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Introduction to Goldsmith Techniques in Syria during the Early and Middle Bronze Age

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Abstract. Jewels constitute a relevant form of documentation relating to the complex society and state formation process in Bronze Age Syria. They provide material evidence of various socioeconomic dynamics, including the capitalisation of precious metals (gold and silver), intensification of exchanges over long-distances, along with the emergence of specialised craftsmen and goldsmiths who mastered the know-how in metallurgy and the manufacture of complex objects. During the 3rd and early 2nd millennia BC jewellery became an important tradition, in response to an increased demand for luxury personal objects for social display by the early Syrian and Mesopotamian kingdoms. Innovative techniques were introduced and would, over time, be transmitted across the Near East and the Mediterranean to Greece, Etruria and Rome, where granulation and many different decorative motifs were appreciated and diffused. The long-lasting continuity of traditional jewellery with its distinct techniques and motifs down to modern times attests to the economic and social relevance of this craft and the capacity of the Bronze Age societies to create a highly specialised craftsmanship. This article aims to illustrate and analyse the techniques documented by the Syrian Bronze Age jewels.

Keywords. Syria**,** Bronze Age, goldsmiths, jewellery-making, metal-working, granulation, filigree.

THE DEVELOPMENT OF JEWELLERY-MAKING

Metal-working appeared in Syria in the 7th millennium BC, when it is documented only by small personal ornaments such as beads and rings, all in copper either in its native form or as malachite.

The earliest evidence comes from Tell Ramad in south-western Syria, where a pendant was found[1] created from a native copper nugget, in level I (end of the 7th millennium BC). At Tell Sabi Abyad[2] rings, pins, pendants and small pendants of copper sheet have also been found.

[1] France-Lanord, De Contenson 1973: 107.
[2] Akkermans, Schwartz 2003: 133.

Further copper beads come from 6th millennium sites of the "Halaf culture", such as Tel Kurdu in the Amuq and Chagar Bazar in the Khabur triangle.[3]

During the 4th millennium, the varying and important properties of different metals were discovered and exploited (silver,[4] copper, lead). The increased use of metals was accompanied by demand and, consequently, greater importance for sites close to areas where they could be found such as, for example, the Taurus in Anatolia, Wadi Araba and central Iran.

Around the mid-point of the 3rd millennium, artefacts in lead, copper, gold, silver, electrum[5] and bronze[6] are widespread throughout the Near East.

Syria was notable for its production of gold jewellery and, today, offers extensive testimony relating to the 3rd and 2nd millennia. The production of objects such as bracelets, pendants and earrings began to increase in various Syrian cities such as Qatna,[7] Byblos[8], Ebla,[9] Mari,[10] and Tell Brak.[11]

During the second half of the 3rd millennium, new and more complex processes appear, especially soldering and decorative techniques involving heat which facilitate the assembling of different elements and the production of decorative features.

Techniques such as granulation, filigree and *cloisonné* developed rapidly from the beginning of the 2nd millennium onwards in the major urban centres of Syria and along the Levantine coast, revealing a profound understanding of the physical-chemical attributes of gold and the various metals essential especially in the processes of fusion and soldering. These techniques were used individually to produce and decorate pendants, beads, rings and bracelets or combined to create composite ornamentation and pieces.[12]

The finds from the royal tombs of Byblos[13] and Ebla,[14] for example, are representative of the artistic techniques and aesthetic qualities of gold jewellery during the Middle Bronze Age in Syria and the Lebanon (2000-1600 BC).

TECHNIQUES[15]

1. Use of sheet metal

As early as the 3rd millennium BC techniques were used in the Near East which made it possible to make containers from sheets of metal by exploiting the malleability of the metals themselves. The hammering of unheated metal is the earliest technique we find used during the Neolithic period in Iran and in Anatolia. The sheet of metal

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[3] Mallowan 1936: 7-26; Moorey 1994: 255.

[4] For the silver production by cupellation in Habuba Kabira in Syria, see Pernicka, Rehren, Schmitt-Strecker 1998.

[5] Electrum: an alloy of gold and silver, in which the ratio of silver varies from 20 to 50%.

[6] Bronze is an alloy of copper and tin and was used extensively during the 3rd and 2nd millennia, thus giving its name to the archaeological Bronze Age.

[7] Formigli, Abbado 2011; Pfälzner, Dohmann-Pfalzner 2011.

[8] Jedijian 1968; Dunand 1950; Montet 1928.

[9] Matthiae 1985; Matthiae 1981; Matthiae in Matthiae, Pinnock, Scandone Matthiae (eds) 1995: nos 121, 391; Pinnock in Matthiae, Pinnock, Scandone Matthiae (eds) 1995: no. 414.

[10] Nicolini 2010; Margueron 2004; Jean Marie 1999; Parrot 1965.

[11] Matthews, Matthews, McDonald 1994; Mallowan 1947.

[12] Dardaillon, Prévalet 2008: 11.

[13] The artisans of Byblos preferred to decorate both jewellery and weaponry with small, spherical beads and round or twisted threads soldered to the objects, with even the settings of semi-precious stones within surroundings of such threads being further embellished by the addition of small granules. See Dunand 1958: 854, n. 16700; Dunand 1950: pl. CXXXII.

[14] The economic importance of Ebla as a centre reveals the technical expertise of Syrian artisans through a couple of dozen jewels found in the princely tombs dating to the end of the Middle Bronze Age (1800-1700). See Matthiae, Pinnock, Scandone Matthiae (eds) 1995.

[15] This paper does not aim to cover all the techniques employed in working gold but only those documented by objects found in Bronze Age Syrian sites which were studied and catalogued in my doctoral thesis.

being obtained by hammering[16] an ingot of metal until a sheet of the required thickness was obtained.[17] The sheet was then cut and shaped according to the type of object desired. Prolonged beating of the sheets produced the so-called "leaves" which were extremely thin, like those produced by machinery today. The use of cylindrical mills is not attested in ancient gold-working.

2. Pierced work decoration

Piercing was used to produce all kinds of ornaments, cutting through the sheets of metal to create decorative *chiaroscuro* effects (alternating metal and spacing) whilst also reducing the w. of the piece. Examples are two pierced sheets from Mari (Figs 1-2)[18] and two from Umm el-Marra (Fig. 3)[19] dating to the Early Bronze Age, as well as another two from Byblos (Figs 4-5)[20] from the Middle Bronze Age. In antiquity pierced work decorations were generally created by using a sharp instrument like a scalpel or chisel, and we find marks left by such tools on numerous objects.[21]

3. Repoussé and chasing work[22]

Repoussé and chasing are techniques which are normally used in combination in making jewellery.

Repoussé work is carried out on the reverse of the sheet metal on which a pattern has been traced, whilst chasing is performed on the face.

Chasing is carried out using a chisel, a purpose-made bar of hard metal with rounded tip which is tapped onto the sheet using a special hammer. The sheet is lain on a layer of pitch during the process. Work on the reverse is done using rounded needle-shaped tools to create the raised parts of the figures whilst the face is decorated using differently shaped chisels, including "profilers" used to creating the outlines of figures. The metal sheets are placed on a flexible material such as lead or pitch during these processes.[23]

An example of this technique can been seen on a pendant from Tell Brak (Fig. 6) dating to Early Bronze Age III-IV, ca. 2350-2159 BC and depicting two incised and entwined lions, their paws represented like the talons of an eagle.[24] The two lions are very finely and carefully produced, especially in the anatomic details (mane, muzzle, eyes), and the pendant was part of a treasure that was buried in a room of one of the buildings at Tell Brak dating to the Akkadian period.

The main ribbing of a pendant in the shape of a sheet from *Ville II*[25] at Mari (Fig. 7) was created by means of a similar *repoussé* technique, with a hard point being pressed into and along the metal. Similar ribbing is found also on other objects from Mari (Figs 8-9) dating to the Middle Bronze Age. The secondary ribbing was roughly rectilinear, created free-hand in firm strokes. Goldsmiths generally used a fine instrument with a rounded point (of different diameters) that, for the sake of simplicity, we can call "soft point". No examples of such tools have been

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[16] The gold was beaten into very thin sheets in Mesopotamia from its earliest appearance in the 4th millennium BC probably with stone hammers and on hard flat stones. Ogden has identified such a tool from Ur as a hematite pestle: Ogden 1982: 35, fig. 4.3.

[17] Giardino1998: 71-72, 83.

[18] Nicolini 2010: 336, no. 184/23; Nicolini 2010: 334, no. 175

[19] Schwartz *et al.* 2006: 611, fig. 15.

[20] Dunand 1958: 694, nos 14435, 14435bis.

[21] Ogden 1982: 43.

[22] The French term *repoussé* indicates both techniques: the motif is first created in relief and then completed with the use of a chisel, Giardino 1998: 83-85.

[23] Formigli 2000: 323.

[24] P. Collins in Aruz, Wallenfels (eds) 2003: 231, fig. 185.

[25] Margueron defines the phases of the city of Mari as *Ville I, II* and *III,* corresponding to: *Ville I*: 2990-2500 BC; *Ville II*: 2500-2300 BC; *Ville III*: 2300-1800 BC.

preserved but they would probably have been in bronze, bone or wood and, in some cases, we can reconstruct the shape of the tool used from the traces left on the finished object.[26]

4. Engraving

Carried out with sharp, pointed tools, engraving consists of creating figures and motifs by removing parts of the metal. It is generally used for the setting of rings, medallions, etc., but can also be employed to create "positive", or raised, shapes by removing the surrounding metal. Fine examples from Mari are a pair of grooved spiral earrings from Tomb 86, dating to the Early Bronze Age (Figs 10-11),[27] where the decorative incisions were made with a burin or chisel.

This technique can also be seen on the beads of the bracelet in the so-called "treasure of Ur"[28] found at Mari (Fig. 12).[29]

A similar incision, though of inferior quality, is found on the bail of a half-moon pendant (Fig. 13) from Mari and dating to the *Šakkanakku* or Amorite phase.[30]

5. Dapping punches

This metalworking technique differs from *repoussé* work since the gold sheet is placed on a base or doming block (like a small anvil) and is worked with a smooth round-headed punch. The head of the punch is the same size and shape as the hemispherical indentations in the doming block. The sheet of metal is placed between the two and the punch tapped with a hammer to produce either concave or convex hemispheres. Unlike *repoussé*, this technique requires the use of a doming block which presupposes mastery of lost-wax fusion processes or forging in order to create both the block and the punches.[31]

Since we have no examples of such tools from the 3rd or 2nd millennia, any analysis of this technique must be based solely on the objects available.

It is possible that the hemispherical relief elements used in the decoration of discs (Figs 14-15) from tomb 300 and dating to the *Ville I* period at Mari, may already indicate the use of dapping with punches then repeated by using the tool on the reverse of the cold metal. However, it is difficult to prove that such processes were employed. In this regard, G. Nicolini, who has conducted extensive research on the jewels from Mari, has employed experimental archaeology to investigate the techniques used: he has produced hemispheres, cutting the sheet before and after the punching. These hemispheres were then assembled in pairs to produce spheres, soldered at the centre and with the holes at top and bottom. An example of such an object is a bead (Fig. 16) from the *Ville II* period, which appears to be the earliest found at Mari although it is not possible to claim whether it predates the quite rare examples from the royal tombs of Ur or t whether it was created at Mari itself.[32]

Another example is from the Royal Necropolis of Ebla (Fig. 17),[33] from the Tomb of the Lord of the Goats and dating to the Middle Bronze Age, 1750-1700 BC. This is a small disc containing eight hemispherical shapes probably produced using rivets or punches.

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[26] Nicolini 2010: 66.
[27] Nicolini 2010: 118; Maxwell-Hyslop 1971: 63, pl. 44.
[28] During the 1956 season, a vase was found in room XXVII of the Pre-Sargonic palace, dating to the 3rd millennium BC, containing a collection of precious objects in different materials including the important bead from a necklace bearing a cuneiform inscription with the name Mesannepada, the founder of the 1st dynasty of Ur, thus indicating the existence of relations between the two kingdoms. See Parrot 1968.
[29] Nicolini 2010: 113, no. 150; Margueron 1965: 227-228, pl. XIV.1.
[30] Nicolini 2010: 2010: 246, no. 139.
[31] Nicolini 2010: 63.
[32] Nicolini 2010: 63.
[33] Matthiae 2010: 345-346; F. Baffi in Matthiae, Pinnock, Scandone Matthiae (eds) 1995: 481, no. 400.

6. Pressing with patterned punches

Pressing of a metal in jewellery-making is usually carried out on a mould on which the desired motif is incised so as to create the design in relief and a punch and hammer are used. The sheet of gold is beaten upon the mould to create a decoration in relief, a method which makes it possible to create rapidly a series of identical decorative elements. A simpler procedure, pressing without a mould, consists of laying the sheet of metal on a smooth, soft surface (leather, lead or pitch) and hitting it with a punch and hammer. This imprints the motif on the metal, the depth depending on the force with which the hammer is used and the softness of the metal itself. This method, however, rarely leaves unequivocal marks on the objects indicating the technique employed, but the fact that many decorative elements and figures are identical, down to small details, lead us to conclude that it must have been the method used.[34]

An example of this technique is a sheet with 12-petalled rose decoration (Fig. 18), dating to between *Ville I* and *Ville II*, with pronounced concavities which result in a marked level of relief. On the reverse, the marks left by the tool used are clearly visible.[35]

7. Filigree

Filigree is a very ancient metal-working technique which involves soldering fine threads of metal onto a sheet to create decorative motifs, sometimes combined with granulation in the same piece of jewellery.[36] Examples exist with single, double and even triple rows of threads which can be smooth, beaded or entwined, flat, rounded or square in section and of varying thickness, twisted and soldered onto sheet metal.

A double-cone-shaped gold bead (U.9779) from a tomb (PG 580) in the Royal Cemetery of Ur[37] represents an example of extremely high-quality filigree work.

A splendid example from Early Bronze IV is a triangular pendant with chain from tomb 1 at Umm el-Marra (Fig. 31). Both sides of the pendant are decorated with eight twisted, double-thread "plaits" framed by thin, double threads. The threads of each pair twist in opposite directions with the effect of a weave between each "plait".[38] The same decoration with double row runs along the edge of the pendant on both sides.

The Mari "treasure of Ur" also includes two gold discs, the edges of which bear two gold threads twisted in clockwise and anti-clockwise directions (Fig. 19).[39]

A further example of this technique can be seen in the disc cited earlier (Fig. 17)[40] which has four double-rows of wavy threads separating four motifs in *cloisonné* in the shape of drops flanked by two golden spheres, all surrounded with granulation, and a central circle of smooth thread separating the two granulated lines.

8. Granulation

This technique involves soldering minute spheres, or granules, onto a metal base so finely that the point at which they are attached is almost invisible to the naked eye. It is normally used on gold but there are also examples of silver bearing granulation. The tiny spheres were applied in straight or curving lines, or filled entire parts of the surface to create complex designs.[41] Granulation can be defined according to three criteria: the calibre (size), method of soldering and use.[42]

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[34] Nicolini 2010: 63.
[35] Nicolini 2010: 64-65.
[36] Giardino 1998: 99-100.
[37] See P. Collins in Aruz, Wallenfels (eds) 2003: 128, no. 75; Woolley 1934: pl. 138, U.9779.
[38] Schwartz *et al.* 2003: 334, fig. 15.
[39] Nicolini 2010: 93, no. 11; Margueron 2004: 298-299; Parrot 1956: 219, fig. 32.
[40] Matthiae 2010: 345-346; F. Baffi in Matthiae, Pinnock, Scandone Matthiae (eds) 1995: 481, no. 400.
[41] Giardino 1998: 100-101.
[42] Nicolini 2010: no 405.

It would seem to have made its appearance in the Near East in the mid-3rd millennium. From tomb 1100 of the royal cemetery at Ur there is, in fact, an earring which is recognised as the first piece of jewellery decorated with true granulation,[43] which is here combined with a filigree spiral.[44]

The first examples of decorative elements created with granulation in the eastern Mediterranean are from Byblos, where it appears for the first time on a circular gold medallion (Fig. 20), found in the so-called "*Jarre Montet*",[45] and dating to late 3rd/early 2nd millennium. We also find granulation used to decorate weapons and jewellery at Byblos.[46]

Granulation is well-represented at Mari, where it came into use relatively early, immediately following its first appearance in the Early Dynastic tombs of Ur, where the technique is characterised by the use of large granules. The pendant of an earring with two pointed pods (Fig. 21) from tomb 1048[47] includes a kind of capsule soldered in an irregular pattern.

G. Nicolini maintains that this "capsule" (Fig. 21) was not necessarily the work of goldsmiths from Ur.[48]

Other jewels from Mari shows two further and different techniques.

One can be observed on a gold earring (Fig. 22),[49] from room 119 of the large palace dated to the late 3rd/early 2nd millennium BC where the granules form decorative lozenges, a motif of Sumerian origin, and the quality is quite refined for the period. This kind of decoration is extremely unusual at the end of the 3rd millennium but would become widespread during the 2nd millennium in Egypt and throughout the Near East. The same kind of work can also be seen on a pair of earrings from Troy,[50] created using large granules.

It is, however, extremely difficult to hypothesise that the goldsmiths of Mari could have furthered developed this craft technique without having general knowledge of methods of eastern gold-working, especially and this becomes more obvious when considering the issue of uncertain dating of archaeological objects since certain objects from the site cannot be dated. [51]

The second example is a pendant (Fig. 23)[52] from room 113 of the royal palace. Its decoration, of Sumerian origin, includes lines upon which triangles, in alternating position, touch along with granulated lozenges, all set in a clearly visible soldering alloy. If this piece is later than the former (Fig. 22), it could be contemporary with the production from Ebla but it, undoubtedly, finds no comparisons amongst pieces made at Mari.[53]

At Byblos most of the finds using granulation were discovered in six deposits in the Temple of the Obelisks. Amongst these, the "*Jarre Montet*" mentioned above also held a large pendant (Fig. 20) which has been compared to the disc of Larsa,[54] from which it differs in that it has a tube for it to hang from on the reverse instead of a ring on the upper part, and is also very simple in its design and limited amount of granulation.[55]

Goldsmiths at Byblos used granulation to produce a metal sheet with a votive scene (Figs 24-25),[56] without a thread or ribbon as border, an extremely difficult task to perform. This style is not as rich as that on the Larsa medallion and may not have been Mesopotamian in origin.[57]

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[43] "The Sumerians were the first people we know to have shown skill in filigree and granulated work": Woolley 1934: 297.

[44] Maxwell-Hyslop 1971: 51, fig. 34; Woolley 1934: pl. 138, U. 11584.

[45] Tufnell 1966. In 1921-1922 during the series of excavations at Byblos, Pierre Montet discovered a large vase and accompanying lid with snake-like handles that contained a treasure of hundreds of precious objects of differing provenance dated to the end of the 3rd millennium BC.

[46] For the jewellery from Byblos decorated with granulation, see Tufnell 1966: fig. 4 no. 85; Dunand 1958: nos 16700, 16701, 16702, 14451, 14452, 16698; Dunand 1950: pl. CXXXII.

[47] Jean-Marie 1999: 189, pl. 218.7.

[48] Nicolini 2010: 72.

[49] Nicolini 2010: 124, no. 24.

[50] For the jewellery from Troy, see Tolstikov, Treister 1996.

[51] Nicolini 2010: 72.

[52] Margueron 2004: 542, pl. 90.

[53] Nicolini 2010: 72.

[54] For the Larsa disc, see Arnaud, Calvet, Huot 1979.

[55] Lilyquist 1993: 38.

[56] Dunand 1958: 854, no. 16700; Dunand 1950: pl. CXXXII.

[57] Lilyquist 1993: 41.

Two more pieces of jewellery with granulation are from Ebla. The first is a necklace (Fig. 26) which was amongst the funerary deposits in the Tomb of the Lord of the Goats. This consists of three elements, each formed by a rectangular plaque from which a disc is suspended, the plaques and discs all being richly decorated.[58] The granulation on all three discs is identical and represents a six-pointed star with six small granulated circles the points and three lines of granulation framing each disc.[59]

The second is an earring (possibly a nose-ring) from the "Tomb of the Princess" (Fig. 27). This consists of two curved sheets soldered along the edges, in relief, and decorated in granulation with sickle shapes, rhomboids and triangles. The earring is very similar to others found in Palestine, at Tel Ajjul, which are also decorated with granulation but the more markedly half-moon shape is probably to be attributed to a later date, although this is still subject to debate.[60]

8.1. Preparation of the granules

The granules are prepared by fusing relatively small pieces cut from gold wire or sheet. These are then placed on a flat base of charcoal and flame applied through a mouth pipe: the effect of gravity turns the pieces into perfectly spherical granules.[61]

To obtain large number of granules quickly, the pieces of gold can be placed inside a crucible made of refracting material on a layer of charcoal powder and other, alternating layers be added.

The furnace is then brought to fusion temperature; the resulting granules are then washed in water and divided according to diameter.[62]

9. Cloisonné

This technique permits the creation of "compartments" (*cloisons*) by means of applying thin gold, silver or copper wire onto a metal base. The compartments thus produced are then filled with coloured vitreous paste or precious stones.

Examples of *cloisonné* in Early Bronze Age Mesopotamia and Syria are, however, quite rare, the technique being attested, instead, at Ebla during the Middle Bronze Age by, for example, the large ring (Fig. 28) found in the "Tomb of the Lord of the Goats". This consists of two lilies each flanked by two buds, enclosing an oval space in which a small scarab in vitreous paste is set and, as noted by G. Scandone Matthiae, is a fine example of *cloisonné* jewellery.[63]

Another example of *cloisonné* work from Ebla is the disc mentioned above (Fig. 17) with four tear-shaped motifs and a central circle formed by thin gold wire. The central, circular *cloisonné* and the two lateral tear-shaped compartments still hold pieces of lapis lazuli, whilst the original stones are missing from the other two *cloisonnés*.[64]

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[58] F. Baffi in Matthiae, Pinnock, Scandone Matthiae (eds) 1995: 471, no. 396.
[59] Matthiae 1981: 217.
[60] F. Baffi in Matthiae, Pinnock, Scandone Matthiae (eds) 1995: 470, no. 394.
[61] This observation derives from the course on Ancient goldsmiths' craft held in Montepulciano (Italy) by Alessandro Pacini attended by the present writer in 2012.
[62] Vitiello 1987: 321.
[63] G. Scandone Matthiae in Matthiae, Pinnock, Scandone Matthiae (eds) 1995: 467, no. 387; Scandone Matthiae 1995.
[64] F. Baffi in Matthiae, Pinnock, Scandone Matthiae (eds) 1995: 481, no. 400.

10. Casting

This technique consists of melting metal in a terracotta crucible and then pouring it into a mould. Once the metal has solidified it produces a positive version of the shaped mould. Earliest metal-workers often made the moulds from soft or fire-resistant stone such as soapstone, or terracotta, and carved the shape of the object to be created. The use of such moulds is well-documented especially in relation to tools and weapons in copper and, later, bronze, whereas we have few examples relating to the production of jewellery.[65]

An example of a mould dating to the Early Bronze Age (2300-2200 BC) comes from Tell Brak (Fig. 29). This is a multiple, rectangular mould[66] used to create two large pins, a standing nude female figurine, two figures of goats, an amulet with animal protome and a circular plaque.[67]

11. Lost-wax casting

This method consists of creating a wax model upon which fine clay is lain to produce a negative mould. The mould is then heated in order to melt and remove the wax through a hole in the terracotta casing. Once the wax has been eliminated, molten metal is poured into the mould and, once this has cooled, the clay casing is broken in order to reveal the finished object.[68]

An example of lost-wax casting from Mari is a small golden bull's head (Fig. 30), today in the Louvre, which was found in the house of the priests of the temple of Ištar and may have decorated the top of a sceptre or ceremonial staff.[69] The head is quite simple in design and appears to have been made using a mould in which molten gold or electrum replaced the original, probably in bitumen.[70]

12. Soldering

The technique of soldering on gold and silver, used to create composite jewels from numerous tiny parts, was known from at least the middle of the third millennium BC in Mesopotamia. The earliest pieces of jewellery often consist of various components assembled by mechanical means or using a variety of techniques that involve the application of heat and which, for the sake of simplicity, can be included under the general heading of "soldering". The use of natural electrum as solder for gold is attested in some pieces from Ur.[71] Other pieces of jewellery of the 3rd millennium, such as the gold *loop-in-loop* chains[72] from Ur,[73] with their carefully soldered links, show instead that a copper-based solder was used for some delicate tasks, since native gold rarely contains more that 1 or 2% copper.[74]

Electrum and silver were soldered from the start of the 3rd millennium onwards, and this technique became more frequently used at the start of the 2nd millennium.[75]

Soldering with copper salts is particularly well-suited to filigree and granulation. This involves the use of a copper compound (a sulphate, an oxide or a carbonate) ground to a powder and applied, together with a liquid, to the

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[65] Giardino 1998: 64-66.
[66] Studying on these moulds provides information on the metal-working techniques used in the 3rd and 2nd millennia, but also on jewellery which is rarely preserved in the archaeological documentation.
[67] Oates, Oates, McDonald 2001: 247-248, fig. 267.
[68] Giardino 1998: 66-70.
[69] Nicolini 2010: 57.
[70] Nicolini 2010: 57.
[71] Moorey 1994: 229-231.
[72] For the *loop-in-loop* chains, see Ogden 1982: 57.
[73] For the chains from Ur, see Woolley 1934: pl. 146.
[74] Ogden 1982: 64.
[75] Ogden 1982: 63-64.

points at which the separate pieces are to be soldered. The object is then heated in a reducing environment, such as a wood-burning furnace, to the temperature needed to transform the copper salts into copper metal. As soon as it is reduced, the copper binds to the gold creating a minimum of soldering alloy with a melting point that is slightly lower than that of the metal of the jewel itself, welding the pieces firmly together.[76]

In ancient goldsmiths, strong brazing was also used in the production of jewellery. Brazing is a form of soldering in which the parts to be joined, heated in a furnace or with a soldering tool.

The filler metal should have a lower melting point than the adjoining metal.[77] Moreover, this method is preferable when the join will have to resist stress or when the high temperatures required by copper salts is too risky to be used.

Autogenous welding was used in certain cases to solder the links of chains and to unite the edges of moulded figures. Hard-soldering could also be used for granulation, as has been observed in some Near Eastern jewellery productions.[78]

13. Chains

In early jewellery-making, as today, chains served not only to hold pendants or link different elements but had their own aesthetic purpose.

Chains from Syrian archaeological sites are of the *loop-in-loop* type. This means that, instead of soldering successive links on inside the next, a number of closed links were prepared and then soldered to each other. The first link was bent in half and a second, also bent, inserted, then a third, and so on, to obtain a *loop-in-loop* chain of the simple type.[79]

We have two Early Bronze Age examples of this kind of chain, one from Tomb 1 at Tell Umm el-Marra (Fig. 31)[80] and the other from Tomb VIIY49 set3 at Mari (Fig. 32).[81] A Middle Bronze Age example was found, instead, at Ebla in the Tomb of the Lord of the Goats (Fig. 33)[82] and there are numerous parallels in the Syro-Palestinian area, although the individual curved elements tend to be bent more tightly in the various contexts at Byblos, Tell Ajjul and Megiddo, where they were used in a variety of objects.[83]

CONCLUSION

The production of gold jewellery became an important activity in the Mediterranean region from the 3rd millennium onwards. The earliest evidence for gold objects in Syria are attested in the sites of Umm el-Marra, Tell Brak, Tell Munbaqa[84] and Mari. The Middle Bronze Age marks a peak in international relations, with continuous exchanges between the courts not only of gifts and merchandise but also of craftsmen and technical knowledge channels.

A significant development in gold-working techniques during the Middle Bronze Age can be seen compared to those that have flourished during the Early Bronze Age in Syria, especially in relation to the methods of granulation, filigree and soldering. Such development manifests itself in both the quality and quantity of the artefacts.

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[76] This observation derives from the course on ancient goldsmiths' craft held in Montepulciano (Italy) by Alessandro Pacini attended by the present writer in 2012.
[77] Pinton 2003: 163; Moorey 1994: 229.
[78] Maryon 1998: 8.
[79] Formigli 2000: 323; Ogden 1982: 57.
[80] Schwartz *et al.* 2003: 334, fig. 15.
[81] Nicolini 2010: 309, no. 149; Margueron 2004: 108, pl. 80.
[82] Matthiae 2010: 345, fig. 194.
[83] F. Baffi in Matthiae, Pinnock, Scandone Matthiae (eds) 1995: 472, no. 398.
[84] Czichon, Werner 1998.

The formation of great kingdoms and their desire to affirm their power favoured the intensive production of precious objects, in gold, silver, gemstones and ivory,[85] the technical aspects of which testify to the existence of both specialised and polyvalent workshops and a marked cultural syncretism.

On the basis of archaeological contexts (palaces, temples, storehouses, treasuries and elite burials) we may affirm that, in all probability, gold jewellery was reserved for the elite and ruling classes, who soon began to consider them also as objects for exchange and commerce. We can cite, for example, the treasure of Ur, a possible gift from king Mesannepada of Ur (2250 BC) to the king of Mari, and a group of objects sent as gifts to a king of Ebla by one or more pharaohs, almost certainly of the XIII dynasty.[86]

On particular occasions, objects in gold and silver were also given to members of the royal family, the family of the minister and members of the administration (based on the individual's rank). Such occasions related to fundamental events such as marriage, the birth of a son (in this case, the gifts were received by women) and funerals.[87] Extremely interesting in this regard are the lists of wedding gifts and four texts concerning funerary offerings from Ebla, published by A. Archi in 2002.[88]

The state invested in raw materials, that is precious metals, and employed craftsmen to transform these into precious objects that entered into circulation through commercial exchanges with other states. Over time, artisans consequently came to represent an extremely important category for the state. One of the texts from Ebla mentions the presence of 500 metal-workers, a detail which suggests that metal arrived in the city in the form of ingots and was then turned into finished objects by local artisans.[89]

Syrian goldsmiths' craft during the Bronze Age appears to be relatively homogenous in both technique and style, although with regional variations. There are, in fact, numerous influences to be noted,[90] resulting from contact with neighbouring regions. Egyptian influences, seen first in the coastal city of Byblos,[91] more easily reached by the pharaohs' commercial expeditions, then spread to a number of centres in the Syrian interior, as shown by the discovery of artefacts of Egyptian manufacture at Ebla.[92] Instead, we find a marked Mesopotamian influence at Mari, in the region of the Middle Euphrates, and at Tell Brak in the Jezirah. Most of the objects found at these sites can be compared to the jewels found in the royal tombs of Ur.

To summarise, whilst in order to reconstruct the various shapes and different kinds of jewels we can rely upon the visual testimony which art or written documents have left to us, in order to re-create the technologies employed we must study the jewellery directly through archaeometric and other non-invasive laboratory analyses. It is only via such examination that we can identify the techniques employed and, therefore, define the procedures and methods of production used in specific cultures, workshops and groups of craftsmen.

The difficulties involved in studying goldsmith techniques in 3rd and 2nd millennium Syria derive also from the scarcity of archaeological finds relating to the workshops and metalworking tools. Amongst the few furnaces known to date there is that used for metalworking discovered in room 138 of Palace P-1 at Mari, with its characteristic "Egyptian" structure and which was probably used, as least in part, by a goldsmith at the end of the *Ville II* period.[93]

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[85] Exotic and precious goods (lapis lazuli, carnelian and tin) arrived in the Syrian city of Ebla from Afghanistan and the Indus valley via complex, long-distance and indirect networks determined by geographically strategic positions of intermediary points. Precious metals (silver and gold) arrived, instead, via a southern circuit of exchange with autonomous cultural groups on the Anatolian plain, along the Euphrates or up the Orontes and the plain of the Amuq: Peyronel 2008: 60.

[86] Matthiae 2010: 350-351.

[87] Archi 2011: 49.

[88] Archi 2002.

[89] Archi 1995: 117.

[90] The Royal Archives of Mari have shown how important this was as an indication both of a Syrian culture, undoubtedly greatly influenced by Mesopotamian elements, and of originals aspects which reveal how Syria was a great cultural and autonomous pole situated between Egypt and Mesopotamia.

[91] For Egyptianising objects from Byblos, see Sowada 2009; Hakimian 2008.

[92] For objects of Egyptian manufacture, see Matthiae 2018; Matthiae 2010: 348-249.

[93] Nicolini 2010: 56.

This kind of interpretation, however, necessitates a multi-disciplinary approach including also ethnographic aspects, which means including an analysis of contemporary workshops. Similarly, experimental archaeology can help establish the diagnostic criteria required in order to identify the methods employed which, at the same time, add to our knowledge of the organisation of goldsmiths' workshop, the status of the craftsmen and the manufacturing process.

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CATALOGUE

Fig. 1
Mari
Mosaic sheet
IXA44NO3
Gold
L. 75 mm, 128 mm, th. 4 mm, w. 2.74 g
Early Bronze Age
Deir ez-Zor, Archaeological Museum
Nicolini 2010: 334, no. 175.

Fig. 2
Mari
Sheet
M 2728
Gold
L. 27 mm; w. 0.19 g.
Early Bronze Age
Damascus, National Museum
Nicolini 2010: 336, no. 184/23.

Fig. 3
Umm el-Marra
Decorative sheet
UMM04 1-027
Gold
Tomb 4
Early Bronze IV
Aleppo, National Museum
Schwartz *et al.* 2006: 611, fig 15.

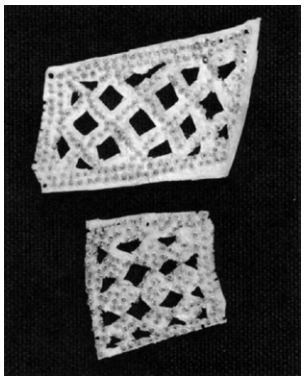

Fig. 4
Byblos
Gold sheet with square perforations
14435
Gold
L. 5.4 cm; th. 0.02 cm
Temple of the Obelisks
Middle Bronze Age
Dunand 1950: pl. CXVII.
Dunand 1958: 694, no. 14435.

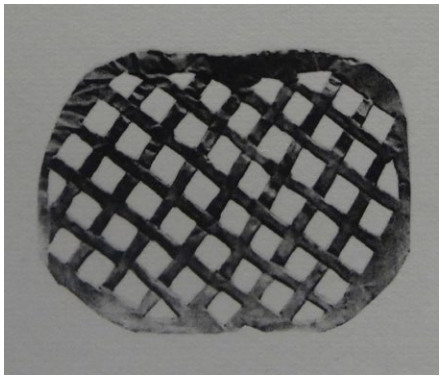

Fig. 5
Byblos
Gold sheet with fish-scale perforations
14435bis
Gold
L. 5.4 cm, th. 0.02 cm
Temples of the Obelisks
Middle Bronze Age
Dunand 1950: pl. CXVII.
Dunand 1958: 694, no. 14435bis.

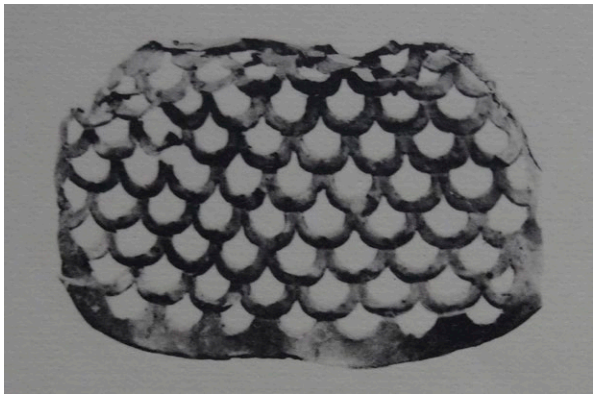

Fig. 6
Brak
Sheet pendant
TB 15070
Gold
H. 4.9 cm, wid. 6.2 cm, th. 0.5 cm, w. 5.5 g
Early Bronze Age
Deir ez-Zor Archaeological Museum
Matthews, Matthews, McDonald 1994: 185, fig. 10.
P. Collins in Aruz, Wallenfels (eds) 2003: 231-232, fig. 158a.

Fig. 7
Mari
Pendant in shape of a leaf
M 2955
Gold
H. 38.6 mm, wid. 19.7 mm
Early Bronze Age
Damascus, National Museum.
Nicolini 2010: 232, no. 118.

Fig. 8
Mari
Pendant in shape of a leaf
M 1843
Gold
H. 72 mm: wid. 49.3
Temple of Dagan?
Middle Bronze I, late Shakkanakku?
Aleppo, National Museum
Margueron 2004: 543, pl. 95.
Nicolini 2010: 243, no. 135.

Fig. 9
Mari
Pendant in shape of a leaf
M 1878
Gold
H. 62.3 mm: wid. 46.4.
Temple of Dagan?
Middle Bronze Age
Aleppo, National Museum
Margueron 2004: 543, pl. 95.
Nicolini 2010: 243, no. 136.

Fig. 10
Mari
Earring with spiral groove
M 639
Gold
H. 17.8 mm, wid. 15.8 mm, th. 9 mm, w. 1.26 g
Tomb 86
Early Bronze
Paris, Musée du Louvre
Maxwell-Hyslop 1971: 63, pl. 44.
Nicolini 2010: 118, no. 13a.

Fig. 11
Mari
Earring with spiral groove
M 640
Gold
H. 14.3 mm, wid. 14 mm, th. 8.3, w. 1.05 g.
Tomb 86
Early Bronze Age
Paris, Musée du Louvre
Nicolini 2010: 118, no. 13b.

Fig. 12
Mari
Bracelet with beads
M 4407
Gold and lapis lazuli
Treasure of Ur
Early Bronze Age
Damascus, National Museum
Parrot 1965: 27-28, pl. XIV-1
Margueron 2004: 297-298, pl. 93.
Nicolini 2010: 310, no. 150.

Fig. 13
Mari
Crescent-shaped pendant
M 1114
Gold
H. 15.2 mm, wid. 25.4 mm
Middle Bronze I
Amorite or Shakkanakku period
Aleppo, National Museum
Nicolini 2010: 246, no. 139.

Fig. 14
Mari
Decorative disc
M 1426
Gold
Diam. 55/54 mm
Tomb 300
Early Bronze Age
Aleppo, National Museum
Jean-Marie 1999: 308, 315.
Nicolini 2010: 327, no. 159.

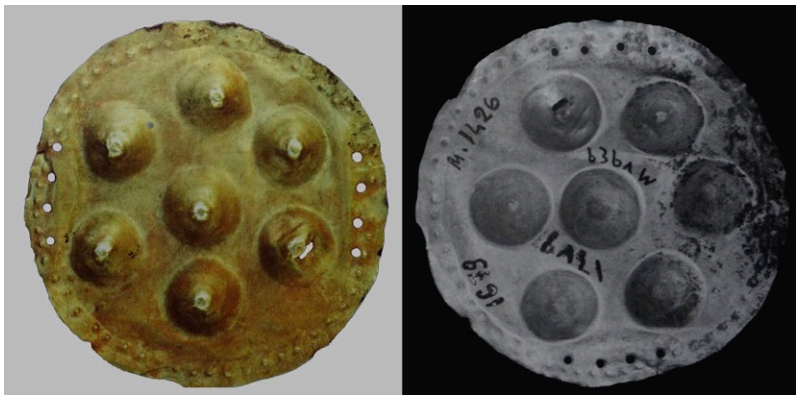

Fig. 15
Mari
Decorative disc
1425
Gold
Diam. 70/72 mm
Tomb 300
Early Bronze Age
Aleppo, National Museum
Nicolini 2010: 328, no. 160.

Fig. 16
Mari
Spherical bead from necklace
M 234
Gold
L. 16.9 mm, diam. 7.8 mm
Early Bronze Age
Damascus, National Museum
Nicolini 2010: 227, no. 100.

Fig. 17
Ebla
Decorative disc
TM.79.Q.200
Gold and lapis lazuli
Diam. 3 cm, th. 0.3 cm
Area Q. Royal Necropolis, Tomb of the Lord of the Goats, Hypogeum C
Middle Bronze II: ca 1750-1700 BC
Aleppo, National Museum
Baffi in Matthiae, Pinnock, Scandone Matthiae (eds) 1995: 481, no. 400.
Matthiae 2010: 345-346.

Fig. 18
Mari
Sheet
SO85.TH06.17
Gold
L. 116 mm, w. 3.27 g
Early Bronze Age
Deir ez-Zor, Archaeological Museum
Nicolini 2010: 347, no. 236.

Fig. 19
Mari
Headband
M 4408
Gold
Wid. 37.3 mm, h. 25 mm
Diam. discs 18.5/19.3 mm
Th. discs 1.2/1.5 mm; w. 6.64 g
Treasure of Ur
Early Bronze (Ville II)
Damascus, National Museum
Parrot 1965: 219, Fig. 31.
Margueron 2004: 298-299, pl. 78.
Nicolini 2010: 93, no. 11.

Fig. 20
Byblos
Decorative disc
Gold
Diam. 5.8 cm
Montet Jar
Middle Bronze Age
Tufnell 1966: fig.4 no. 85.
Maxwell-Hyslop 1971: pl. 69.

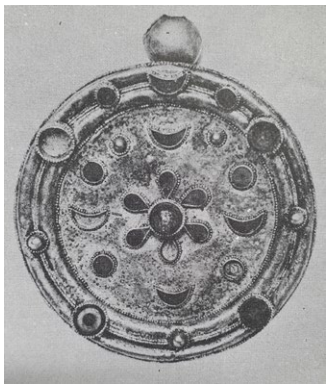

Fig. 21
Mari
Earring with two pods
IIID1 SE46.TH91.7
Gold
H. 24.5 mm, wid. 17.9 mm, th. 18.5 mm, w. 5.05 g
Tomb 1048
Shakkanakku
Deir ez-Zor, Archaeological Museum
Jean-Marie 1999: 189, pl. 218-7.
Nicolini 2010: 191, no. 74.

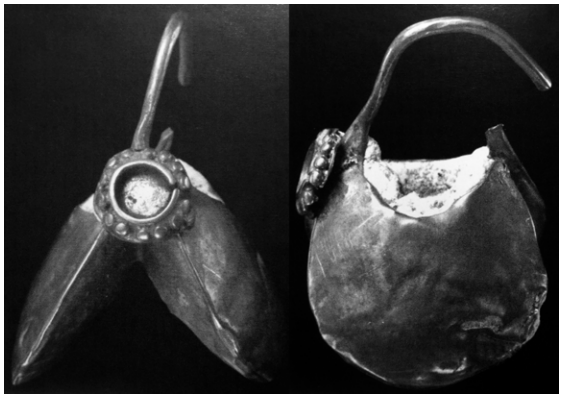

Fig. 22
Mari
Granulated curved earring
M 4533
Gold
H. 16.3 mm, diam. 17.5 mm, t. 4.2 mm, w. 2.15 g
Late 3rd/early 2nd millennium
Room 119, Great Palace
Damascus, National Museum
Margueron 2004: 542, pl. 88.
Nicolini 2010: 124, no. 24.

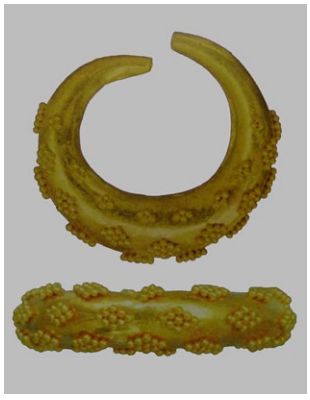

Fig. 23
Mari
Pendant with granulation
M 4549
Gold
H. 17.8 mm, wid. 11.5 mm, t. 6.5 mm, w. 3.30 g
Royal Palace, Room 113
Middle Bronze I
Damascus, National Museum
Parrot 1967: 23, pl. IV-4.
Margueron 2004: 542, pl. 90.
Nicolini 2010: 246, no. 140.

Fig. 24
Byblos
Sheet with granulation
16701
Gold
L. 4.8 cm, wid. 3.7 cm
Temple of the Obelisks
Middle Bronze Age
Dunand 1950: pl. CXXXII.
Dunand 1958: 854-855, no. 16701.

Fig. 25
Byblos
Sheet with granulation
16702
Gold
L. 5.3. cm, wid. 3.9 cm
Temple of the Obelisks
Middle Bronze Age
Dunand 1950: pl. CXXXII;
Dunand 1958: 854-855, no. 16702.

Fig. 26
Ebla
Necklace
TM.79.Q.250a-c
Gold
L. 10.4 cm, h. 4.4 cm, diam. discs 2.5 cm
Area Q. Royal Necropolis, Tomb of the Lord of the Goats, Hypogeum B
Middle Bronze II: ca 1750-1700 BC
Aleppo, National Museum
F. Baffi in Matthiae, Pinnock, Scandone Matthiae (eds) 1995: 471, no. 396.

Fig. 27
Ebla
Earring
TM.78.Q.166
Gold
Diam. 3.2 cm, th. 0.6 cm, w. 6.8 g
Area Q. Royal Necropolis, Tomb of the Princess
Middle Bronze I-II: ca 1825-1775 BC
Aleppo, National Museum
F. Baffi in Matthiae, Pinnock, Scandone Matthiae (eds) 1995: 470, no. 394.

Fig. 28
Ebla
Ring
TM.79.Q.23e
Gold, pale blue vitreous paste
H. 2.2 cm, diam. 2.4 cm, l. 1.4 cm.
Area Q. Royal Necropolis, Tomb of the Lord of the Goats
Middle Bronze II: ca 1750-1700 BC
Aleppo, National Museum
G. Scandone Matthiae in Matthiae, Pinnock, Scandone Matthiae (eds) 1995: 467, no. 387.

Fig. 29
Tell Brak
Multiple mould for jewellery
Oates, Oates, MacDonald 2001: 247-248, fig. 267.

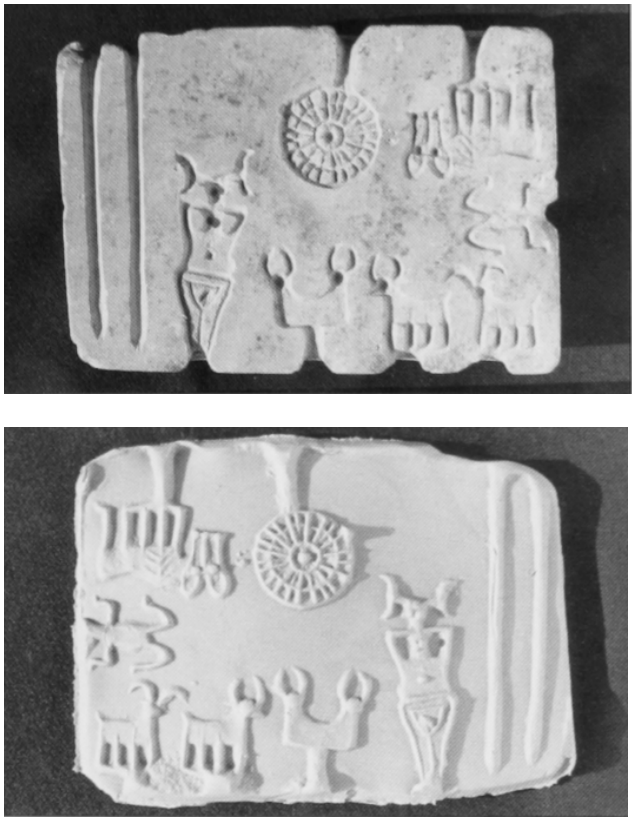

Fig. 30
Mari
Head of a bull
M 1069
Gold
H. 12.3 mm, w. 0.715 g
Early Bronze
Paris, Musée du Louvre
Nicolini 2010: 330, no.165.

Fig. 31
Umm el-Marra
Pendant with chain
UMM00 M-032
Gold
H. 2.6 cm, wid. 1.2 cm, th. 0.3 cm, w. 2.6 g
Chain l. 1.1 cm
Tomb 1
Early Bronze IV
Aleppo, National Museum
Schwartz *et al.* 2003: 334, fig. 15.

Fig. 32
Mari
Bracelet with linked beads
TH03.79 (bead), TH03.80 (chain)
Gold
Bead: L. 18, diam. 9.7, w. 1.25 g
Chain 1: L. 144 mm, w. 3.28 g
Chain 2: L. 142 mm, w. 3.37 g
Tomb VIIY49 SET3
Early Bronze Age
Deir ez-Zor, Archaeological Museum
Margueron 2004: 108, pl. 80.
Nicolini 2010: 309, no. 149.

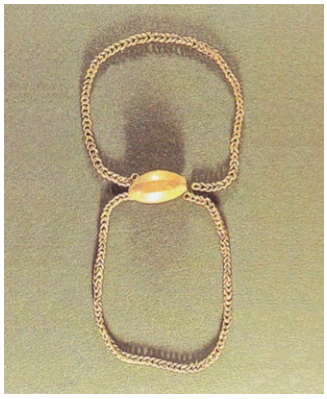

Fig. 33
Ebla
Necklace with two pendants
TM.78.Q.407
Gold, rock crystal and greyish-green translucent stone
L. chain 22 cm, L. stones 2 cm, diam. 0.8 cm
Royal Necropolis, Tomb of the Lord of the Goats, Hypogeum C
Middle Bronze II: ca 1750-1700 BC
Aleppo, National Museum.
F. Baffi in Matthiae, Pinnock, Scandone Matthiae (eds) 1995: 472, no. 398.