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Craft Specialization: Operational Sequences and Beyond

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Technological Study as a Means of Identifying Bronze Production Forms: The Archaeological Record of Etruria in the Early Iron Age Period

Anne Le Fèvre-Lehöerff

INTRODUCTION

The aim of this paper is twofold: not only do we wish to propose various new lines of thought to those who work upon the same material and whose interests correspond with ours, that is to say concerning specialized crafts and the possibility of establishing lines of production, but also to furnish a small series of results upon one specific aspect of the latter.

The following aspects are discussed: firstly certain methodological problems related to bronze metallurgy in central Italy; secondly, some proposals and hypotheses concerning different types of bronze working at the end of the second and the beginning of the first millennium BC (the hypotheses and the results presented here are extracted from my doctoral thesis in archaeology at the University of the Panthéon-Sorbonne, Paris I).

BRONZE WORKING IN CENTRAL ITALY: INTERPRETATION OF THE EVIDENCE

Understanding bronze working in central Italy between the Late Bronze Age and the beginning of the Iron Age is not easy. That being said, the geographical area together with the period taken into account present certain advantages which one does not necessarily find elsewhere, especially in protohistory. In effect, central Italy, especially on its Tyrrhenian facade, has attracted a great deal of attention. A direct corollary of this is that there has been a steadily increasing number of studies concerning its territorial, economic and social transformations during the end of the second and the beginning of the first millennium BC (see Peroni 1969, 1989, 1994, 1996; Bietti Sestieri 1981, 1996; Barker & Stoddart 1994). When viewed from a metallurgical perspective, this allows us certain possibilities in studying the bronze working production techniques, helping us to work our way back from the objects towards the craftsman who made them.

Our knowledge, however, is far from perfect. Even if the general context is promising and particularly stimulating, the material necessary for a specific technological study presents problems. In order to examine production processes, and all their technical possibilities, information is required not only about production sites but also about tool fragments, moulds, crucibles, wasters, roughouts, unsuccessful objects, etc. Since much of these extant remains in themselves rarely tell us little, one also needs to

have a good first hand knowledge of the material in order to be able to identify and recognise it on sites (see Chardon-Picon & Pernot in press and references therein). Until very recently, such prerequisites were not seriously addressed in central Italy, and in fact the first proper attempt to specifically answer these questions dates to 1992 (Antonacci Sanpaolo 1992; Francovich 1993). In the initial studies, one finds that it was the Anglo-Saxon and German authors who were more concerned with these questions (e.g. Barker 1971 and Formigli 1993 which represent an attempt at synthesis after having conducted several years of research in Italy or in Germany).

For the Protovillanovan and Villanovan periods the systematic excavation of huge and impressive cemeteries such as Veio (AA.VV. 1963, 1965; Toms 1986), Tarquinia (Hencken 1968) and Terni (Müller-Karpe 1959) has furnished us with more information than anything else has been able to offer for well over a century (see Bartoloni 1989). Late Bronze Age hoards have also attracted the interest of the researchers (Carancini 1979; Pellegrini 1989; Peroni 1963, 1967; Ponzi Bonomi 1970). More recently, especially under the impulse of the British School at Rome, important questions of urban morphology and land use have been raised (see Potter 1985; Negroni Catacchio 1977, 1981; Pacciarelli 1982; Di Gennaro 1982; Rendelli 1993). Even if on the other hand, for a long time bronze metallurgy has been universally considered as fundamental (as reflected in *L'Etruria mineraria, Atti del XII convegno di studi etruschi e italici* 1979 [Florence 1981] and Camporeale 1985), much of this work has only focused on the chronological and stylistic problems, or upon its role in the processes of commerce and exchange (for the problems concerning type-series, see Peroni 1980 and the volumes in *Prähistorische Bronzefunde*; for the question of exchange in connection with metallurgy, see Bietti Sestieri 1973, 1976/77, 1981a; Lo Schiavo *et al.* 1985; Giardino 1995; to avoid unnecessary repetition, the reader should consult the remarks and bibliographic references found in Le Fèvre-Lehöerff in press b).

Questions might be asked here concerning the situation leading to the present state of research. The interest that has existed for some time in Etruscan metallurgy ought in fact to have led to more systematic research into the structures of production of their ancestors. In effect, a certain number of studies have clearly demonstrated the importance of metallurgy at the end of the second millennium BC. The fact still remains nonetheless that these are attempts which can rarely be classed as genuine technical studies, contrary

occasionally to what might be claimed. In the 1930's the History of Techniques was underlined by L. Fèbre and the Annales School as a discipline still to be created. Moreover, in 1926, M. Bloch devoted his article *Technique et évolution sociale* to the subject. In France, as in the Anglo-Saxon world, this type of problema was fiercely debated early on in the archaeological field. As concerns other materials and other periods such as those known for their use of metal, note the importance of the school of A. Leroi-Gourhan (1943, 1945) whose influence went beyond that of the domain of prehistory with, for example, the creation in the 1980's of the journal *Technique et Culture*, with the support of other researchers such as P. Lemonnier (e.g. 1993). Also influenced by the thinking of M. Mauss, A.G. Haudricourt brings together a part of his works in *La Technologie Science Humaine* (1987). The studies conducted in Italy upon this theme still remain marginal, at least for the periods pre-dating the Etruscans (see above). On the other hand, outside the field of the history of techniques, the problems concerning the continuity of occupation of certain settlements and certain future towns makes excavation complicated.

Whether it be a consequence or an explanation of the state of research, the fact remains: all evidence pertaining to bronze metal working is scarce. In fact, we are mainly limited to only one type of source: the objects themselves. This is not entirely the case, since some material exists such as the moulds found in the cave at Scarceta (Soffredi 1973). No workshop nor any slag coming from metal production exists that can match the numerical importance of the pieces discovered in central-Tyrrhenian Italy, with the exception of Sardinia. The available evidence is however promising for possible discoveries in the future. Hence, although the moulds made of stone are easily recognisable on excavated sites, this is not necessarily the case for those made of other materials and other processes. Workshops using non permanent moulds are much more difficult to identify, unless found in great quantity. Consider the site of Bibracte and the experimental work conducted there (Pernot *et al.* 1993). Remains corresponding to each of the different sequences in the manufacturing process are for the most part missing. These, when viewed as a "chaîne opératoire", would allow us to reconstruct the functioning and the technological diversity of a workshop, of a place, or of a group of people. Even if the role of metal working is considered to be important for our understanding of society at the end of the second millennium BC, little if anything allows us study it. Since no Bronze Age workshop has yet been unearthed and its remains studied, some have been inclined to think that there is no room left for debate, or perhaps so one might think. However, by observing the progress made in more recent periods, periods that are much richer in material remains, one might ask whether this wealth of workable data has in the end led to the foundation of better arguments, and more viable conclusions. Or should the latter statement be considered as just an easy way of side-stepping the problem in hand? Surely the quintessence

of our research is to interpret and form hypotheses, whatever the risk of error might be, even with the most conclusive-looking data? The latter mode of thinking has been adopted in forming the following methods of approach.

METHODOLOGY: THE OPTIONS

The lynch-pin of this research concerns a flourishing craft industry dated to the end of the second and the beginning of the first millennium BC for which we have very little evidence. Hence, before any in depth study can be attempted, certain key methodological terms must be established.

The term "artisan production" encapsulates the representative character of the varying technical capacities in any given geographical area. Since the body of material ought to reflect this definition, even if composed only of finished metallic pieces, the whole corpus is processed in several stages, according to the foregoing criteria. Since we can never hope to know the scale of production in a town or in a workshop, one is forced to resort to what one might call a "representative sampling of a product range". Once selected, this is then processed. In the absence of an entire type-series, all non-classified but existing pieces from a certain number of archaeological contexts are gathered, whatever these may be. Thereafter, a hierarchical classification system is set up. This should include classifying the objects according to "class", "group" and "type". For example the type "Tarquinia with antenna" belongs to the class of swords, which falls within the group weapons. Thirdly, a technical study is conducted for a dozen pieces belonging to each type. The objective is to try to establish an inventory of identifiable technical processes. Let us take for example the group 'ornaments', which comes under the class of 'clothing ornaments' and the type "Tarquinia" in which one finds a particular sort of "metal girdle" (Figure 1). For the latter, all aspects concerning its founding, hammering, decoration and repair are investigated. Initial observations are conducted by visual examination with the aid of a binocular microscope.

FABRICATION AND DECORATION: THE LABORATORY

Although initial observations are indispensable in identifying a certain number of characteristics, some finer aspects call for more elaborate means, such as a metallographic examination. This is particularly the case where decoration bearing linear lines is concerned. Without further observation, it is difficult to know if the workmanship consists of, for example, chasing or engraving. The experiment carried out at the British Museum (London) by I. MacIntyre is revealing: as director of the laboratory responsible for metal restoration, he has claimed for many years that observation with the naked eye

is insufficient in determining whether designs traced on metal have been formed by engraving or chasing. With a characteristic British sense of humour, he set up a small test for his visitors. Five different decorations were traced onto a metal sheet, each one distinguished by a symbol and upon another the corresponding techniques that were used to create them. Ever since, he has been trying to find someone who is able to match them successfully! In this instance, only a study of the microstructure of the metal, with or without chemical etching, would allow for any hypotheses to be formed. The metallographic examinations of the copper based alloys were carried out on altered materials, for which there is no systematic treatment. For certain samples chemical etching is not always the best option.

Intergranular corrosion that occasionally leaves traces on the material (mechanical twin especially), testifies to the type of treatment it received at the metallurgic stage in which it was left. On the other hand, the unique application of chemical etching, or its improper use, can sometimes leave the microstructure more damaged than it was prior to application. The points to bear in mind are the following: the sample should be taken from a well identified area, so that we know what we are looking at; the samples should be taken one at a time according to the material; and the objectives should be clearly defined beforehand for each test. The question of metallography combined with the analysis of metallic composition is not without its problems. Since the latter often requires sampling, which is said to be 'destructive', this can easily lead to clashes between curators and restorers whose interests are not always the same, especially when the restorers come up against the methods and problematics of the curators. That being said, laboratory analysis is a precious tool, necessary for confirming or invalidating certain hypothesis, and much needed in any study of metal working techniques.

The decoration found upon two metal girdles of the "Tarquinia type" has recently been subject to research. The belts represent a sample from a whole group of other metal girdles. One of these comes from the cemetery of Monterozzi in Tarquinia (Figure 2) and is currently housed in the Museum of Tarquinia (Italy), inventory number 250. The second belt is in the Ashmolean Museum (Oxford), inventory number 1890-619. The provenance of both is unknown. For ease of writing in the text we thus distinguish the belt of "Tarquinia" from that of "Oxford". The metal girdle of Tarquinia had two samples taken from it. The first was taken from a centrally situated hole, made in order to study part of the linear decoration, and the other from a small bump located on the outer most part of the decoration, running along the edge of the object. The belt of the Ashmolean Museum was also sampled twice: the first sample was taken by widening one of the perforations of the fastening, and the second was taken from a metal patch that had been used to repair the back of the main plate. In all cases, samples were taken in such a way as to obtain a transversal cut, perpendicular to the linear decoration.

Subsequent metallographic examinations of these samples allowed the following points to be made: the belt of Tarquinia (Figure 3) revealed corrosion on the surface to a thickness of 100 to 200 μm . It is on this layer, separated from the metallic core by a gap of about 20 μm , that the decoration rests. In this case, and also for a study of the decoration, chemical etching would be useless. In section, it appears as a triangle for which the third side, on the level of the surface, has disappeared. It is made of two slightly rounded segments that meet in an obtuse angle at the bottom of the decoration. Conversely, the junction between the line of the decoration and the surface of the piece is an acute angle, the latter being curved slightly by the impact of the tool when the decoration was made. Besides the shape, clues concerning the sort of decorative technique employed upon the girdle come in the form of sulphur inclusions, clearly visible as black against red in the dark field light. The inclusions are all aligned and are elongated by up to 20 μm . At the level of the decoration itself, the alignment changes to follow the curved lines on either side of the groove. However, on the back of the decoration, the inclusions quickly regain their regular alignment, which is rarely interrupted.

The decoration examined in the Oxford sample shows different characteristics (Figure 4). On this occasion, the profile is rounded to create a decoration twice as deep (approx. 200 μm against 100 μm). Moreover, the modification of the surface is less and its orientation opposite to that of the previous sample. On each side of the decoration, the surface tends to bend in on itself, and not the reverse. The elongated sulphur inclusions are less clearly oriented and are seen to gain in thickness, almost reaching 100 μm . Whilst this phenomenon remains more or less constant over the entire decoration, in the Tarquinia sample, where the decoration is less profound, a difference occurs. In this sample, although the orientation of the sulphur inclusions is clearly modified at the bottom of the groove, they do not seem to have been significantly altered when the decoration was applied. Although it is too early to propose an interpretation about the types of tools and the manufacturing techniques employed, one may nevertheless draw a few tentative conclusions. The foregoing analysis indicates that chiselling was used rather than engraving. There is no removal of metal, merely displacement, which explains the change in orientation of the sulphur inclusions, instead of their sectioning. However, even if it is a case of chiselling in both artifacts, the technique and the tools used are probably different. The work on the piece from Oxford seems to have been conducted by applying force to an implement with a rounded end. The piece from Tarquinia however was most probably made by means of light tapping upon the surface using a sharp-headed chisel.

The aim here has been essentially to demonstrate the distinctions that can be made between chiselling and engraving using metallographic analysis. Besides this basic distinction, a long-term study would probably help improve

our knowledge in many ways, especially in the field of tool types and decoration techniques. Besides these two examples, I was only able to conduct metallographic examinations on a limited number of pieces. The confirmation of hypotheses concerning the techniques used together with the tools (a question currently being studied in France for other types of objects, and in particular I am referring to the work of M. Pernot and B. Armbruster at Dijon), presented here only in part, will need more study. In particular one might ask whether or not the craftsmen at the beginning of Iron Age had the tools and the techniques necessary to undertake engraving.

FROM DECORATIVE MOTIF TO TOOL: SOME PROPOSALS

Above and beyond the technical inventory we have just outlined, the second objective is to attempt to study in a much broader way the art of the craftsmen themselves. Notwithstanding the limitations of our material (see above), this immediately involves trying to trace some sort of chronological evolution in the bronze working techniques, and throwing light onto the problems that concern workshops, authorship, and the organization of production. On an even broader level, it involves the forming of hypotheses concerning the links between metal working transformations and the evolution of Protovillanovan and Villanovan society. Technological results aside, let us not forget that the quantity and quality of the material at our disposal is as always extremely poor. Here, just a few proposals are made.

After having drawn up an inventory of bronze working techniques in central Italy during five centuries, one notes a complex evolution of techniques. These tend to turn around type, class and category of object, some of which undergo big transformations within the period studied. For this aspect which has not been developed here in detail, the reader is asked to consult the publication dealing with the first results, now finished, which show the characteristic of evolution in technique (Le Fèvre-Lehöerff 1998b). However, a preliminary study has been made of the fibulae of the same period, proposing certain variations within a single class (Le Fèvre-Lehöerff in press).

Despite the synthetic nature of these results, essential elements are missing. Within the framework of a study concerning forms of organization of production, the question of production sites occurs, which is in itself inextricably linked to the question of type (morphological as well as technical) and the quantities produced. However, when faced with thousands of accumulated objects, objects that originate from countless excavations, many brought to light over the course of decades, and without the extant remains of any workshop, how can one go any further with the research? One possibility is to look for any distinguishing or unique characteristics in the worked

objects, to look for features that would perhaps be found in certain objects but not in others. This entails seeking a common technical denominator, something that might lead to the discovery of a production site, to a craftsman, just as the distinguishing features of a painting might lead to the painter who created it. Since bronze workers use a wide range of techniques and tools to create an infinite variety of designs, it is seen that this method might best lend itself to an in depth study of the decorative motifs.

In September 1996, the first proposals drawn from visual examinations were presented at the Forlì Conference (Le Fèvre-Lehöerff 1998a). The latter was an attempt to collate certain designs and decorative techniques and then classify them into specific decorative groups, which could then be traced back to certain workshops or a certain group. The focus here was very much on the identification of a single implement which always left the same distinctive trace upon the object and which could be used to decorate one piece after another. In this way, since a certain number of Villanovan metal sheets were used for making several different items (vessels, shields, urns), and these were all found on different sites, how much importance can we attribute to the common decorative design found upon them? In this particular case, the decoration is made on the reverse of the piece by stamping it with a single headed tool, a process which is then repeated for other objects (Figure 5).

Can we deduce from the cases where two motifs are superimposed, one on top of each other, that they were both made with the same tool? Could one also postulate, for example, that the series of horses (Figure 6) on the flask of tomb FF7-8 and the shield of tomb AA1 were decorated using the same tool, even if we could never say that they were made by the same artisan? The argument may also be inverted: could one suggest the use of a different tool for the Urn of the Vulci, since the animal decoration upon it could never have been superimposed, despite its similar style?

These proposals are however limited to some extent by certain methodological constraints: such postulations for example can only be made after careful observation and meticulous measurement of the objects themselves. After the initial findings are made, one also needs to add other data to this information, data which only a detailed and costly laboratory analysis can offer. But here again one cannot expect that all the answers will be found via analysis or just through metallography. In this particular case, the key is to try to refine the interpretations based upon the first results. These might then allow us to seek similarities in the choice of alloys for certain types of objects, or at least for pieces that are identical in form. In the case of the horse designs mentioned previously for example, comparisons of different alloys can be made since the metal sheet that they were made from was shaped and decorated by similar processes, even if the finished product, after having undergone all the necessary phases of working, is made to fulfill a different function. Unfortunately it is impossible to present here

either a work proposal or any results. These objects found within a funerary context are generally considered to be precious objects of some prestige. In this light, any attempt at 'destructive' sampling would be considered as an act of vandalism, and yet more so were it on the decorated face! Unfortunately, the metal sheets that were sampled (museum of Tarquinia, Ashmolean Museum) do not carry this design. We can never hope to get definite responses from this type of research. Perhaps the most we can hope for is to obtain a little convergence in the threads of hypotheses with which we work.

CONCLUSIONS

This paper has attempted to make a contribution towards the problems of metal working techniques, techniques that were in use in a period and place that have long been the subject of study. Questions of methodology apart, we have emphasised the contribution of laboratory analysis. This is an immense subject and there would be little to gain in tackling it in its entirety. Thus we have concentrated our attentions on just one small aspect of it: the decorative designs. Incomplete, provisional, imperfect, these often offer little more than a fine thread (a sort of "fil d'Ariane") which, as we unravel it, leads us via the objects and the microscope towards new hypotheses and closer to the craftsmen themselves. Research into the craftsman's arts concerning the copper based alloys in the Protovillanovan and Villanovan societies now boasts our own 'tool' which can no longer be ignored: the laboratory. To this we might add a reserve: that the use of this tool is preceded by asking sensible questions of it and that we are prepared to accept its responses.

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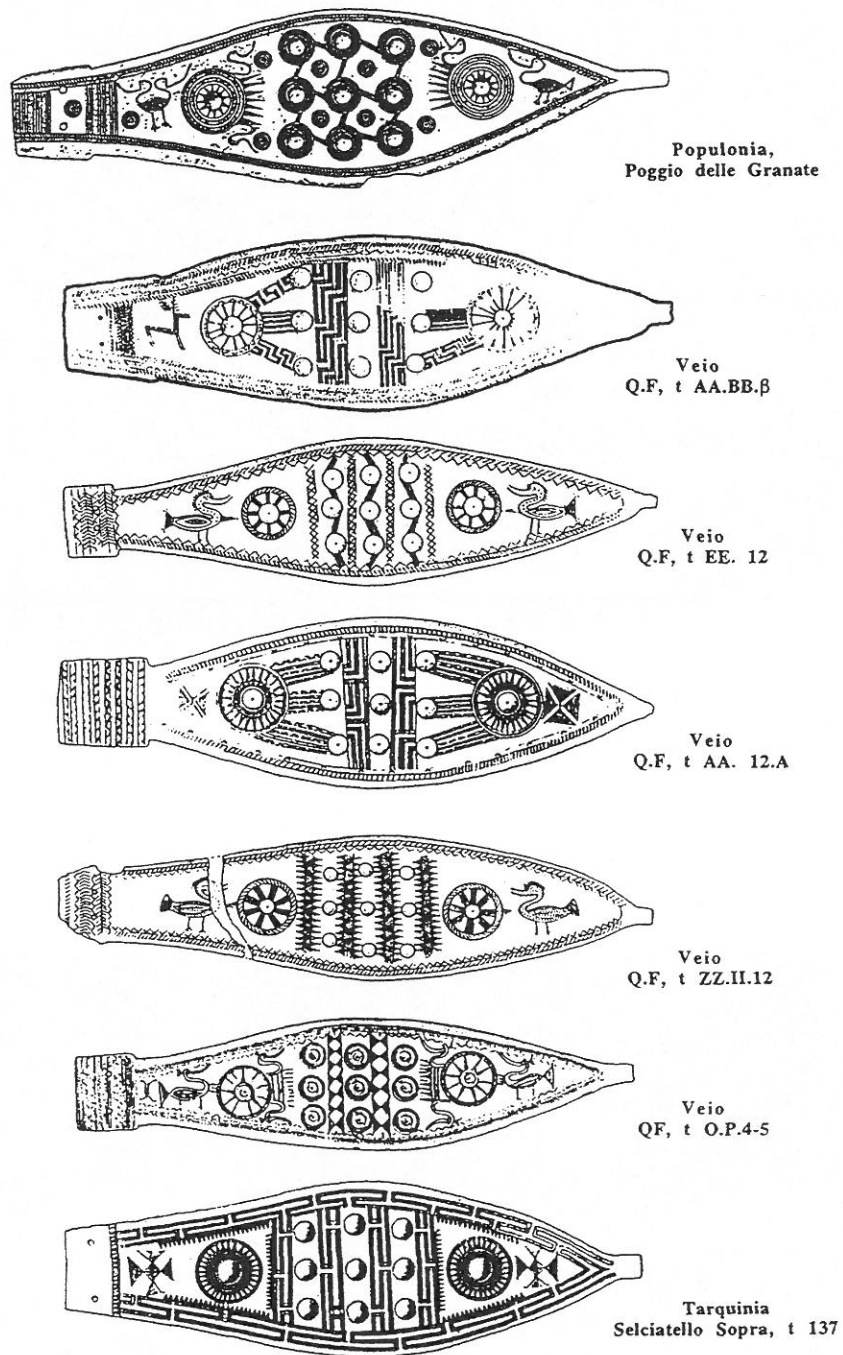


Figure 1: "Tarquinia type" metal girdles

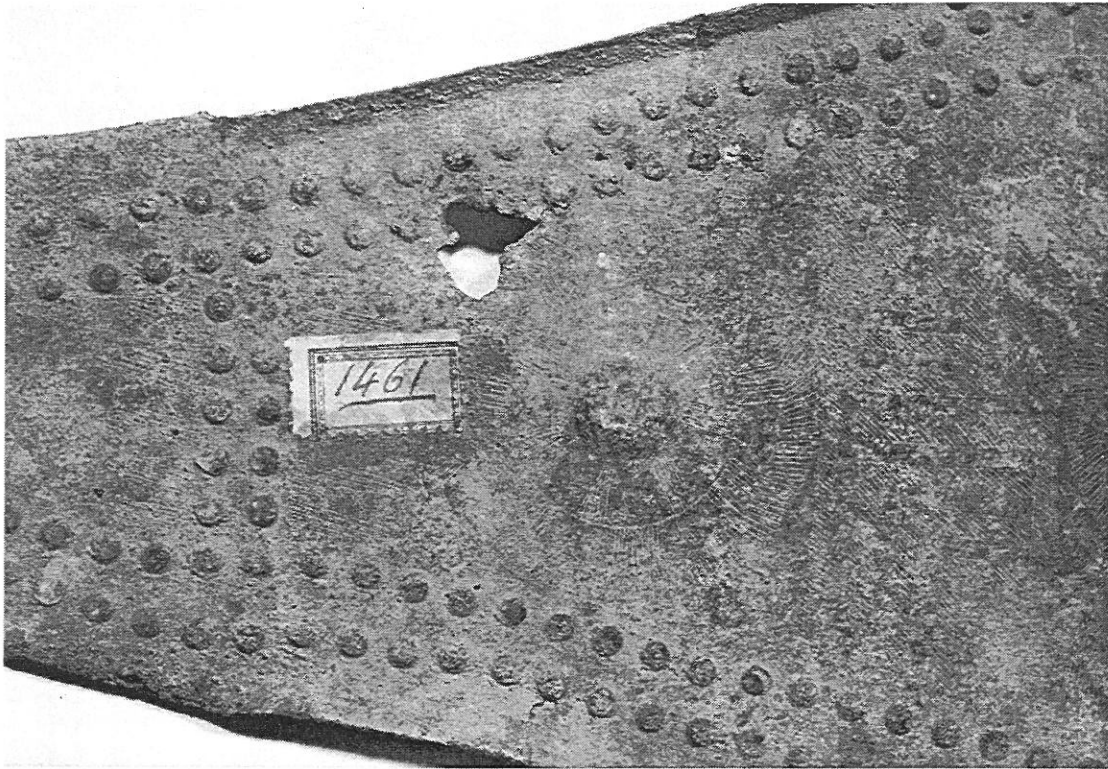


Figure 2: "Tarquinia type" metal girdle from the Monterozzi cemetery

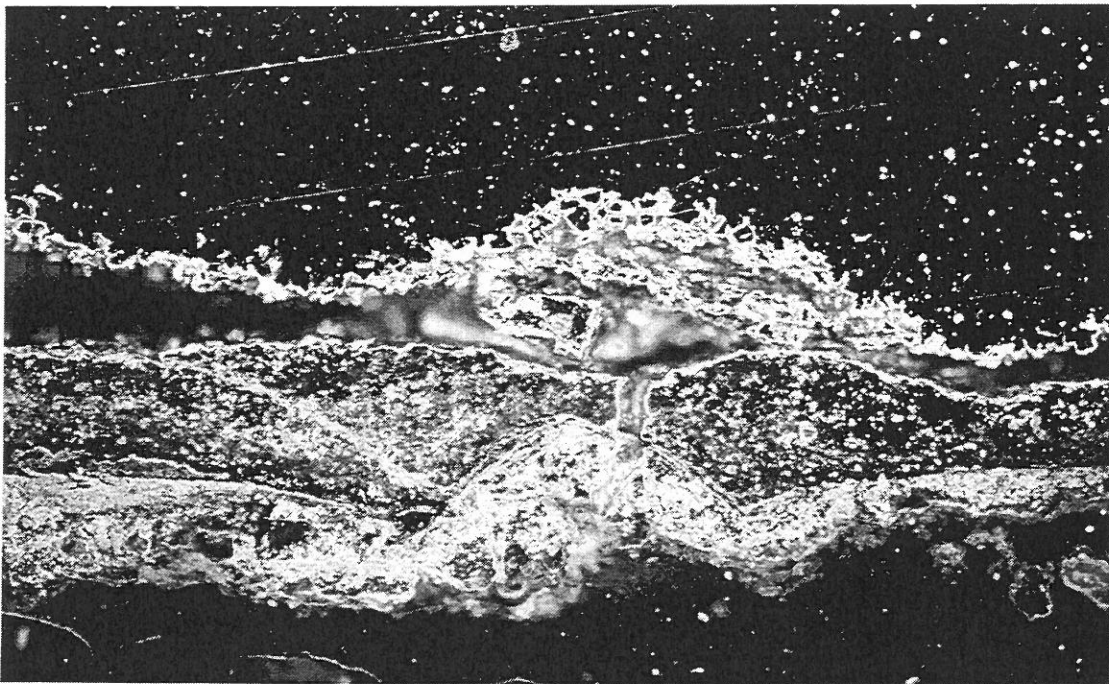


Figure 3: Corrosion on the "Tarquinia type" metal girdle from the Monterozzi cemetery



Figure 4: "Tarquinia type" metal girdle from Oxford

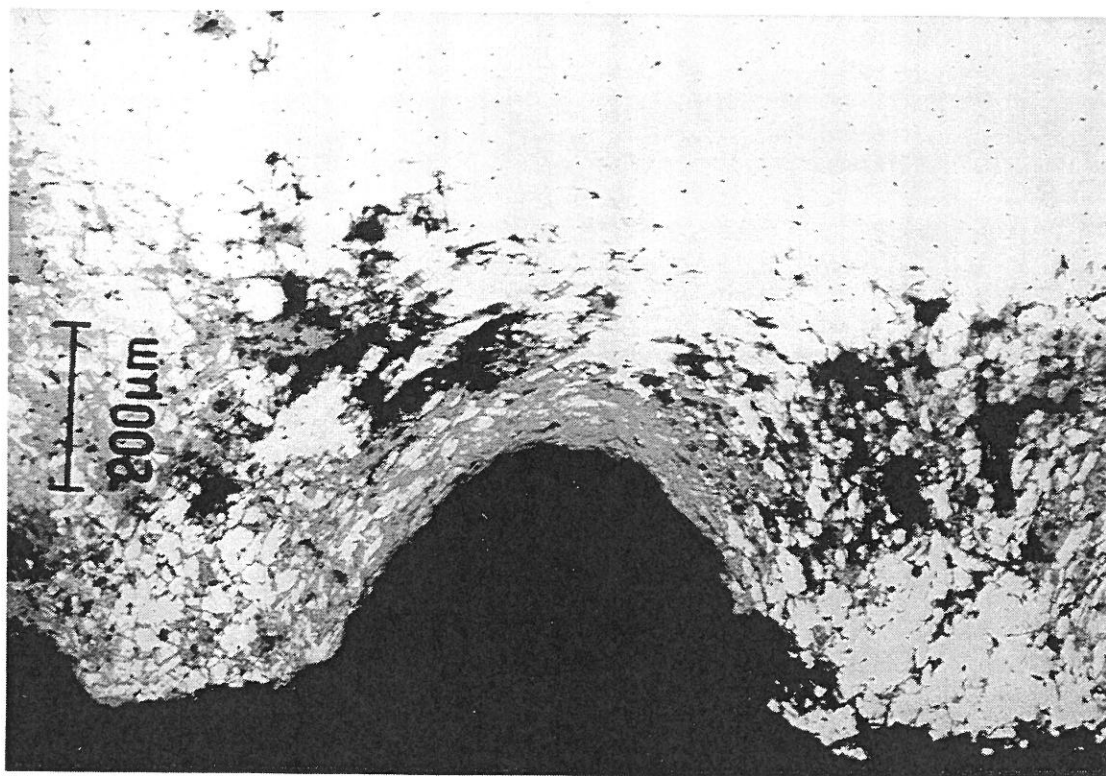


Figure 5: Horse decoration

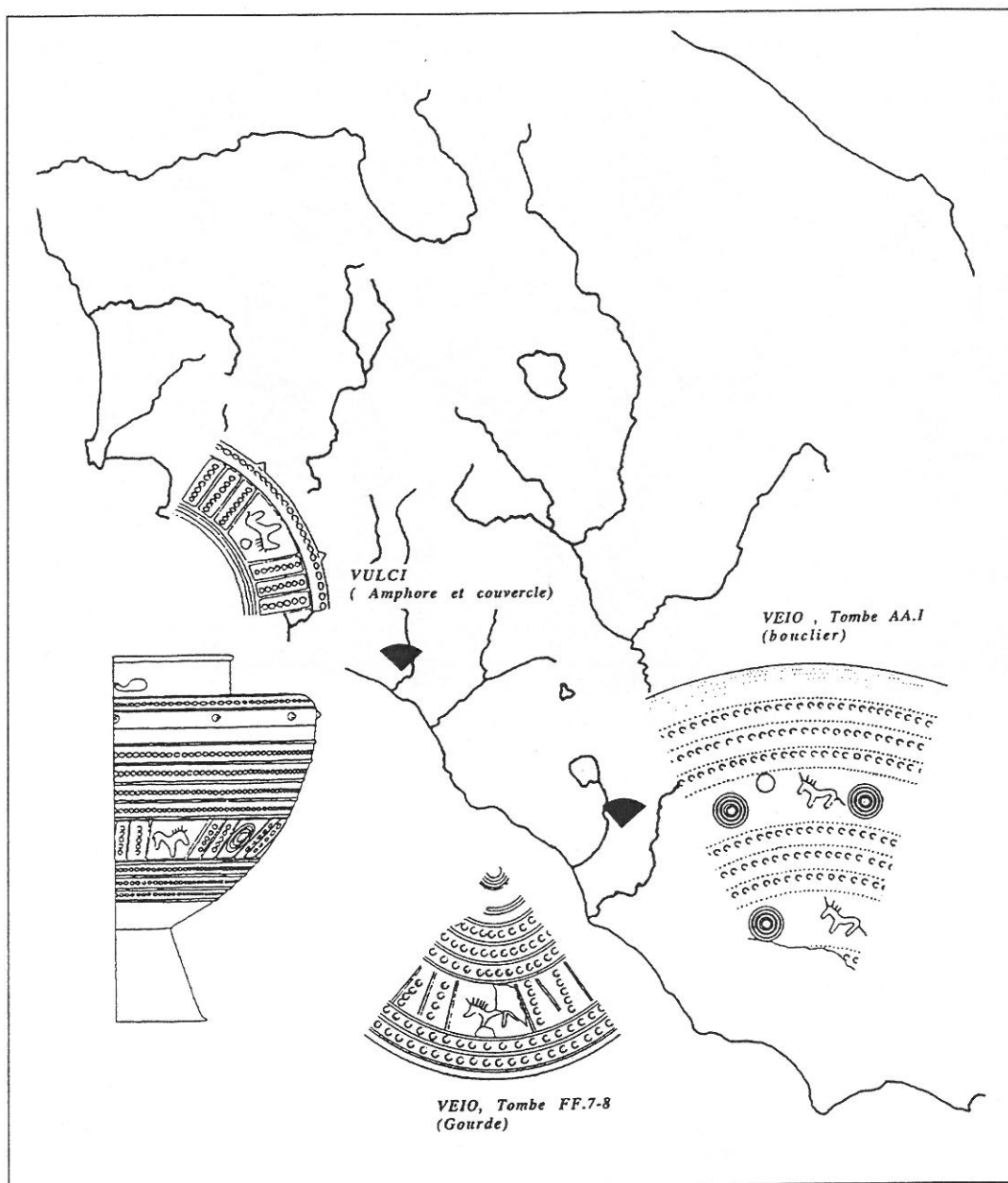


Figure 6: Animal decorations from Veio and Vulci

