The use of radiographic techniques as support to the typological studies of iron finds
Part one: the knife from Introbio

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RIASSUNTO - Tecniche radiografiche per lo studio di un coltello tipo Introbio - Un coltello in ferro di tipo Introbio (II - I secolo a.C.) è stato sottoposto ad esami radiografici per comprendere la forma della lama, analizzare la tecnica di produzione del fodero e verificare l’esistenza di particolari decorativi. Tali analisi hanno messo in luce aspetti inaspettati, legati soprattutto al livello di alterazione del reperto originario a causa di un restauro eccessivamente integrativo e che in una certa misura ne ha influenzato la classificazione e la conoscenza. Vengono presi in considerazione come confronti per definire gli attributi del tipo altri due coltelli: il primo è il coltello di Coccaglio (BS), e il secondo è quello di Fontanella di Casalromano (MN), conosciuto solo attraverso una vecchia fotografia. Altre evidenze utili per definire il tipo sono le oltre cinquanta incisioni trovate in Valcamonica. Tutti questi coltelli sono oggetto della mia ricerca di dottorato in “Quaternario: materiali e culture” presso l’Università de Trás-os-Montes e Alto Douro di Vila Real in Portogallo.

SUMMARY - Radiographic techniques in the study of a knife of Introbio type - An iron knife of Introbio type (2nd - 1st century BC) was subjected to X-ray examinations in order to identify the real shape of the blade, to analyse the technique of production of the sheath, and also to verify the presence of decorations on it. These analyses have shown unexpected particulars, related to old restorations that have changed and falsified the aspect of the find and, somehow, influenced its classification. Two others knives are compared, to better understand the attributes of the type: the first is the knife from Coccaglio (BS), known as real object and the second is the one from Fontanella di Casalromano (MN), known just as an old photograph. Other useful evidences to define the type are the over fifty engravings found in Valcamonica. These knives are all object of my Phd project in “Quaternary: materials and cultures” at the Universidade de Trás-os-Montes e Alto Douro in Vila Real in Portugal.

Keywords: Italy, Introbio, Valcamonica, Late Iron Age, X-ray, iron knives.
Parole chiave: Italia, Introbio, Valcamonica, tarda età del Ferro, radiografie, coltelli in ferro.

1 The Introbio and Coccaglio knives were object of study, graphic and photographic documentation, analysis and publication with the permission of the Ministero dei Beni e le Attività Culturali e del turismo - Soprintendenza per i Beni Archeologici della Lombardia.

1. INTRODUCTION

In this article the results of some X-ray examinations on an iron knife of Introbio type and its sheath are shown (Figg. 1, 3). The classification and study of this kind of finds was begun some years ago by M. Tizzoni (1982) and then continued by A.E. Fossati (1989), who recognized the link between real finds and engravings in Valcamonica representing the same type. No other studies about this topic were really explored in-depth. Aim of this research is to understand more clearly some typological and structural questions. Other knives, known as Lovere type, object of the same analysis and rich in other interesting news, will be considered in a next article (The use of radiographic techniques as support to the typological studies of iron finds. Part two: some Lovere knives).

2. THE INTROBIO KNIFE: DESCRIPTION AND COMPARISONS

The find analysed is a knife from Introbio (Valsasina, LC) with its sheath (ST 26383/1-2), usually exhibited in the Civic Archaeological Museum of Lecco. This knife, that gives the name to the type, was found in 1928 and published by F. Magni (1929: 99), with details of the discovery and of the associations.

On the basis of these reports and of new studies, M. Tizzoni (1982) dated the find to the LT D, but from his drawings (Tizzoni 1982: Fig. 11, b) I have already formulated the hypothesis that the restoration, made in 19791, was too
reconstructive (Roncoroni 2011, p. 215). The new drawing of mine shows the same condition (Figg. 1a, 1b).

This knife lacks the tip, the front quillon and also a part of the flat and large tang. The front quillon is clearly missing in the front because a part of a rivet hole to fix the handle is visible. The blade has a sinuous shape, both in the spine and in the edge, and the tip rises a little higher than the spine. The back of the tang is curved, and it is broken, so it was certainly longer than now. There is a long and thick rivet at the end of the tang. It is possible that the shape of the tang was similar to the Coccaglio (BS) knife (Figg. 2, 4a), that has kept the decorative iron plate of the guard and suggests that the handle, made from organic material, was not very thick in this part (about 1 cm). Moreover the tang of Coccaglio knife is complete and rounded in the end. The length and the end, whose edges don’t curve upwards, show a partial tang, and the sides, which curve a little bit upwards, suggest that the tang was left partially exposed along the back and the belly of the handle. The knife seems to have three rivets attached to the fixing of the handle (two under the guard in the front and in the back parts of the front quillon) and another one that fixes the plate of the guard in a central position, also passing through the handle and so fixing it. Unfortunately Coccaglio knife, indicated as Introbio type by R.C. de Marinis (1988: 155, note) on the basis of the dating (LT D2) of the materials of some tombs disturbed during building works in 1969, is very well preserved just in the proximal portion, but not in the blade. It may not be of the same type of the Introbio one, also because the sheath is not preserved, or at least it is possible to suspect the non standardization of the type, clearly shown in Valcamonica engravings. In fact in Valcamonica more than fifty engravings of sheathed knives or sheathes alone are known, characterised by a tip that reminds an animal tail (Fossati 1989; Roncoroni 2011: 207, note 47). As recorded this animal attribute could be linked with religious imaginary (Roncoroni 2012). They are prevalently of the Introbio type, but some are more ancient according to the studies of the superimpositions and of the style and to the comparison with real weapons (de Marinis 1988; Fossati 1989, p. 44 and fig. 3 p. 41).

Getting back to the subject, the Introbio knife doesn’t have the section of the tang with curving upwards sides, but rectangular, so it’s not possible to affirm surely if it was visible in the sides of the handle, even though it is probable, considering some older knives from Venetic area (Bianco Peroni 1976: nn. 164-169). As regards the length of the tang it was probably similar to the one of the knife from Fontanella di Casalromano (MN), known from a photograph of the Castelfranco’s archive, part of the Civic Photographic Archive of Milano (Fig. 4b). This find was not probably in the Castelfranco’s collection and the photograph could represent just a document of the existence of this kind of object. In fact the majority of the finds from Casalromano were found by Locatelli and ended up into the Pigorini Museum collections. Nevertheless at the moment the research at Pigorini has not given any results. Unfortunately the photograph shows just the back of the sheath, but the knife is useful for a comparison with the Introbio one. In fact the Casalromano knife shows a little concavity underneath the

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2 Preliminary research in the archive of the Soprintendenza per i Beni Archeologici della Lombardia done by F. Rossi. See also Rossi 1991: 63, n. 455. For dating of the associations see de Marinis & Motta 2007: 137, n. 6.

3 Kind information of R.C. de Marinis.
front quillon, the edge of the blade is sinuous but the spine is straight in the first part and the tip curves higher than the spine. The tang is curved, flat and large, but longer than the Introbio one, and presents more rivets, but in essence it is very similar. An angle, at the link of the tang to the spine, is present. The shoulder is horizontal with about a 90° angle between it and the tang. The end of the tang is rounded as in the Coccaglio knife and also in this case doesn’t seem full. And so we should admit that the Introbio type had a partial tang not fixed into the pommel, and this, on the basis of the opinion of modern constructors of knives⁴, is a frailty point. The handle was probably entirely in organic material, built in just one piece or two valves fixed with rivets and with a pommel in the shape of a bird head, exactly as we can see in some Valcamonica engravings (ex. Fig. 6). The rivets used in the Casalromano exemplar to fix the handle were probably five, and the one in the middle of the quillon was used to fix the metallic plate of the guard, passing through the handle too. It is acknowledged in fact that all the quillon was bandaged all around by a metallic plate forming the guard (as we can see in Coccaglio knife). In the Introbio knife it seems that just one rivet was present in the front of the quillon to fix the handle, and this is an anomalous situation, comparing with the other ones.

The function of the quillon, and therefore of the guard, is to assure a firm grip and to prevent the hand from slipping forward onto the blade. So it is possible to assume that this knife served to do rough jobs, as an instrument, but more probably as a weapon.

The knife has its sheath (Fig. 1b) but it is not inside it, probably because of the wrong restoration due to the very fragmentary state of the find, or more probably because at the moment of the discovery the knife was sheathed and extracted by force. In fact the Lovere type knives discovered more recently are often sheathed.

The Introbio type, when sheathed, probably presented the guard partially covered, as recognizable in the engravings of Piancogno, Roccia delle spade (Fig. 6).

Also the sheath (Fig. 1b) is very interesting for this research, as said before, and has a shape defined as anatomic, because it has the same curved trend of the blade, with a tip shaped like an animal tail (fish or bird). It is characterized also by iron sides, with U section, and some transversal plates, to fix the structure, imitating a metallic thread wound all around to fix the sides. This particular suggest an original model really realized in this way, and the memory is present in Lovere type as simple transversal incisions. Even though at the moment the sheath doesn’t have any lining, Tizzoni (1982) reported that in the eighties of the last century some oak wooden fibres were present⁶. Moreover this kind of lining was common in the iron sheaths of the Retiche area and in the more recent Lovere type knives as a protection of the blade. The contrast between the colour of

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⁵ There are some sheaths of daggers or big knives in central Europe, dating between HA D1 and HA D2 or sometimes to a fase HA C/D, of the variants Hoffenheim (Sievers 1982, n. 126), Sulz (op. cit., nn. 132-133), Hobermodern (op. cit., 137) and Erkertshofen (op. cit., n. 149), that show this constructive particular, that is a metallic thread rolled up the structure fixing the various parts. These sheaths have also a tip similar to an anchor or a tail, not very different, with the due prudence, to the one of Introbio knife. Nevertheless the handle is of the type with antennas or T shaped. The big knife shown on rock 4 at In Valle in Paspadro (Valcamonica, BS) hanging to the belt of a big warrior, is dated to the half of the 6th century BC, in base to comparisons with the handle of big knives of the Venetic area. But imitations and conservative models in the field of weapons are always possible.

⁶ The fibres were identified by Lanfredo Castelletti.
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the oak wood and the shiny iron could be very fine. In the front of the sheath a tubular loop is present, used to hang the knife to the belt.

In the Casalromano knife (Fig. 4b), that is certainly a part of the same type, the wooden lining was almost surely present but not visible in the front. The find has kept the shape of the tip, but is open on the back and closed in the front. The back is closed in two points, over the tip and in the proximal part with the superimposition of two borders of the iron plate and certainly fixed with rivets.

Also the sheath of Martigny, that is a bit different in the tip, is similar in the general shape, closed in the front, and open in the back, so that the wood was not visible. This sheath is exposed in a window of Giannadda’s Foundation in Martigny (Vallese, CH) and published just in a drawing (Deschler-Erb 2010, p. 201, fig. 8) that doesn’t clarify the technique of the fastening of the lining, but it seems to see the head of a rivet. So we could admit the same technique found in the Casalromano sheath. In these two models the loop is more similar to the one of the Lovere type, that is triangular, rather than one in the Introbio knife.

So for these many reasons (the front closed, the back open, the kind of the loop, the general shape) it is possible to suppose that Casalromano and Martigny sheaths are models of transition, even though there is the consciousness of the riskiness of a too much rigid use of the typological seriation in presence of such a small sample.

these models have not necessarily a dating meaning, but they could simply attest a big variability in the shape that in the course of time were fixed in a specific model (the Lovere type).

3. METHODS

The first approach to the finds was of using the scattered light and performed with Canon 5D Mark II, to produce a photographic documentation. Then the knives were X-rayed using a portable X-ray generator (CP120B of the ICM s.a) and some phosphorus plates (50 µm). The exposure time for each knife was 30 seconds with 80 kV, current 1.5 mA, and each plate was scanning with a Durr product and processed with a CR (Computer Radiography) - System / W000153.

Digital radiography is a fast technique, which allows one to have in a few minutes high-resolution digital images - 16 bit, which means 65.536 of grey levels (Radelet 2013; www.duerr-ndt.de; www.icmxray.com). The knives were radiographed in a horizontal position, and the analysis were realized by Thierry Radelet.

4. RESULTS AND DISCUSSION

The images obtained were further analyzed with a graphic editing program that permitted the comprehension of a lot of particulars invisible to the naked eye. A special 3D vision (Fig. 3c) enables one to understand which are the parts in the front and which those in the back, because the simple radiography gives a flat image in which front and back are not distinguishable. In particular the radiography shows the irregular thickness of the metal, depending on the state of conservation and also on the technique of production. A lot of rivets were discovered, used in the assembling of the sheath and also the real level of the restoring integration is shown.
As mentioned before, there was the suspicion that the shape of the blade underneath the front quillon was altered. The radiography (Fig. 3a) shows an unexpected concavity, more similar to the one of more modern knives of the Lovere type, that are known in a lot of exemplars, and that is possible to consider, for a lot of reasons, the direct descendant in the typological seriation (Roncoroni 2011). Nevertheless the real shape could be shown just removing the restoration material (epoxy resin), and examining the edge of the concavity.

Furthermore it is possible to see on it the junction point between the back of the handle and the spine, that shows an angle similar to the one present in the casalromano exemplar, and also in the Coccaglio one. In the middle of the guard a broken rivet with quadrangular section, invisible to the naked eye, is also present. So we have the typical triangular position of the guard rivets, clearly shown in the other knives from Casalromano and from Coccaglio, but typical of the most part of the knives with handles covered with organic material. So the rivet in the front of the quillon fixed the handle, and the one in the middle fixed at the same time the handle and plate of the guard.

It is probable that the original length of the handle was similar to that of Casalromano knife and that the number of the rivets was the same.

As regards the sheath the X-ray analysis shows a lot of integrations in epoxy resin, that result perfectly transparent in the plates.

The radiography shows also very clearly some hidden rivets used to assemble the iron plates and probably also used to fix the wooden lining to the plates themselves. Each plate is fixed in the back side with a rivet and the tip is stiffened with a V shape plate. Traces of two holes on the front of the tip sheath may be testify the existence of another similar plate.

5. CONCLUSIONS

In conclusion it is clear that X-ray analyses have shown a lot of particulars invisible at a simple observation. In particular the shape of the blade of the Introbio knife, even though with some differences (ex. the curved first part of the spine) appears more clearly similar to the Coccaglio and the Casalromano ones, as in the presence of the angle between the attach of the handle and the first part of the spine. In all the cases the knives have a curved and partial tang, although the number of the rivets seems no standard, but this could depend for the craftsman. In fact it is important to remember that the real objects were found in distance places, and that could be also due to the wide presence of this type of object in the North of Italy. The great number of engravings known in Valcamonica representing these knives leads one nevertheless to consider the type originating from this area or at least that in this area this kind of knife was considered something more than a simple instrument or weapon. The sheaths were probably really anatomic, i.e. built over the knives, and this is evident observing the Casalromano and Introbio ones that follow closely the shape of the blades, in particular of the spine that is straight in the first part in Casalromano knife and curved in the Introbio one. This obviously does not exclude the re-use of a sheath for a different knife.

The differences of the aspect could depend on a lot of factors that are not seriously comprehensible in archaeological sense on the basis of this little sample. Evidently differences in time and in craftsmen could be all valid reasons for what is possible to know at the time. About the dating it is important to remember that M. Tizzoni dated
the Introbio knife generically to the LT D for the presence in the association of a Pescate ladle, but R.C. de Marinis dated the Coccaglio one to LT D2 in base of the other finds and in particular for the presence of a Celtic inscription on a little bowl. The style of the Valcamonica engravings oriented instead to a more wide dating (Roncoroni 2011). So the possibility to consider the Casalromano knife more recent in base of the similarity of its sheath (in the loop and in the closed front) to the Lovere type sheaths is interesting, but not demonstrable for certain at the moment.

THANKS

Thank to D. Caporusso, director of the Civic Archaeological Museum in Milan, that provided the spaces to realize the analysis. Thank to G. Ruggerio, J. Lorenzi, F. Rossi and A. Gasparetto of the Soprintendenza per i Beni Archeologici della Lombardia, and M. Ruffa of the Civic Archaeological Museum of Lecco. Furthermore thank to professor A.E. Fossati for our constructive discussions about this argument.

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