

The Metallurgy of the Sicilian Final Bronze Age/Early Iron Age necropolis of Madonna del Piano (Catania, Sicily)

La metalurgia de la necrópolis siciliana del Bronce Final/Primera Edad del Hierro de Madonna del Piano (Catania, Sicilia)

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ABSTRACT

This paper presents the analysis results of the copper-based finds, from the important Sicilian necropolis of Madonna del Piano, near Grammichele (Catania), dated between the local Final Bronze Age 2 and the Early Iron Age IA. 122 copper-based finds from the 273 graves (1970-71) of the large cemetery have been analysed.

The sampled objects belong to different classes, there are for instance weapons of offence and defence, such as swords and greaves, small decorative objects for personal use, such as rings, fibulae, belt hooks, belt decorations, and small tools, such as the knives used by women, reels, needles and razors, but also small functional parts, such as rivets and nails, repairs and even a kind of musical instrument, such as the tintinnabula.

The methods employed were AAS and SEM, where possible, and XRF in all cases.

The aim of the research was that of evaluating the skill of the local artisans, of determining the most common copper-based alloys in use in Sicily in this period and comparing the data with the analysis results of contemporary groups of finds from other areas of the Italian peninsula and from other European regions.

RESUMEN

El artículo presenta el resultado de los análisis realizados a los metales de base cobre de la importante necrópolis siciliana de Madonna del Piano, próxima a Grammichele (Catania), fechada entre el Bronce Final 2

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y la Primera Edad del Hierro IA. Se han estudiado un total de 122 objetos de base cobre procedentes de 273 tumbas excavadas entre 1970 y 1971.

Los objetos muestreados pertenecen a diferentes tipos, armas ofensivas y defensivas tales como espadas y grebas, pequeños objetos de uso personal como anillos, fibulas, broches de cinturón y pequeñas herramientas como cuchillos usados por las mujeres, carretes, agujas, navajas, pero también elementos funcionales como remaches, clavos y un tipo de instrumento como el tintinnabulo.

Los métodos de análisis utilizados fueron AAS y SEM, cuando fue posible y XRF para todos los casos. El objetivo de esta investigación es evaluar la habilidad de los artesanos locales y determinar el tipo de aleación más común en Sicilia durante este período, comparando los datos con los resultados obtenidos en grupos de hallazgos contemporáneos de otras partes de la península italiana y otras regiones europeas.

Key words: Final Bronze Age; Early Iron Age; Necropolis; Copper-based finds; Sicily; Madonna del Piano; AAS; XRF; SEM.

Palabras clave: Bronce Final; Primera Edad del Hierro; Necrópolis; Objetos de base cobre; Sicilia; Madonna del Piano; AAS; XRF; SEM.

1. SITE AND MATERIALS (Rosa Maria Albanese Procelli)

In 1970 and 1971 two excavations were carried out in the necropolis of Madonna del Piano,

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near Grammichele (Catania, Eastern Sicily) (Fig. 1). In this occasion 273 graves were brought to light (Albanese Procelli 1992, 1994, 2003; Albanese Procelli, *La Piana*: forthcoming). Previously, in 1889, 14 graves had been excavated by Paolo Orsi in the nearby site of Mulino della Badia (Orsi 1905). In 1959 further 47 graves had been discovered in Madonna del Piano (Bernabò Brea, Militello, *La Piana* 1969). The funerary gifts of 12 more graves were recovered in 1974.

The 1970-1971 excavations brought to light 844 copper-based grave gifts, 10 of which were composite objects (*tintinnabula* pectorals). 122 analyses were performed on around 75 objects (5 are sporadic finds). Different classes of objects were selected: decorative objects of personal use, weapons, tools and utensils. The largest group is that of the fibulae, with 206 specimens.

The wheel-shaped decorations, which, because of the position in the graves and the comparisons with Southern Italian funerary contexts, can be defined belt decorations, are typical of female burials. These have been found in ten of the graves. The specimens with the inv. n. 71209 from the grave 211 and inv. n. 71363 from the grave 255 have been analysed.

The so-called *tintinnabula* pectorals are particularly complex ornaments which belonged to few women who played a special role in the local community. Of these, the examples from the graves 197 and 255 have been analysed. These objects were most probably worn as pectorals



Fig. 1. The map shows the location of the site of Madonna del Piano in Sicily.

hanging from a bronze chain (as more complete finds show, see Bernabò Brea, Militello, *La Piana* 1969, Fig. 14, t. 5/1959) and tinkled whenever the person wearing them moved.

In grave 197 a zoomorphic pendant, of a kind documented also in three more graves (150 bis, 209, 251) was found under a fibula and perhaps it was hanging from it. Zoomorphic pendants in the shape of bovines or small bulls were found together with *tintinnabulum* pectorals in the graves 150bis, 197 and 251, but not in grave 209, therefore the connection between the two items cannot be confirmed (Fig. 2).

In the necropolis 4 plate-shaped belt hooks have been found in male burials, however the analysed example inv. n. 71354 from grave 253



Fig. 2. *Tintinnabulum* from grave 197, tubuli, perforated bar, rings and perforated calf figurine. NotaBene, on this photo the tubuli are arranged in the wrong direction. They hung vertically from the bar.

was found with a knife and this fact might indicate that it was buried in a woman's grave.

Only four of the male depositions contain weapons, 2 with a sword of Contigliano type (graves 26 and 40) and one of Alleronia type (grave 194) (Albanese Procelli 1994; Albanese Procelli, Lo Schiavo 2004). Both types have parallels in Southern Italy. Only the warrior in grave 26 had a set of offensive and defensive weapons. To this grave belongs the only pair of graves found up to now in the necropolis (and in Sicily). This type has Aegean prototypes and there are close parallels in Calabria and Campania (Albanese Procelli 1994).

Except for the graves the only further objects in the necropolis which show a repoussé decoration are some sheet metal discs with a central perforation.

Razors are present in 16 male burials. Of these 3 examples from graves 11, 194 and 195 have been analysed.

Knives with a one sided cutting blade seem to belong exclusively to female depositions. Their position in the graves seems to indicate that they were hanging from the belt. Over 60 specimens have been recovered and among the analysed pieces there were the knives inv. nos. 70589 from grave 7 (*enchytrismos* burial, Fig. 3) and 70577 from grave 4 (pit burial) which are of especially accurate manufacture. However the set of funerary gifts found in the two graves are common finds (fibula, finger ring, needle, jug and spindle in grave 4; fibula, finger ring and jug in grave 7). The remaining knives inv. nos. 71353, 71362 and 71208 come from the graves 253, 255 and 211 respectively. Graves 255 and 211 have a more complex set of burial gifts. For example in grave 255 there are 4 bronze objects, a *tintinnabulum* pectoral and a glass paste bead, while in grave 211 there are 5 bronze objects, vessels and an amber bead. The interpretation of the knife from grave



Fig. 3. Knife (inv. n. 70589) of good quality from grave 7. L.: ca. 19 cm.



Fig. 4. Miniaturised knife (inv. n. 71185) from grave 207. The tool has an awkward, not very functional shape. Perhaps it is a broken and readapted blade. L.: ca. 12 cm.

207 (Fig. 4) which shows traces of wear but was shown by the analyses to be less functional than other examples, is quite problematic, as the type of grave (a 1.58 m long pit) and the grave gifts – an elbow fibula of *serpeggiante* type, a finger ring, an ivory comb and a distaff made of bone – are not compatible with a child burial.

In other cases, and in particular in the case of *enchytrismos* burials there are funerary gifts which, because of their dimensions and typology, can be possibly interpreted as objects for children's burials. Of these there are examples which show a high level of complexity and indicate that their social standing was established at birth. The grave 260 with *enchytrismos* burial is that of a child and it contains anklets (inv. n. 71377) and a miniature fibula (inv. n. 71375).

The rods with perforated ends – interpreted as reels – and needles are connected with female working activities.

Metallurgical analyses allow important observations on the production technology and – with due caution, because of the still limited statistical basis – also some hypotheses on everyday life habits and on the funerary rituals. The latter show a great variability, both in the burial procedures – such as for example trench burials, *enchytrismos* burials and cremation – and in the large number of combinations in the set of burial gifts, with quantitative (between one and 16 objects) and qualitative differences, and give us an idea of the complex social organisation structure, divided into classes according to age, of the local community.

THE ANALYTICAL PROJECT (Alessandra Giumlia-Mair)

This project was initiated, because of the importance of the necropolis and to obtain analytical data on the metallurgy of Sicily, but also be-

cause previous analyses of materials from the Sicilian site of Modica and from the chronologically comparable sites, such as Pertosa, Cuma and Noepolis – all in the Pigorini Museum in Rome – had given interesting results concerning the production technology of some of the fibulae (Lo Schiavo *et al.* 2002; Giumlia-Mair, Lo Schiavo 2002). The analyses evidenced clear differences in the composition of the alloys employed for the different parts of some thickened bow- and elbow fibulae.

The results seemed to suggest that in Sicily leaded bronze alloys had been employed for cast on parts of fibulae as early as in the Late Bronze Age. On the other hand the analyses of materials from other Italian regions and from the area around the Eastern Alps had shown that leaded alloys, correlated with the function of the objects and with the production technology, had been introduced in the local metallurgy only at the beginning of the full Iron Age (Giumlia-Mair 1995; 1998 a; b, c; 2000, 2005b). Therefore a further important result of the analyses of the materials from Madonna del Piano was that of obtaining data which could be compared to that of the analyses of the fibulae from Modica, Pertosa, Cuma and Noepolis and confirm the use of leaded alloys also in this Sicilian area.

METHODS OF ANALYSIS

To be able to collect the maximum number of data and to obtain a preliminary screening of all selected objects it was decided to use X-rays spectrometry (XRF) on all metal finds. Wherever it was possible to obtain samples from metallic objects atomic absorption spectrometry (AAS) was also used. Corroded items were not selected for analysis and sampled.

Particularly interesting fragments, such as the fragments from the *tubuli* of the *tintinnabula*, but also small fragments of the organic material from the handle of the knives, were also examined and, in the case of metal, analysed in the scanning electron microscope (SEM/EDS) before the dissolution for the AAS analysis. The results have a precision of approx. $\pm 1-2\%$ for Cu, $\pm 5\%$ for elements present at a level greater than 1%, but decreasing to $\pm 50\%$ at the respective detection limits.

Before the XRF analysis and before sampling, all objects were examined with various optical magnification devices to determine the conservation conditions of each piece and to find the best area for sampling. Objects which were too corroded for analysis were discarded from the selection. The selected items belong to different classes and are of different usage: among the most important groups there are small decorative objects of personal use – such as fibulae, rings, anklets, pins and belt hooks – tools, such as needles, knives, razors and tools for reeling thread –, weapons – such as swords and greaves –, and important ritual items such as the interesting *tintinnabula*.

In the case of complex objects all different parts, also small mechanical parts, such as rivets and nails, were analysed.

DISCUSSION OF RESULTS

The analyses (see Table of results and Fig. 5) have shown that the average tin content in all objects analysed is around 9%, however the range is 4-14% (standard deviation 2,9), even if outliers, such as the belt decorations and *tintinnabula*, which contain higher tin percentages than the average, have not been taken into account in this calculation.

The highest tin contents were determined in the wheel-shaped belt decorations with up to

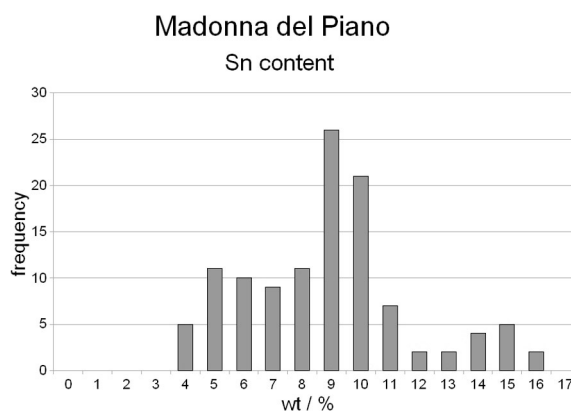


Fig. 5. The histogram shows the overall tin content of the analysed objects. The average is around 9%, but the range is 4-14%. The items with Sn contents over 11% are the *tintinnabula* and the wheel-shaped belt elements. The items with Sn contents under 7% are mainly everyday objects and tools.

17 % of tin. The objects with the lowest tin content are the knives found in the graves of women, the tools for reeling thread and the razors, but there are also other items, for example miniature objects used as funerary gifts in children's graves (see below) which contain low tin percentages.

Only a few objects among those selected for analysis are made of unalloyed copper. These are a piece of thread, found in grave n. 15 together with a fibula, a decorative part of a sword sheath made of wood and the thin nails which were employed to fix it on the wood from grave n. 48. In this particular case it is clear, that the choice of having nails made of copper, on a decorative piece of copper applied to a prestigious object like the sheath of a sword, is due to the wish of having all details made of a metal of the same colour for aesthetic reasons, however in other cases copper alloys with low tin contents were employed for very minor items, such as rivets and similar mechanical parts.

The copper employed for the objects from the necropolis seems in general to be very pure, with very little trace elements and it would be compatible with the copper of the oxhide ingots found in Sicily at Cannatello and in Thapsos (Lo Schiavo *et al.* 2005; 2009; Giunlia-Mair 2009a). It is well known that the trace elements determined in the oxhide ingots from different sites all around the Mediterranean and in European contexts are always extremely low and the copper has a purity of over 98-99 %.

As mentioned in the introduction, the use of lead (Fig. 6) as a functional and deliberate alloy-

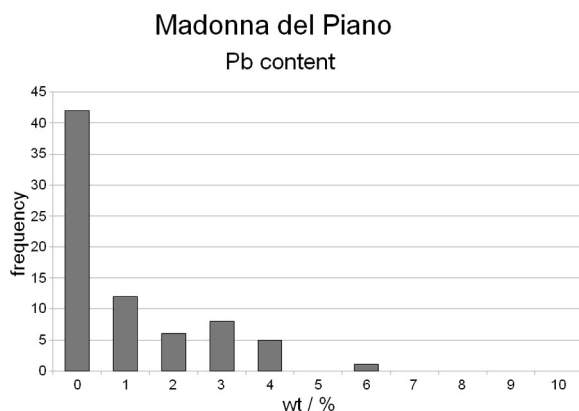


Fig. 6. The histogram shows the overall lead content of the analysed objects. Only very few objects contain more than 2 % and most of them are fibulae.

ing element, correlated with the production technology and the employment of the object is one of the most important points for this research and will be discussed below, in the section dedicated to the fibulae.

WEAPONS

The weapons recovered from the graves of Madonna del Piano are certainly some of the most representative and interesting pieces found in the necropolis.

The swords dated to this period which have been analysed in different contexts and in different regions of Europe and around the Mediterranean contain in average around 10 % of tin and are among the most carefully prepared and accurately worked classes of objects. Also the examples of swords found at Madonna del Piano are carefully finished items and in excellent condition.

Two of the swords are of Contigliano type. However, while the one contains ca. 8 % Sn and some Pb, the other – which also has a sheath with a point made of a good bronze, with a tin percentage of around 10 % – surprisingly contains only 5.3 % of tin. Both swords are in excellent condition and do not seem to have ever been used. This fact, together with the very low tin content of the second example, might suggest that these were ceremonial weapons, carried only in some special circumstances, or even that, at least the second sword, had been produced for funerary use only.

However an Aegean sword blade analysed by Craddock (1976: 102) and some examples found in the Ría de Huelva hoard and in other Iberian sites also have a similar composition (Rovira 1995; Rovira and Gómez 1998: 34-37), and, among the many swords from Greece, dated to the Late Bronze Age, analysed in the British Museum and with a tin average of 9.3 %, there are also some of lesser quality. Their tin content range goes from 6.8 to 12.4 % (Craddock 1976: 101) and their composition can be compared with that of the sword examples from Madonna del Piano.

The third sword found in the necropolis is of Alleronia type and the alloy which was used for its production is a well purified copper with around 10 % of tin, i.e. it is the most commonly employed alloy for swords. The third sword

seems therefore to be an efficient weapon which has certainly been used by its owner.

The swords from the Iberian peninsula analysed by Rovira (1995) contain in average around 10 % of tin and low percentages of lead. Their alloys are quite different from those employed for the swords analysed in the British islands and in France, which contain noticeably higher lead percentages, up to 5-7 % (Rovira and Gómez 1998: 82). The Mediterranean tradition in the manufacture of swords seems to be homogeneous and quite distinct from the metallurgical tradition in Northern European countries, in particular because of the lead content.

Greaves of Aegean type (inv. n. 70630) have been found in grave 26 of the necropolis (Albanese Procelli 1994 and above). It is important to note that among the finds from the necropolis there are only very few objects made of sheet metal. The preferred production technique seems to have been casting with only limited hammering for finishing some parts of the items.

Except for the greaves, the only analysed sheet metal objects from the cemetery are a thin decorative disc (inv. n. 70751) and the *tubuli* belonging to the *tintinnabula* (see below). The greaves belong to a small group of objects worked by repoussé and their production technology is quite different from that of most of the other finds (which are mainly cast and sometimes slightly wrought). This more time consuming technology seems to indicate that these defensive weapons were a special and highly prized item. Between the composition of the metal used for the greaves and that of the other objects from the necropolis no difference can be distinguished, however this does not mean that the greaves must be of local production. As already mentioned the copper employed for the production of all objects from the necropolis of Madonna del Piano is pure, with only low trace elements, and the presence of oxhide ingots on the island seems to testify that at least part of the copper employed in Sicily came from Cyprus. This does not exclude the import of copper from other areas or even perhaps some – most probably very limited – local extractive activity (which up to now has never been evidenced). The uniqueness of the greaves and of their production technology and decoration on the site of Madonna del Piano are therefore the only objective observation which can be expressed for the moment. However it should also

be mentioned that similar items are known from the Italian peninsula, in particular from Calabria and Campania (see Albanese Procelli 1994 and above) and that they might have been imported from there.

THE TYPOLOGY OF THE FIBULAE (Fulvia Lo Schiavo)

The class of the fibulae is one of the most important in the necropolis and it deserves a detailed discussion. The following study is part of a larger research on the fibulae of Southern Italy and Sicily (Lo Schiavo forthcoming) which takes into consideration the examples from Molino della Badia (Orsi 1905) and those from Madonna del Piano published in 1969 (Bernabò Brea, La Piana, Militello 1969). Fibulae and weapons are the largest classes of objects found in protohistoric cemeteries in general, and in particular in Madonna del Piano. The study of these finds allows us to understand larger cultural phenomena and supports the historical reconstruction of the population and the region (Albanese Procelli, Lo Schiavo 2004; Lo Schiavo 2008). The multidisciplinary approach is the only one which concretely helps overcome the problems of a partial understanding of the objects and of their presence in different combinations in the set of burial gifts. The technical data are a significant element in the development of fashion, customs and rituals (Lo Schiavo 2003; Albanese Procelli, Lo Schiavo 2004; Lo Schiavo *et al.* 2009).

In the group of 23 fibulae (sampled each 1-4 times with a total of 43 analyses) 18 types can be recognized (10 bow fibulae and 8 of *serpeggian-te*-type). Type 289 consists of 5 different varieties with 7 fibulae belonging to the same type. This is preliminary data, the entire study will be published in due time.

Fibule ad arco (bow fibulae)

The earliest analysed example is inv. n. 70792, a *Fibula ad arco semplice con parte centrale appiattita e sottile costolatura centrale* (Tipo 21 B, Fig. 7). This type is inhomogeneous, but typologically well characterized and parallel to the Castellace-type, produced in Ionian Calabria,



Fig. 7. *Fibula ad arco semplice con parte centrale appiattita e sottile costolatura centrale*, inv. n. 70792 (simple bow fibula with flattened central part and thin central rib). W.: 9,2 cm.

in the Locris area. It is documented in the Final Bronze Age 2, but was possibly also used later.

A *Fibula ad arco ritorto* (similar to type 27, n.70582) belongs to the same time and it is known from 3 sites in Eastern Sicily (Molino della Badia, Pantalica Nord grave 28 and Vizzini hoard). Peroni indicates the Final Bronze Age 2 as first appearance of this type. It was in use until BF 3 / I Fe 1A. 2 examples (70582, Fig. 8, and 70839) belong to *Fibule ad arco semplice con schema decorativo continuo* (type 31 B). They have a wide regular bow, a wide catchplate, and a small spring, often with a square section. The herringbone decoration covers the entire bow. The date is Final Bronze Age 3, Pantalica phase II (also called Cassibile-Molino della Badia).

The following types 44 and 47 belong to class VIII *FIBULE AD ARCO INGROSSATO DALLA SICILIA*.



Fig. 8. *Fibule ad arco semplice con schema decorativo continuo*, inv. n. 70582 (simple bow fibula with continuous decoration). L.: 7,1 cm.

Fibule ad arco ingrossato e decorazione incisa (type 44, here 71375) are of large and medium sizes with a semicircular uniformly thickened bow. The rich and various decoration allows us to distinguish different types. The date is Final Bronze Age 3, as confirmed by an example from the Modica hoard (Lo Schiavo, Albanese Procelli, Giunilia-Mair 2002).

The *Fibule ad arco ingrossato ed inornato* (type 47, here 70573, Fig. 9) are not homogeneous and are characterised by the absence of decoration and by the wide bow which is mostly not homogeneously thickened. The date is the same of the previous type.



Fig. 9. *Fibula ad arco ingrossato ed inornato*, inv. n. 70573 (fibula with thickened and non-decorated bow). W.: 7,9 cm.

The fibulae belonging to class IX *FIBULE AD ARCO INGROSSATO CON COSTOLATURE LONGITUDINALI E A SEZIONE POLIGONALE O QUADRANGOLARE* are typical for Molino della Badia/Madonna del Piano: these are the inhomogeneous types 48: *Fibule ad arco ingrossato con costolature longitudinali* (n. 71310, Fig. 10) and 49: *Fibule ad arco ingrossato e decorato con sezione poligonale* (nos. 71144 e 70750). Known examples are medium size, with a wide bow (and in one case a lowered bow). The decoration is different on all pieces. From the characteristics of the artifacts it is evident that they were produced in the workshop of Molino della Badia/Madonna del Piano and are dated to Pantalica II, Final Bronze Age 3.

A further inhomogeneous type from the same workshop and date are the *Fibule ad arco ingros-*

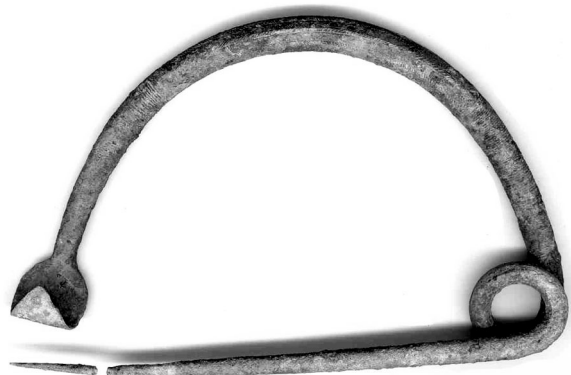


Fig. 10. *Fibule ad arco ingrossato con costolature longitudinali*, inv. n. 71310 (fibula with thickened bow and longitudinal ribs). W.: 14 cm.

sato con sezione quadrangolare o orizzontalmente appiattita (type 56). The studied piece (71389) is uncommon, because it is not decorated.

Fibule serpeggianti (Fig. 11) belong to class XXXIV: FIBULE SERPEGGIANTI A GOMITO. The earliest example analysed is a *Fibula serpeggiante a gomito con espansione centrale appiattita e costolata* (type 286 A, 70890), characterized by its large size, a thick twisted rod on the fore part (variety A) or by a square section (variety B), both on the front and back of the bow, while in the centre it widens to a rectangular section, with longitudinal ribs on the upper face. Undoubtedly they are of local production and dated to the Final Bronze Age 3.

A further analysed example belongs to the *Fibule serpeggianti a gomito decorate, a sezione rettangolare* (type 287.2), characterized by large size, open elbow, bow with rectangular section, here decorated on the rim of the upper face by two longitudinal, thin ribs (n. 70721). *Fibule serpeggianti a gomito con staffa simmetrica* (type 288) are represented by inv. n. 70776, which is near the variety C of this type: instead of groups of annular lines it shows a continuous decorative pattern. All examples are different, but the type is well characterized and recognizable. The date is Pantalica II, Final Bronze Age 3 as indicated by the piece found at Lipari, at earth level, outside the hut α II, dated to the archaic Ausonio II (Bernabò Brea, Cavalier 1980).

The best represented type are *Fibule serpeggianti a gomito con staffa allungata e spillone diritto, tipo Cassibile* (type 289), mostly large,

with a long bow, pronounced elbow and concave central part. The bow is thickened in the front and central part and becomes thinner near the catchplate, the elbow and the spring. The catchplate is elongated and the size of the spring is proportional to the size of the piece, mostly with a round section and a straight pin. At least 9 main varieties can be distinguished. Also this type is not homogeneous, but well characterised and recognizable.

Among the analysed pieces we have variety C (n. 70646) with groups of thin longitudinal ribs and groups of lines, and variety F (nos. 71101, 71369), with bands of lines. Other examples show different decorations (nos. 70623, 70395). Some fragmentary fibulae of the Castelluccio di Scicli hoard can be easily classified as belonging to these varieties. Giardino underlined the similarity of the decoration of examples from the hoard of Ria de Huelva, although the production technology is different (Di Stefano, Giardino 1994; Ruiz-Gálvez Priego 1995; Lo Schiavo 1992). Also the Castelluccio hoard is dated to the Final Bronze Age 3. The fibulae from the acropolis of Lipari are difficult to define because of their bad conservation. The shape is altered and there are only traces of decoration. The date can be assigned to the archaic period of Pantalica II, distinctive for Molino della Badia/Madonna del Piano. The pieces from Lipari (possibly the oldest examples), found under the huts α II and β IV (archaic Ausonio II), confirm this date.

The *Fibule serpeggianti a gomito con antenne a globetto* (type 291) are particularly interesting. Of these there are 3 (not identical) examples. One belongs to the Castelluccio hoard and its closest parallel is from Soria or Guadalajara, now in the National Archaeological Museum in Madrid. The Iberian example seems to have a round section and this and the schematic representation of this type on the stelae in Estremadura allow the hypothesis that Iberian workshops produced types similar to the Sicilian fibulae (Di Stefano, Giardino 1994).

Fibule serpeggianti a gomito a contorno quadrangolare (type 293) are also typical. They have in common a quadrangular bow, with 2 symmetrical and opposite elbows. The analysed example (inv. n. 70606) has no decoration.

Finally a *Fibula serpeggiante a contorno quadrangolare con due occhielli, staffa a spirale ed arco foliato con cappi ad 8, da Madonna del Pia-*

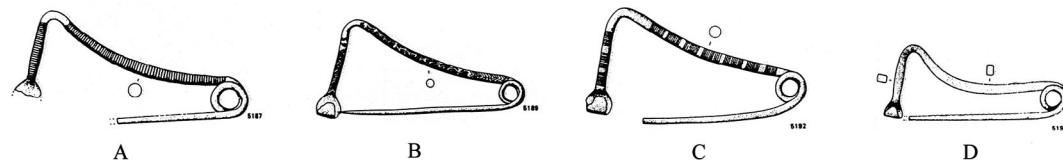
XXXIVth class: The Elbow Fibulae



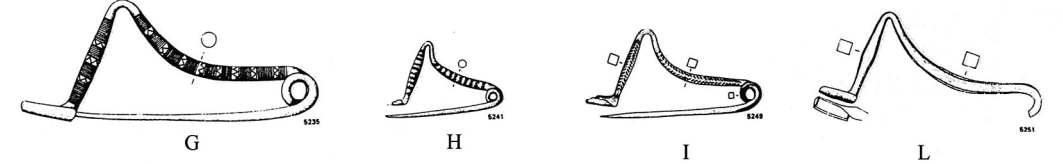
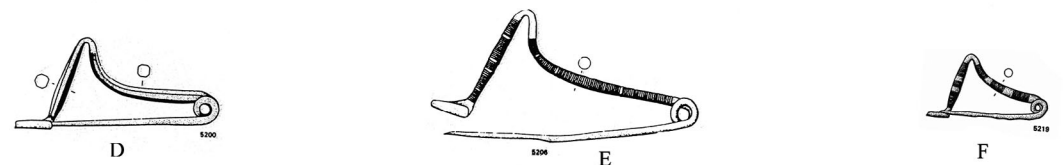
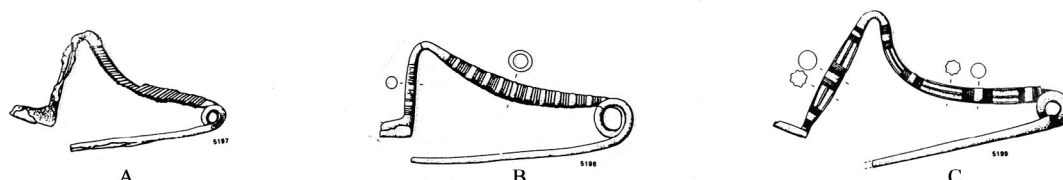
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Type 287.1

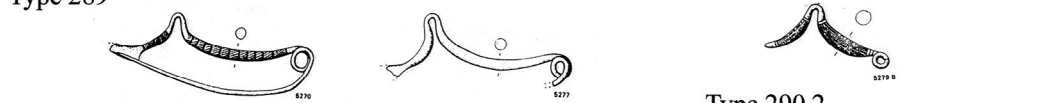
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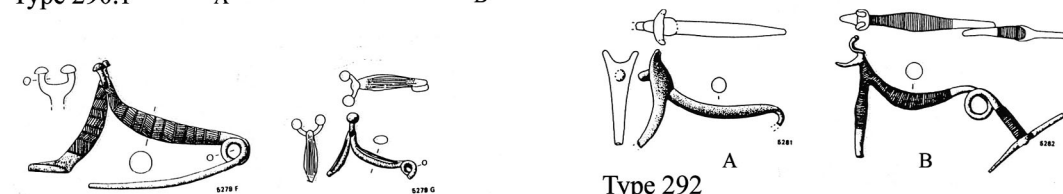


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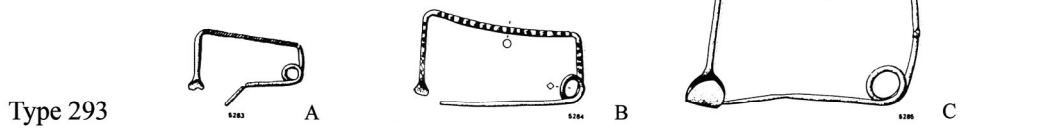
Type 290.1

Type 290.2



Type 291

Type 292



Type 293

Fig. 11. The different types of fibule a gomito from the necropolis (drawings Lo Schiavo PBF, forthcoming; layout G. Ugolini).

no (type 297 n. 71204) was also analysed. This type is well characterised and consists of several elements which are found in the full Protovillanovan in Central and Southern Italy and in Sicily. This is the oval plaque with longitudinal edge, the quadrangular bow, the 3 loops and the decoration on the fore part of the bow (cfr. type 289 variety G, also in the necropolis of Madonna del Piano). Parallels to the two 8-shaped loops and the spiral catchplate are found in 2 *fibule ad arco di violino di verga* of Vösendorf type and two 8-shaped loops and the decorated leaf-shaped bow in the Röschitz-Sanislâu type.

The typological study confirms the data of analysis and indicates the presence of a rich, characteristic, original and variegated local production. The workshop production was not limited to the local market, but it is also found in the entire area of eastern Sicily (and in Lipari), with sporadic finds in other parts of the island, and it is to be dated between the end of the Final Bronze Age (BF 3) and the beginning of the Early Iron Age (I Fe and IA).

There are interesting formal parallels both with Calabria and with the Iberian peninsula. The general impression is that there are affinities and analogies due to the circulation of models and not of objects connected to the dress and the set of ornaments.

FIBULAE AND DECORATIVE OBJECTS OF PERSONAL USE (Alessandra Giumlia-Mair)

The class of the fibulae is the largest among the finds from Madonna del Piano. The average tin content (Fig. 12) is 9.5 % (range 4.2-11 %). All fibula specimens were first cast (most probably in a simple clay mould) and only slightly wrought, with repeated annealing, after the removal of the casting skin, to obtain a sharp point and form the catchplate. In the group of fibulae analysed for this project the tin content shows a variation of 3 or 4 %, however the composition range is always in the alpha phase, i.e. the pieces are can all be worked by hammering and the alloy is always malleable.

The average lead content (Fig. 13) is 1.5 %, however the range is 0.1-6.3 % (standard deviation of 1.5) and clearly shows that there is a great variation in the content of this element. Only a

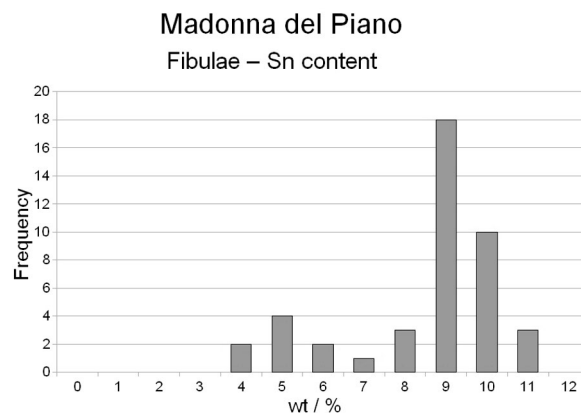


Fig. 12. The histogram shows the tin content in the fibulae. The average Sn content is 9.5 %, the range is 4-11 %. Only poor quality or miniature fibulae contain less than 7 % of tin.

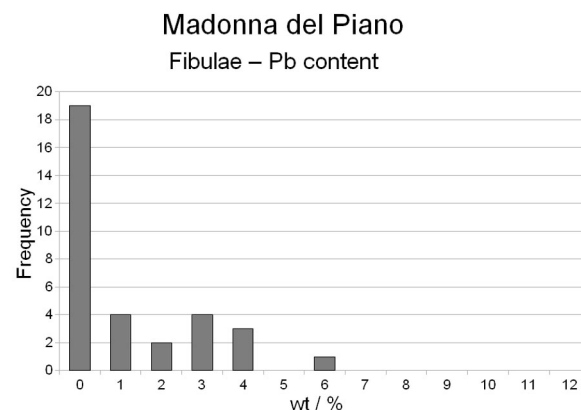


Fig. 13. The histogram shows the lead content of the fibulae. There are not many examples with a lead content over 3 %, but high lead is found in cast on parts. Therefore the addition of lead to the alloy seems to be deliberate and correlated with the technology (photos and histograms A. Giumlia-Mair).

few examples of fibula contain percentages of lead higher than 3 %. However it is important to note that the pieces which contain more lead seem to be produced in different parts. The fibula with the inv. n. 70582 for example shows very similar tin percentages in the bow and the pin. However, while the lead determined in the pin is very low, in the bow there is a lead content of 6 %. As it was the case with some of the fibulae from Modica, it seems that the bow was produced by casting the thickened part on the (elongated and curved) thin bar employed for the pin, by using a leaded alloy.

In this way the alloy had a high fluidity and reproduced in detail the decoration and there was no risk of ruining the pin, as the cast on part had a lower melting point.

The thickened and decorated parts of the elbow fibula with the inv. n. 71101 (Fig. 14) seem to have been produced in the same way and at the elbow there is also a very evident and quite rough repair, made with an alloy which contains even more lead than the bow. This seems to confirm that in the Sicilian Late Bronze Age leaded alloys were already deliberately and knowingly employed in correlation with technique and use of the piece in production.

A special case is that of the elbow fibula with *antennae* (inv. n. 71204, Fig. 11, type 291A, or *fibula de codo* with *antennae*), of a type which in Sicily is known also from the Castelluccio hoard found at Scicli, near Ragusa. However it has to be mentioned that this type of fibula is found also in Spain, for example in Guadalajara, and it is even represented on the famous stela of Torrejón el Rubio 2 in Cáceres (Ruiz Delgado 1989; Storch de Gracia y Asensio 1989).

The Iberian examples which have been analysed by Carrasco *et al.* (1999) contain high tin percentages, but no Pb (with one single exception). Relatively high tin contents have been also determined in the fibulae from Fraga dos Corvos in Portugal (Figuereido *et al.* 2009), but also in the Iron Age fibulae from Castro de Pragança (Melo 2009). The use of higher tin in copper alloys is not a surprise in a country in which this important metal was easier to find (Penhallurick 1986: 95-104; see also Giumlia-Mair, Lo Schiavo 2003). The example from Madonna del Piano contains 11 % Sn and it is therefore one of the ob-

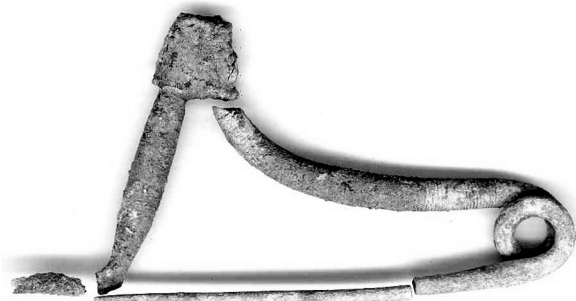


Fig. 14. Elbow fibula with thickened bow and repair inv.n. 71101. W.: 11,5 cm.

jects with the highest tin content found in the necropolis.

It is also important to underline that, while in the Italian peninsula no fibulae of this type are known, there are several ones in the Iberian peninsula, both in Spain and in Portugal, but that also other very similar types, called “oriental” or Cypriot types (Buchholz 1985; Lo Schiavo 1992 and in print) exist in various Mediterranean areas, such as for example in Spain, France and Sardinia. A study and in particular chemical analyses of these pieces would be quite important and might allow the reconstruction of the complex relationships between the different shapes and the contacts between the regions in which they are found.

The addition of lead to the alloys for cast-on parts seems for the moment to be a Sicilian invention and it appeared in Northern Italy only 2 or 3 centuries later (Giumlia-Mair 2000; 2005b).

Among the decorative objects of personal use analysed for this project there are also a miniature bow fibula (inv. n. 71375), a miniature fibula of Cassibile -type (inv. n. 71395) and the small spiral-shaped anklets for children (inv. n. 71377 sporadic). It seems quite possible that they have been manufactured for funerary use only, because the alloys employed are of lesser quality, with low tin percentages between 4 and 5 %.

KNIVES

Several knives belonging to the set of grave gifts found in female burials have been analysed. The results have shown that there is a great variation in the composition of their alloys. Some examples show an excellent quality, for example inv. n. 70589 (Fig. 3) and 70577, with the use of a carefully refined copper and a particularly well worked blade. These two specimens might perhaps have been objects of special status and this might also be indicated by the fact that the handle of one of knives (inv. n. 70577) has a handle made of ivory. Other examples of analysed knives (inv. nos. 71353, 71362, 71208 etc.) seem to be of more common manufacture.

In two cases the quality of the bronze used for the rivets which fix the handle on the blade is better than the metal employed for the blade. This seems to indicate that the artisans kept in the workshop small parts, cut from other objects, to

be worked into rivets. In one case (inv. n. 71353) the blade and the rivets seem to have been made of the same alloy. Most probably the pouring channels had been cut from the blade blank and hammered into rivets.

The largest groups of knives dated to this period which can be compared with the materials from Madonna del Piano are the Greek examples analysed by Craddock (1976, 99) and the knives from several central European sites analysed by Riederer (1992: 295-300; 1994-1995). They show similar compositions with an average tin content of 7.8 % (range 5.6-9.2 Sn %). Also the knives from the French Alps analysed by Verney and Bocquet (1998) are chronologically and compositionally comparable, and the saw (clearly a knife blade adapted to a saw) from a Calabrian hoard found south of Kroton and analysed by Alberto Palmieri (Marino and Pizzitutti 2008: 333-334) has a composition very similar to that of the knives from Madonna del Piano.

The Italian knives dated to the Iron Age (Antonacci Sanpaolo *et al.* 1992: 172-173; Craddock 1986; Giumlia-Mair 1998b: 201-202) have tin percentages between 6 and 8 %, while in earlier times the tin content of blades was much higher. For example the blades from Moscosi di Cingoli, dated to the Recent Bronze Age contain as much as 19 % of tin and clearly reflect the archaic technology of earlier periods (De Marinis *et al.* 2003: 21). It has to be noted that real bronze was introduced only in the Middle Bronze Age and that tin was an expensive and rare commodity that had to be imported from far away. For a long time arsenical copper was recycled and there are many instances of "strange" alloys: copper was occasionally mixed with other metals, such as lead and even silver as tin substitutes (see for example Tylecote 1976: 14-16; 1986: 26-35; Craddock 1976: 93-113; 1995: 144-17).

The miniature knife inv. n. 71185 from grave 207 (Fig. 4) represents a special case. For this object a bronze with only around 5 % of tin was employed and the blade has an anomalous and awkward arched shape, with a rounded point. In general this knife does not look like an efficient tool, however the suspension ring on the handle shows noticeable traces of wear as if the knife had been regularly worn hanging from the belt. The small size and the composition might suggest that the knife had been produced for funerary use, for example for the burial of a young girl (see

above), but the person in the grave is a woman, not a child. In this case, the awkward shape and the traces of wear, as well as the relatively low quality of the alloy, might perhaps indicate that possibly a common blade which had been broken was readapted for further use. The rather low tin content might be due to the reworking of the object. Nevertheless the study and analysis of more miniature knives might represent an interesting topic of research for the future.

TOOLS AND EVERY DAY ITEMS

In the male burials of the necropolis of Madonna del Piano there is a noticeable number of razors. They have been found in 6 % of the graves, however only very few examples have been analysed for this project, because of the bad conditions of conservation of this kind of objects. The analysed razors are made of bronze with low tin contents of around 6 %.

Their composition is similar to that of the knives found in female graves. The Bronze Age razors from Greece have a different composition, with higher tin contents (Craddock 1976).

The lowest tin percentages are those of the already mentioned tools for reeling thread, but in the case of these objects lead is also present in the alloy.

The composition of the razors, knives and tools found in the graves of the necropolis seems to indicate that the alloys for every day objects were not considered important and that cheaper materials were employed.

OBJECTS WITH HIGH TIN CONTENT: BELT ELEMENTS AND *TINTINNABULA*

From the metallurgical point of view, the most striking objects from the graves of the necropolis are the wheel-shaped belt elements (Giumlia-Mair 2005a: 362-364). The analyses have shown that they contain a very high tin percentage which goes up to 17 %. The belt decorations inv. nos. 71363 and 71209 consist of a flat ring and a smaller ring with an inscribed cross (Fig. 15) and were most probably worn attached to the belt. The alloy of which they are made is very different from that used for the belt-hook



Fig. 15. Wheel-shaped belt decoration. These objects contain high tin percentages. Diam.: ca. 7 cm.

inv. n. 71354, which contains only 6.3 % of tin and traces of lead.

The massive hook is quite solid and very suitable as a functional part of the belt, while the high tin content renders the wheel-shaped ornaments rather fragile. It does not seem possible that the thin circlets could have had a practical function, such as being an element for fixing or binding the belt. The most probable reasons for choosing an alloy with such a high tin content are the almost silvery colour of the metal, but also the pleasant jingling sound of the decorations, which had most probably an apotropaic function similar to that of the *tintinnabula* (see below) and kept away the “evil eye”. In later times alloys of this composition were employed for bells and *tintinnabula*, because of their pleasant sound (compare for example Giumlia-Mair 1988; 1992; 1996; 2000b: 303-304; 2001).

The shape and the colour of these belt decorations remind us very closely of the wheel-shaped pendants known from many contexts, in particular around the Alps, but also in some sites in southern Italy (Mordant *et al.* 1976; Wels-Weyrauch 1978; 1991; Lochner 1998-1999; Bándi and Fekete 1977-1978; Heath *et al.* 2000; Žbona-Trkman and Bavdek 1995-1996; Trampuž Orel and Heath 2001; Giumlia-Mair 2008; 2009b). They have many different shapes, some of which rather complex, and their colour is invariably silvery. In some cases this is due to the presence of elements like arsenic, antimony,

nickel and cobalt in the copper, in other cases the alloy is similar to that of the belt decorations, with a high tin content. Sometimes they seem to have been surface treated, perhaps with some kind of organic acid, so as to oxidise the copper of the alpha phase from the dendritic structure and leave the tin rich and more corrosion resistant dendrites of the delta phase to achieve a silvery colour (Heath *et al.* 2000; Trampuž Orel and Heath 2001; Giumlia-Mair 2003; 2005a; 2008; Paulin *et al.* 2003; Angelini *et al.* 2007).

As noted by Peter Turk (2001), wheel pendants – obviously with the exception of the ones belonging to hoards – have been found in particularly rich female burials, together with representative jewellery and other precious gifts. In each necropolis there was never more than one such grave for each generation and this seems to indicate that the person who was wearing this ornament had some special function in the society of the time. Biba Teržan (1987) considers them persons who had exceptional importance in the settlements and suggests that they were entitled to perform special rituals or ceremonies in favour of the community they belonged to.

Pendants of different shape, but surprisingly made of the same material, i.e. with the same silvery colour and found in very rich female graves and in similar contexts of the full Iron Age, have recently been recognised (Giumlia-Mair 2008; 2009b). The materials coming from the same necropolis had been previously analysed (Giumlia-Mair 1995; 1998a; c; 2003; 2003b; Giumlia-Mair *et al.* 2003) and they were all normal bronzes or leaded bronzes. The pendants and the set of ornaments belonging to them were the only objects made of this kind of alloy among several hundreds of items made of common bronze or leaded bronze.

This is certainly an important detail which might perhaps shed some light also on the meaning of the wheel-shaped belt ornaments from Madonna del Piano, and from other southern Italian cemeteries. The date, the shape and the colour are more or less the same as the wheel pendants, even if in some cases the colour is achieved by using different materials and alloys. In addition the belt decorations are found in particularly rich graves and they might be a distinctive object which denoted the special status of the woman who was wearing them.

The motive of the wheel is found all over Europe, and up to Scandinavia and it seems to belong to the general and diffused religious beliefs of the Bronze Age (but also of later times) and to be a powerful symbol in the society of the time.

In the past the wheel pendants have been interpreted as solar or lunar symbols, connected with fertility and water (Kossak 1954; 1990). Because of their colour, and as they always belong to women, the lunar context seems to be the better interpretation.

One of the two *tintinnabula* analysed (inv. n. 71360) has been found in the grave of the woman who was wearing one of the wheel-shaped belt decorations and it consists of 12 *tubuli* with 4 different diameter sizes, made of sheet metal, and 10 small rings, which were most probably worn as a pectoral. The *tubuli* and rings are made of alloys which contain up to 15 % of tin. Their different sizes definitely produced different chimes.

In this case it is difficult to reconstruct the original shape of the *tintinnabulum*, however the second piece, inv. n. 71155 (Fig. 2), is more complete in its part and a reconstruction can be attempted. The composite object consists of a perforated bar with 14 holes, 14 bronze tubules of the same size and composition, and 7 rings of different sizes. The tubules are made of well purified bronze with around 11 % of tin. The rings are all made of the same alloy, which contains over 15 % of tin.

The *tubuli* were most probably hanging from threads passing through the perforations in the bar. In this grave there was also a small cast figurine of an animal resembling a calf, vertically perforated through the centre from which the threads might have been suspended. Similar objects have been found also in other graves containing *tintinnabula* pectorals, except in one case in which only a bull figurine with a fibula was present and there were no *tubuli*. It seems that the zoomorphic part belonged to the same set or it could have been worn separately.

By tinkling at each step and movement, the *tintinnabula* had with all probability an apotropaic function and kept away the "evil eye", but they also attracted attention to the person who was wearing them and emphasised the richness of the attire.

CONCLUSIONS (A. Giumlia-Mair, R.M. Albanese Procelli, F. Lo Schiavo)

The analysis results allow us to draw conclusions on the technology level of the local community and the everyday habits and some funerary practice. They allow the hypothesis that the miniature objects found in children's burials are not functional, but were produced for funerary use only. The quality control in the swords production and in the manufacture of complex objects as the *tintinnabula* demonstrate the sophistication of the local workshops.

Comparisons with objects from the south of Italy, particularly Calabria, reveal close relationships, however our research on Sicilian material is for the moment pioneering work. Analyses of Campanian, Calabrian and Apulian contemporary material are still needed. In particular it would be interesting to extend the metallurgical analyses to Calabrian cemeteries on the Tyrrhenian coast (Torre Galli) and in the Locris area and (Canale, Janchina, Patariti) so as to examine the further developments of the production. Much more data is needed to establish the kind of relationship between Sicilian and Iberian elbow-type fibulae and which elements played a role in the production of these particular objects. Nevertheless it is quite important to note that this is (at least up to now) the earliest scientifically determined occurrence in Italy of the use of lead as alloying element employed in correlation with the production technique. The Sicilian cast-on technique in the production of thickened elbow fibulae segments has never been documented before.

The complete study of the finds from Madonna del Piano will be published in the *Notizie di Scavi d'Antichità*.

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Nr.	Object	Nr. Inv.	Part	Cu	Sn	Pb	As	Sb	Fe	Ni	Co	Ag	Zn	Mn
1	fibula	70750	bow	91,2	6,3	0,08	0,02	0,04	0,2	0,04			0,1	
2	disc	70751		88,5	8,9	0,02	0,02	0,02	0,1	0,01				
3	razor	77150	blade	90,3	6,2		0,03							
4	knife	70589	blade	87,1	11,0	1,50	0,01	0,03	0,2					
5	pin	70579		90,2	7,4	0,05	0,07		1,2			tr.		
6	knife	70577	blade	83,9	14,0	0,03			0,5					
7	knife	70577	rivet 1	98,0	–	tr.	tr.		1,8		0,01			
8	knife	70577	rivet 2	97,0	–	tr.			2,3				0,6	
9	ring	70580		86,2	8,2	3,00	0,20		0,4					
10	fibula	70573	bow	88,9	9,8	0,20			0,2					
11	ring	70574		87,7	11,0		tr.		tr.					
12	sword	70870	blade	90,2	7,9	0,70	0,40		0,4			tr.		
13	sword	70870	rivet 1	89,4	8,0	0,90	0,20		0,8				0,3	
14	sword	70870	rivet 2	91,2	7,0	0,70			0,5				0,2	
15	fibula	70582	pin	91,7	5,6	tr.	0,10							
16	fibula	70582	bow	87,8	5,3	6,32	0,20						0,4	
17	fib. bow s.	70617	bow	88,1	9,1	1,50			0,4					
18	fib. bow s.	70617	pin	89,2	10,0	0,10			0,1					
19	point	70870		89,6	9,7	tr.	0,20		0,3		0,01			
20	scabbard sh.	70870	sheet	98,8	–	–	0,10		0,4				0,3	
21	rivet	70870	rivet	89,3	9,2		0,40	0,10	tr.	tr.				
22	rivet	70870	rivet	93,7	5,7	0,50			0,1					
23	fib. elbow	70623	pin	90,2	9,2	tr.	0,20		0,5	tr.	tr.		tr.	tr.
24	fib. elbow	70623	bow	89,8	10,0	2,20		tr.	0,5				tr.	
25	razor	70593	blade	90,1	6,7				0,1					
26	razor	70593	handle	89,8	7,2		0,03							
27	f. foliata	70792	spring	90,7	9,2									
28	simple bow f.	70839	bow	90,6	8,5	0,07			0,03					
29	simple bow f.	70839	bow	90,8	8,0	0,10			0,4					
30	simple bow f.	70839	pin	89,2	8,8	–			0,1					
31	fibula	71310	pin	87,8	10,3	0,20			0,2					
32	fibula	71310	catchplate	87,5	11,0	0,10			0,8					
33	fib. elbow rit.	70890	pin	87,2	8,1	2,60	0,04	0,30	0,5	tr.			0,3	tr.
34	fib. elbow l.	70721	pin	92,5	6,0	0,20			0,3					
35	fib. elbow l.	70721	spring	91,8	6,5	0,20	tr.		0,2	tr.		tr.		
36	fib. elbow l.	70776	pin	88,3	11,0	0,30			0,2					
37	fib. elbow l.	70646	bow	89,1	10,0	0,10		0,10	0,7					
38	fib. elbow l.	70646	bow d.	87,4	10,0	0,20			1,4					
39	fib. elbow l.	70646	catchplate	88,7	9,8	0,20			1,3					
40	fib. elbow rep.	71101	repair	81,2	11,0	3,50	0,60	0,30	1,2	tr.		tr.	tr.	
41	fib. elbow rep.	71101	bow	86,6	11,0	1,20			0,3				tr.	
42	fib. elbow rep.	71101	bow	83,2	11,0	3,30			0,8					
43	fib. elbow rep.	71101	bow	83,5	12,0	3,10			0,7					
44	sword	70627	blade	93,6	5,3	0,30			0,2					
45	sword	70627	point	91,5	8,4	tr.			0,3					
46	sword	70627	sheet	90,2	9,3	–	tr.		0,7				tr.	

Table 1. Madonna del Piano – integrated XRF–, AAS– and SEM/EDS results (% in weight).

Nr.	Object	Nr. Inv.	Part	Cu	Sn	Pb	As	Sb	Fe	Ni	Co	Ag	Zn	Mn
46b	sword	70627	sheet	91,3	8,3	–	tr.		0,5					
47	sword	70627	rivet	89,7	9,7	0,30			0,5					
48	sword	71146	blade	85,8	11,2	1,80	tr.		0,7	tr.		tr.		tr.
49	sword	71146	point	86,2	9,4	2,70	0,50	tr.	0,2			tr.		
50	sword	71146	rivet 1	88,9	8,7	0,70			1,1	tr.		tr.		
51	sword	71146	rivet 2	90,4	8,5	0,40			0,5	tr.				
52	sword	71146	rivet 3	90,6	8,5	0,50			0,5			tr.		
53	sword	71146	rivet 1	98,5		tr.			0,9			tr.	tr.	
54	sword	71146	rivet 2	98,8		tr.			0,8					
55	sword	71146	sheet	98,3		tr.			1,2					
56	greave 1	70630		88,4	10,3	0,80	0,30	tr.	0,2					
57	greave 2	70630		87,1	10,6	1,20	0,40	tr.	0,4					
58	knife	71353	blade	90,7	6,4	0,90			1,5	tr.				
59	knife	71353	rivet 1	91,2	5,9	0,80			1,3					
60	knife	71353	rivet 2	91,4	6,1	0,80			0,9	tr.				tr.
61	knife	71353	rivet 3	91,2	6,2	0,70			0,9				tr.	
62	belt hook	71354	hook	92,2	6,3	0,50			1,2					
63	knife	71362	blade	89,3	8,2	1,60			0,5					
64	knife	71362	rivet 1	88,6	10,5				0,4					
65	knife	71362	rivet 2	88,4	10,2				0,5					
66	belt decor.	71363	cross	78,3	17,0	0,80	0,50	0,40	0,4	tr.				
67	belt decor.	71363	ring	79,8	17,0	1,10	0,40	0,30	0,3	tr.				
68	tinnabulum	71360	tub. Large	88,5	10,9				0,5					
69	tinnabulum	71360	tub. med.	87,7	11,8	tr.			0,6				tr.	
70	tinnabulum	71360	tub. Small	86,9	12,2				0,3					
71	tinnabulum	71360	tub. Small 2	88,2	11,6				0,2					
72	tinnabulum	71362	ring 1	85,3	13,2	tr.			0,7		tr.			tr.
73	tinnabulum	71362	ring 2	85,8	12,8	tr.			0,9			tr.		
74	f. bow	71144	bow	88,8	10,5	0,30	tr.	tr.	0,6					
75	razor	71145	handle	93,7	4,5				0,8				tr.	
76	f. elbow	70606	bow	89,4	10,2	tr.	tr.		0,3					
77	wire	70605		98,9					0,9					
78	f. antennae	71204	catchplate	88,7	10,0	0,20	0,20	–	0,1				tr.	
79	f. antennae	71204	antennae	88,2	9,2	1,20			0,4	tr.				
80	f. antennae	71204	bow	89,6	11,0	–			0,2					tr.
81	f. antennae	71204	pin	89,8	10,0				0,1					
82	belt decor.	71209	int. cirlet	84,1	14,8	tr.	tr.	tr.	0,1			tr.		
83	belt decor.	71209	ext. cirlet	83,4	15,0	0,70	tr.	tr.	0,1					
84	knife	71208	blade	90,2	6,0	2,20			0,7					
85	knife	71208	rivet 1	88,9	8,0	1,10			1,5	tr.				
86	knife	71208	rivet 2	89,3	7,5	0,90			1,3					tr.
87	knife	71208	rivet 3	89,2	8,0	1,10			0,9	tr.				
88	reel	71205		85,4	7,3	4,20			0,4					
89	f. elbow	71369	catchplate	87,1	11,2		tr.	tr.	0,6					
90	f. elbow	71369	bow long	88,2	10,0	0,60			0,8					
91	f. elbow	71369	bow short	87,4	9,5	1,40	tr.	tr.	1				tr.	
92	f. elbow	71369	pin	87,9	11,0				0,8					
93	f. 3 loops	70961	plaque	92,3	4,2	0,80			0,3				tr.	
94	f. 3 loops	70961	bow	91,1	4,5	0,90			0,3					
95	knife	71385	blade	91,6	5,2	2,10	tr.		0,4					
96	reel	71418	head	93,7	4,2	3,20			0,6	tr.				tr.
97	reel	71418	centre	90,2	4,5	4,00			0,3					
98	reel	71406	centre	91,3	6,2	1,80			0,2					
99	tube	71406		92,4	5,2	0,60	0,03	0,01	0,5	tr.			tr.	
100	tinnabulum	71155	barra	91,7	7,2	0,30	tr.	tr.	0,4					
101	tinnabulum	71156	tube 1	88,6	11,0				0,3					
102	tinnabulum	71156	tube 2	89,2	10,7				0,3					
103	tinnabulum	71156	tube 3	88,2	11,3				0,2					
104	tinnabulum	71156	tube 4	88,5	10,8				0,1					

Table 1. Madonna del Piano – integrated XRF–, AAS– and SEM/EDS results (% in weight) (continuación).

Nr.	Object	Nr. Inv.	Part	Cu	Sn	Pb	As	Sb	Fe	Ni	Co	Ag	Zn	Mn
105	tintinnabulum	71165	toro	85,3	10,2	3,50	tr.	tr.	0,2			tr.		
106	tintinnabulum	71161	ring	84,2	14,3	tr.			0,1					
107	tintinnabulum	71161	ring	83,4	15,2	tr.			0,2					
108	tintinnabulum	71161	ring	83,3	15,3	tr.			0,1					
109	tintinnabulum	71161	ring	84,5	14,9	tr.			0,1					
110	tintinnabulum	71161	ring	83,6	15,2	tr.			0,2					
111	tintinnabulum	71161	ring	83,5	15,1				0,1				tr.	
112	tintinnabulum	71161	ring	83,4	15,3	tr.			0,2					
113	anklet	71377		86,8	7,2	4,20			0,6	tr.				tr.
114	anklet	71377		87,9	6,6	3,80			0,5					
115	f. bow	71375	bow	88,2	6,0	5,00	0,03	tr.	0,2		tr.			
116	f. Cassibile	71395	bow	85,4	10,0	4,00			–					
117	f. Cassibile	71395	catchplate	85,3	10,0	4,20			–					
118	f. bow rit.	71136	bow	90,2	9,2	0,40							tr.	
119	f. bow dec.	71135	bow	88,3	11,3	tr.			0,1	tr.				tr.
120	knife	71185	blade	93,8	5,2		tr.		0,2					
121	f. ribbon	71389	bow	84,9	9,8	4,30			0,5					

Table 1. Madonna del Piano – integrated XRF-, AAS- and SEM/EDS results (% in weight) (final).