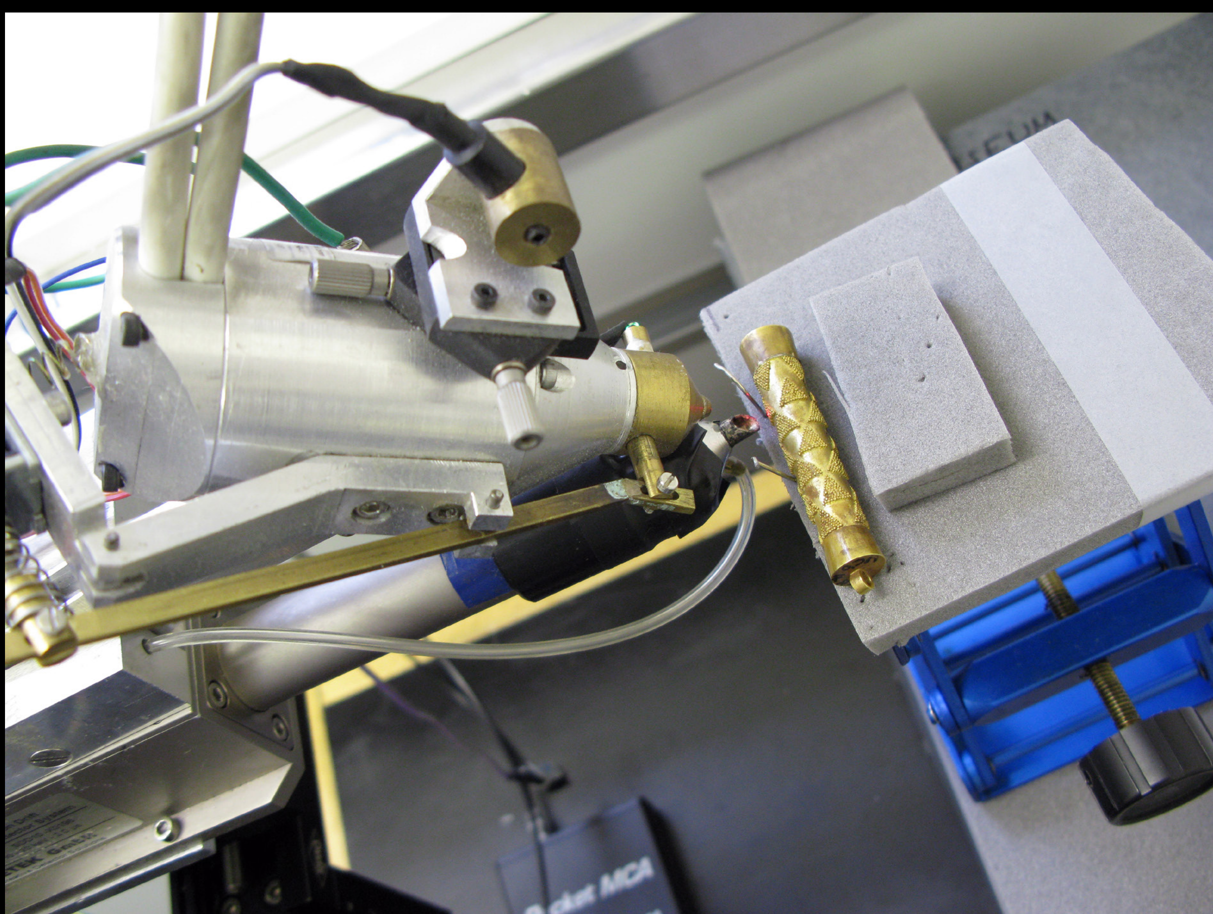
McDONALD INSTITUTE MONOGRAPHS

Ancient Egyptian gold

Archaeology and science in jewellery (3500–1000 BC)

Edited by Maria F. Guerra, Marcos Martinón-Torres & Stephen Quirke



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with contributions from
Wolfram Grajetzki, Maria F. Guerra, Marei Hacke, Mona Hess, Susan La Niece, Quentin Lemasson, Lindsay MacDonald, Margaret Maitland, Marcos Martinón-Torres, Nigel Meeks, Gianluca Miniaci, Brice Moignard, Jack Ogden, Claire Pacheco, Sandrine Pagès-Camagna, Laurent Pichon, Matthew Ponting, Campbell Price, Stephen Quirke, Martin Radtke, Uwe Reinholz, Ian Shaw, Jim Tate, Isabel Tissot & Lore Troalen

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On the front cover: *Analysis of the gold cylindrical amulet from Haraga at The Petrie Museum of Egyptian Archaeology (UC6482) using a portable XRF spectrometer*.
On the back cover: *Details under the SEM of the triangular designs of granulation on the tube of the cylindrical amulet from Haraga*.

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Editorial foreword

This volume aims to present a wide range of perspectives on early Egyptian goldwork, integrating the complementary yet distinct approaches of archaeology, materials science, jewellery and Egyptology. On one level, our primary task has been to present new analytical data on the manufacturing technology and elemental composition of dozens of artefacts preserved at six European museums. At the same time, we have sought to anchor and contextualize this new information based on current research from three perspectives: an introduction to the fundamental geochemistry and material properties of gold, a reanalysis of historical sources and of goldwork manufacturing-techniques, and a guide to the key analytical techniques employed. In this way, we wish to ensure that the volume is accessible to specialists and students from different backgrounds. We anticipate that this body of material will provide a rich source of information for further interrogation and discussion in the future, and our concluding chapter offers a first synthesis of some key points emerging from this new research. There we focus particularly on the findings that seem to us most significant, alongside open questions and suggestions for future work. In so doing, we explicitly highlight some of the many strands beyond the scope of the work presented here, hoping that they may provide pointers for others. We emphasize that the volume is addressed not only to those interested in the archaeology of Egypt in the timespan covered, but equally to scholars researching past technologies and archaeological goldwork elsewhere, who may find technical observations of broader scope that could prompt cross-cultural comparisons.

In spite of the substantial amount of data compiled here for the first time, it is important to remind ourselves of some potential biases that are inherent to this work and may thus skew our interpretations. The most important of these concerns the selection of objects. This project starts and, in many ways, remains throughout its course with the exceptional group of gold jewellery buried in Qurna, on the west bank of Thebes in Upper Egypt, with a woman and child whose names are unknown to us, at some point in the 17th or 16th century BC. Today the Qurna group is the most important Egyptian assemblage in the National Museum of Scotland, Edinburgh. In 2008, curator Bill Manley with materials scientists Jim Tate, Lore Troalen and Maria Filomena Guerra launched a programme of new analyses of the goldwork from the group. Already in this first investigation, the scope extended to comparison with jewellery from the preceding and following centuries (Tate et al. 2009; Troalen et al. 2009). With funding obtained from the CNRS, Guerra could then expand the range of collections involved in collaboration with Thilo Rehren at UCL, to include the UCL Petrie Museum of Egyptian Archaeology and the UCL Institute of Archaeology with its laboratory facilities, as well as the National Museums of Scotland and the British Museum as project partners (CNRS project PICS 5995 EBAJ-Au). On the initiative of Jim Tate, contact had been established already with colleagues Matthew Ponting and Ian Shaw at the University of Liverpool. As a result, the Garstang Museum is also participant in the wider project, together with the Manchester Museum, through the support of curator Campbell Price, and the Louvre Museum, through the support of curator Hélène Guichard and the late Sandrine Pagès-Camagna, material scientist at C2RMF (Centre de Recherche et de Restauration des Musées de France). We wish to emphasize here the fundamental role of Sandrine Pagès-Camagna in crucial stages of the project; without her participation the project could not have achieved a significant part of its aims – notably comparison between the Qurna group and the nearest securely dated examples of royal goldwork from the reigns of kings Kamose and Ahmose.

Other institutions participated with the provision of access to particularly specialized equipment: AGLAE facilities at C2RMF, Bundesanstalt für Materialforschung und –prüfung, and LIBPhys at NOVA University of Lisbon

With this new support, the research agenda was able to grow organically, adapting to fresh questions emerging from preliminary results, while contingent on the artefacts present in museums that were accessible to the project. Indeed, the history of the collections has been a significant factor, both enabling and constraining our research. The Louvre collections contain a range of jewellery from early excavations in Thebes, including representative material from the late second millennium BC settlement Deir al-Madina, and major works from 16th century royal burials uncovered during fieldwork directed by Auguste Mariette. The British Museum and the other participating museums in England and Scotland also preserve a mixture of material from documented excavations and earlier undocumented collecting practice. Here colonial history frames the kinds of material available. During and after the full British military occupation of Egypt (1882–1922), the Antiquities Service of Egypt under French Directors permitted officially recognized institutions to excavate in Egypt and, in return for the enrichment of the Egyptian Museum Cairo, to take a share of finds from excavations. Following division of finds in Egypt, excavation funding bodies based at Liverpool (since 1903) and London (since 1882) distributed finds to dozens of sponsoring museums (Stevenson 2019). The university museums in Liverpool and London were among the major recipients of these finds, and also hold substantial excavation archives. The Qurna group itself and several other sets of jewellery analysed during the project are unusual examples of this pattern of dispersal, where the vast majority of items distributed belonged to the types of objects found in large numbers in fieldwork. The project was therefore able to investigate objects from a wide social spectrum, from palace production (Qurna group, Haraga fish and cylinder, items of kings Ahmose and Kamose from Thebes) to finds in cemeteries of regional rural towns and villages (Qau, Badari, Matmar). At the same time, in expanding the chronological scope of analyses forwards to the New Kingdom and back to the late prehistory of Egypt, the participating museums could not cover every social group for every period. Most notably, and perhaps surprisingly for those outside the museum circle, these collections hold none of the major goldwork from the age of the great pyramids, the mid-third millennium BC. At that period, the concentration of power at Memphis around kingship separates the royal court from the regions, and this is reflected in the tombs of the period and in the distribution of finds. Gold and gilt ornaments are more prominent in burials at the Memphite cemeteries: Giza and Saqqara. The single outstanding assemblage of Egyptian goldwork from the mid-third millennium BC is the unparalleled burial of material related to Hetepheres, mother of king Khufu; the finds are on display in the Egyptian Museum Cairo. Egyptologists from Cairo, Vienna, Boston, Hildesheim and Leipzig directed excavations at Giza; their museums received a share in finds (Manuelian 1999). The museums in our project, from Paris to Edinburgh,

Table 0.1. *Numbers of artefacts (museum inventory numbers) analysed by site and period.*

	Dyn 1-2	**First IP**	**Middle Kingdom**	**Second IP(-Dyn18)**	**New Kingdom**	**?**	**Total**
Memphis					2		**2**
Riqqa			4		7		**11**
Haraga			13 + 1?				**14**
Lahun			5				**5**
Ghurab					1		**1**
Sidmant			1		1		**2**
Amarna					8		**8**
Qau area		15		5			**20**
Abydos	4		2 + 2?	2		3	**13**
Naqada			2				**2**
Thebes			2	2 + 7?	4		**15**
*Qurna				12			**12**
Buhen			1				**1**
?		1	5	2	22		**30**
TOTAL	**4**	**16**	**36**	**30**	**45**	**3**	**136**

are not on that distribution map. With this and other lesser gaps, our sample, however extensive, cannot and does not claim to be random or representative of an underlying population of 'Egyptian goldwork'. On our chronological range from fourth to second millennia BC, there are peaks and troughs in the frequency of artefacts, and we encourage the reader to keep these in mind graphically, in order to assess our interpretations in context and to develop their own further research agendas (see Table 0.1).

Another delimiting factor in the selection of objects derives from our focus on technique, directing our attention predominantly to jewellery, rather than other gold elements such as the prominent use of sheets for gilding larger substrates of wood or plaster. Gold foils were included for comparative purposes, particularly in the investigation of composition, but to a lesser extent. Furthermore, within the rich repertoire of Egyptian gold jewellery, we took a particular interest in select assemblages, starting with the Qurna group itself, and within these certain specific features, such as the small beads found in the child's coffin and the adult's girdle. While these are fascinating manifestations of both technology and consumption, they are not necessarily representative of a broader corpus. We would also emphasize that we sought primarily artefacts with well-recorded archaeological contexts, as these evidently allow for more robust inferences, and provide the most secure foundations on which to build further research. Where the museums could provide access to material not from documented excavations, but acquired before 1970, we have included certain items if they helped to complete gaps in understanding, as a secondary circle of supplementary information. In each such case we have done our utmost to investigate their authenticity and source, but undeniably any interpretation based on an unprovenanced object will have to remain tentative. Indeed, one of our analytical investigations demonstrated the risks in building historical conclusions on material without documented excavation context; a gold shell inscribed with the name of king Taa, who reigned close in time to the Qurna group, presents disconcerting features more consistent with modern rather than with ancient manufacture.

A final and equally important constraint concerns the background and expertise of the editors and contributors to this volume. While together we span interdisciplinary breadth, and have found synergies in our research, inevitably there remain areas beyond our interests and access, and indeed beyond the time scope of the project. For example, our data may be used as a starting point to address issues of provenance, but targeted consideration of the extraction methods and possible geological sources of gold is not addressed in detail in this volume. Instead, much more emphasis has been placed on issues of technology, and the application of the results to a concluding interpretation of the Qurna group. We look forward to seeing how others may take up such topics, and feel sure that the woman and child of Qurna will continue to pose new questions.

Finally, for the opportunity to share our discussions and findings with a wider research audience, we would like to express our gratitude to the McDonald Institute for Archaeological Research for including this volume in its series.

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Chapter 7

The early jewellery

Wolfram Grajetzki, Maria F. Guerra, Marcos Martinón-Torres, Nigel Meeks & Stephen Quirke

Goldworking of outstanding quality appears in the late 4th millennium BC*, in jewellery from Saqqara, Naga al-Deir and, famously, the bracelets from the tomb of the 1st Dynasty king Djer at Abydos. Expanding on available published data, select items from early contexts were analysed, notably a remarkable diadem from a non-royal burial at Abydos, dated to* c. *3300* BC*, and a range of artefacts from regional cemeteries at Qau and Badari dated to* c. *2200–2000* BC*. The results help to shed light on the chronological and geographical range of Egyptian goldworking prior to the 'experimentation' and 'new knowledge' of the Middle Kingdom.*

Chapter 7.1

The early jewellery analysed

Maria F. Guerra

The very rich Middle Kingdom grave goods that include remarkable groups of jewellery (Grajetzki 2014) reinforce the expectation of a broad circulation of raw materials, productions, skilled workers and expertise in the Eastern Mediterranean area during the beginning of the 2nd millennium BC. This wide circulation undoubtedly sparked in Egypt a search for new technologies in many domains, including jewellery making. Therefore, searching for diachronic changes in the art and traditions of goldsmithing and of the exploitation of gold supplies, our project chiefly focused on jewellery produced between the Middle Kingdom and the first reigns of the New Kingdom. However, to contextualize the most significant changes in these transitional periods, it turned out to be necessary to approach the earliest technologies and gold alloys used in Egypt.

The art of goldsmithing underwent a pronounced evolution until the advent of the Middle Kingdom. The commonest gold productions expected for the earliest periods, spanning from the 4th to the first half of the 3rd millennium BC (which in Egypt corresponds to Naqada and Early Dynastic periods), are sheets or foils and small objects. From gold sheet, it is possible to obtain significant pieces of jewellery; moreover, by plating or gilding diverse substrates, it is possible to enhance objects made using a large sort of materials. Objects made of gold sheet as well as small cast gold items, such as amulets and beads of various shapes and dimensions can easily be combined with other components in various materials. A rather large variety of polychrome jewellery can be obtained using parts in gold and coloured beads and amulets in stone, faience, ivory, etc. This is well represented by the mid-1st Dynasty necklace from tomb 3507 excavated at Saqqara, dated by seal impressions of king Den to his reign (Emery 1958, pl. 99), and the group of jewellery found in tomb N1532 at Naga al-Deir (Reisner 1908, 29–33, pls. 6–9). To these examples, we can add the four bracelets from king Djer's tomb excavated at Umm al-Qaab (Petrie 1901), which illustrate the unlimited expertise of Egyptian goldsmiths since the 1st Dynasty. It is however difficult to conclude whether these four bracelets or the jewellery in gold sheet from tomb N1532 at Naga al-Deir are truly representative of the skilled art of the Early Dynastic goldsmith. They might in fact be sets of items made by particularly highly skilled goldsmiths. Nevertheless, these objects undoubtedly show the great expertise available in Egypt during the earliest periods, which is confirmed by the presence of remarkable objects in other tombs, such as the sumptuous and delicate grave goods from the tomb of Hetepheres (Dunham 1958; Reisner 1955). The tomb, dated to the 4th Dynasty, contained among others gold drinking cups, a gold razor, a gilded carrying chair, and one exceptional gilded wooden box containing (originally 20) silver bracelets inlaid with butterflies.

Against this background, it seemed important to us to analyse a few contextualized early made gold objects. Few were accessible for study, but we could select some, mainly in the collection of the Petrie Museum. The selected pieces described in this chapter cover a very large period that goes from *c*. 3300 BC to *c*. 2100 BC, predominantly found in Predynastic, 1st Dynasty, and First Intermediate Period burials. Despite being produced during a period of transition, jewellery made during the First Intermediate Period (*c*. 2181–2025 BC) derives from knowledge acquired during earlier periods. The analysis of this early jewellery should somehow be an indicator of the workshop practices and traditions in Egypt before entering the period of 'experimentation' and 'new knowledge' that is the Middle Kingdom.

The results obtained for the technologies employed in the manufacture of the studied objects are presented below, in two separate sections. The first one is focused on the three earliest gold items studied in this volume, all from excavations at Abydos. One is a Predynastic diadem in the collection of the British Museum (EA37532), and the others, dated to the 1st Dynasty, are one string of beads (UC36517) and four pieces of gold leaf (UC35689) in the collection of the Petrie Museum. The second section is devoted to objects (bracelets, strings of beads, amulets, etc.) in the collection of the Petrie Museum, mostly found in First Intermediate Period tombs excavated at Qau and Badari.

References

For references see pp.241–3 at the end of this chapter.

Chapter 7.2

Introduction to sites

Wolfram Grajetzki

Abydos

Abydos (26° 11′ N, 31° 55′ O) is one of the most important cities and archaeological sites of ancient Egypt. Here were buried the kings of the 1st and two kings of the 2nd Dynasty. Here stood the temple of Khentamentiu, that later became the temple of Osiris. From the Old Kingdom Osiris was one of the main Underworld gods of Ancient Egypt. His cult became especially popular in the Middle Kingdom, when many Egyptians erected chapels at Abydos to be symbolically close to the festivals performed for the god. In Abydos there were also extensive cemeteries, with burials dating to all periods of Egyptian history. Under Senusret III a royal tomb complex was built at South Abydos; the king might have been buried there. In the 13th Dynasty, Sobekhotep IV and perhaps Neferhotep I built their tombs at Abydos (Wegner & Cahail 2015). It seems likely that some high court officials followed and were buried here in the 13th Dynasty. Therefore, we can expect tombs belonging to the highest level of society. Abydos remained a burial ground for much of the Second Intermediate Period, with a large number of graves, some equipped with high status objects, something not found at many other sites for this period.

The Abydos cemeteries were excavated in large part around 1900, when the recording of tombs was not yet so refined. In particular, John Garstang worked there for several seasons, and found several hundred tombs.[1] Although the tombs were often looted and reused, he discovered several undisturbed burials of the late Middle and New Kingdom. Some of these were richly equipped with golden jewellery. However, often only the objects which were regarded as important were published. The information on tomb architecture is very limited. As a result, we have a high number of burials from Abydos, with very limited information on exact find spots within a tomb. Very often it is not known how many burials were found in one tomb. The information of the placement of jewellery on bodies is most often lost (Garstang 1900, 4-5, pls. 1, 3, 5; Zakrzewski 2016). The excavations by Peet (1914) after Peet & Loat (1913) between 1911 and 1914 were on a far higher standard, and his publications are also much more detailed. However, not many burials with personal adornments were found and here too recording lacks the detail expected in modern fieldwork.[2]

Qau and Badari

Qau (26°54′N 31°31′E) and Badari (27°00′N 31° 25′E) are two villages in Middle Egypt. In Egyptology, they refer to a series of cemeteries excavated in the nearby desert. Qau, also known as Qau el-Kebir no longer exists, as the remains of the ancient town along with the modern village were destroyed by a Nile flood at the beginning of the 19th century. Qau is most likely the ancient Tjebu, the main city and capital of the Wadjet nome, the 10th Upper Egyptian province in hieroglyphic lists. In the history of Egyptian Archaeology, the province is of special importance, because here, between 1922 and 1925, Guy Brunton excavated a series of cemeteries covering a substantial length of a province, at the edge of the eastern desert, from Qau in the south to Badari in the north, and in the following years beyond to the sites of Matmar and Mostagedda. At Qau there are also several impressive rock cut tombs of the Middle Kingdom, and the excavators found in addition an important burial of a New Kingdom local governor, and some painted tomb chapels dating to the Roman Period.

The cemeteries closest to Qau evidently belong mainly to the people living in this provincial town. In contrast, the chain of desert-edge cemeteries farther north near Badari most likely served a number of villages along the Nile. Therefore, the finds represent mainly objects typical for burials of the broader population. A high percentage of the burials belonged most likely to the local farmers of the region (Seidlmayer 1990, 206–9). In contrast to sites such as Thebes, conditions are not very good at Qau and Badari for the preservation of organic materials. Coffins and other wooden objects rarely survived. Therefore, pottery, stone vessels and personal adornments, form the bulk of objects found. Art objects and objects of a funerary industry, so typical for many cemeteries of the ruling classes, are extremely rare here. The main exception is the group of Middle Kingdom rock cut tombs at Qau, which are higher up the desert cliff-face, and were the target of several archaeological expeditions. Here were found products of a funerary industry, including decorated sarcophagi, statues and canopic jars. However, the burials had been heavily robbed and did not contain much jewellery.

The excavations directed by Brunton were published over the following decade in several volumes, and provide an excellent dataset (Brunton 1927, 1928, 1930). The fieldwork was of a high standard for its day, but has many shortcomings by modern standards. First, Brunton did not excavate empty tombs or those with few objects. This means that a high percentage of the burials for the poorest people are missing. Furthermore, for the same reason, periods when few objects were placed into burials are also underrepresented in the excavation reports. Another problem is the documentation of finds. It seems that many burials were not recorded beyond basic information on the objects and tomb architecture. In most instances, the exact position of objects found is not mentioned in the publication, an especially problematic point for personal adornments. All too often, any information on the stringing of beads, the placement of amulets and jewellery is lost and we only have the information that specific objects come from one burial.[3] Furthermore, Brunton was acutely interested in typologies. He and his team recorded all types of objects found. In the tomb register, in the final excavation report, they therefore recorded only the types of each object found. Seven identical vessels in one burial appear there as one vessel type without information on the number found. The same is true for the jewellery found. Beads are published in terms of their types, but the number of beads of any one type does not appear in the tomb register. Fortunately, Brunton describes a certain number of burials in the text of the publication, mentioning the number of beads and vessels, and provides rough sketches for several graves.

The Qau-Badari cemeteries cover almost all periods of Egyptian history. However, as already indicated, some periods are better represented than others, most likely in relation to the burial customs of a given time. In the classical Old Kingdom, especially in the 4th Dynasty, burials were not richly equipped with burial goods of any type. Therefore, there are few tombs published dating to the 4th Dynasty. Within the 5th Dynasty, at other sites tombs were often more richly equipped and this is also visible in the number of burials at Qau and Badari. This trend continues for the 6th Dynasty and for the First Intermediate Period.[4] Several thousand burials at Qau and Badari are datable to this period and provide a particularly rich dataset. The burials of First Intermediate Period are often rather simple in terms of architecture, frequently just holes in the ground or shallow shafts without a further chamber. However, deeper shafts with a chamber at the bottom appear too. Some of the tombs were lined with bricks, evidently belonging to people with rather more resources.

The burial equipment is often simple too. Traces of wooden coffins are often noted, but the bad organic preservation precludes evidence as to whether they were once inscribed. There are no signs that the bodies were mummified, and no canopic jars were found, but the bodies were wrapped in linen. Pottery and stone vessels are common, as are personal adornments, especially in burials of young women. The jewellery is placed on the body, but also in jewellery boxes, found near the body of the deceased. In general, women are equipped with more jewellery than men, although the burials of men are usually larger. The richer finds here date to the late 3rd millennium BC, often seen as time of decline and disorder, and this discrepancy has caused some discussion in Egyptology. Already Brunton noted that the wealthiest tombs in the region belong exactly to the First Intermediate Period. He counts 59 burials with golden beads ore amulets. Brunton wonders whether there was a redistribution of wealth at that time, and refers to the literary composition known in Egyptology as the Admonitions of Ipuwer, where it is lamented that jewellery was now owned by servants (Brunton 1927, 75–6).[5] From an in-depth study on the dating of the tombs, Stephan Seidlmayer concluded that gold objects appear most often in the middle of the First Intermediate Period. He also pointed out that a high proportion of gold is most likely lost from the archaeological record, as gold is one of the main targets for tomb looters (Seidlmayer 1987, 190–1).

Qau had further heydays in the Middle Kingdom, especially in the 12th Dynasty, as attested by the monumental rock cut tombs of the local governors. However, there are very few burials of this period belonging to the broader population, as already noted by Brunton, who wondered whether the broader population was buried somewhere else (Brunton 1930, 2). For the

Second Intermediate Period, the burials make a rather impoverished impression in marked contrast to those of the First Intermediate Period. Burials from the New Kingdom are in general less well preserved, making it harder to assess the general level of wealth in the town and its region at that time and in later periods.

Notes

1. For the excavation history of the Abydos cemeteries see Richards (2005, 136–47).
2. See the much too small depictions of personal adornments in Peet & Loat (1913, pls. VIII–XII).
3. Dubiel (2008) gathered all information available, for reconstructing how the jewellery was worn.
4. Brunton (1927, 1928) publications are mainly dedicated to the Old Kingdom and First Intermediate Period.
5. The composition is now generally dated to the late Middle Kingdom (Enmarch 2008, 18–24).

References

For references see pp.241–3 at the end of this chapter.

Chapter 7.3

Predynastic and Early Dynastic goldwork from Abydos

Maria F. Guerra, Nigel Meeks & Stephen Quirke

Chapter 7.3.1
Predynastic diadem from tomb 1730 at Abydos
Maria F. Guerra & Nigel Meeks

Among the three earliest gold items studied in this volume, diadem EA37532 stands out in its complexity and the materials employed. The object, which entered the collection of the British Museum in 1926, was found during the excavations of the cemetery of Abydos, in undisturbed grave 1730, dated to the end of Naqada II (*c*. 3300 BC). This middle Predynastic grave contained the body of an adult woman in a contracted position. Among the grave goods was found a diadem still attached to the head of the woman. The excavation director H. Frankfort remarks: 'At the back of the head there had been the string only, which disappeared under the tresses; the beaded part in front went from ear to ear, and seemed to hold a piece of cloth like a veil over the face of the woman' (Frankfort 1930, 214). The diadem was restrung in the original order after discovery.

Diadem EA37532 is a string of turquoise, garnet, gold and malachite beads, arranged in alternate coloured sections, as shown in Figure 7.1. The small gold beads are arranged in four groups each with four large looped strings of gold beads placed between single strings of the coloured stone beads. A small loop of gold beads at one end of the necklace could have been used to attach the diadem to the cloth. In contrast to the small gold ring-shaped beads (Fig. 7.1), the various semi-precious stone beads are of different and quite irregular forms (cylindrical, discoid, etc.). This might denote the work of less skilled crafts or reuse. Many of the very irregular turquoise beads are quite similar to the turquoise chips in the 1st Dynasty bracelet with the rosette found in the tomb of king Djer at Umm al-Qaab (shown in Fig 5.4). Contrary to those in the diadem, the turquoise beads in the bracelet are pierced longitudinally.

The tiny nature of the gold beads is extraordinary when seen against a scale, as shown in Figure 7.2. In this same figure, the table gives the measurements of some beads' width and diameter. In Figure 7.3a the wide diversity of the gold ring beads is illustrated under the SEM. Even if a few are quite regular cylinders, the small gold ring beads are of quite variable dimensions and shapes. Many contain PGE inclusions, as shown in Figure 7.3b for two of them. Therefore, we can assume the use of alluvial gold. The observation of the joining areas revealed that the beads are made from short strips of gold which were not soldered (Fig. 7.3c).

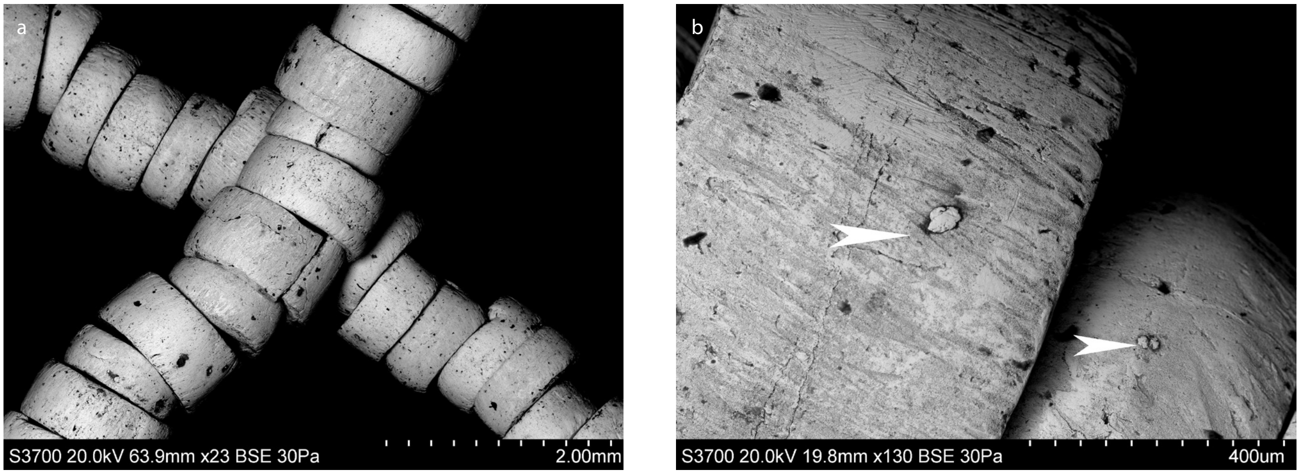
The gold beads, shown in Figure 7.3a under the SEM, can be roughly separated into tubular and narrower ring beads. The ring-shaped beads have a rounded shaped body with thinner edges. This fact can be associated to either two types of production (and thus two different functions) or two workshop traditions (and thus different goldsmiths).[1] It is difficult to provide other interpretations for the fabrication of both tubular and ring beads, as they are very small, between 0.92 mm and 1.26 mm in diameter (see the table in Fig. 7.2), and presumably difficult to make uniformly. It is even more difficult to explain why both types are strung in one item, unless they are reused or simply because they are difficult to make perfectly similar from different goldsmiths work.[2]

H. Frankfort remarks that the beads in diadem EA37532 were made by bending strips of gold cut from gold sheets (Frankfort 1930, 214). This is a preferred method of making small rings of gold or silver, in modern workshops whereby narrow strips of the metal are wrapped tightly in a spiral around a wire former of appropriate diameter, and then cut longitudinally across the spiral wire with a sharp saw or blade to release the individual beads of similar diameter. This technique, described by several authors (Reisner 1923; Oddy 1984; Echt et al. 1991), is illustrated in Figure 7.4.

Figure 7.1. *Diadem EA37532 in the collection of the British Museum, found in undisturbed grave 1730 at the cemetery of Abydos, with a detail of the small gold ring beads under the stereomicroscope.*

	Dimensions	No. of beads
Width (mm)	0.36–0.42	7
	0.46–0.52	5
	0.58–0.70	4
Diameter (mm)	0.92–0.94	2
	1.0–1.06	7
	1.1–1.16	3
	1.2–1.26	4

Figure 7.2. *Detail of diadem EA37532 showing the tiny gold beads. The measurements of some bead widths and diameters are provided in the table.*



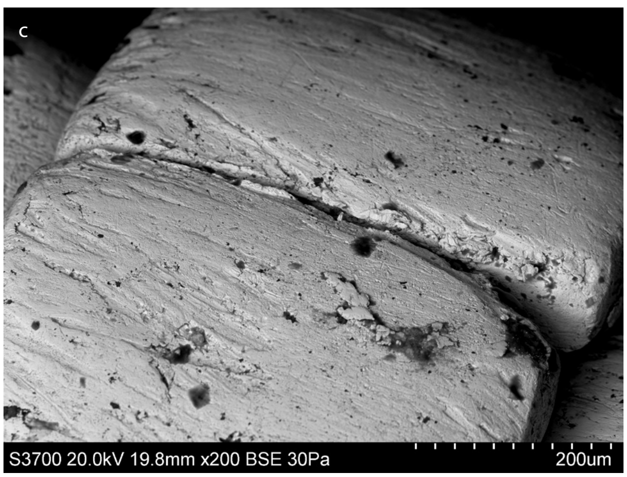


Figure 7.3. *Details under the SEM of the small gold ring beads in diadem EA37532 showing: (a) the diversity of their dimensions and shapes, (b) the small PGE inclusions (arrowed) and (c) the unsoldered joining seam.*

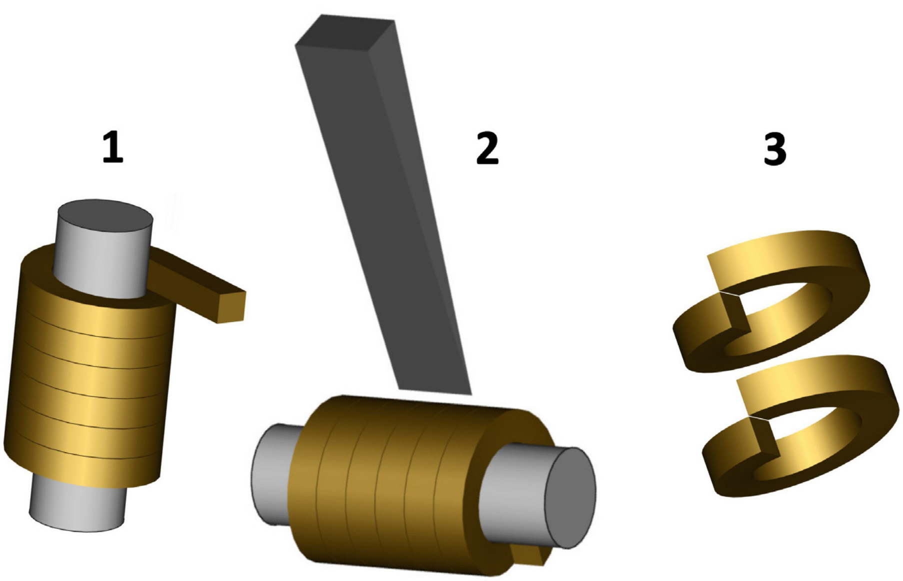
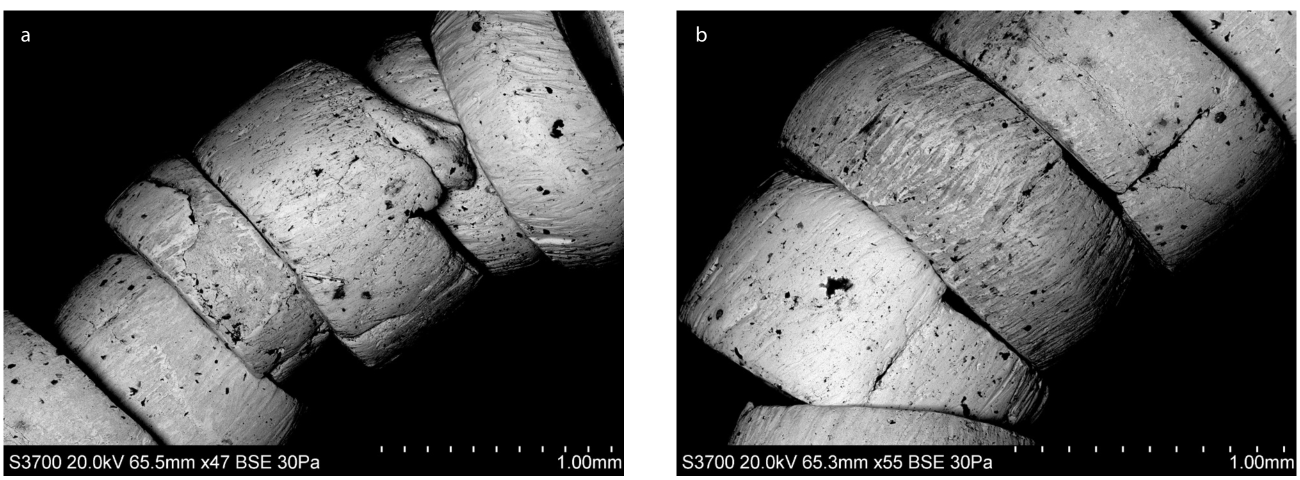


Figure 7.4. *Method of making small rings: (1) narrow strips of the metal are wrapped tightly in a spiral around a former of appropriate diameter and (2) cut longitudinally across the spiral wire to (3) release the individual round beads of similar form and diameter.*

The coexistence of several forms and decorations in gold beads has also been recorded for more recent periods in the African continent. Several types of small gold beads were found in the Iron Age graves excavated at Mapungubwe Hill in the Limpopo River Valley (South Africa). Several production techniques were also identified by examination and metallurgical studies of the beads: some were cold worked and perforated by punching (Miller & Desai 2004), whereas others were made from strips of gold bent into loops (Oddy 1984), sometimes by wrapping a gold strip around a core (Miller & Desai 2004).

At this point, it is interesting to explore Reisner's considerations on the small gold beads excavated at Kerma in Sudan, because he also describes two different sorts of beads (Reisner 1923, 109): '(…) it is again difficult to distinguish between the ring-beads and the short cylindrical beads; although the latter are quite distinct in character from the true cylindrical bead (…)'. He suggests a bead-by-bead manufacturing process by bending gold strips. However, his second suggestion is perhaps the most interesting one: '(…) some of these beads may have been made by rolling a long strip of gold about a solid core (or axis) of metal or wood, and then dividing the long tube thus formed into small sections (…)' (Reisner 1923, 283). Petrie (1910, 121) suggested the use of this process for the manufacture of early Egyptian glass beads, and Eluère (1990, 110–11) and Echt et al. (1991, 650–1) for the manufacture of the small gold beads excavated at Varna. Its advantage is that it facilitates the production of large quantities of beads.

It is noticeable that among the earliest copper objects made in Egypt[3] are six tiny beads, dated to the Badarian period, which are made using the two techniques. Guy Brunton (1937, 37, 41, pls. 39.75W9, 86W15) found in tombs 596 and 2229 at Mostagedda four now in the collection of the British Museum (EA62158). Brunton described the beads as follows: 'The copper beads are of two varieties. In 2229, where there were two, they were made of thin rectangular sheet-metal bent round (over a rod of some kind) (…). In 596 there was one of thin metal ribbon wound up spirally to form a ring and three others (…) a thick



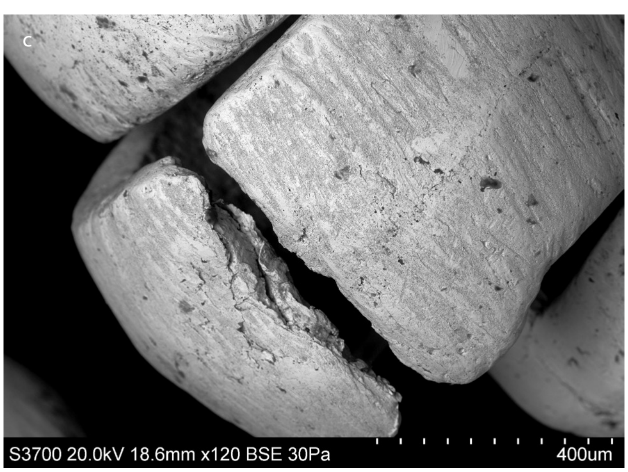


Figure 7.5. *SEM details of the small gold ring beads in diadem EA37532 showing (a) the irregular forms and sheet cutting, (b) the marks of polishing and (c) the joining seam.*

Table 7.1. *Results obtained by SEM-EDS for the composition of the small gold ring beads of diadem EA37532.*

Bead	Type	Au wt%	Ag wt%	Cu wt%
1	tubular	97	3	0
2	tubular	97	3	1
3	tubular	97	2	1
4	tubular	96	3	1
5	tubular	97	3	0
6	ring	99	1	0
7	ring	98	2	0
8	tubular	99	1	0
9	ring	98	2	0
Average		*98*	*2*	*0*

strip of copper, rectangular in section, was bent round in a fiat circle till the ends touched (…)' (Brunton 1937, 51–2).

A closer view under the SEM in Figure 7.5a shows for some of the tubular beads in diadem EA37532 a surface morphology expected for hammered and cut gold sheet. The production process suggested by Reisner should provide the gold beads with a surface morphology similar to that observed for our tubular beads. However, based on simple observation it is impossible to say whether cutting or rolling was the first step of the process. Some of the ring-shaped beads – one is shown on the top of Figure 7.5a and two others in Figures 7.5b,c – have apparently scraped angled surfaces that suggest a shaping or finishing process involving abrasion or filing. No consideration is provided either by Reisner or by Petrie on gold ring beads with scraped surfaces. However, polishing was used to form the earliest faience beads in Egypt (Nicholson & Peltenburgh 2000) and could thus be applied to metallic beads. Gold has appropriate mechanical properties for this forming process. In addition, small gold beads such as those found in the Chalcolithic site of Cheile Turzii–Peştera Ungurească in Transylvania (shown in Lazarovici et al. 2015, fig. 40) are of two types and some have marks of polishing on their surfaces. It is interesting to consider Echt et al.'s (1991) suggestions on the finishing process by polishing of the gold objects excavated at Varna, among which are many small beads. The polishing marks revealed under the SEM at the surface of the Varna objects are similar to those observed for diadem EA37532. Whatever process was used, it was probably a long and multiple-step process for preparing and shaping hundreds (possibly thousands) of such beads.

The analysis by EDS of nine ring beads of different dimensions and shapes in diadem EA37532 has shown the use of high purity alloys containing more than 96 wt% Au. Data obtained is summarized in Table 7.1. The presence of 1–3 wt% Ag and less than 1 wt% Cu in the alloys of diadem EA37532 is consistent with the composition expected for alluvial gold. The presence of low contents of alloying elements indicates the use of lower hardness and tensile strength alloys (Grimwade 2009), which would make cold working easier.

The use of such high purity alloys does not seem to be a regular practice during the Predynastic period. In fact, data published by Gale & Stos-Gale (1981) for goldwork dated to this period in the collection of the Ashmolean Museum at Oxford, shows the use of quite varied alloys. The objects are listed in Table 7.2, with information contained in both Gale & Stos-Gale (1981) and the catalogue of Predynastic objects in the Ashmolean Museum collection published by J. Crowfoot Payne (Payne 2000). Plotted with our data in Figure 7.6, the Predynastic objects in this collection contain up to 61 wt% Ag and 26 wt% Cu, even if two of

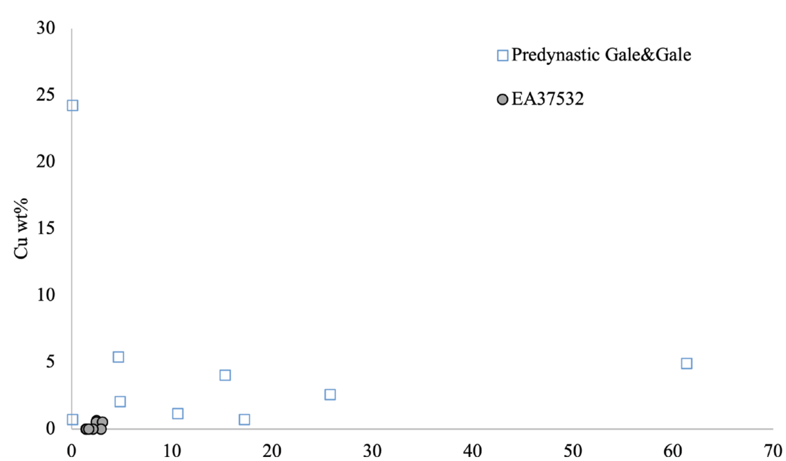


Figure 7.6. *Silver versus copper contents of the gold alloy used for diadem BM EA37532 compared to Predynastic jewellery in the collection of the Ashmolean Museum Oxford published by Gale & Stos-Gale (1981).*

Table 7.2. *Data published for predynastic items in the collection of the Ashmolean Museum Oxford published by Gale & Stos-Gale (1981) and by Payne (2000). *Queen's College loan 1949.*

No. Payne	Ashmolean Museum Acc. No.	Object	Context	Au wt%	Ag wt%	Cu wt%
1155	AN1895.987A	lid of stone necked jar	Naqada Tomb 1257	1.0	83.5	15.0
1180	QC1123*	Rim cased of vase	undated	33.7	61.4	4.9
1390	AN1959.442	Handle of flint knife with gold leaf	Naqada Tomb 331	99.3	<0.1	0.7
1684	AN1895.883 (E.E.48)	tiny bead	Naqada Tomb 822	82.1	17.2	0.7
1697	AN1895.888 (E.E.42)	bead gold on clay core	Naqada Tomb 5	80.7	15.3	4.0
1698	AN1895.893 (E.E.51)	bead gold on clay core	Naqada Tomb 5	93.1	4.8	2.1
1703	AN1895.876 (E.E.39)	cylindrical bead	Naqada or Ballas	89.9	4.7	5.4
1705	AN1895.890 (E.E.52)	barrel bead	Naqada or Ballas	88.2	10.6	1.2
1716	E.E.36	spehrical bead on frit core	El-Amra Tomb b62	75.8	<0.1	24.2
2064	AN1895.985	sleeve of lapis lazuli tube	Naqada Tomb 1257 or 1349	71.6	25.8	2.6

them show Ag and Cu contents close to the measured values in diadem EA37532. These two objects, which contain 93–99 wt% Au, are the handle of a flint knife with gold leaf and one bead made by covering a clay core with gold leaf. The first was found in tomb 331 and the second in tomb 5 at Naqada (Petrie & Quibell 1896, 50–1, 19–20). We can also mention one bead in the same collection (E.E.202) containing 99.2 wt% Au, <0.1 wt% Ag and 0.8 wt% Cu (Stos-Fertner & Gale 1979, table 1). The bead was found in one of the earliest tombs excavated at ElKab by Quibell (1908).

Chapter 7.3.2
Beads and gold foils from 1st Dynasty tombs at Abydos
Maria F. Guerra & Stephen Quirke

Among the items in the collection of the Petrie Museum, four pieces of gold foil (UC35689 A to D) are recorded in the museum register as formerly having a label 'with Narmer', interpreted by previous curators as indicating an Abydos provenance, 'possibly Tomb B10. Tomb of Hor-Aha', the successor of king Narmer, who ruled at the start of the 1st Dynasty. One of them (D) is a thin strip bent on one side and may have been originally pleated over the border of an object, such as the lips of a stone vessel (shown in Fig. 7.7a with foil C). These foils were analysed to obtain information on the alloy composition. Also selected for analytical study was string of beads UC36517, shown in Figure 7.7b, which contains among the carnelian, amethyst and faience beads, one large biconical bead and one spherical bead in gold. The museum register gives the provenance of these beads as tomb 500 at the funerary enclosure for king Djer of the mid-1st Dynasty, though there is no mention of gold beads either on the excavation tomb-card in the Petrie Museum archives (no. PMA/WFP1/103/1/1)[4] or in the published register of finds (Petrie 1925).

The spherical bead in string UC36517, shown in Figure 7.8a, is made by shaping, creasing and burnishing a gold foil over an unidentified round core. The other is a hollow elongated biconical bead. Biconical bead are often present in strings. One bead of this type was found, for example, during the excavations of cementary L at Qustul (Williams 1986, 159, pl. 110c) and several later examples were excavated in the Royal cemetery of Ur.[5] Of particular importance in this regard are the ten gold and silver biconical beads from tomb H41 at Mahasna (E.02971 and E.02972, Musée d'Art et Histoire in Brussels; Ayrton & Loat 1911; Eyckerman & Hendrickx 2011). Dated to Naqada 1 (3900–3700 BC), these and the beads from tomb H17 at Mahasna (E.02931 in the same museum), are the earliest examples of the goldwork so far found in Egypt.[6]

The scraped surface across the bead in string UC36517, shown in Figure 7.9, suggests in fact a shaping or finishing process involving abrasion or filing. This process was discussed in Chapter 7.3.1, focusing on the small gold beads of diadem EA37532 that also show scraped surfaces. As mentioned, other early beads, such as those found in Varna, have similar scraped surfaces (Echt et al. 1991). A closer examination of the elongated bead evidenced polishing marks in the same direction for each of the two halves (see in Figs. 7.8b and 7.9). This could correspond to a curved sheet of gold, probably formed over a shaped core in two steps to complete each conical half of the bead. The central flat shape results from the goldsmith's work on the two bead sides.

The four gold foils UC35689 and the two gold beads in string UC36517 were analysed *in situ* by XRF. The averages obtained for three repeated analyses are

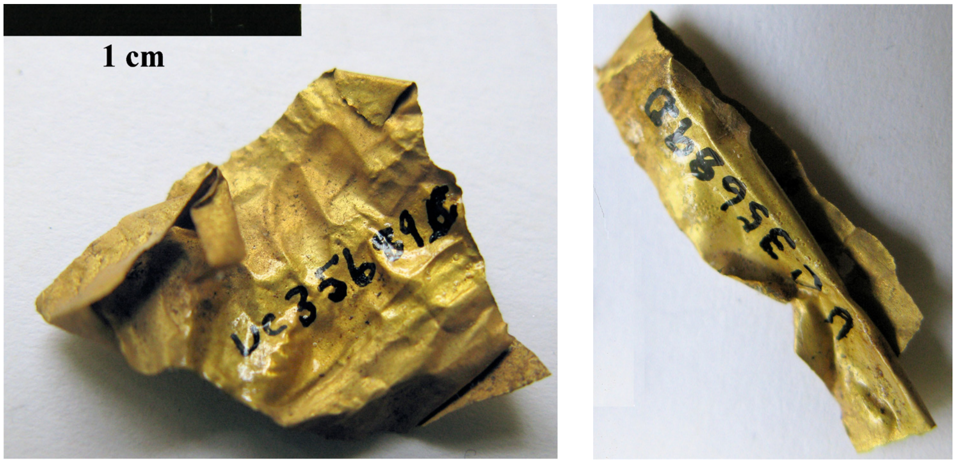


Figure 7.7a. *Two (C and D) of the four pieces of gold foil UC35689, thought to be from tomb B10, tomb of Hor-Aha, at Abydos.*

Figure 7.7b. *String UC36517 recorded as from tomb 500 at the funerary enclosure for king Djer of the mid-1st Dynasty.*

provided in Table 7.3. It can be seen that the four foils contain in average 11 wt% Ag and 0.2–0.3 wt% Cu. Three of them (UC35689 A, B and C) were made using the same alloy and may have been part of the same item. Foil UC35689 D, the one that is bent, containing a little more silver, may come from another item. The alloys employed in the manufacture of the two beads in string UC36517 are different. The biconical bead also contains about 10 wt% Ag, but the spherical bead is made from an alloy containing about the same quantity of copper as the biconical one (1.2 wt% and 1.6 wt%, respectively), but twice the concentration of silver (*c*. 20 wt% Ag). The silver contents in these items are higher than the values obtained for the beads contained in the Naqada II diadem EA37532 (1–3 wt% Ag), discussed in Chapter 7.3.1.

Although published data on the composition of early gold alloys are scarce, it is interesting to consider the analyses carried out by Gladstone (1901) on gold foils from the royal tombs excavated at Umm el-Qaab by Petrie (1901). The data obtained for the foils from the tombs of kings Djet, Semerkhet and Qaa, as well

Figure 7.8. *String UC36517: a) detail of the ball-shaped gold bead made by shaping, creasing and burnishing a gold foil over a round core and (b) the biconical gold bead perhaps worked from the middle.*

as from Idu (6th Dynasty), were included in Table 7.3 with the data provided by Berthelot (1906, 20) for gold foils from undetermined 6th Dynasty tombs given by Maspero for analysis. The levels of copper are said to be always below detection limits. This could, in fact, be equivalent to the low amounts detected in foils UC35689 (*c*. 0.2 wt% Cu) and in diadem EA37532 (0–1 wt% Cu), which should correspond to natural levels. Indeed, an average value of 0.17 wt% Cu was obtained for 500 placer gold grains from Northern Ireland by Moles et al. (2013) and many of the earliest gold objects contain less than 0.2 wt% Cu.[7]

Gold nuggets are seldom found in excavations, but Quibell (1898, 7) found at ElKab, in early stairway tomb 2, a small partially robbed tomb, two gold nuggets with one single thick gold hoop bracelet and components of a string (barrel-shaped carnelian beads, small gold beads and a gold spacer with five holes). One of the nuggets (shown in Müller & Thiem 1999, 40) is in the collection of the Cairo Museum (53838 in Vernier 1907–27, 514), but the other, in the collection of the Ashmolean Museum (E.455), was analysed by Stos-Fertner & Gale (1979), who have shown that it contains 84.8 wt% Au, 15.3 Ag and <0.1wt% Cu. This

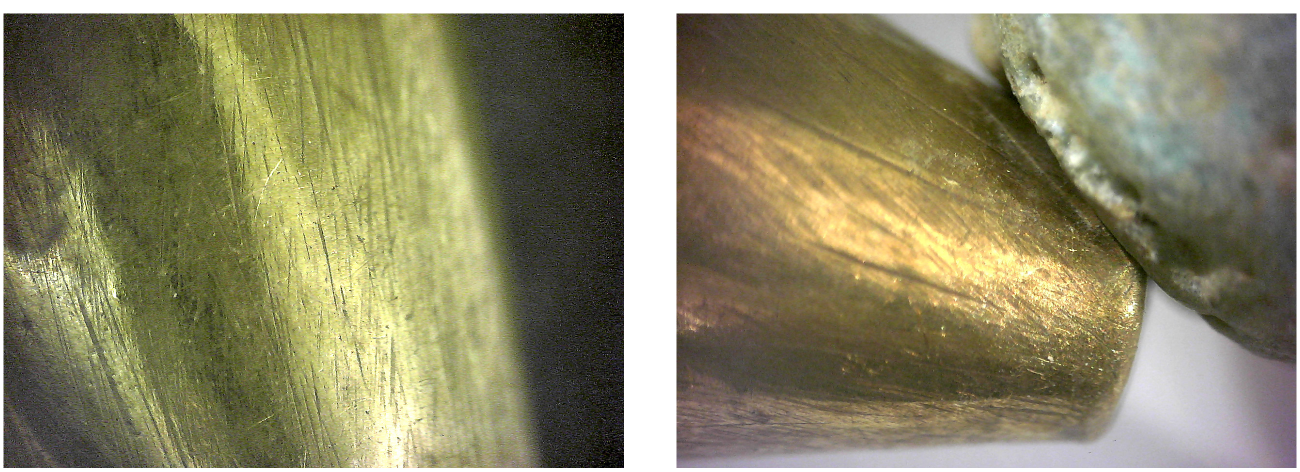


Figure 7.9. *The scraped surface of the biconical gold bead in string UC36517 that suggests a shaping or finishing process involving abrasion or filing.*

Table 7.3. *Results obtained by XRF for the composition of the four pieces of gold foil UC35689 (A to D) and the two gold beads from string UC36517. Other data contained in the table published by: Gladstone (1901), Berthelot (1906), Amélineau (1899) and Firth & Quibell (1935).*

Acc. No.	Context and object	Au wt%	Ag wt%	Cu wt%
UC36517	*Abydos*			
	spherical bead	78.9	19.9	1.2
	biconical bead	88.2	10.2	1.6
UC35689	*Abydos*			
	foil A	88.8	11	0.2
	foil B	88.6	11	0.3
	foil C	88.6	11.2	0.2
	foil D	87.9	11.8	0.3
Period and site	**Publication**	**Au wt%**	**Ag wt%**	**Cu wt%**
Dynasty 1-2				
Umm el-Qaab	Friedel in Amélineau 1899	38.11	60.35	1.48
Abydos, Djet	Gladstone 1901	79.7	13.4	
Abydos, Sermerkhet	Gladstone 1901	84.2	14.3	
Abydos, Qaa	Gladstone 1901	84	13	
Dynasty 2-3-4				
Saqqara	Cox in Firth & Quibell 1935	79.5	16.8	2.8
Saqqara	Cox in Firth & Quibell 1935	91	9	
Late OK				
Abydos, Idu I	Gladstone 1901	77.9	18	
Abydos, Idu I	Gladstone 1901	81.7	16.1	
VI Dynasty	Berthelot 1906	92.3	3.2	
VI Dynasty	Berthelot 1906	92.2	3.9	

composition matches well the values expected for Egyptian native gold (Klemm & Klemm 2013, 42) and is close to the composition obtained for gold foils UC35689 and for the biconical bead in string UC36517. The higher copper content found in the bead might correspond either to addition of a small quantity of copper to native gold or just reflect gold processed using tools and equipment also used to process copper. The spherical bead in string UC36517 contains *c*. 20 wt% Ag, a value also expected for Egyptian native gold, and should thus correspond to the exploitation of another deposit. These deposits should be alluvial, because a few small PGE inclusions were visible on the surface of the biconical bead.

It is interesting to notice that the gold samples analysed by Gladstone (1901) and by Berthelot (1906) contain 3 to 18 wt% Ag, a range of silver amounts that includes the gold nugget from ElKab, foils UC35689 and closely the gold beads in string UC36517. Also included in Table 7.3, in the same block of silver contents, are two gold sheets from a 3rd Dynasty coffin found inside a chamber under the Step Pyramid at Saqqara (Firth & Quibell 1935, 41–3); these were analysed by H. Cox (in Firth & Quibell 1935, 140–1). Although containing a little more copper, five objects in the collection of the Ashmolean Museum, dated from Naqada I–II to Naqada III- 1st Dynasty, analysed by Gale & Stos-Gale (1981) and mentioned in Chapter 7.3.1 (see Table 7.2), are in the same range of silver contents. Two of them are from tomb 5 at Naqada (Petrie & Quibell 1896, 19–20; Payne 2000, nos. 1697–8), one is from tomb 822 at Naqada and the other two from unreported tombs at Naqada or Ballas (Petrie & Quibell 1895; Payne 2000, nos. 1684, 1703, 1705). However, one rim cased of an unprovenanced vase in amethyst (Payne 2000, no. 1180) has shown to contain 61.4 wt% Ag. One gold sheet from excavations at Umm al-Qaab (analysed by M.C. Friedel in Amélineau 1899, 274) also contains *c*. 60 wt% Ag, values not expected to be regularly found in native gold.

In order to facilitate further discussion on the composition of the earliest gold alloys, we plotted in the diagram of Figure 7.10a the gold foils UC35689 and the gold beads in string UC36517 with the data summarized in Tables 7.2 and 7.3. To the diagram were added a few objects in the collection of the Museum

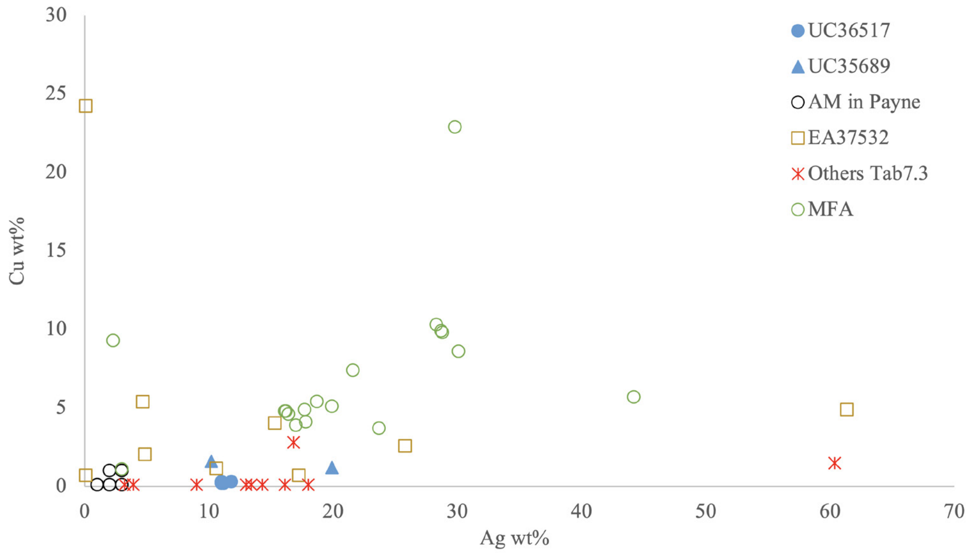


Figure 7.10a. *Silver versus copper contents for gold beads in string UC36517 and gold foils UC35689 compared to Predynastic objects in Tables 7.1 and 7.2, to which were added the early objects in Table 7.3 and those in the collection of the MFA analysed by Hatchfield & Newman (1991), Newman (2002) and Newman & Derrick (2002).*

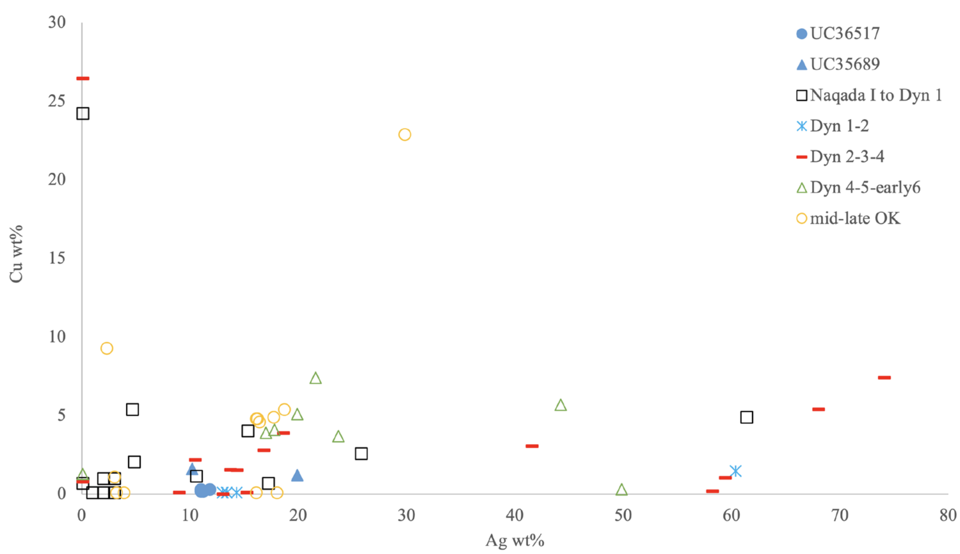


Figure 7.10b. *Silver versus copper contents in chronological representation for the same objects plotted in Figure 7.10a, to which were added objects from the same period in the collection of the Ashmolean Museum analysed by Stos-Fertner & Gale (1979) and Gale & Stos-Gale (1981, Oxalid).*

of Fine Arts Boston excavated at Giza. One of them is a bead from a broad collar in wood and faience (MFA 27.1548.2, dated to the 4th Dynasty) from tomb G 7440 Z.1927 analysed by Hatchfield & Newman (1991, tab. 1 no.20). The others were analysed by Newman (2002). Three of them, the broadcollar (MFA 13.3086), the string (MFA 13.3422) and the bracelet (MFA 13.3414) were found in the tomb of Impy (G 2381 A, dated to the 6th Dynasty, reign of Neferkara Pepy II). The rest are gold foils from: tomb G 4341 A dated to the 4th Dynasty (MFA 24.1749a); tombs G 4516 C (MFA 35-8-54a-c) and G 2200 B-G 5080 (MFA 33-2-115) and pit G 7143 B (MFA 27-2-462) dated to the 5th Dynasty; and tomb G 2360 A (MFA 13.3424) dated to the 6th Dynasty. Finally, though unprovenanced, the 'seal of office' in gold (MFA 68.115) dated to the 5th Dynasty, reign of

Djedkare Isesi, analysed by Newman & Derrick (2002) was also considered.

The diagram of Figure 7.10a shows that the majority of the analysed items contain silver amounts under 20 wt%. UC35689 and UC36517 fall in the same bracket, which, as mentioned, is expected for gold from Egyptian deposits. The objects containing 20–30 wt% Ag are the broadcollar bead from tomb G 7440 Z.1927, the bead from El Amra and the unprovenanced 'seal of office'. In Figure 7.10b, we plotted the same objects chronologically (excluding the unprovenanced 'seal of office') and a few contextualized objects in the collection of the Ashmolean Museum analysed by Stos-Fertner & Gale (1979) and Gale & Stos-Gale (1981, Oxalid), dated until late Old Kingdom. These objects were found in stairway tomb 2, and in tombs 2, 166 and 167 at ElKab (Quibell 1898), tomb Q172 at Ballas (Petrie & Quibell 1896, 15, pl.5 no.23), tomb 1310 at Armant (Mond & Myers 1937, 84–9), tomb 1126 at Qau (Brunton 1927, 24) and tomb 183 at Haraga (Engelbach & Gunn 1923, 9).

We can observe that the earliest objects, dated from Naqada I–II until the 4th Dynasty, split into two groups according to their silver contents. One group contains objects with less than 30 wt% Ag (the majority concentrating in the bracket 10–20 wt% Ag) and the other group contains those with more than 55 wt% Ag. Therefore, other early objects contain high silver contents. These objects are beads from tomb 166 at ElKab (Quibell 1898) containing 58–59 wt% Ag and from tomb 1310 at Armant (described by Beck in Mond & Myers 1937, 84–9, pl. 39.7) containing *c*. 68 wt% and 74 wt% Ag. One pendant from tomb 183 at Haraga (Engelbach & Gunn 1923, 9), a quite particular tomb that contained some grave goods typical of the Old Kingdom and of the First Intermediate Period (Grajetzki 2004), contains *c*. 50 wt% Ag. The objects dated from the 4th Dynasty to early 6th Dynasty also split into two groups, but the second group contains those with *c*. 40–45 wt% Ag. Those dated to the 6th Dynasty are all contained in the group characterized by silver amounts under 30 wt%.

Concerning the copper contents, in general the early objects considered contain <5 wt% Cu. However, three of them, all dated to different periods, contain *c*. 25 wt% Cu. These objects are one bead from tomb b62 at El-Amra, one pendant from tomb Q172 at Ballas, and the gilded bracelet from the tomb of Impy. These alloys could have been obtained by addition of copper to gold. However, the absence of silver (<0.1 wt%) in the bead from El-Amra and in the pendant from Ballas is uncommon for native gold. The gold leaf decorating the handle of a flint knife from tomb 331 at Naqada (see Table 7.2) and the item from tomb 1126 at Qau are in the same situation and diadem EA37532 contains only 1–3 wt% Ag. These objects show that very fine gold was available in Egypt to produce the earliest objects.

In brief, the most common gold employed in the earliest periods to produce the objects (at least those considered in Fig. 7.10b) contains 5–30 wt% Ag and most frequently 10–20 wt% Ag. This type of gold was available in Egypt, according to Klemm & Klemm (2013). However, since the earliest periods some (perhaps few), certainly alluvial, deposits also provided the Egyptian workshops with very pure gold, >95 wt%, as demonstrated by the composition of the above mentioned excavated objects. The gold palette was improved for several objects by using reddish and whitish gold alloys. While the reddish ones were in principle obtained by adding copper to gold, and this workshop practice should be available, the whitish alloys remain difficult to explain.

Gale & Stos-Gale (1981) suggested the use of aurian silver in Egypt. Although native gold generally contains no more than 35–45 wt% Ag, among the gold-bearing minerals can be found a few containing higher silver contents (see Chapter 1). Consequently, the use of this type of alloys during the earliest periods in Egypt might result from access to (sporadic? small? local?) sources of gold containing such high silver contents. It is difficult otherwise to explain the composition of certain objects, such as the remarkable inlaid silver bracelets from the tomb of Hetepheres, dated to the 4th Dynasty, made from an alloy containing 90.1 wt% Ag, 1 wt% Cu and 8.9 wt% Au (analysed by H.E. Cox, in Reisner 1955, 44). The possibility of mixing during recycling, as evoked by Rehren et al. (1996), is difficult to conceive, at least during the earliest periods in discussion (see Chapter 5).

The recurrent presence in the gold alloys of rather high copper contents also draws our attention, but we can easily accept that copper was melted with gold to obtain a reddish gold alloy, even when it reaches 25 wt%. This can correspond to an alloy containing one part of copper and three parts of gold. If 'yellow' gold was melted with 'red' copper, why wouldn't it be melted with a 'white' metal, either silver-rich gold or silver? In other words, could the reddish and whitish alloys result from the same 'colouring' practice?

Further reflection can be proposed by considering a possible mixture of several parts of a 'yellow' metal with several parts of a 'white' metal.

As mentioned above, the 'yellow' metals that we could identify in the objects are, in general, of two types. One is high purity gold containing amounts of silver under 5 wt% and amounts of copper under 1 wt% (in average alloys containing 2 wt% Ag and 98 wt% Au)

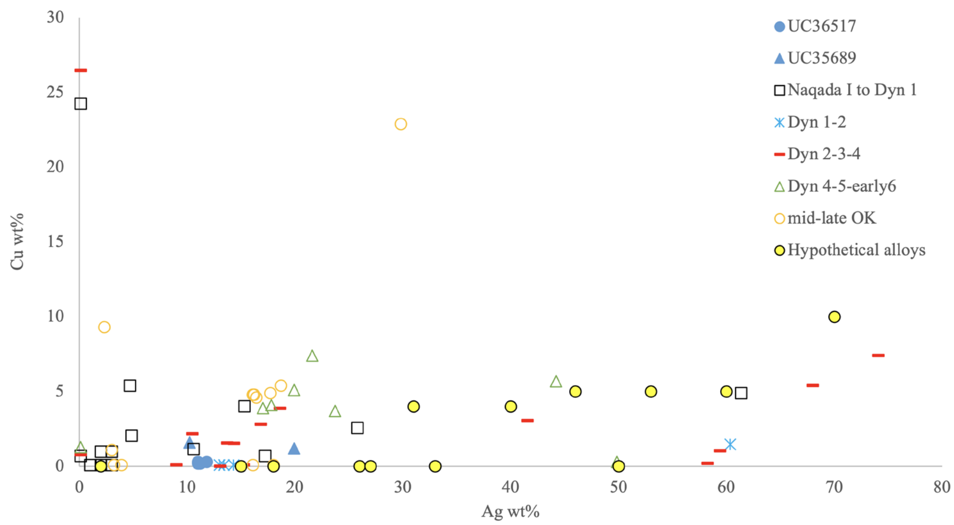


Figure 7.11. *Silver versus copper contents in chronological representation as in Figure 7.10b, to which were added the hypothetical alloys estimated based on the alloys proposed in Table 7.4 (with the exception of the silver alloy).*

and the other, common in Egypt, contains 10–20 wt% Ag, on average 15 wt% Ag, less than 1 wt% Cu and 85 wt% Au, such as the mentioned gold nugget from ElKab. As silver objects were produced in Egypt, we can imagine that silver alloys could also have been used as 'white' metal. Recycling of silver alloys by melting them with gold would explain the regular presence of rather high copper contents in the gold objects. In the case of the lid for stone necked jar found in tomb 1257 at Naqada (Petrie & Quibell 1896, 48) analysed by Gale & Stos-Gale (1981), the alloy was found to contain 84 wt% Ag, 15 wt% Cu and 1 wt% Au (see Payne no. 1155 in Table 7.2). However, the 'white' metal could also be a gold alloy containing *c*. 50 wt% Ag, as these silver amounts (see Chapter 5) were found in early objects such as those from Varna (Hartmann 1982; Echt et al. 1991; Leusch 2019). This type of gold (local or imported?) could have been available in Egypt.

Based on these hypothetical alloys, we can speculate as to the palette available in the Egyptian workshops by mixing them. Table 7.4 gives the results obtained when mixing one or two parts of each 'yellow' metal (y1 and y2 in the table) with one or two parts of each 'white' metal (w1 and w2 in the table). Results from this calculation include alloys containing regularly 5 wt% Cu and a large variety of silver contents. The hypothetical alloys were plotted in Figure 7.11 with the objects (represented in Fig. 7.10b), showing that the silver levels obtained by calculation cover the whole bracket of earliest alloys, including the high-silver ones observed. It is possible to imagine that gold alloys containing several parts of a 'white' metal could have been also employed to enlarge the colours available with nuances increased by the use of certain amounts of copper.

We thus demonstrate with a simple calculation that the hypothetical compositions that can be obtained by melting 'yellow' and 'white' metals can cover almost the totality of the alloys employed in the production of the earliest Egyptian jewellery. With the data presently available for the earliest Egyptian productions, it is impossible to go further in the discussion and therefore our suggestion remains hypothetical. The analytical data discussed in the next sections, obtained for the objects dated to the First Intermediate Period, should shed new light on this discussion.

Table 7.4. *Hypothetical native gold alloys (two yellow and one white) and artificial silver alloy (white 1) used to estimate the composition of the hypothetical 'coloured' gold alloys plotted in Figure 7. 11, obtained by adding one or two parts of one of the yellow alloys to one or two parts of one of the white alloys.*

Hypothetical alloys	Au wt%	Ag wt%	Cu wt%
yellow 1 (y1)	98	2	0
yellow 2 (y2)	85	15	0
white 1 (w1)	1	80	15
white 2 (w2)	50	50	0

Notes

1. An alternative explanation for ring beads having thinner edges is wear between adjacent beads, as these beads can also be used as gold spacers between stone beads.
2. These feature can be seen in beads made from other metals. For example, the strings found at Giurgiulesti (Moldavia), in five Suvorovo burials dated to the 5th

millennium BC, contained many tiny copper beads of different sizes. Those from grave 3, containing the body of a child, were published by Bicbaev (2009, 220, figs. 10.9–10) and those from burial 5, containing the body of an adult female, were drawn in detail by Govedarica & Manzura (2019, 16, fig. 14, no. 1). We can also mention the copper and silver beads from a mid-4th millennium BC context at Ilgynly-depe (southern Turkmenistan) with 'abrasion-polishing marks aimed at rounding and regularising the outer surface' (Salvatori et al. 2009, 55).

3. One of the earliest copper objects is a bent pin in the collection of the Petrie Museum (UC9059) found in tomb 5112 (Brunton & Caton-Thompson 1928, 7, pl. 26). The other two copper beads 'of metal ribbon, wound round spirally to form rings' were found in tomb 5413 (Brunton & Caton-Thompson 1928, 12, pls. 26, 50.86W3). Small copper beads are among the earliest known metallic objects. Examples are those found at Çayönü (Özdoğan 2016), Aşıklı Höyük (Zimmermann 2016, 313, fig. 6), Tell Halula (Molist et al. 2010) and Ali Kosh (Pigott 2004; Helwing 2013).
4. For the tomb card system of documentation, see Serpico (2008, 7–10).
5. An example is the diadem from a child's tomb (U.11806 from tomb PG1133) in the collection of the British Museum (1929,1017.8-10), dated to Early Dynastic III (Woolley 1934, pl. 133). The typology of the beads found in the excavations of Ur is provided by Maxwell-Hyslop (1971, 8).
6. String E02971 and two beads from string E.02931 were analysed by Hauptmann & von Bohlen (2011) showing that some of them are in silver and others in a gold alloy (further information is given in Chapter 1).
7. This is for example the case of the earliest gold objects found in Iberian Peninsula (for example Murillo-Barroso et al. 2015; Valério et al. 2017; Guerra & Tissot 2021).

References

For references see pp.241–3 at the end of this chapter.

Chapter 7.4

First Intermediate Period goldwork from Qau and Badari

Maria F. Guerra, Marcos Martinón-Torres & Stephen Quirke

The fourteen contextualized jewellery items selected for analytical study are presented in Table 7.5. They are in the collection of the Petrie Museum and come from tombs dated to the First Intermediate Period excavated at Qau and Badari. To this group of jewellery were added three objects in the same collection, dated to the same period, with particular typologies. One is an unprovenanced button seal and the other two are beads and one string from tombs excavated at Matmar.

In the sections below, the studied objects are shortly described by type, and the composition of their alloys discussed in terms of the amounts of silver and copper, which involve changes in the colour of the employed gold alloys. These objects are discussed with reference to the data obtained for the earliest objects described in the previous chapters of this volume, in order to gather further information on the variety of gold alloys employed during a long period. The presence of PGE inclusions on the surface of the objects was also investigated to make inferences about the use of alluvial gold.

Table 7.5. *The First Intermediate Period jewellery in the collection of the Petrie Museum analysed in this chapter.*

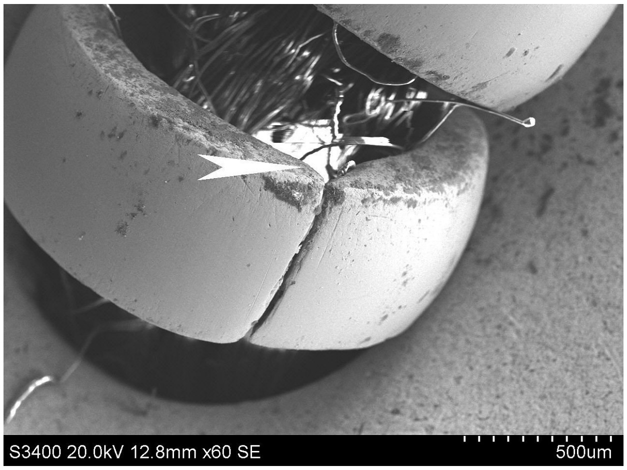
Reference	Origin	Jewellery
UC18092	Tomb 7923, Qau	String
UC18054	Tomb 7923, Qau	Bracelet
UC18055	Tomb 7923, Qau	Bracelet
UC20651	Tomb 4932, Badari	Amulet
UC18059	Tomb 1030, Qau	String
UC18060	Tomb 1030, Qau	String
UC20896	Tomb 7777, Qau	String
UC18025	Tomb 4903, Badari	String
UC18026	Tomb 4903, Badari	String
UC20881	Tomb 5270, Badari	String
UC20882	Tomb 5281, Badari	String
UC20649	Tomb 4915, Badari	String
UC20589	Tomb 3306, Badari	String
UC20625	Tomb 4802, Badari	String
UC42397	Tomb 3053, Matmar	Beads
UC34110	unprovenanced	Button seal
UC42422	Tomb 3029, Matmar	String

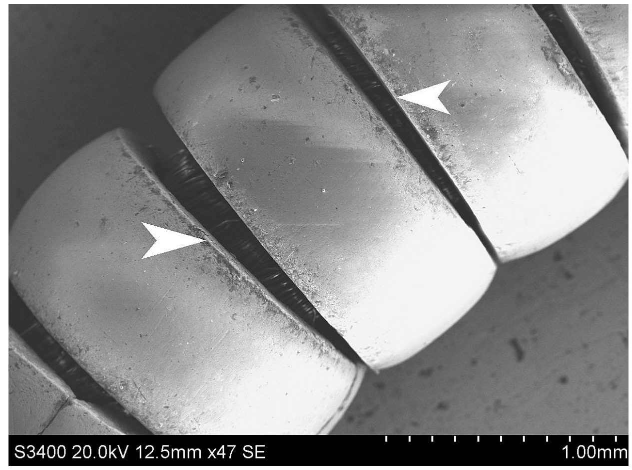
Polychrome strings with cowrie-shaped beads

String UC18092, found in undisturbed tomb 7923, dated to the early First Intermediate Period (Seidlmayer 1990, 139; Phase IIB), and located in the Southern cemetery near the site of the ancient town at Qau (Brunton 1927, 37, pl 46), is shown in Figure 7.12. It consists of twelve gold cowrie shell-shaped beads[1] enhanced with small whitish ring beads in electrum and disc beads in faience. The cowrie beads are embossed gold sheets perforated twice in order to make a bead-band[2] of cowries and to position the strung whitish small ring beads over the arched groove. The mounting of the cowrie beads with the ring beads provides a polychrome yellow-whitish group that alternates with sequences of faience discs originally blue, a polychrome effect that can only be imagined today (see Fig. 5.14 in Chapter 5), because the surface alteration of the materials has changed the original colours of the strung components.

The small ring beads in string UC18092, made by loop bending and cutting hammered sheet, are quite regular. Contrary to those in diadem EA37532 discussed in a previous section, none of the beads is tubular, and none has a scrapped surface. They can be attributed to a single goldsmith or workshop. Under the SEM, we were unable to find neither remains of solder at the edges nor signs of heating around the joining seams. As shown in Figure 7.13, the bead surfaces are smooth, the ends are polished, and the joining is roughly linear. For many beads, the edge has

Figure 7.12. *String of beads UC18092 from tomb 7923 at Qau with a detail of the reverse of the cowrie shaped beads.*





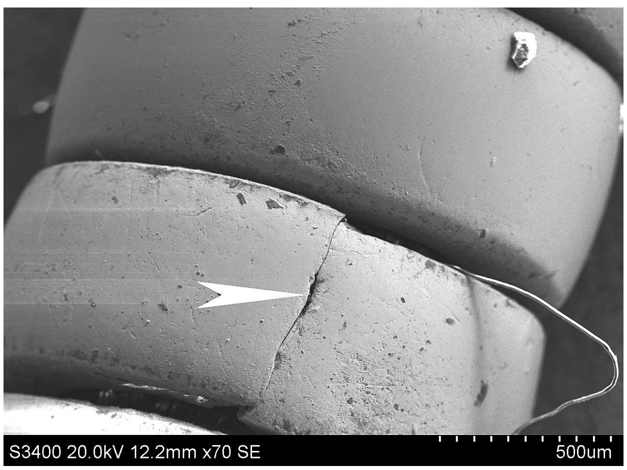


Figure 7.13. *Small ring beads from string UC18092 under the SEM showing (arrowed) several production details described in the text.*

a 'V' shaped form (Fig. 7.13). It is possible to imagine, as suggested by Reisner for the small gold ring beads from the excavations at Kerma (Reisner 1923), that they were made by wrapping narrow strips of gold around a former and cutting longitudinally across the spiral wire, as shown in Figure 7.4. The released beads seem to be slightly polished at both ends in the case of string UC18092.

Similar gold cowrie-shaped beads were found in tomb 3053, dated to the end of the Old Kingdom (Seidlmayer 1990, 136; Phase IIA), at Matmar (Brunton 1948). These specimens (UC42397) are of two types, as shown in Figure 7.14. Three of them, the largest ones with an arched groove, are similar to those in string UC18092 (number 146 in Brunton 1948, pl. 32). The fourth specimen, with a rectilinear groove, is smaller

Figure 7.14. *The four cowrie beads UC42397 from tomb 3053 at Matmar.*

Figure 7.15. *A detail of string UC18025 from tomb 4903 at Badari and of some of the gold beads: tubular, ribbed tubular, barrel, and geometrical tubular.*

(number 147 in Brunton 1948, pl. 32). They are all made from embossed sheet gold, holed twice to be strung in bands. Therefore, they could have been originally mounted similarly to those from tomb 7923 at Qau.

We also selected for analytical study a pair of gold bracelets in the collection of the Petrie Museum (UC18054 and UC18055) found in the same tomb 7923 at Qau. These overlapping bangles, in bent curved sheet gold, were formed by hammering, certainly over a tubular form.

The large beads

Six strings of beads and amulets made from different materials, including gold (Brunton 1948, 36) were found among other grave goods in tomb 4903 excavated at Badari, dated to the early First Intermediate Period (Seidlmayer 1990, 138; Phase IIB). From this tomb, which contained the burial of a young woman, we selected two strings for analytical study. One, UC18025, contains four gold amulets in the shape of the god Heh, alternating with sequences of beads. The beads are of different types and made in different materials. Those in gold (some shown in Fig. 7.15), have different forms. They are barrel, tubular and ring beads as well as spiral and lozenge decorated beads. In general, they are made by covering an undetermined core with a gold leaf or foil. Owing to dirt and sometimes presence of corrosion products, it is difficult to determine whether they are soldered.

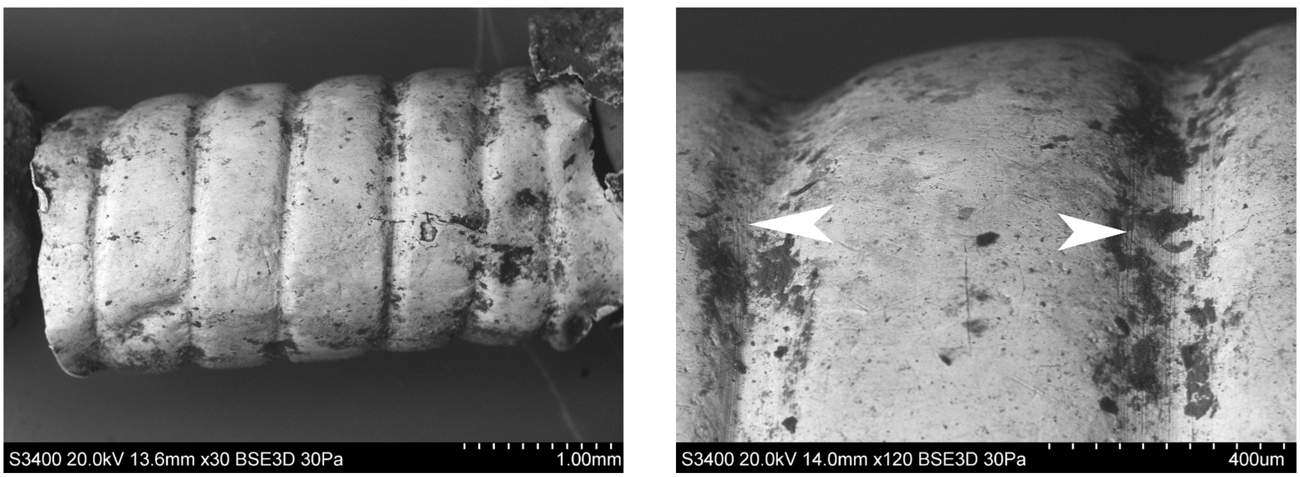


Figure 7.16. *One of the ribbed tubular gold beads in string UC18025 under the SEM with a detail showing the marks inside the grooves.*

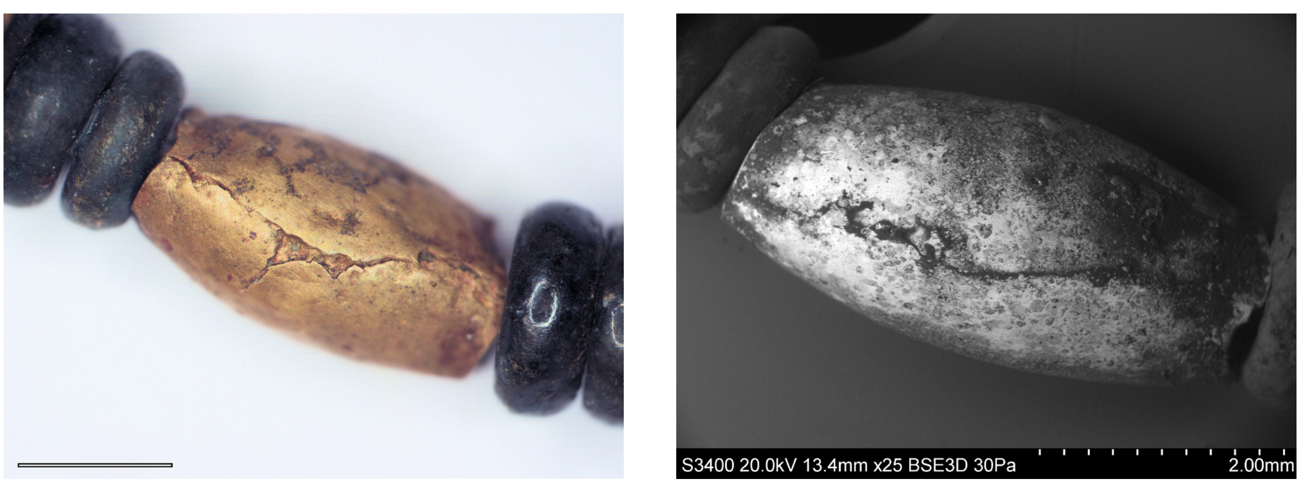


Figure 7.17. *One of the barrel beads in string UC18025 from tomb 4903 excavated at Badari, made by covering an unidentified core with a rectangular gold foil.*

Figure 7.18. *Detail of string UC18059 from tomb 1030 at Qau showing the tiny beads, some of the gold amulets and two of the four spherical beads. The detail shows the polished surface of the double crown shaped amulet.*

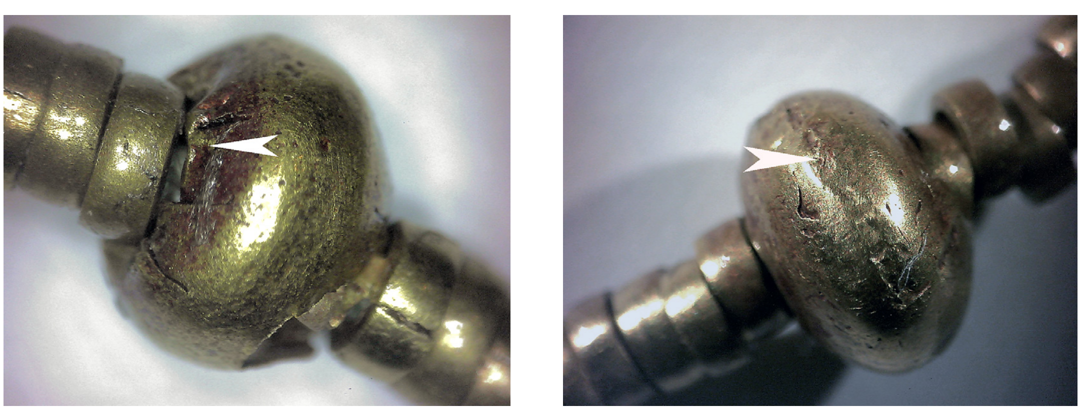


Figure 7.19. *Two of the spherical beads in string UC18059 showing the joining seam of the two halves and the gold foil creasing.*

Observation of the decorated gold beads under the SEM showed the presence of some toolmarks. Thin parallel lines can be seen in their grooves associated either to gold sheet forming (perhaps using an unsharpened tool) or finishing by polishing. This is particularly visible in the grooves of the spiral beads, shown in Figure 7.16.

The other string of beads from tomb 4903 excavated at Badari (UC18026) also contains barrel and tubular gold beads, showing today different colours due to dirt and corrosion. The gold beads alternate with coloured beads made from different materials. Observation under the stereomicroscope showed that the gold beads are identically made by covering a core with a gold foil. Figure 7.17 shows for one of the barrel beads that the gold foil employed is rectangular. Again, dirt hampers our attempts at determining whether the foils are soldered.

It is also interesting to consider the four ball beads contained in string UC18059 (Fig. 7.18), found in tomb 1030 excavated at Qau, dated to the early First Intermediate Period (Seidlmayer 1990, 137; Phase IIC). The tomb contained the partly disturbed burial of a young female, who still had on each wrist a gold bangle with overlapping ends, and around her neck several strings, among which UC18059 (Brunton 1927, 33, pls. 35, 48). The remaining small ring beads found in the tomb are contained in another string, UC18060, from her left wrist.

The museum register gives the location within burial 1030 of string UC18059 as 'neck', and records the string as comprising many small gold beads, four larger gold beads, and eight small gold amulets. However, the ball beads are made using two different technologies. The two types of beads can be seen in Figure 7.19. One is a hollow specimen made by joining two halves. The joining seam is visible at the edge. The other bead is made by creasing and burnishing a gold sheet over a round unidentified core.

Last, we considered the gold beads in string UC20896, found in tomb 7777 among the cemeteries near the site of the town at Qau, dated to the late First Intermediate Period (Seidlmayer 1990, 139; Phase IIIA), containing a female burial. In addition to three small tubular beads and a few ring beads, this string contains an exquisite barrel bead in gold decorated with filigree patterns and showing signs of extensive wear. Details of the beads are shown in Figure 7.20. The hollow small

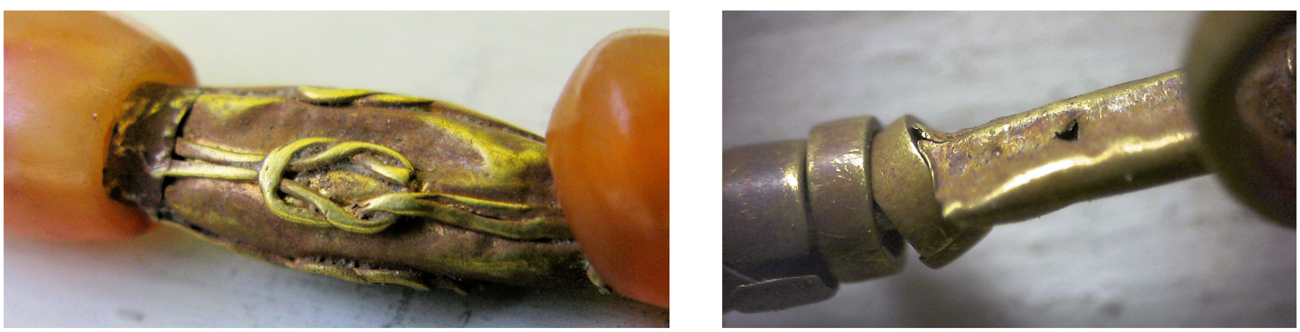


Figure 7.20. *Some of the gold beads in string UC20896 found in tomb 7777 at Qau.*

Figure 7.21. *Details of the decorated gold barrel bead in string UC20896 under the stereomicroscope showing the rolled wire and the signs of use-wear.*

tubular beads are made by rolling a gold sheet, but we could not detect under the stereomicroscope the presence of solder at the edges. The decorated barrel bead, also hollow and made by rolling a gold sheet, has a cap at both ends. The decoration consists of reef knots made with gold wires. This bead therefore holds one of the earliest representations in Egypt of reef knots.[3] The wires are hollow, as shown in Figure 7.21. Some of them had collapsed, probably by wear.

The amulet pendants

The four gold amulets in the shape of the god Heh in string UC18025 are made with different components soldered together. The suspension rings are bent strips of gold sheet and the palms and arms are wires, both rectangular and round in section. To make these (see the construction details in Fig. 7.22), a rectangular-section wire was obtained by hammering; then, by flattening and hammering this wire, the goldsmith obtained the round sectioned wire whose seam is visible. After bending the wire to form the arms and the palms, the ends were soldered together. The god Heh's body, which is soldered to the wires recreating the arms and palms, was obtained by casting, hammering, cutting and chasing. Under the SEM the surface aspect demonstrates the use of these techniques (Fig. 7.22).

Another gold amulet in the shape of the god Heh (UC20651) in the collection of the Petrie Museum, found in disturbed tomb 4932 at Badari, dated to the early First Intermediate Period (Seidlmayer 1990, 139; Phase IIC), is of a quite different type. The various parts of the amulet corresponding to the god's body and arms and to the palms are identically made separately and soldered together to form the amulet. Similar to the god Heh in string UC18025, the arms

Figure 7.22. *One of the of the gold amulets in the shape of god Heh in string UC18025, showing the soldered wire ends, the initial rectangular and the final rounded in section wire, the rolled wire seam, and the body's decoration.*

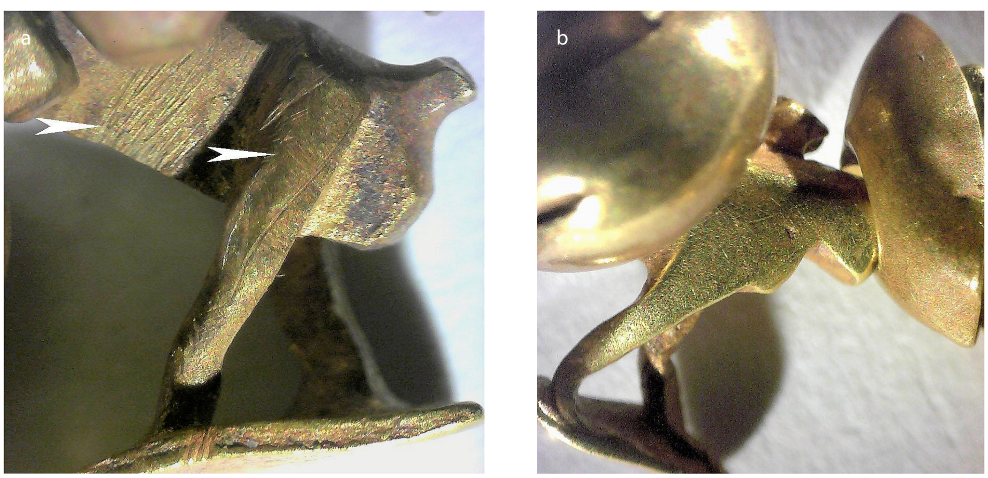
Figure 7.23. *Details of the flattened and rolled wires in gold amulet in the shape of the god Heh UC20651 from tomb 4932 at Badari.*

and palms of the god Heh in UC20651 are wires obtained by hammering, subsequently soldered to the body. Figure 7.23 shows that one of the wires used to represent the arms is not fully rolled. One end might have been more intensively flattened by hammering for the soldering process.

Amulets shaped in other forms are made using equivalent technologies. This is the case of two amulet pendants in the shape of a quail chick wearing the White Crown, found during the excavation of two late First Intermediate Period tombs at Badari (Seidlmayer 1990, 139; Phase IIIA). They were made by soldering to the cast body the legs recreated with wires; the suspension rings were made by bending a gold strip. One of the amulets, part of string UC20881, found in tomb 5270 (no. 49C6 in Brunton 1928, pl 98), is made from a quite reddish alloy and shows the presence of some corrosion products. The other, yellowish, is part of string UC20882, found in tomb 5281 (no. 49C3 in Brunton 1928, pl. 98). The rather rough surface (probably treated) is possibly due to casting, because the irregular appearance of the back surface evokes an as-cast aspect. Amulets on strings UC20881 and UC20882 are shown in Figure 7.24.

Figure 7.24. *Amulet pendants in the shape of a quail chick with crown included in strings (left) UC20881 (right) UC20882, respectively from tombs 5270 and 5281 at Badari.*

Figure 7.25. *Detail of string UC42422 from tomb 3029 at Matmar showing amulet pendants in the shape of a quail chick with crown and of an ibis, two spherical beads and the tiny beads.*



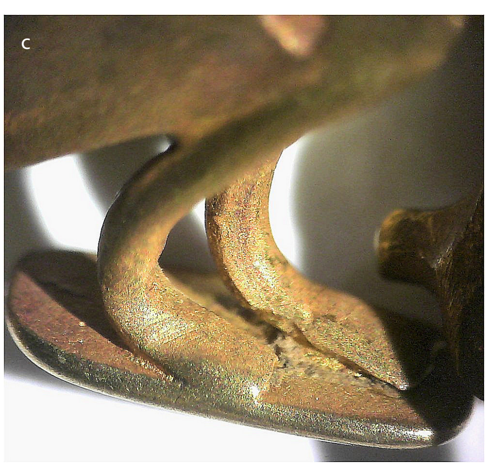


Figure 7.26. *Details of the legs of pendant amulets shaped in the form of birds in string UC42422: (a) the biggest quail chick with a crown, (b) the small quail chick with a crown and (c) the small ibis.*

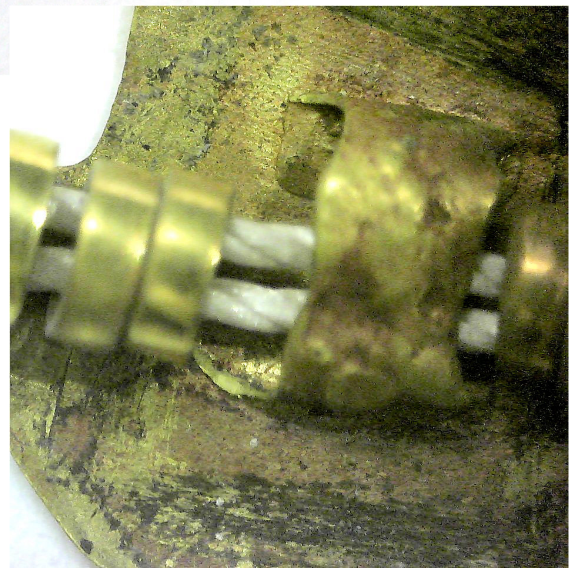
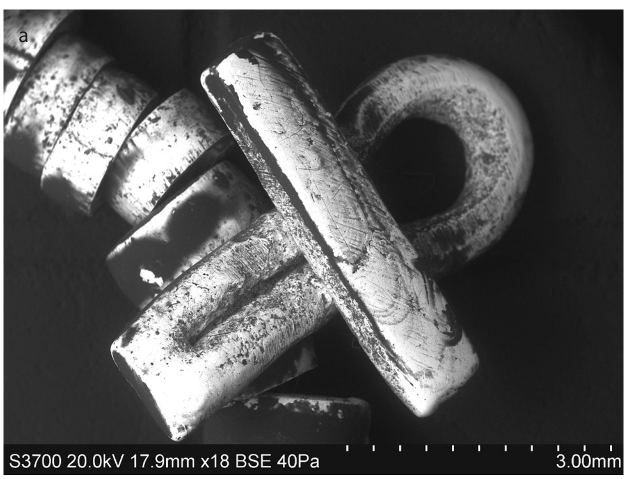
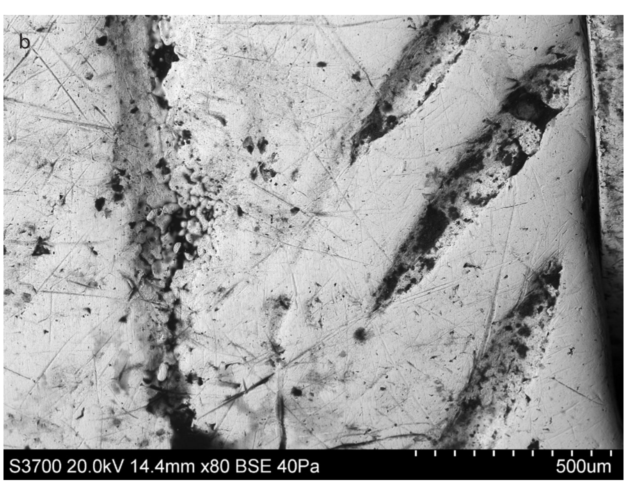


Figure 7.27. *Detail of string UC20649 showing some of the gold tiny beads and pendant amulets, with a detail (on the right) of the suspension ring of the crown-shaped amulet in gold.*





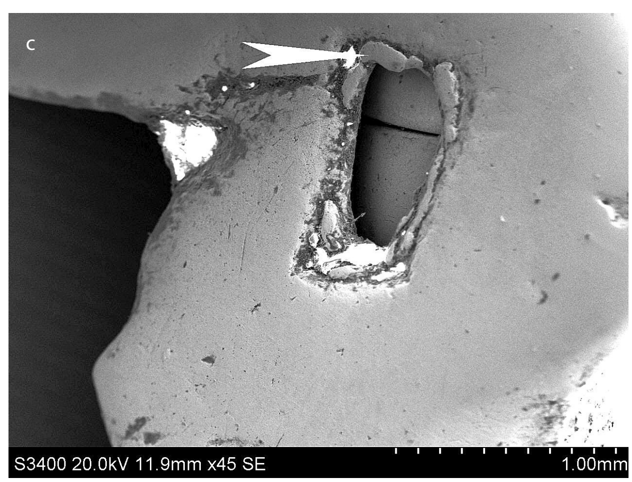


Figure 7.28. *Details of string UC18059 showing (a) one of the ankh-shaped amulets and (b) the decoration of the Taweret-shaped amulet. (c) The hole of the bee-shaped amulet in string UC20649.*

A detail of string UC42422, from tomb 3029 excavated at Matmar and dated to the late First Intermediate Period (Seidlmayer 1990, 136; Phase IIIA), is shown in Figure 7.25. This string contains small ring beads in gold (discussed in the next section), some spherical hollow gold beads made by soldering two halves (some are damaged and split into two parts), and three gold pendants in the form of two birds. The largest one is in the shape of a quail chick with crown and the others are in the shape of an ibis and of a quail chick with a crown. As for all the other amulets, their suspension rings are strips of gold bent to form a loop, soldered to the back of the animals' bodies.

A closer observation of the obverse of the largest amulet reveals toolmarks around the legs that can be associated with removal of the excess metal by filing. This could indicate a two-phase work: the form is first cast, and then finished using scrapers and files. This would explain the many scratches on the pendant's back, shown in Figure 7.26a, similar to those observed at the surface of the small gold beads in diadem EA37532 and the biconical gold bead in string UC36517 (see Chapter 7.3). Gilded copper amulets seem to have been made using the same technique, such as the small gilded copper *djed* column shaped amulet in string UC20625, found in tomb 4802 excavated at Badari with visible scratches and a suspension ring made by bending into a loop a strip of copper that is soldered to the reverse. Therefore, the same technology could have been used in the production of both copper, gilded copper and gold objects.

The neck of the big amulet in the shape of a bird in string UC42422 is also highly polished. Its head is faceted, indicating the use of hammering. The small amulets in the shape of a quail chick with crown and in the shape of an ibis, also made in one piece, could result from an equivalent but less time-consuming work of casting and hammering (Fig. 7.26b). Their flattened feet were soldered to a base made with a gold strip (Fig. 7.26c).

Another gold pendant amulet from the excavations of Badari studied in this work was also made by casting and has a soldered suspension ring. It is a fly-shaped amulet contained in string of beads UC20589, found in an undisturbed burial of a female body wearing seven strings in tomb 3306 (Brunton 1927, 35), dated to the early First Intermediate Period (Seidlmayer 1990, 138; Phase IIC). This string also contains some small gold ring beads that are discussed below. In order to check whether casting processes are employed for all type of amulets, a few tiny pendants contained in two strings from other burials excavated at Qau and Badari were also analysed and submitted to examination under the SEM. One of the studied strings, UC18059, was found in tomb 1030 excavated at Qau (Fig. 7.18). The amulets are shaped in diverse forms: four are double crowns, two are ankhs, one is the hippopotamus goddess Ipi (later called Taweret), and one is an ibis.[4] The other string, UC20649, was found in tomb 4915, dated to the early First Intermediate Period (Seidlmayer 1990, 138; Phase IIC), during excavations at Badari (Brunton 1928, pl.62). In addition to three tiny gold amulets shaped in the forms of a bee, a falcon and a crown,[5] the string contains small gold ring beads and one tubular gold bead.

Just as for all other pendants, the suspension rings of the amulets in strings UC18059 and UC20649 are made by bending a strip of gold that is soldered to the reverse. One of them is shown in Figure 7.27. On the surface, the amulets show marks of polishing, as shown in Figure 7.18 for one of the double crown-shaped amulets.

The observation of the amulets under the SEM is quite instructive. Their surface morphology, with remnant porosity in areas that are less worn or polished, indicates that they were probably made by casting. Details of one of the ankh-shaped and of the Ipi-shaped amulets are shown in Figures 7.28a,b. Despite their smooth finished surfaces, inside the toolmarks and in less accessible regions (more difficult to finish), an as-cast morphology can be observed. Therefore, the motif seems to have been made on the mould, not on the objects. Figure 7.28c shows the hole in the bee-shaped amulet. The metal burrs are still visible around the hole, showing that the amulet was perforated, or at least the hole was enlarged, after casting.

Making small ring beads

As mentioned for string UC18092 from the excavations at Qau (Fig. 7.12), the small ring beads in silver-rich electrum that decorate the gold cowrie shell-shaped beads are very homogeneous in size and shape, have polished ends and a 'V' shaped edge. This morphology is entirely different from those of the gold beads in Predynastic diadem EA37532 (Fig. 7.1). In order to obtain further information on small ring beads manufacturing, in this section are considered the specimens contained in the strings from Qau, Badari and Matmar described in the previous sections.

Some strings contain small ring beads quite regular in shape and size, such as string UC20649 from tomb 4915 at Badari. A few are shown in Figure 7.29. They have 'V' shaped edges, and some contain quite visible PGE inclusions, suggesting the use of alluvial gold. Figure 7.30 shows some beads under the SEM. Their surface is smooth, but their edge is rather irregular, where no signs of solder could be

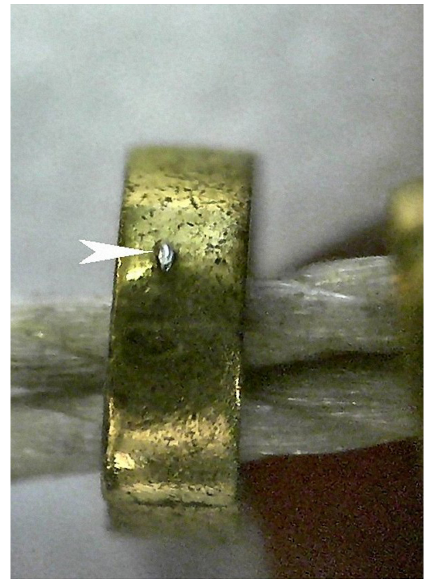


Figure 7.29. *The quite regular ring beads of string UC20649 and one of their visible PGE inclusions.*

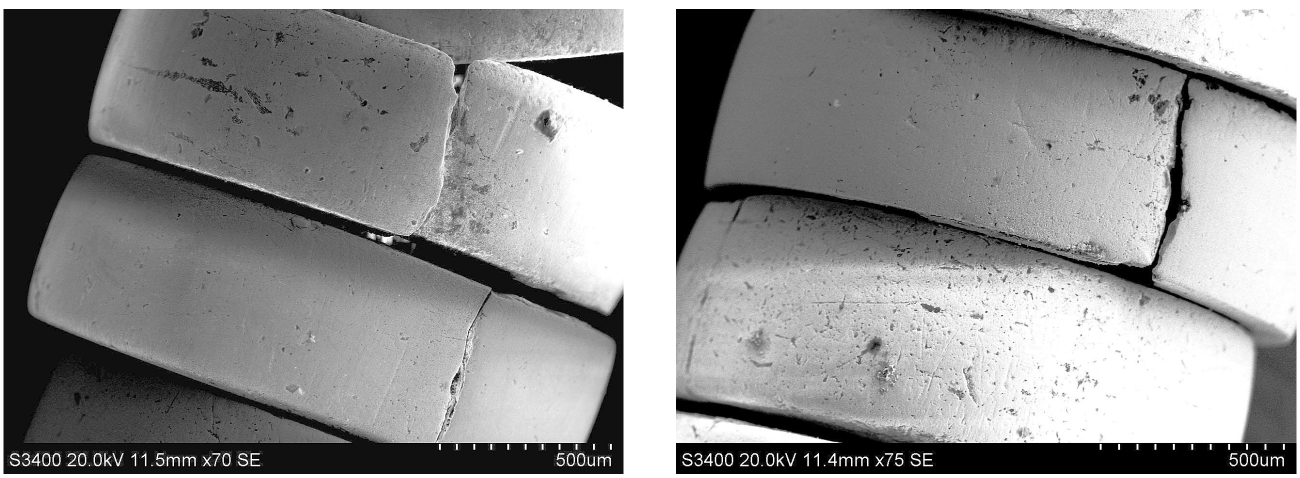
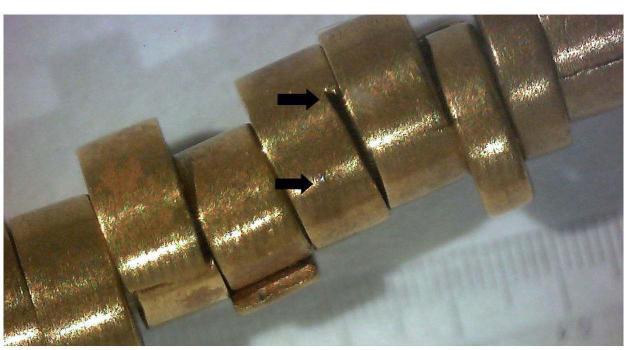


Figure 7.30. *The ring beads of string UC20649 under the SEM showing the joining seam with no signs of solder.*



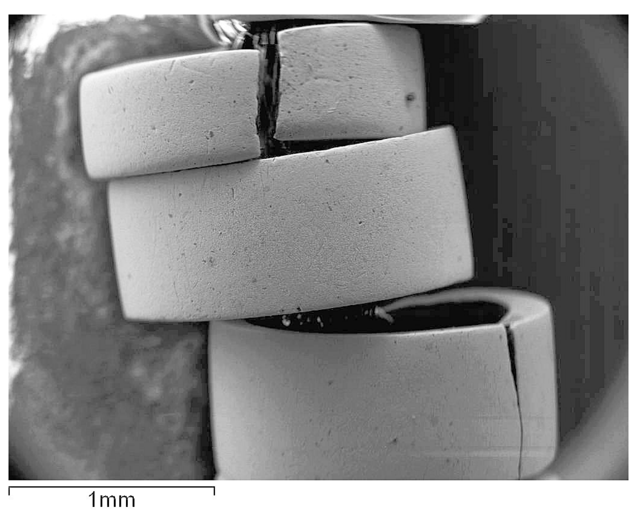


Figure 7.31. *The tiny beads of string UC42422 showing under the stereomicroscope the cutting marks of the gold sheet and one PGE inclusion and under the SEM the joining seams without solder.*

detected. In addition, there are no marks of abrasion. They were possibly made by wrapping narrow strips of gold around a former and cutting longitudinally across the spiral wire, as shown in Figure 7.4.

Conversely, string UC42422 from tomb 3029 at Matmar contains small ring beads of very different sizes. Some of them are shown in Figure 7.31 under the stereomicroscope, where can be seen that they have either a tubular or a discoid form. One of the beads in the figure (the one in the middle) has a visible PGE inclusion and was roughly cut, such as one of the beads in diadem EA37532 shown in Figure 7.3. This is related to a production by cutting and bending gold sheets, but it is difficult to suggest an order to these two steps of production. Under the SEM (Fig. 7.31b) we were unable to find solder at the roughly aligned edges. Many of the beads contain PGE inclusions showing the use of alluvial gold.

The small ring beads from tomb 1030 at Qau, shown in Figure 7.32, are contained in two strings: UC18059 and UC18060. Some of them are covered with substances that could be embalming materials. As in other strings, these beads have visible PGE inclusions. The variety of their size, shape and colour is visible to the naked eye. Their morphology is very different from those in strings UC20649 and UC42422 discussed in the previous paragraphs. Just as in Predynastic diadem EA37532, both tubular and ring beads can be found strung together. They have thinner diameters at the ends and show scrapping marks at both ends, which seem related to polishing. These marks are not as pronounced as in the beads contained in diadem EA37532 (some entirely scrapped). The marks are shown under the SEM in Figure 7.32. Marks of polishing at both ends, such as those observed in the electrum ring beads of UC18092 (Fig. 7.13), are also visible under the SEM. Signs of neither solder nor heating were seen at the edges of both ring and tubular beads.

In Figure 7.33 are shown four of the few ring beads in string UC20896. They are of very irregular shape and dimensions. One of them (on the left in the figure) shows a transversal cutting mark at one of the ends. This results from the process of cutting the gold strip. String UC20589, from undisturbed tomb 3306 at Badari, contains the largest variety of beads strung together. The variety of their colours attests to the use of both gold and electrum alloys. Different morphological details are visible under the stereomicroscope as illustrated in Figure 7.34. In Figure 7.34c, the second bead from the left is an opened strip of gold. The fourth one is an overlapping strip of electrum. The first bead from the left is a bent roughly cut strip of gold, while the third seems to evidence the superposition of two gold sheets when making the beads.

Considering the many morphologies observed for the small ring beads studied in this work, it is possible to suggest the use of different technologies and the work of many different goldsmiths. In fact, some beads seem loop bent one-by-one, others by wrapping narrow strips of gold around a former and cutting longitudinally across the spiral wire. While we thus document that at least two manufacturing processes existed, we are unable to determine whether the variety observed for the beads corresponds to either a chronological change, or different workshop traditions coexisting in the same period. However, as mentioned in Chapter 7.3, tiny gold beads in strings are often of different types and dimensions. This was observed, for example, at Kerma (Reisner 1923), at Varna (Echt et al. 1991; Eluère 1990) and at Cheile Turzii–Peştera Ungurească (Lazarovici et al. 2015). At this point, it is impossible to affirm whether two types existed and/or coexisted without further study of other groups of contextualized beads made in Egypt and surrounding areas. It is nevertheless interesting to notice that the many tiny copper beads found in five Suvorovo burials at Giurgiuleşti (Moldavia), dated to the 5th millennium BC, are also of different sorts (graves 3 and 5 in: Bicbaev 2009, figs. 10.9–10 and 10.16; Govedarica & Manzura 2019, 16, fig. 14, no. 1).

The coexistence of all the observed sorts of beads in one tomb in Egypt suggests a diversity of production during the First Intermediate Period. The quite different alloys sometimes employed in the manufacture of the beads found in Qau and Badari and the correspondingly different colours observed tend to confirm this suggestion. Nevertheless, we must also consider that some strings contain very regular beads. Thus, the level of irregularity of beads of different sorts inside tombs can be accentuated by the presence of several unidentified strings, each made by a different goldsmith. Simultaneous production of such different beads by a single workshop does not seem very plausible, in particular in a context where the number of gold components in tombs is quite limited. Another and perhaps more convincing explanation is high reuse of these small beads to make several strings along time. In an organized system, reuse would result in the same 'mixture' of bead types, but greatly reducing the labour required for manufacturing the objects as well as the costs of production. These costs are not only related to labour, but also to energy spent during the metallurgical processes.

The gold alloys

The polychrome objects

String UC18092 and the cowrie beads UC42397 were analysed *in situ* by XRF. As the beads cannot be removed from the string, due to their size being

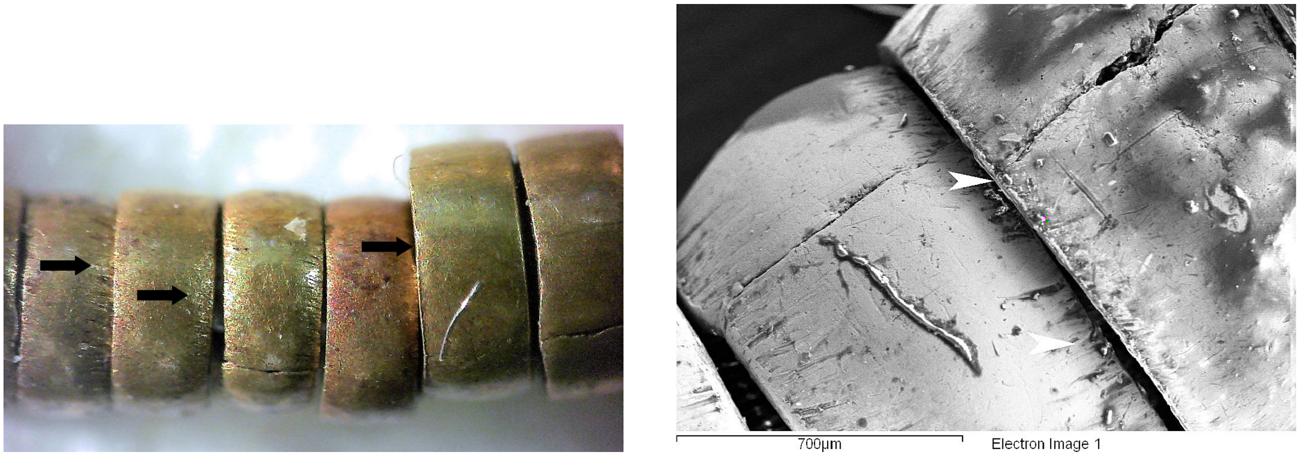


Figure 7.32. *The tiny beads of string UC18060 showing under the stereomicroscope the variety of their colour and shape. The scrapping and polishing marks visible under the stereomicroscope appear more clearly under the SEM.*

Figure 7.33. *Some of the ring beads of string UC20896. The arrow shows one cutting mark.*

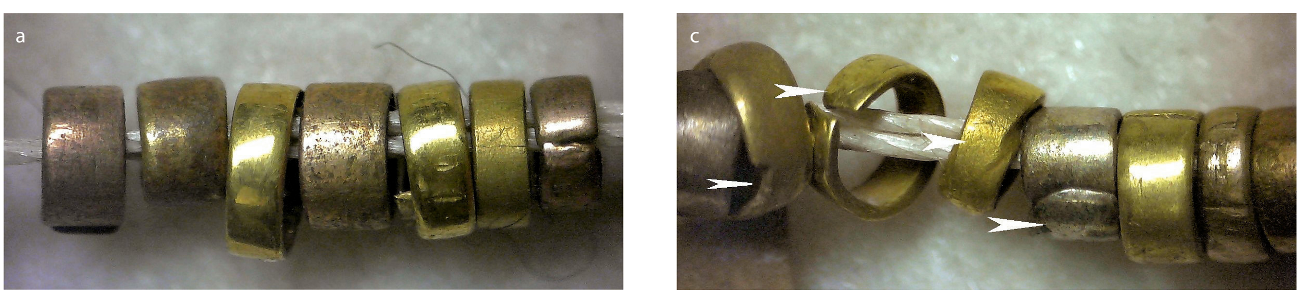


Figure 7.34. *(a,b) The small ring beads strung in UC20589 are of varied shape, size and colour. (c) Some of them showing other different (arrowed) morphological details.*

smaller than the XRF spot beam size, some of them were analysed by SEM-EDS. The averages obtained for three repeated analyses of the beads are summarized in Table 7.6 and plotted in Figure 7.35. Two types of gold alloys emerge from the diagram, one containing about 15 wt% Ag, and another, a high-silver electrum alloy, containing *c*. 55 wt% Ag. The former is used in the manufacture of the cowrie beads and the latter in the manufacture of the whitish ring beads. The other objects from tomb 7923 at Qau and tomb 3053 at Matmar were also plotted in the diagram of Figure 7.14 showing that all the items analysed are made from alloys containing 10–20 wt% Ag. These alloys were demonstrated in Chapter 7.3 to be the most 'common' among the analysed early objects, including one of the gold nuggets found in stairway tomb 2 at ElKab (Quibell 1908, 7), which contains 15.3 wt% Ag and <0.1 wt% Cu (Stos-Fertner & Gale 1979). A few other objects excavated at Qau and Matmar analysed by Gale & Stos-Gale (Oxalid) and by H.C.H. Carpenter (in Brunton 1948, 54)[6] were added to the diagram of Figure 7.35. They confirm the regular use of gold alloys containing 10–20 wt% Ag. These objects, dated to the First Intermediate Period, are one pair of gold bangles and two beads from tomb 7762 at Qau (the burial of a child, Brunton sequence date '7th–8th Dynasty'), and one fragment of a flat bracelet with holes found in burial 587 at Matmar (Brunton sequence date '8th Dynasty'). The first showed to contain 9–18 wt% Ag and 0.6–3.6 wt% Cu and the fragment of bracelet 14.9 wt% Ag and 0.4 wt% Cu.

In Egypt, gold alloys containing the high silver contents observed for string UC18092 were also in use during the earliest periods. We demonstrated in Chapter 7.3 that several objects contain quite high silver contents (>50 wt% Ag): one gold sheet from Umm al-Qaab, one undated rim cased of a vase, the beads from tomb 166 at ElKab and tomb 1310 at Armant, and the pendant from tomb 183 at Haraga. The silver and copper concentrations in the earliest objects represented in Figure 7.10b were plotted in Figure 7.36 together with the objects from Qau and Matmar analysed in this chapter and other published data: the objects in the collection of the Ashmolean Museum from tomb 1981 at Hammamiya, tomb 5207 at Badari, tomb 87 at Mahasna, tomb Y250 at Hu, and three from undocumented contexts, all dated to the First Intermediate Period (Gale & Stos-Gale 1981, Oxalid).

Despite the use of a gold alloy containing *c*. 55 wt% Ag to produce the ring beads in string UC18092, all the other objects dated to the First Intermediate Period are made from alloys containing lower silver contents, always below *c*. 36 wt%. Like the objects produced during the earliest periods, the majority of those produced between the end of the Old Kingdom and the beginning of the Middle Kingdom contain 10–20 wt% Ag. However, several alloys contain 30–40 wt% Ag, values seldom observed for the earliest

Table 7.6. *Results obtained by XRF and SEM-EDS for the jewellery from tomb 7923 at Qau and tomb 3053 at Matmar.*

XRF	**Au wt%**	**Ag wt%**	**Cu wt%**
UC18054	81.2	13.4	5.4
UC18055	82.2	14.7	3.1
UC18092			
cowrie beads	79.5	15.4	5.1
	79.1	15.8	5.1
	79.6	15.9	4.6
	80.6	15	4.4
	79.4	15.6	5
	79.6	16.3	4.1
	79.4	16.2	4.4
average	79.6	15.7	4.7
UC42397			
	71.8	14.1	14.1
	73.5	14.7	11.8
	75.9	15.8	8.3
	63.2	11.3	25.5
SEM-EDS	**Au wt%**	**Ag wt%**	**Cu wt%**
UC18092			
Ring beads	40	53.4	6.6
	42.9	51.6	5.5
	40.2	54.4	5.4
	39.9	53.8	6.3
	39.8	54.6	5.7
	39.7	55.2	5.1
	43.3	51.5	5.2
	40.8	53.3	5.9
	39.9	54.2	5.9
	39	54	7
	39.6	54.5	5.9
	40.8	54.5	4.8
	41.6	54.1	4.3
	42.8	53.3	3.9
	41.8	53.7	4.5
	41.7	52.2	6
	39.2	54.2	6.6
	39.7	54.8	5.5
	42.2	53.4	4.5
average	*40.8*	*53.7*	*5.5*

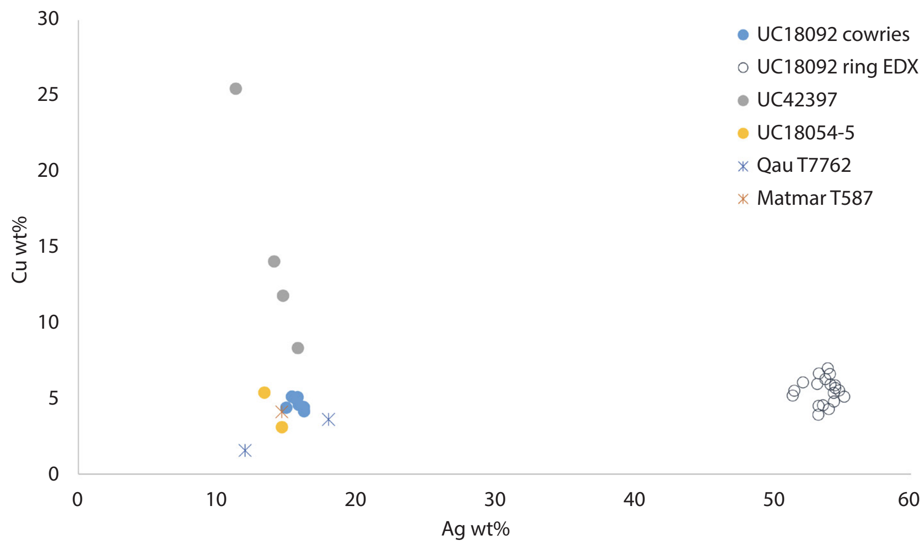


Figure 7.35. *Silver versus copper contents for the jewellery from tomb 7923 at Qau and the four cowrie beads from tomb 3053 at Matmar. The bangles from tomb 7762 at Qau (AN1924.370-71 Ashmolean Museum, Gale & Stos-Gale Oxalid) and the fragment of a bracelet from tomb 587 at Matmar (Brunton 1948, 54) were added to the diagram.*

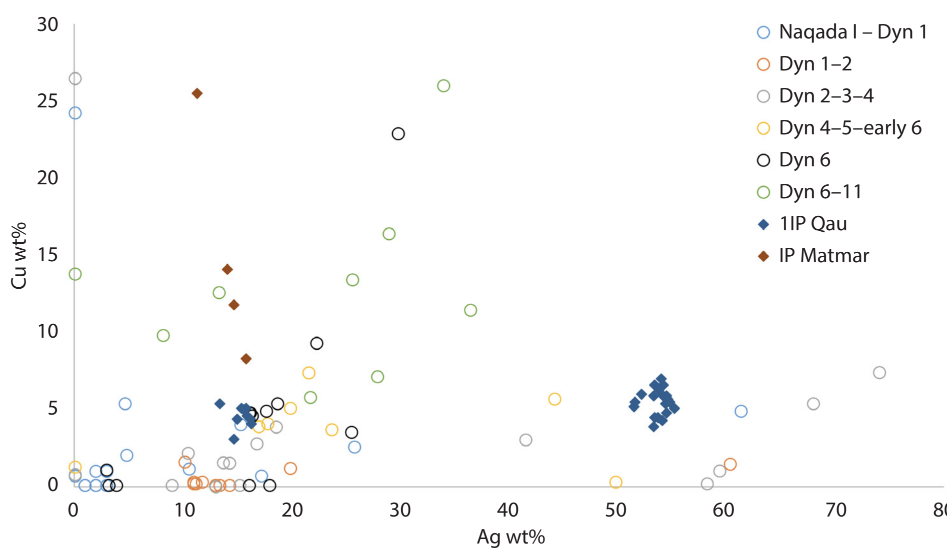


Figure 7.36. *Silver versus copper contents for the jewellery from tomb 7923 at Qau and tomb 3053 at Matmar compared to objects dated to the same and previous periods analysed in this volume and published by several author mentioned in the text.*

objects, and in general higher copper contents than the earliest objects. This could be related to a colour preference or to the use of (traditional local?) practices to colour gold. It is interesting to notice that, while the polychrome effect in string UC18092 is obtained by using yellow gold and whitish electrum with blue faience, the cowrie shell beads UC42397 are made using a gold alloy containing the same silver content (the quite common *c.* 15 wt% Ag), but increasing amounts of copper. The addition of copper, which reaches more than 25 wt% in cowrie-shaped beads UC42397, is generally used to obtain different shades of reddish gold alloys. This 'colouring' technique might have also been used during the earliest periods, because as mentioned in Chapter 7.3 a few early objects contain similar quantities of copper.

The use of gilded copper is also documented in tombs. As mentioned, tomb 4802 at Badari contained

Figure 7.37. *Some of the rings of the gilt copper chain UC36832 found during the excavation at Umm el-Qaab of the tomb of 2nd Dynasty king Khasekhemwy, with a detail.*

a string with a gilded *djed* column amulet (UC20625). Perhaps the most significant early object made from gilded copper is chain UC36832, attesting to the early use of the technique. Consisting of 21 open circular rings, it was found at Umm el-Qaab inside the tomb of the 2nd Dynasty king Khasekhemwy. Figure 7.37 shows one detail of this chain where the copper core is visible at the edges of the rings under the gold layer and the corrosion products formed over time. The very rough surfaces seem to correspond to casting porosity, which do not seem to have been removed by a finishing process before gilding.

The small ring beads

The technologies and alloys employed to manufacture the small ring beads in string UC18092 and Predynastic diadem EA37532 could not be reconstructed conclusively, but it is clear that they are variable. Because the dimensions of these beads are too small to be reliably analysed *in situ* by using the XRF equipment available, four strings from First Intermediate Period burials in Qau and Badari were selected for analysis by SEM-EDS. The selected strings are UC18059 and UC18060 from tomb 1030 at Qau, string UC20649 from tomb 4915 at Badari, and string UC42422, from tomb 3029 at Matmar. The silver and copper contents of the analysed small ring beads are summarized in Table 7.7 and plotted in Figure 7.38. The small ring beads from diadem EA37532 and from string UC18092 were added to the diagram. It can be seen that the majority of the beads are contained in an area corresponding to 2–12 wt% Ag and 1–3 wt% Cu. A few contain more copper and several ones contain lower Ag contents, similarly to those in diadem EA37532. None of the analysed beads in the four selected strings contains the high silver contents observed for the alloys employed in the manufacture of those in string UC18092. However, although we could not analyse them, based on their colour it seems likely that some components in string UC20589 should contain quite high amounts of silver and copper. It is also noticeable that on average the beads contain lower silver amounts than the other objects, the latter typically containing 10–20 wt% Ag.

The tubular and ring beads in diadem EA37532 have shown similar compositions; therefore, they were likely made from a single type of gold, available in the Naqada period at least. The analysis of the other four strings shed no further information. No relation could be found between composition and shape. Indeed, no particular chemical pattern emerges for the analysed beads, but it has to be noted that their composition is rather heterogeneous in each string. Those in strings UC18059 and UC18060, recovered from the same tomb, are quite representative of this heterogeneity, even if several specimens seem to group in the diagram. The group of analysed beads from strings UC20649 and UC18092, which are quite regularly sized and shaped, have Ag contents that could correspond to the use of the same gold supplies, because for each group roughly the same Ag content was found for each bead. The slightly variable copper contents could result from different batches. This regularity contrasts with the compositional spread of string UC42422, which is however quite representative of the higher copper contents that could be observed for the jewellery from this period.

The variety of the alloys and the different types observed reinforce the proposition that several goldsmiths were working at the same time and that beads could as well come from reuse of beads from ancient strings. The fact that the beads in one item correspond to several sizes, shapes and colours, however, most likely indicates reuse. The more reuse goes on, the more variability one would expect to observe. The diversity of types and alloys would then correspond, at least partially, to a chronological variation in production techniques.

Table 7.7. *Results obtained by SEM-EDS for the analysed small beads.*

Acc. No.	Au wt%	Ag wt%	Cu wt%
UC18059			
	93.4	5.3	1.3
	93.4	5.1	1.4
	93.7	5.0	1.3
	93.3	5.1	1.6
	93.3	5.2	1.5
	93.5	5.0	1.5
	91.2	7.6	1.3
	90.6	7.8	1.6
	90.7	7.9	1.5
	86.5	11.5	2.0
	86.8	11.4	1.9
	85.9	12.7	1.3
	93.5	5.3	1.2
	88.5	10.1	1.4
	89.4	9.3	1.3
	86.2	12.2	1.6
	93.1	4.7	2.1
	90.2	9.8	0.0
	90.3	8.5	1.2
	80.3	15.3	4.4
	87.6	10.3	2.1
	85.0	11.9	3.1
	82.0	14.0	4.0
UC18060			
	92.2	6.1	1.6
	89.9	8.3	1.8
	91.4	7.1	1.5
	93.0	5.6	1.4
	92.2	6.1	1.6
	89.8	8.1	2.2
	92.5	6.2	1.3
	92.1	6.5	1.3
	89.9	7.8	2.4
	84.4	12.8	2.8
	96.2	3.8	0.1
	92.9	6.4	0.8
	93.6	5.7	0.7
	91.2	7.6	1.3
	95.0	4.3	0.7
	91.7	6.8	1.5
	94.8	4.5	0.7
	94.2	4.7	1.1
	94.5	4.9	0.7
	86.5	10.6	2.9
	85.9	10.8	3.3
	86.9	10.5	2.6
	85.2	11.3	3.4
	86.8	10.6	2.7
	83.1	12.8	4.1
	86.6	10.5	2.9
	85.0	11.6	3.3
UC20649			
	93.8	4.3	1.9
	96.2	3.1	0.8
	95.2	4.2	0.6
	94.3	4.4	1.3
	94.4	4.4	1.2
	97.3	1.6	1.1
	96.0	2.9	1.1
	92.2	5.2	2.6
	93.9	5.1	0.9
	94.6	4.3	1.0
	95.7	3.0	1.2
	95.8	3.0	1.1
	94.1	4.5	1.4
	94.9	3.8	1.3
	96.3	3.0	0.8
	95.3	4.4	0.3
	93.7	3.7	2.6
	94.1	3.9	2.0
UC42422			
	84.1	11.2	4.7
	85.3	10.6	4.1
	80.1	13.4	6.5
	85.5	10.7	3.8
	80.6	16.1	3.3
	86.4	8.3	5.3
	90.8	8.8	0.5
	88.9	8.3	2.8
	79.3	11.8	8.9
	78.6	18.5	2.9
	91.3	8.1	0.7
	84.8	14.2	1.1
	94.3	4.7	1.0
	86.8	11.1	2.2
	92.1	6.8	1.1
	89.9	7.1	3.0
	86.8	11.1	2.2
	94.2	5.3	0.5
	89.9	7.1	3.0
	92.9	5.4	1.7
	89.1	6.9	4.0
	86.5	9.9	3.6
	96.0	3.1	1.0
	88.2	6.3	5.5

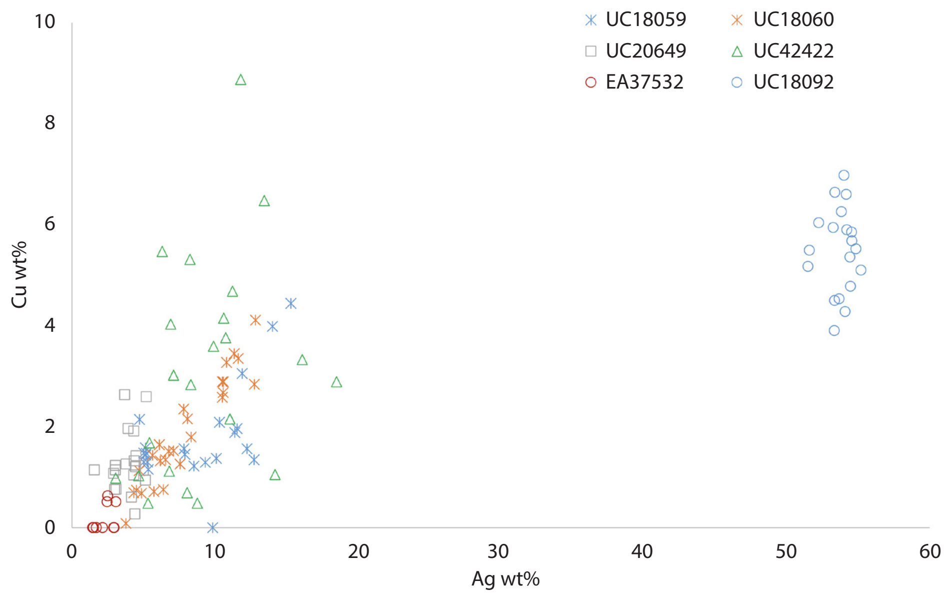


Figure 7.38. *Silver versus copper contents obtained for the small ring beads analysed in four strings from the excavations of Qau and Badari. The gold ring beads of Predynastic diadem EA37532 and the electrum ones in string UC18092 were also plotted for comparison.*

Amulets and beads

Some of the amulet pendants described above as well as some of the beads other than the small ring ones were analysed for the composition of the gold alloys. The data obtained for the analysed amulets is summarized in Table 7.8 and plotted in the diagram of Figure 7.39.

The elemental analysis of the amulets in the shape of a different bird shows the use of gold alloys containing 5–15 wt% Ag, values expected for Egyptian native gold. The different components (body, legs, suspension ring and base) of the bird-shaped pendant in string UC20882 are made with an alloy containing about 10 wt% Ag. The three amulets in string UC42422, one ibis and two quail chicks wearing a crown, contain similar Ag contents. However, their copper contents are different, between 4 and 11 wt% Cu. The various components that constitute amulet UC20882 yielded copper amounts ranging from 16 to 30 wt% (perhaps due to surface treatment, though some of the higher values might derive from the accidental analysis of a

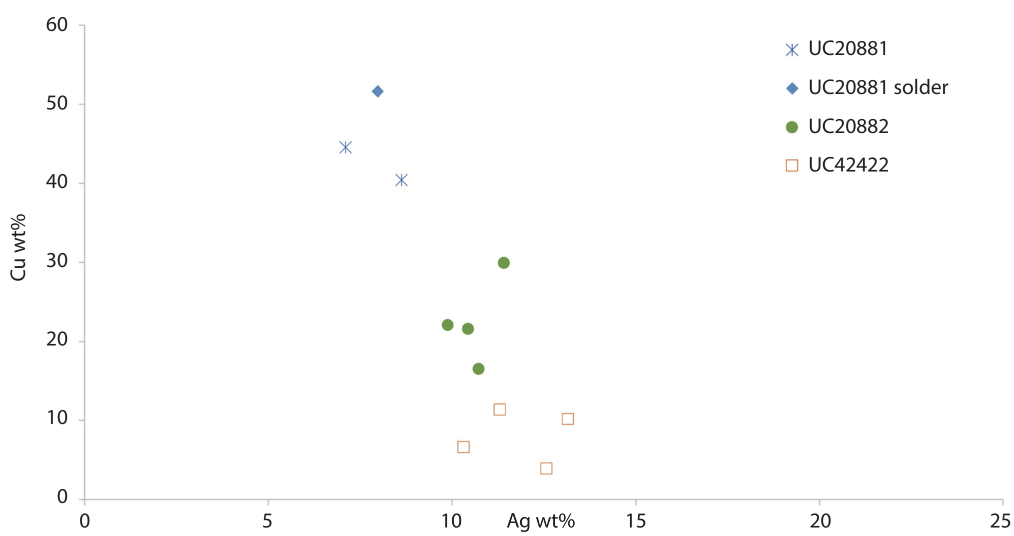


Figure 7.39. *Silver versus copper contents obtained for the analysed amulets in the shape of birds.*

join, given the relatively large XRF beam spot). The analysis of the pendant in the form of a quail chick wearing the White Crown in string UC20881 shows the use of an alloy containing lower Ag and higher Cu contents than the other analysed pendants. The analysis of one of the quite visible joining areas shows that the technique employed was hard soldering, which involved the use of a solder alloy containing higher Cu contents than the parts to be joined together.

Data obtained for the few tiny amulet pendants analysed were plotted in Figure 7.40 together with the data obtained for the bird amulets. With the sole exception of one of the tiny pendants, all analysed items are contained in an area corresponding to silver contents ranging again from 5 to 15 wt%. The main difference observed for the alloys is the copper amount, which for the tiny pendants is always under 7 wt%. Therefore, we can suggest so far the use of natural gold to which variable amounts of copper were added. The same chemical pattern in observed when the amulet in the form of a fly in string UC20589, and the pendants in the shape of the god Heh UC20651 and in string UC18025, are added to the diagram. The diagram of Figure 7.41 shows all the data obtained for the analysed amulet pendants. The analysis of the body and wires that constitute Heh amulet UC20651 shows the use of slightly different alloys. The analysis of the four pendants in the shape of the god Heh in string UC18025 shows the use of different alloys to make each pendant, with equivalent copper amounts, but silver contents ranging from 11 to 15 wt%. This difference has no influence on the colour of the gold alloys.

Also plotted in Figure 7.41 is one of the rare Egyptian button seal-amulets, thought to derive from one production group/'workshop' (Wiese 1996). This unprovenanced gold button seal, UC34110, is tentatively dated to late Old Kingdom - early First Intermediate Period. It is a mounting of three parts in gold: one disk, one plain support in the form of the upper side of a double-falcon-head, and a suspension ring. As shown in Figure 7.42, the suspension ring is a bent gold strip soldered to the support. Despite the use of a regular Egyptian technique to produce suspension rings, the spiral form of UC34110 ring was not observed in the other analysed items. The cast support is roughly finished by polishing. The falcon heads, the most exposed parts, show signs of intense use-wear. The motifs, made in the mould, as shown by the as-cast surface inside some deeper lines, was finished by removing excess of metal after casting. The support is soldered to the disk. An almost imperceptible line along the border, perhaps made in the wax, looks like a wave and almost vanished by use-wear. The rounded border of the disk also shows signs of intense use-wear.

Table 7.8. *Results obtained by XRF for the analysed amulets.*

Acc. No.	Region of analysis	Au wt%	Ag wt%	Cu wt%
UC20881	body	51.3	8.6	40.4
	legs	48.6	7.1	44.5
	body with solder	40.7	8.0	51.6
UC20882	base	73.2	10.7	16.5
	body	68.4	10.4	21.6
	ring	59.1	11.4	29.9
	legs	68.4	9.9	22.1
UC42422	ibis body	77.3	11.3	11.4
	ibis base	83.5	12.6	3.9
	bird big	83.1	10.3	6.6
	bird small	76.7	13.2	10.2
UC18059	tawerte	93.4	5.9	0.7
	ahnks	90.7	7.2	2.1
		90.6	8.1	1.4
	crown	83.0	11.8	5.2
		84.2	11.0	4.7
	ibis	82.6	13.4	4.0
UC20649	crown	82.3	11.7	5.9
	hawk	85.5	9.6	4.9
	hornet	75.9	17.3	6.8
UC18025	Heh 1	82.3	13.5	4.2
	Heh 2	81.2	13.3	5.5
	Heh 3	83.5	11.4	5.1
	Heh 4	82.0	14.6	3.4
UC20651	wires	81.6	12.5	5.9
	body	78.6	14.1	7.3
UC20589	fly	79.3	17.0	3.7
		79.5	16.8	3.8
UC34110	ring	85.6	12.8	1.6
	disk	76.5	17.8	5.7

Many scratches are visible on the disk surface, but its reverse looks as-cast. The central motif, deeply incised, was applied over the line along the border. In some regions, the motif seems to be made in the mould, but some visible toolmarks and burrs are remnants from removing metal, as shown in Figure 7.42. This process is expected after casting to complete and enhance the motif made in the wax. It is however surprising to see evidence of this despite wear. The composition of this item, plotted in the diagram of Figure 7.41 shows that the disk and the suspension ring are made from different alloys. Both components are made using the quite 'common' Egyptian alloys, those containing 10–20 wt% Ag. The compositions of the suspension ring and the tiny amulets match together, and the disk matches

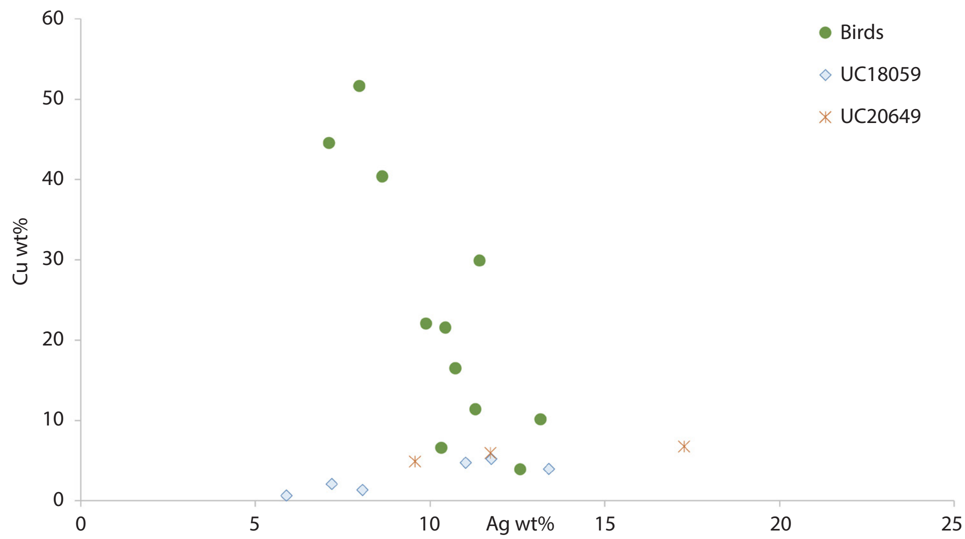


Figure 7.40. *Silver versus copper contents obtained for the analysed amulets in the shape of birds compared to the tiny amulets of different shapes in two strings.*

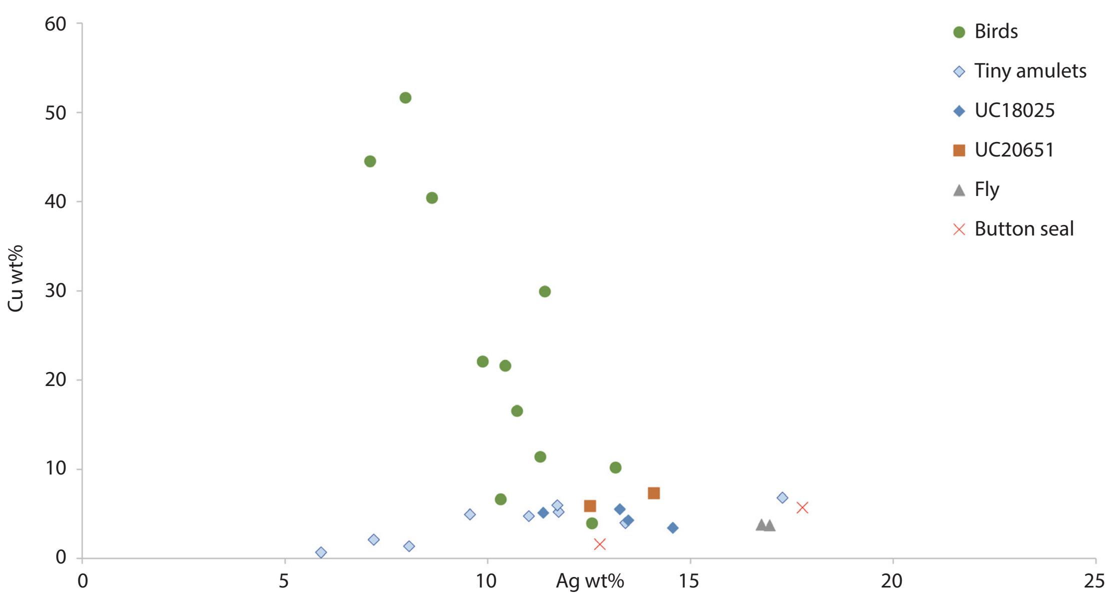


Figure 7.41. *Silver versus copper contents obtained for all the analysed amulet pendants and button seal UC34110.*

the fly amulet in string UC20589 and one of the tiny amulets in string UC20649.

The elemental analysis of several beads, other than the small ring ones, shows again the use of gold alloys containing 5–15 wt% Ag and variable copper contents. The chemical patterns obtained for the beads and the amulets are therefore similar. To provide a quite representative panorama of the alloys employed for the production of gold components to be strung, the copper and silver contents obtained for different barrel and tubular beads contained in string UC18026 are plotted in Figure 7.43. Interestingly, part of the large barrel beads shows the use of reddish alloys, with copper contents almost attaining *c.* 25 wt%, a value also observed for several early objects (see Chapter 7.3). The other analysed beads (summarized in Table 7.8) were also plotted in Figure 7.43, showing that only one of the spherical beads in string UC18059 does not fall in the bracket 5–15 wt% Ag. The three beads of different types (tubular, ribbed and barrel beads) in string UC18025 contain very different copper contents, with the barrel bead containing the highest copper amounts.

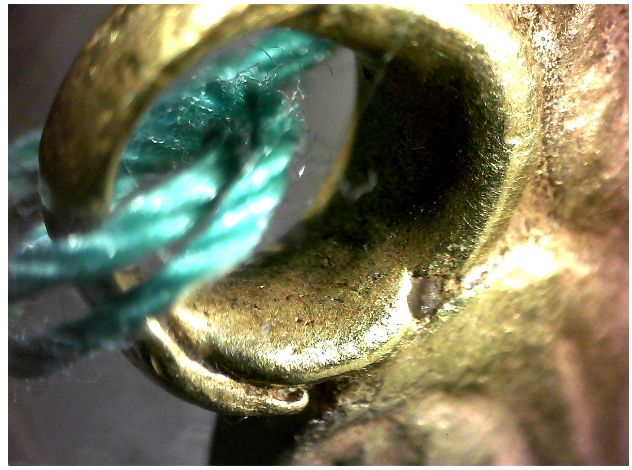


Figure 7.42. *Unprovenanced button seal-amulet UC34110 dated to late Old Kingdom to early First Intermediate Period with details showing the suspension ring soldered to the cast support and one of the engraved lines of the disk decoration over the almost invisible line applied along the border.*

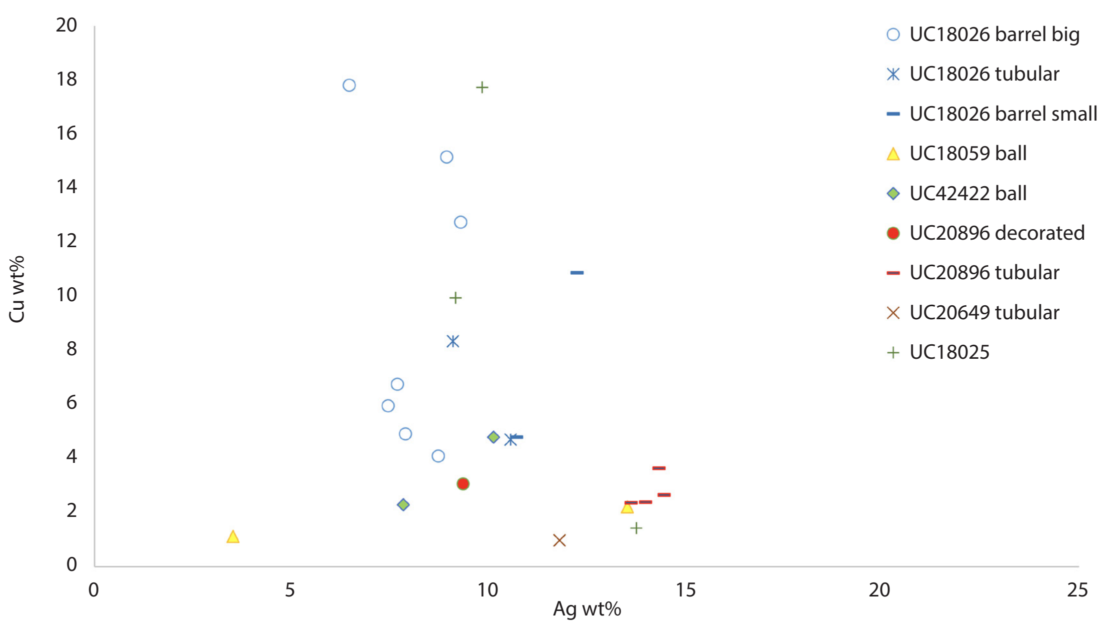


Figure 7.43. *Silver versus copper contents obtained for all the analysed beads with the exception of the small ring beads.*

Table 7.9. *Results obtained by XRF for the analysed beads with the exception of the small ones.*

Acc. No.	Bead type	Au wt%	Ag wt%	Cu wt%
UC18059	spherical	84.3	13.5	2.2
		95.4	3.5	1.1
UC42422	spherical	89.9	7.8	2.3
		85.1	10.1	4.8
UC20896	decorated	87.6	9.4	3.1
		87.9	9.4	2.6
		87.4	9.7	2.9
	tubular	83.6	14.0	2.4
		82.0	14.3	3.6
		82.9	14.5	2.6
		84.0	13.6	2.4
UC18026	tubular	82.6	9.1	8.3
		84.7	10.6	4.7
	barrel small	76.9	12.3	10.9
		84.5	10.7	4.8
	barrel big	78.0	9.3	12.7
		75.9	8.9	15.2
		75.7	6.5	17.8
		87.2	7.9	4.9
		87.2	8.7	4.1
		85.6	7.7	6.7
		86.6	7.5	5.9
UC18025	ribbed	84.8	13.8	1.4
	tubular	80.9	9.2	9.9
	barrel	72.4	9.8	17.7
UC20649	tubular	87.2	11.8	1.0

The alloys in brief

In order to provide an overview of the alloys employed in the First Intermediate Period, all the objects analysed in this chapter were plotted by typology in Figure 7.44. For the tiny beads, only the area covered by the alloys in the diagram of Figure 7.38 is represented; the whitish beads from string UC18092 were omitted.

The gold alloys used to produce the objects excavated at Qau, Badari and Matmar contain *c*. 5–20 wt% Ag, the majority containing 7–15 wt% Ag. The tiny beads are more heterogeneous in composition than the other items, but some are also made with purer gold alloys, perhaps because they were made by hammering gold into sheet. While the silver contents observed for the objects are those expected for native gold alloys, which is confirmed by the almost systematic presence of PGE inclusions on the surface of the analysed objects, the amounts of copper indicate the regular use of artificial alloys. In fact, the majority of the analysed objects contain copper contents below 10 wt%, but many of them reach 20 wt% Cu and the bird-shaped amulets are made with alloys containing up to 50 wt% Cu.

The use of alloys containing high copper contents is observed for objects from the same period excavated in other sites, as shown in the diagram of Figure 7.36. In these objects, the silver contents show higher values than those observed for the jewellery in the collection of the Petrie Museum, but remain below 36 wt%. In fact, when we consider objects dated to early 6th Dynasty onwards together with the objects analysed, only string UC18092 contains components made from alloys containing more than 36 wt% Ag.

In order to provide an overall impression of the alloys employed in Egypt until early Middle Kingdom (of course, as far as allowed by the objects considered in this volume and those published by different authors and used here as comparators) we merged in the diagram of Figure 7.45 the diagrams of Figures 7.36 and 7.44. We can observe that almost all the First Intermediate Period objects are contained in the rectangle highlighted, which shows a preference for gold 'coloured' with copper. The use of gold alloys containing high copper contents might be an aesthetic choice, denoting preference for reddish gold to make particular types of objects, and/or indicate a traditional workshop practice. The use of the same metallurgical equipment for gold and copper by a regional metal-worker would result on some 'contamination' of the gold alloys, but this practice alone does not explain the presence of such high copper contents in gold. It is also possible that copper was the only available metal to 'colour' gold, because silver or silver-rich gold was not accessible: perhaps it was impossible to obtain if not issued from a local source, or too expensive at least for a certain 'rank' of burials. The regular use of gold containing 10–15 wt% Ag might in fact result from access to a limited number of gold deposits. The few objects dated to 6th–11th Dynasty in Figure 7.45 containing 20–36 wt% Ag were found in tomb 87 at Mahasna, tomb Y250 at Hu and tomb 5207 at Badari. The Mahasna and Hu cemeteries are located at or near the central town of their rural areas, whereas Badari cemetery 5200 seems farther from the central town of its region (Qau). Therefore, these particular instances of higher silver content do not seem to correspond to a socio-economic factor such as scale of population. However, at least one of the three can be dated to the very end of the First Intermediate Period (Badari 5207, Seidlmayer 1990, 139, 395 Phase IIIA). Possibly, therefore, the expanding power of Dynasty 11, as it extended north beyond Qau, altered the local access to precious metal. This hypothesis may be tested in the

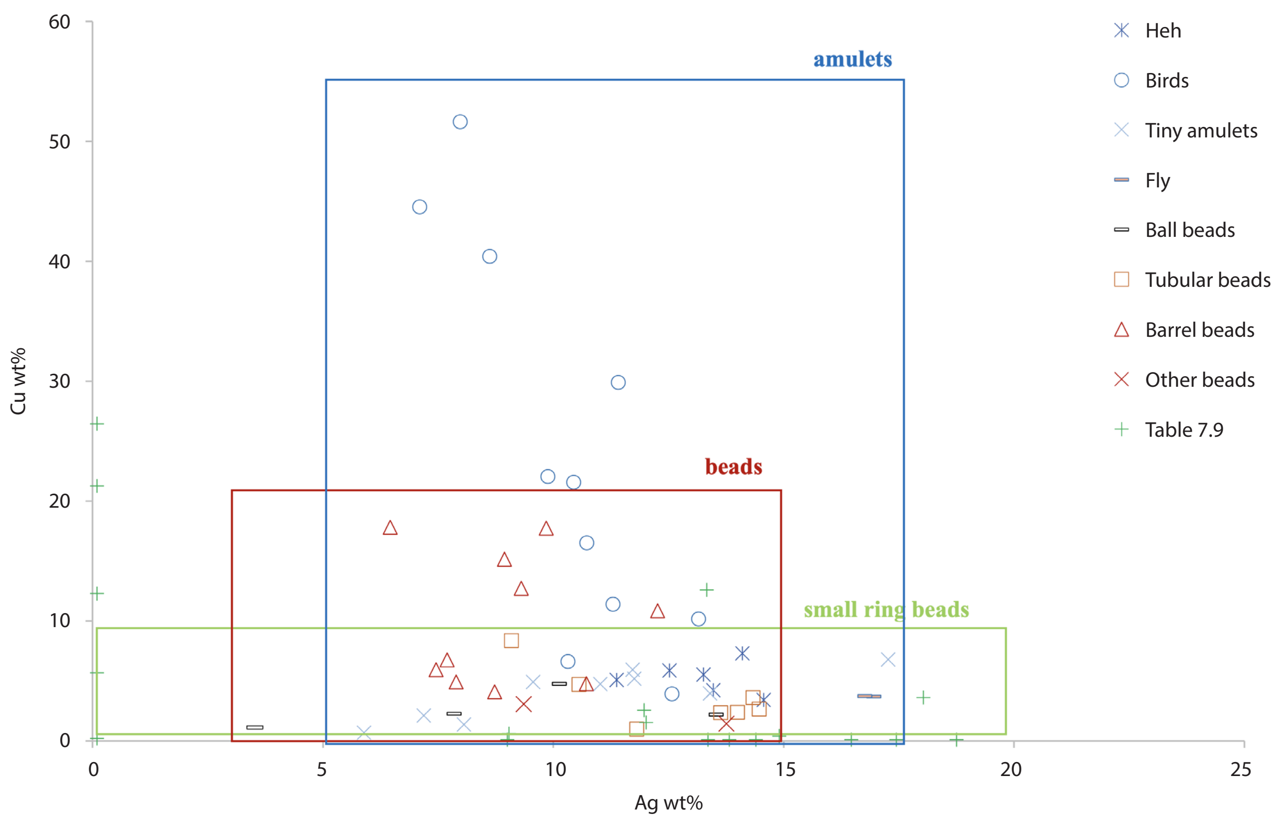


Figure 7.44. *Silver versus copper contents obtained for all the analysed amulets and beads.*

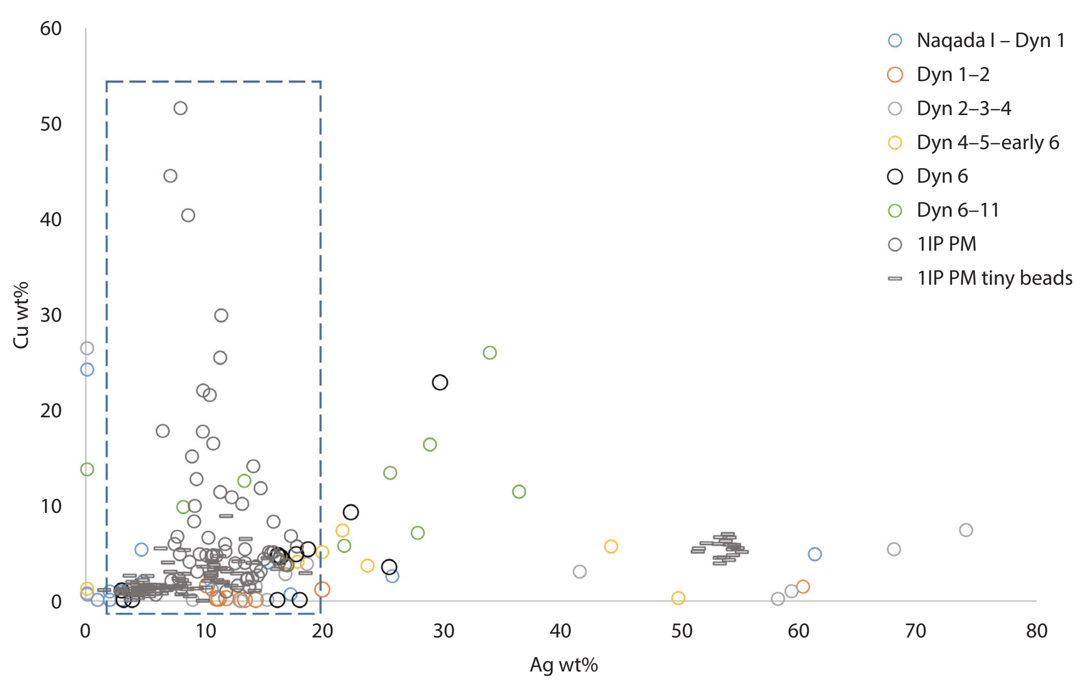


Figure 7.45. *Silver versus copper contents obtained for the First Intermediate Period jewellery in the Petrie Museum compared to published jewellery from the same and previous periods and to the earliest objects analysed in this volume.*

future through a detailed review of the archaeological context, above all the associated ceramic finds.

In brief, the gold alloys employed during the First Intermediate Period show some continuity with those employed during the earliest periods. The most 'common' gold alloys remain those containing 10–20 wt% Ag, but alloys containing either high silver contents or, especially, high copper contents, were also used. Interestingly, only the homogeneous whitish tiny beads in string UC18092 contain more than 50 wt% Ag. In the same vein, only one ball bead in string UC18059 and some tiny beads that might come from reuse of those contained in older strings are made from alloys containing more than 95 wt% Au. The particularity of the objects from this period remains the use of different amounts of copper to 'colour' gold and to obtain polychrome effects in a single jewellery item.

Notes

1. Cowrie-shaped beads are a very typical element in Middle Kingdom female girdles (see Chapter 3), but the excavator considered that this set could have come from the ankles (Brunton 1927, 37).
2. This type of beads composition is discussed by Bosse-Griffiths (1975).
3. Y. J. Markowitz & P. Lacovara (2009, 59) describe two gold bracelets with reef knots found on the wrist of a woman in burials dated to the First Intermediate Period excavated at Sheikh Farag and Mostagedda.
4. Visible in Brunton (1928): 63B6, 63D3 and 63B1 in plate 98, 66C3 in plate 99, 21C3 in plate 95, and 47G3 in plate 97.
5. Visible in Brunton (1928): 38G3 (bee) and 45F6 (falcon) in plate 97, 63G8 (Red Crown on basket) in plate 99.
6. The fragment is said to be 'rusty' (Brunton 1948, 54), certainly because of surface sulphidation.

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