Observations on italian bronze age swords production: archaeological record and experimental archaeology

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THE ARCHAEOLOGICAL CONTEXT

In spite of the very large quantity of swords coming from Northern Italy Middle-Late Bronze Age sites (FIG. 1-2), only four stone moulds and two made in ceramic have been found (FIG. 3-4). Consequently, a question emerges: which methods could have been used in the bronze age sword production? Which are technically preferable?

Fig. 1: distribution of sword findings in Northern Italy. The red points show some recent findings (Bianco Peroni 1970, tav. 67).

Fig. 3: distribution of sword moulds from Northern Italy.

Fig. 2: chronological progression of sword types in Italy from Middle to Late Bronze Age (modified from Carancini 1997, pp. 382-384).

Chronology (*Cardarelli 2009*):
- Middle Bronze Age 1: 17th – 16th century b.C.
- Middle Bronze Age 2: 16th – 15th century b.C.
- Middle Bronze Age 3: 15th – 14th century b.C.

} MBA

- Recent Bronze Age: 14th – 12th century b.C.
- Final Bronze Age: 12th – 10th century b.C.

} LBA

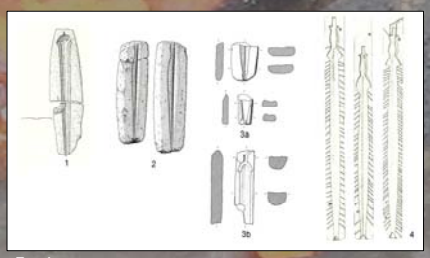


Fig. 4:
1. *Castione Marchesi (PR): sandstone sword mould (Roncoferraro type), MBA 1-2 (Bianco Peroni 1970, tav.2).*
2. *Coriano (RN): calcarenite rapier moulds (Pieve San Giacomo type), MBA 2 (Bianco Peroni 1994, tav 42).*
3. *Castellaro del Vho (CR): calcarenite sword moulds (3a) ceramic sword mould (3b), MBA 2 (Cierny et alii, 2001, p.76).*
4. *Piverone (TO): three chiseled faces of the same soapstone mould for a grip-tongue sword (Erbenheim type), FBA (Bianco Peroni 1970, tav. 75).*

EXPERIMENTAL ARCHAEOLOGY – STONE MOULDS PRODUCTION

Through experimental archaeology performed by the authors in the Open Air Museum "Terramara di Montale", it has been possible to realize two stone moulds for two different swords (Bigarello type, Erbenheim type). For this purpose, a sandstone has been used, similar to the original Bronze Age material (see also *Barbieri, Cavazzuti* in this poster section). Therefore, it has been documented that carving such big stone matrix for swords, in same cases more than 60 cm long, requires a big amount of raw material, many hours of work, a certain manual skill, rather than a wide set of implements such as stone hammers, bronze chisels and flint blades.

The experimental stone moulds have been used during the experimental activities of bronze casting to test their properties. After the bronze pouring, when the temperature of the metal reaches 1300 °C, it is possible to notice that the shape tend to lose details, expecially on the blade profile, because of the fragility of the material itself (FIG. 5-6). Moreover moulds get deformed when they come in contact with the flowing melted bronze: the two surfaces do not fit together, getting a singificant concavity and causing burrs on the bronze sword (FIG. 7). Therefore they need to be periodically repaired to reach good results.

This could suggest that moulds were made through other techniques and different materials, which did not leave any visible traces on metallurgical sites.

Fig. 5 – 6: deterioration of experimental stone moulds due to frequent utilization.

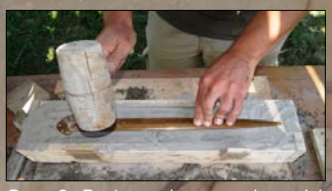
Fig. 7: deformations of the mould surface due to thermal expoistion causes burrs on final result.

EXPERIMENTAL ARCHAEOLOGY – SAND CASTING

One of these "invisibile" techniques could be sand casting, as suggested by some Italian Authors (*Carancini 1991-92; Giardino 1998*). This method has been explored and is schematically presented below.

Step 1. Filling one of the two wooden boxes with calcareous fine sand and pressing it with a hammer

Step 2. Covering wet sand with a thin layer of dry sand in order to facilitate the re-opening of the boxes



Step 3. Pushing the sword model into the sand to obtain the shape

Step 4. Re-opening of the two boxes after having filled the upper box

Step 5. Bronze casting

Step 6. Opening of the valves

SAND CASTING vs STONE MOULDS CASTING

Fig. 8: one sword from sand casting in comparison with three swords from stone moulds.

Fig. 9: notice the degree of precision in the edges of the two blades made out from sand casting (on the top) and from sandstone casting (below).

A DAY OF EXPERIMENTS... NEVER GIVE UP!

Changing little details in the experiments leads to a significative progress in the final results (FIG. 7).

After a stronger pressure and a better compacting of the sand (cfr. *STEP 1, supra*)

After changing the inclination of the moulds during the bronze cast (cfr. *STEP 5, supra*)

After the reduction of water in the sand

7. Different results

After the realization of the blow hole close to the lower part of the blade (cfr. *STEP 4, supra*)

After the use of the dry sand on the top and under the sword model (cfr. *STEP 2, supra*)

CONCLUSIONS

The archaeological record concerning bronze age swords and stone moulds leads to the hypothesis that swords were cast through different techniques, which did not leave any identifiable trace on metallurgical sites, such as sand casting.

Experiments carried out by the authors document that this method can be easily performed with materials and tools available at that time. Sand casting seems to have some important benefits: the raw material is much more abundant in the plains in comparison with specific types of sandstone; the mould can be made in shorter time (10 minutes ca.) and with easier operations; since the results are finer, the loss of bronze is reduced and the finishing operations become quicker (FIG. 8-9).

Future experiments will test alternative techniques, such as lost wax and ceramic moulds casting.

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BIBLIOGRAPHY:

- Bernabò Brea M., Cardarelli A., Cremaschi M. 1997, *Le Terramare. La più antica civiltà Padana*, Catalogo della mostra (Modena 15 marzo / 1 giugno 1997), Milano.
- Bianco Peroni V. 1972, I pugnali dell'Italia continentale, Praehistorische Bronzefunde, VI, 10, Monaco.
- Bianco Peroni V. 1970, Le spade nell'Italia continentale, Praehistorische Bronzefunde, IV, 1, Monaco.
- Carancini G.L. 1991-1992, La metallurgia e gli altri rami dell'artigianato: organizzazione, stile e tecniche della produzione e modi di circolazione dei manufatti – L'Italia centro-meridionale, in *L'età del bronzo in Italia nei secoli dal XVI al XIV a.C.*, Atti del convegno di Viareggio, 1989, *Rassegna di archeologia*, 10, pp. 235-254.
- Carancini G.L. 1997, La produzione metallurgica delle terramare nel quadro dell'Italia protostorica, in M. Bernabò Brea, A. Cardarelli, M. Cremaschi (eds.) *Le Terramare. La più antica civiltà Padana*, Catalogo della mostra (Modena 15 marzo / 1 giugno 1997), Milano, pp. 379-389.
- Cardarelli A. 2009, Insediamenti dell'età del bronzo tra Secchia e Reno. Formazione, affermazione e collasso delle terramare, in A. Cardarelli, L. Malnati (eds.), *Atlante dei Beni Archeologici della Provincia di Modena*, vol III, tomo I, pp. 33-58.
- Cierny J., Degasperi N., Frontini P., Prange M. 2001, Le attività metallurgiche in P. Frontini (ed.), *Castellaro del Vho. Campagne di scavo 1996-1999. Scavi delle civiche raccolte archeologiche di Milano*, Como.
- Giardino C. 1998. *I metalli nel mondo antico. Introduzione all'archeometallurgia*, Laterza, Bari, pp. 64-70.