some stage in its early post-excavation history, possibly in the 1930's, the head was extensively cleaned since little surface patina or corrosion is apparent. Whether the cleaning also resulted in loss of any residual inlay material is impossible to say but superficially there is no inlay remaining. However, a microscopic examination reveals traces of possible inlay residues within the deeper recesses of the incised eyebrows. This takes the form of a blue crystalline material within a cream coloured substrate; also embedded within this are a few flakes of gold leaf. Minute samples of the material have been analysed by X-ray diffraction (XRD) and X-ray fluorescence. The cream component was identified as the calcareous material gypsum, calcium sulphate, and the blue seems to include traces of lapis lazuli. It is possible that the gypsum is a residual gesso layer, over which gold leaf or foil was mounted. This method of gilding was common in Egypt on metalwork and has already been recognised on a uraeus from Kawa (EA63593). The alloy composition of the head, leaded bronze, is similar to the statuette above and typical of the other cast metalwork from Kawa.

Nuri

The items from Nuri which have been examined are the foundation deposits from the pyramids at the Napatan funerary site (see the lower photograph on the back cover). These were excavated by Reisner (1916-18) and the main publication of the finds is by Dunham (1955). The material is contemporary with that from Kawa and dates from the mid 7th to late 4th century BC.

In Egypt foundation deposits are particularly interesting for scientific study as they purport to include the range of materials used in the building construction and furnishing and are fairly closely dateable. It is rare to be provided with such a comprehensive range of raw materials and in a form which is more likely to enable sampling compared with finished artefacts.

The Nuri deposits include tablets or small blocks of various materials including metals and alloys, minerals, faience, precious and semi-precious stones and model artefacts (colour plate XXII). Interest has focused on the metals or metalliferous materials. Within the sets examined the metals include lead, silver alloys, gold alloys and copper alloys. One of the functions of the scientific examination was to confirm the identification of the materials. In the excavation report by Dunham and also in the Museum acquisition registers there are some, mostly minor, misidentifications. This is not surprising considering the corroded nature of the

Cat/Reg	Cu	Sn	Pb	Zn	As	Ag	Sb	Ni	Co	Fe	Au	S
EA63585	82.1	8.2	7.8	0.02	0.43	0.023	0.19	0.054	0.10	0.040	<0.004	0.19
EA63597	89.7	7.5	3.2	<0.02	0.18	0.020	0.02	0.032	0.028	0.033	<0.004	0.09

Table 1. ICPOES Analyses of Kawa Metalwork

Precision and accuracy are ±1-2% for copper, ±5% for lead and tin and ±10-35% for the remaining minor and trace elements. Other elements analysed for but not detected were cadmium (<0.002%), manganese (<0.001%), phosphorus (<0.02%) and bismuth (<0.01%).

Ref. No.	Tomb	% Cu	% Sn	% Pb	% As	% Au	% Ag
Copper-based							
EA55568(228)	Nu.10	93	6.1	0.9	<0.3		
EA55571(271)	Nu.4	89	9.6	0.9	<0.4		
EA55572(282)	Nu.19	99	0.5	0.2	<0.3		
EA55573(300)	Nu.11	79	4.1	15	<0.3		
EA55575(349)	Nu.13	94	4.0	1.2	0.3		
EA55581(424)	Nu.27	95	1.5	2.2	0.8		
Silver-based							
EA55568(224)	Nu.10	20		0.1		0.5	80
EA55569(245)	Nu.7	95		<0.1		<0.1	5
EA55570(270)	Nu.2	18		0.3		3	78
EA55573(299)	Nu.11	11		0.4		0.8	88

Table 2. XRF analyses of drillings from copper and silver alloy plaques.

The precision (reproducibility) of the above analyses is about ±2-5% relative for the major components (e.g. copper and silver) and ±5-20% relative for the remaining elements. The accuracy is expected to be similar.

Ref. No.	Tomb	% Au	% Ag	%Cu	Pb
EA55568(227)	Nu.10	39	60	1	trace
EA55573(297)	Nu.11	26	70	4	trace
EA55570(260)	Nu.2	18	79	3	

Table 3. Approximate XRF analyses of gold alloy plaques

The precision of the above analyses are approximately ±5-10% relative for gold and silver and about ±20-30% for copper; the accuracy cannot be defined because of uncertainties arising from surface effects.

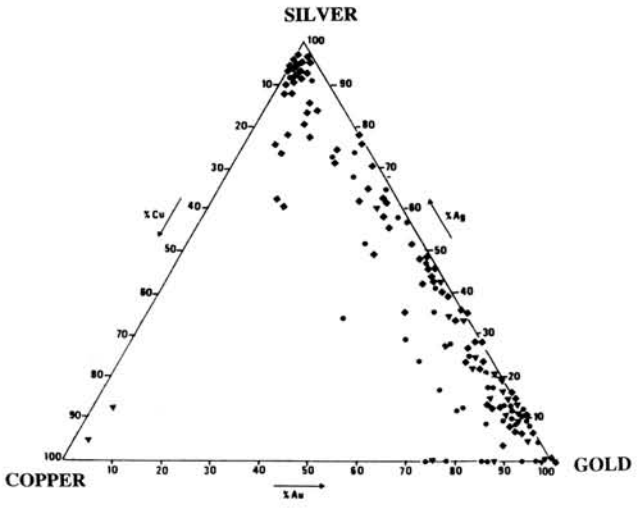

Figure 1. Ternary diagram of analyses of gold-silver-copper alloy artefacts by Stos-Fertner and Gale (from Stos-Fertner and Gale, 1978).

metal artefacts and the fact that rapid non-destructive analytical techniques were not available when the artefacts were acquired. A particularly interesting example is a tablet (EA55568, 1922-5-13,226) from the pyramid of Amaninatakelebte (Nu.10), which is recorded as corroded silver (colour plate XXII, bottom right). This proved on analysis to be made of cassiterite, or tin oxide, the usual ore of tin. The morphology and mineralogy of the material confirm that this is an example of the natural mineral rather than corroded metallic tin. This is a particularly interesting find since tin, or especially its ore, although widely used to make bronze in antiquity is rarely found in an archaeological context. Cassiterite is recorded by Carter (1933, 176-7) from the New Kingdom tomb of Tutankhamun, although here the material was thought to be artificial tin oxide, and a number of occurrences of tin metal in Egypt, including two in Nubia, are listed by Lucas and Harris (1962).

Metal plaques

A selection of the metal alloy plaques was analysed by energy dispersive X-ray fluorescence (XRF). For the copper and silver-based examples, small samples drilled from the edge were analysed but for the gold plaques the analyses were completely non-destructive. Since XRF is essentially a surface analysis method, and it was not possible to remove unrepresentative surface material such as patina, the gold analyses are only semi-quantitative or approximate. The results are shown above in Tables 2 and 3.

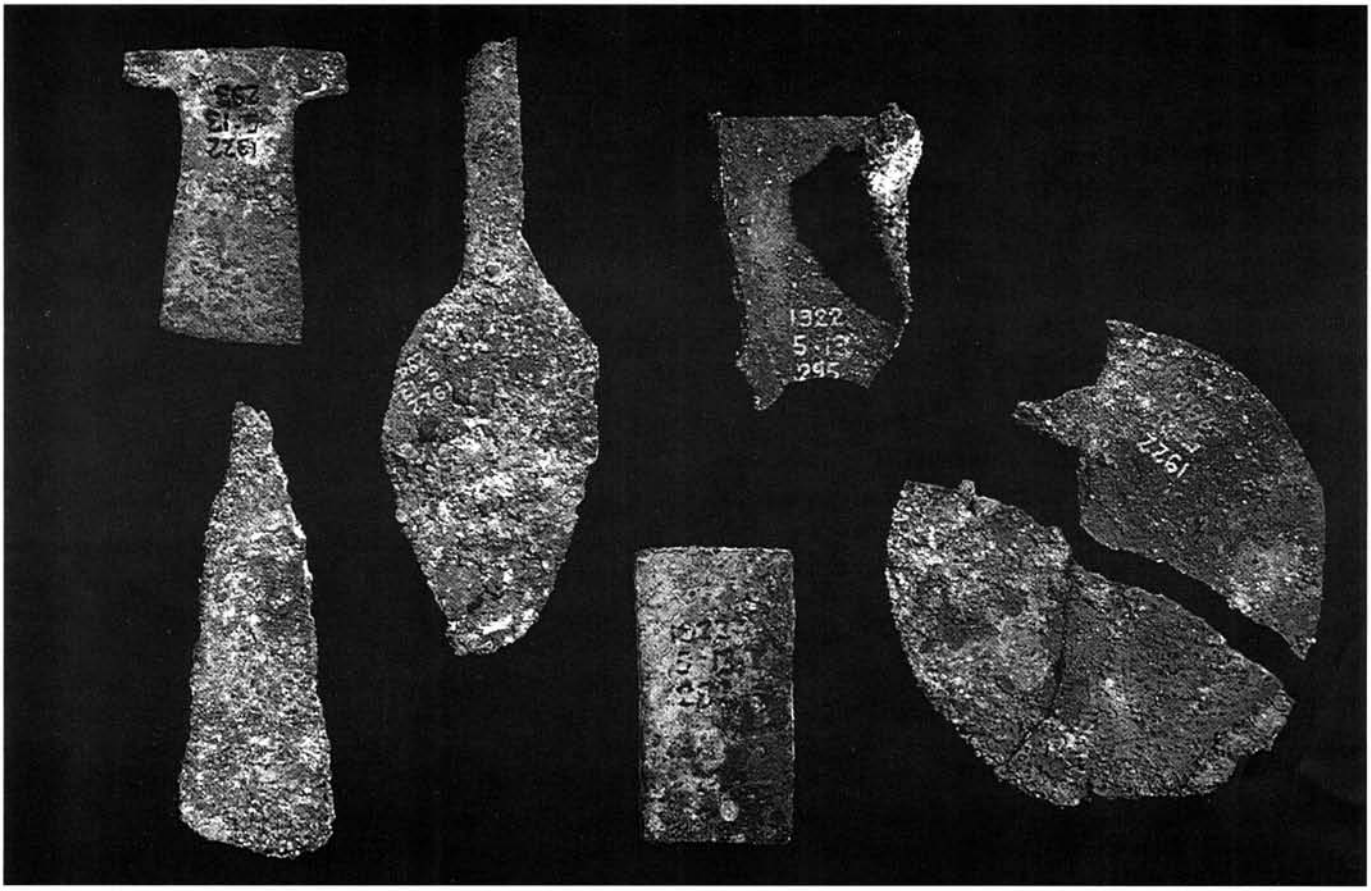

Plate 1. Part of a foundation deposit from Nu.19, Nasakhma, showing the model artefacts.

The copper-based plaques are almost exclusively tin bronzes, only one example is unalloyed copper. They cover a range of compositions with, in one case, considerable amounts of added lead. In all cases they exhibit a working range of alloys typical of, for example, those found for the contemporary finished artefacts from Kawa. The silver-copper alloys generally contain considerable amounts of added copper and in one case significant amounts of gold. The presence of traces of lead indicates a source from silver-rich galena or the use of lead in the refining process of cupellation.

The gold-based plaques should be more correctly termed silver-gold alloys, or 'white-gold', since gold is the minor component of the alloy. The compositions of this group may be compared with the large body of data on Egyptian gold-silver-copper, from all periods and areas, published by Stos-Fertner and Gale (1978) (fig. 1). Their data show that Egyptian gold-silver exists over the full alloy range with, in addition, small to rather large amounts of copper.

Naturally occurring gold-silver or native gold rarely contains more than about 1-2% copper and usually much less than 1% (Antweiler and Sutton 1970). Stos-Fertner and Gale concluded that copper was intentionally added to gold and silver at all periods to produce some of the alloys they encountered, perhaps with the intention of creating alloys of different colours. The slight trend of silver and copper in the diagram suggests that a combination of silver

Tomb	Registration	No.	Artefact	Alloy description
Nasakhma (Nu.19)	EA55572	(292)	adze	copper with traces of tin and lead
..		(293)	axe	tin bronze with some lead
..		(294)	spear	tin bronze
..		(295)	plough-share	tin bronze with lead
..		(296)	dish	tin bronze
Malowiebamani (Nu.11)	EA55573	(315)	adze	tin bronze
..		(318)	spearhead	tin bronze
..		(319)	rod	tin bronze
..		(320)	plough-share	tin bronze
..		(321)	dish	tin bronze

Table 4. Qualitative XRF Analyses of Model Artefacts.

and copper may have been added. The Nuri gold plaques have very similar gold-silver ratios (1:2 to 1:3) and most contain more than 2% copper, suggesting that they are at least partially artificial alloys. Significantly, they also contain traces of lead, not usually found in native gold but a common trace component of silver derived from galena and refined by the cupellation process, which also involves the use of lead. Their high silver content is consistent chronologically since Stos-Fertner and Gale's data seem to show that later artefacts are more likely to contain higher amounts of silver. A significant feature of the composition of these plaques, in common with the copper and silver based examples, is that they seem to be examples of alloys actually used rather than false substitutes.

Models

Two groups of model tools and weapons have also been examined from Nuri (Nu.19 Nasakhma, pl. 1, and Nu.11 Malowiebamani). These were analysed by X-ray fluorescence on small areas after some removal of corrosion products. The results are summarised in Table 4.

Most of the models are made of sheet metal generally using a tin-bronze alloy. The use of an alloy is interesting in the context of their method of manufacture since pure copper would have been adequate for their production considering that they were intrinsically non-functional. However, the rather more expensive bronze or leaded bronze have been used, which would have been the correct alloy for the full-size artefacts included. For one group (EA55573, Nu.11) there is little variety in composition and all are of tin bronze but the other (EA55572, Nu.19) includes pure copper as well as bronze.

The close relationship between model and full-size artefact composition has been observed before. From the scientific examination of the British Museum collection of Egyptian axes (Cowell 1987) there was a general similarity between the alloys used for particular forms of models and full-size counterparts. In one case an archaic style axe deposited in an 18th Dynasty context at Deir el-Bahri was a low arsenic copper alloy rather than the contemporary tin bronze. Clearly the type of metal used for a model was an important element in its typology and it may have been derived from a broken down full-size artefact.

Summary

The two artefacts from Kawa are consistent in alloy type with those in the previous study and residual material indicates that one was originally gilded over a gesso layer. The analyses of the Nuri foundation deposit plaques show that the metals and alloys included represent functional materials rather than cheaper or more convenient substitutes. The identification of cassiterite among the Nuri foundation deposits is an important discovery which may ultimately be of use in determining sources of tin used in Egypt.

Acknowledgements

I am grateful to Janet Lang for the radiography, to Duncan Hook for the ICPOES analyses and to Paula Jervis for assisting with the XRF.

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Plate XX. Female statuette from Kawa, EA63597. (see p. 40)

Plate XXI. Head of a goddess from Kawa, EA63585. (see p. 40)

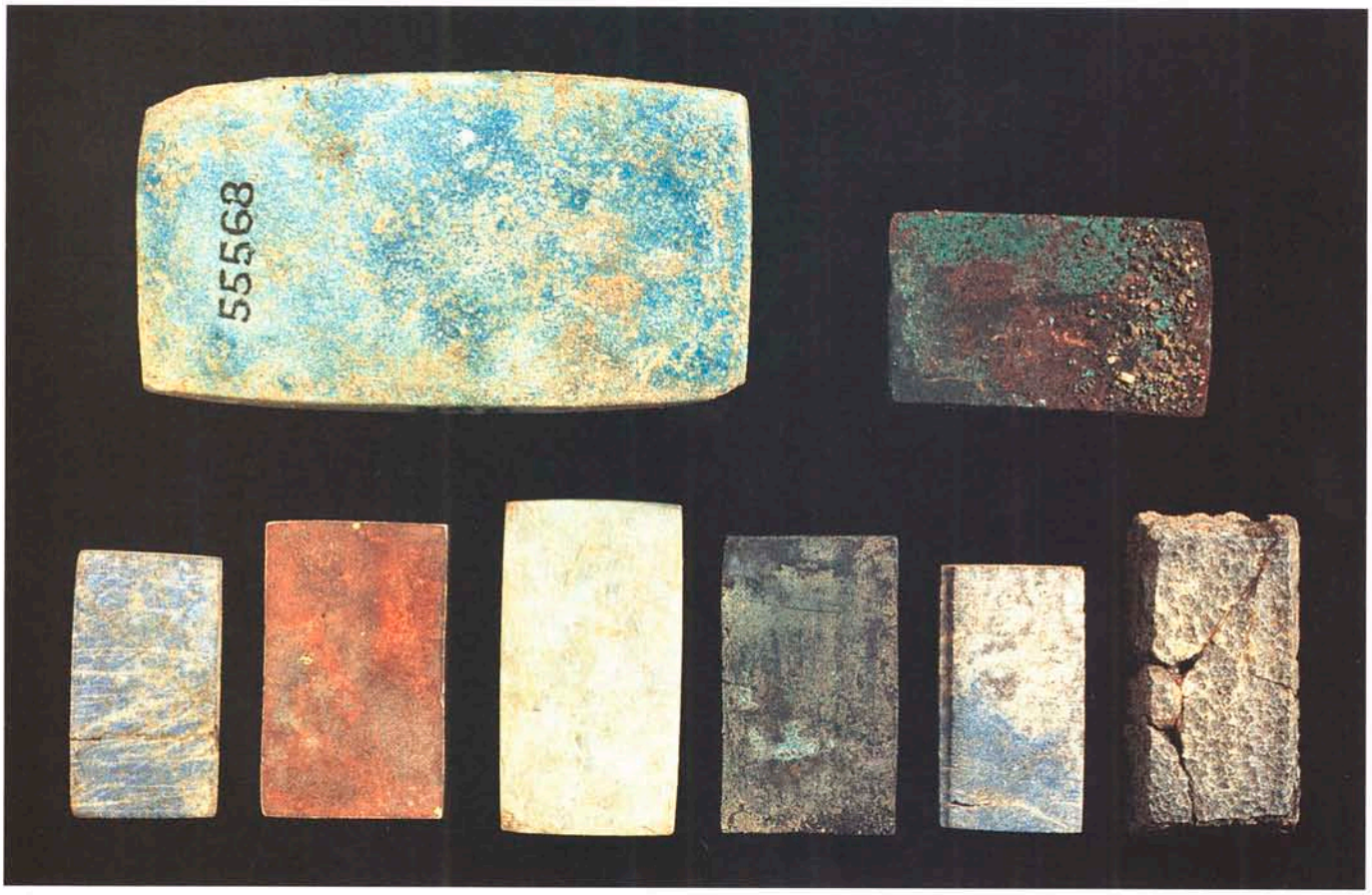

Plate XXII. Part of a foundation deposit from Nu.10, the tomb of Aminatakelebte, Nuri. The cassiterite plaque is bottom right. (see p. 40&41)