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*Questo volume è dedicato alla cara memoria
di Giovanni Carboni e Lucia Vagnetti*

FRAGMENTATION OF METAL IN ITALIAN BRONZE AGE HOARDS: NEW INSIGHTS FROM A QUANTITATIVE ANALYSIS

Giancarlo Lago*

ABSTRACT – Bronze Age metal hoards have been widely investigated over the past 150 years throughout Europe. A considerable number of fragments were deposited, mostly stemming from the LBA. Fragmentation has been mainly mentioned in supporting both the ritual or non-ritual deposition purposes. Despite the well-known phenomenon, studies are still lacking that focus on the fragmentation per se. The research presented here takes into account 5700 metal objects from Italian hoards, systematically collected and analysed. The main patterns of hoards are recognisable. In the transition between the Middle and Recent Bronze Age, the quantity of bronzes deposited increases and the fragmentation practice definitely begins. The fragmentation was apparently not performed for the deposition purposes only. Most of the fragments probably wandered around for a time before being deposited. Raw materials, which were replaced with fragments of objects through time, have become the main medium of exchange.

KEYWORDS – *Bronze Age, Italian hoards, fragmentation, bronze scrap.*

ABSTRACT – *Il fenomeno dei ripostigli dell'Età del Bronzo è stato ampiamente studiato negli ultimi 150 anni di ricerche. Soprattutto nel Bronzo tardo si trova un numero considerevole di frammenti nei ripostigli. Tuttavia, la frammentazione è principalmente menzionata per supportare o screditare le teorie sulla ritualità delle deposizioni e, nonostante il fenomeno sia ben noto in letteratura, pochissimi studi si incentrano nello specifico su di essa. Per questa ricerca sono stati schedati e analizzati in maniera sistematica 5700 oggetti in metallo rinvenuti nei ripostigli italiani. Sono riconoscibili alcuni principali pattern nella composizione dei ripostigli e, nella transizione tra Bronzo Medio e Recente la frammentazione si attesta in maniera definitiva, in corrispondenza con l'incremento nella quantità di bronzi deposti. Lo scopo della frammentazione non è unicamente correlato a quello della deposizione e probabilmente buona parte dei frammenti ha circolato per qualche tempo prima di essere deposto. Il metallo grezzo è stato rimpiazzato nel tempo dagli oggetti frammentati, divenuti il principale mezzo di scambio.*

PAROLE CHIAVE – *Età del Bronzo, ripostigli italiani, frammentazione, rottami di bronzo.*

The phenomenon of metal object depositions developed significantly in Europe around the late 3rd millennium BC and continued throughout the 2nd millennium BC. These assemblages of intentionally deposited objects, which were buried together simultaneously, can be defined as *hoards* (Bradley 2013). The debate around

this phenomenon generally focuses on the attribution of a specific meaning, mostly shifting between either a *ritual* or a *non-ritual* interpretation. One of the most frequently used criteria in classifying the context of a hoard as ritual or non-ritual is the level of integrity/fragmentation of the included objects, thus distinguishing

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between hoards with either complete or broken objects (Bradley 1990).

Hoards with fragmented bronze items and ingots have often been interpreted as scrap storages of a metallurgist that were supposedly collected to fulfil utilitarian goals within a non-ritual context. Hoards containing mostly complete objects have been generally comprehended as votive offerings in a ritual context (e.g. Levy 1982; Carancini 2006). This distinction can be upheld only by considering certain significant exceptions: hoards exclusively containing objects of the same type and consisting of non-fragmented and/or unfinished objects by previous generations of scholars were often interpreted as depositions of merchants, which were originally intended as short-term deposits with no ritual significance (e.g. Childe 1930: 43-45). Nevertheless, some scholars suggest that the fragmentation of objects is linked to sacrificial practices, and therefore associated with a ritual context (e.g. Bietti Sestieri *et alii* 2013).

In Central Europe, the practice of fragmentation of bronze objects can be traced back to the Middle Bronze Age¹ (1700/1650-1330/1300 BC), becoming a more general phenomenon during the LBA (1330/1300-950/925 BC) (Hansen 2016: 197). In Italy, the fragments overcome the complete objects in the LBA. Several explanations have been proposed to interpret the change toward the hoarding of fragmented metal objects.

Three main hypotheses seem to prevail in archaeological studies:

- *Ritual fragmentation.*
- *Recycling hypothesis* (founders' hoards).
- *Pre-monetary hypothesis.*

None of these hypotheses seem to give a definitive solution to explain the complete variability of fragment hoards.

The systematic study of the fragments within a broad area may help respond the following questions: How shall we explain the depositions of broken objects? Why have the bronze objects been reduced to fragments?

Despite the fact that fragmentation is often mentioned in the archaeological debate, studies of the phenomenon *per se* are still scarce. The research shown here represents the first systematic attempt to quantify the rate of fragmentation and to highlight the crucial moments of change of the Italian record.

The study area corresponds to the Italian mainland, and the sample includes all the published Bronze Age hoards. The quantitative analysis shows a growing trend in metal fragmentation throughout the Bronze Age, with an abrupt increase in the RBA (1330/1300-1200/1150 BC). While in the EBA and the MBA the norm is the deposition of complete objects and recurrent sets, starting from the RBA the pattern shifts to the deposition of fragments and raw material. I suggest that this shift reflects a change in metal circulation and, based on the results of the study, I propose that starting from the FBA (1200/1150-950/925 BC), the fragments turned into the main form in which metal circulated. Several indications lead to the conclusion that the fragmentation occurred in a different time from the deposition, and that the fragments circulated rather as means of exchange. Further researches on this topic would provide the opportunity to compare the data and gather more information on the quantity of metal and how it circulated in Europe. Throughout Europe, the amount of metal during the Bronze Age and the occurrence of a new mode of circulation of bronze in the form of fragments has been only seldom investigated with a quantifying approach (e.g.

¹ Hereafter Early Bronze Age = EBA; Middle Bronze Age = MBA; Recent Bronze Age = RBA; Final Bronze Age = FBA; RBA + FBA = Late Bronze Age; Late Bronze Age = LBA; Early Iron Age = EIA.

Sommerfeld 1994; Gabillot 2000; Rezi 2011). The Italian sample might serve as a starting point for comparison.

THE SENSE OF A BREAKING: LITERATURE REVIEW

The marked difference between hoards of complete objects and fragment hoards emerged in the 19th century, when every year several new hoards began to be discovered. The three main interpretive theories on the fragmentation of metal objects (i.e. ritual, recycling and pre-monetary) were already proposed during those times.

Ritual hypothesis

The ritual theory was presented for the first time regarding Bronze Age depositions in Danish bogs (Worsaae 1866-1871). Based on this theory, the intentional fragmentation of a bronze object can be seen as a means to erase the use-value of an object (Cardarelli 2014 (1): 95-107; Bietti Sestieri *et alii* 2013: 169), or to metaphorically mark the passage from one state to another (e.g. Brück 2006). The combustion and fragmentation of metal items can also be intended as a sacrificial offering for the deities (Peroni 1996: 20-21). Destroying metal objects and thereby wasting their material value can be seen as a strategy of élite to display social power. In general, the fragmentation as a ritual act has been also intended as a social practice (e.g. Carancini 2006: 29).

Indeed, the treatment of several objects are inconsistent with utilitarian practices. L. Nebelsick used the concept of *aimless violence* in order to describe the break marks on objects found in certain Central European Late Bronze Age hoards. Many artefacts are not simply fragmented, but are also twisted, hammered, bent and folded (Nebelsick 2000). L. Nebelsick bases his study on a very limited number of LBA hoards from a wide area ranging from Hungary to France, arbitrarily selected from

several hundreds of hoards of the same period. Such treatments - grouped under the definition of damaging (Bradley 2017: 130; Rezi 2011: 308) - did not find any functional reasons and, when attested in large quantities, they could be deemed as ritual markers. In the Italian sample, there is well-known evidence of these treatments, most of them related to cult places. An exemplary case is provided by the RBA weapon deposition at Pila del Brancòn (Veneto). At least 13 swords and 54 spearheads, mostly bent and fragmented, and also various pieces of defensive armours, were deposited there in the bed of the Tartaro River. There are all the reasons to believe that “a radical and relatively fast de-functionalization occurred on the weapons” (Bietti Sestieri *et alii* 2013: 161). The treatment seems unsystematic and nearly all the weapons have been exposed to fire, since some spearheads were partially melted together (Salzani 1994, 1998; Bagolan, Leonardi 2000; Cupitò, Leonardi 2005; Bietti Sestieri *et alii* 2013). The combustion of objects is reminiscent of the contemporary habit to incinerate the dead buried in urnfields and the relative ritual implications (Peroni 1996: 300-301; Nebelsick 2000: 169). Another example of possible ritual fragmentation originates from the MBA-RBA cemetery of Casinalbo (Emilia-Romagna). Numerous fragments of weapons and ornaments were discovered dispersed on the ancient ground of this cemetery, which was probably burnt on the funerary pyre and then bent and/or fragmented. Their destruction and distribution within a restricted area may have been the consequence of a ritual practice related to the cemetery (Cardarelli 2014(1): 95-107).

However, the ritual hypothesis of fragmentation cannot explain the vast majority of the hoards. During ritual destruction, mostly partial melting, bending, etc. are often executed. Evidence for this is seldom documented. Despite the

fragmentation involving 70-80% of objects from LBA Italian hoards, barely 5-8% are damaged² (fig. 5). Furthermore, one would assume that the ritual fragmentation is linked to a well-considered choice of items, related to aspects such as prestige. This choice, statistically measured for scrap hoards in England and Wales, appears to be either limited to very few hoards or completely absent (Wiseman 2018). Most of Italian fragment hoards present neither well recognizable composition patterns nor special treatments performed on the objects. However, some scrap hoards have been discovered in special places (e.g. atop mountain sites), commonly interpreted as cult sites³. The presence of apparently unselected bronze fragments deposited within cult sites suggests a ritual deposition, whereas ritual fragmentation cannot be taken for granted. This shows that aspects such as the context of discovery should be taken in consideration in interpreting the hoards; moreover, it suggests that a non-ritual fragmentation does not exclude a ritual deposition.

Recycling hypothesis

In the recycling hypothesis, the deposition is interpreted as an impermanent action and therefore non-ritual, and fragment hoards are usually interpreted as founders' storages. The latter has, for a long time, appeared in archaeological studies as one of the most mainstream theories (e.g. Evans 1881: 457-459). According to this hypothesis the fragmentation is connected to metallurgists' activities and metal fragments – either broken objects or raw materials – could be metal scraps accumulated to be re-melted.

The circulation of fragments either of bronze objects or ingots intended to be recycled became significant from the LBA (Pernicka *et alii* 2016).

However, the interpretation of fragment hoards as temporary concealment of metallurgists' stocks has some critical and still unsolved issues. A massive amount of scraps is presumed to be related to melting activities; some authors suggested the scarcity of casting moulds, crucibles and other traces of production associated with the hoards contrasts heavily with the presence of a workshop site close by (Fugazzola Delpino, Pellegrini 2009-2010: 157).

Conversely, these remains are well-attested in the settlement sites where workshop activities were found, although proof of metallurgical activities is rarely identified in the absence of durable remains (Cavazzuti *et alii* 2018).

Some metallurgical activity cases are well documented from central-northern Italy: Castellaro del Vhò (Lombardy) (Cierney *et alii* 2001); Scarceta (Tuscany) (Soffredi, Poggiani Keller 1999); Laguna Vecchia (Lake Garda) and Castellarano (Emilia Romagna) (De Marinis 2006); Montale (Emilia Romagna) (Cardarelli 2004; Candelato *et alii* 2002); Beneceto and Poviglio (Emilia Romagna) (Bianchi 2018). Furthermore, the recycling hypothesis remains unconvincing to explain the burial of such a large number of metals that have never been recuperated. More significantly, the founder's hypothesis does not sufficiently explain the fragmentation. In fact, breaking and melting should happen one after the other over a short period of time. Why would the metallurgist have to break objects beforehand without melting them?

² The definition of damage is explained in the following section about methods of data collection.

³ Italian mountain cult sites have been studied and classified taking into account geo-morphological features and structural remains of buildings aimed at performance ceremonial consumption, including object deposition. The research, still unpublished, involves hoards considered here (Bartolo 2018).

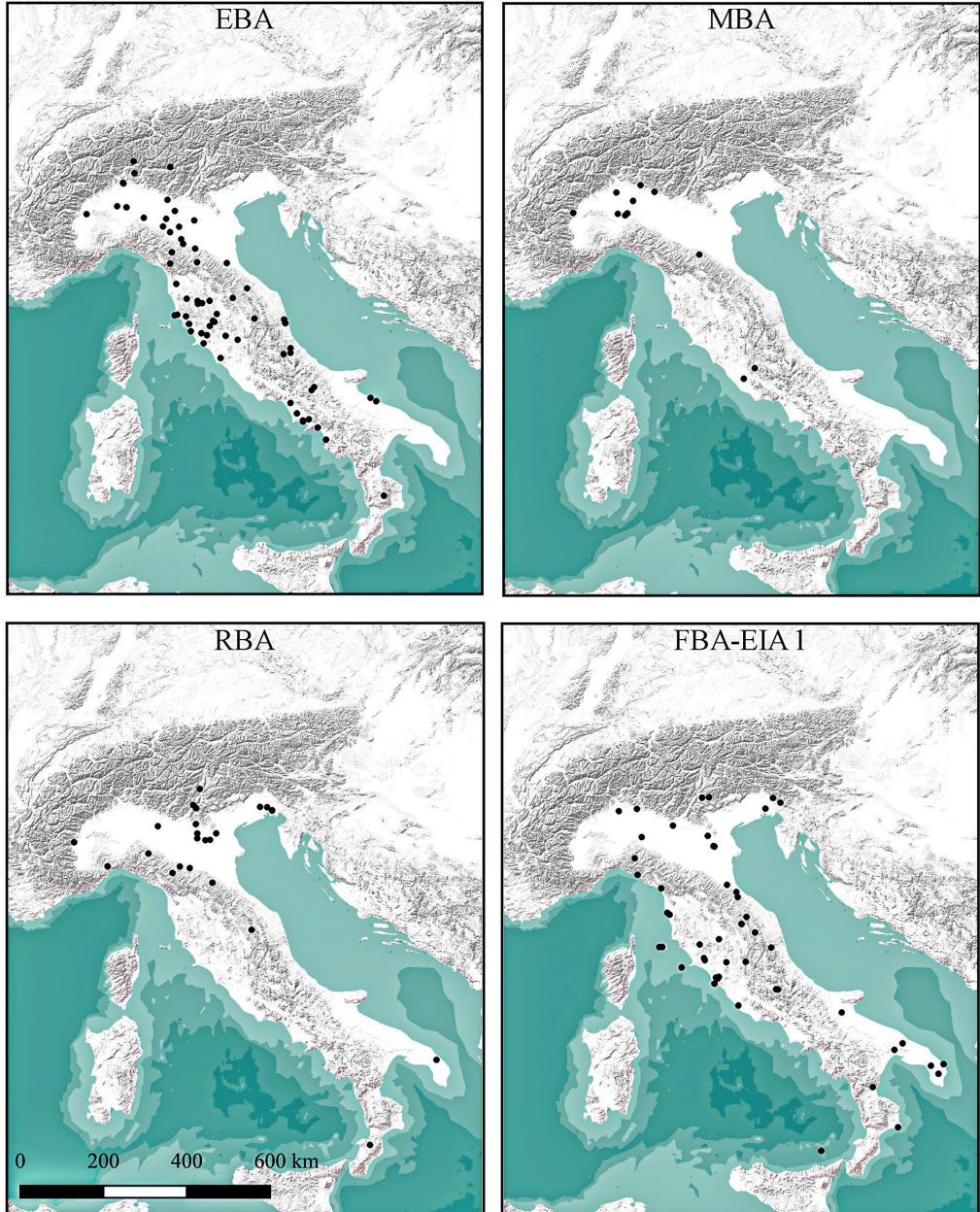


Fig. 1 - Distribution Map of Italian hoards.

The fact that rarely we find more fragments from the same object suggests the objects were not fragmented at the moment of deposition but rather circulated already as fragments (fig. 6).

Pre-monetary hypothesis

The pre-monetary hypothesis was proposed in Italy in the late 19th century (De Rossi 1886), with the debate peaking in the 60s and the early 90s (Peroni 1966: 190-196; Sorda 1976;

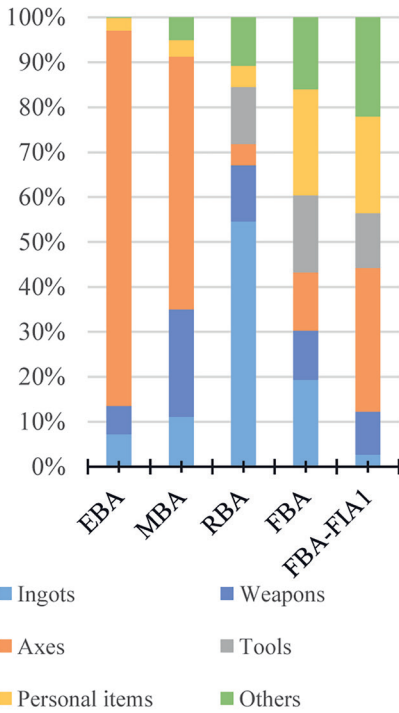


Fig. 2 - Number of objects or fragments of objects per period.

Primas 1986; Sommerfeld 1994). Based on this hypothesis, the metal objects could have been fragmented in order to attain a desired weight, and the fragments would have been traded in exchange for other commodities. There are some promising results in frequency distribution analysis (FDA) of the objects' weight values (e.g. Primas 1986; Sommerfeld 1994). The FDA is a descriptive method which highlights clusters of similar values (in this case objects with similar weight). However, it is unlikely that all fragments were weight-regulated, or that all attempts to cut the metal into standardised shapes were successful. The outcomes of metrological studies based on hoard items highlight peaks of recurrent values, but ultimately these arguments have been not convincing enough to settle in mainstream

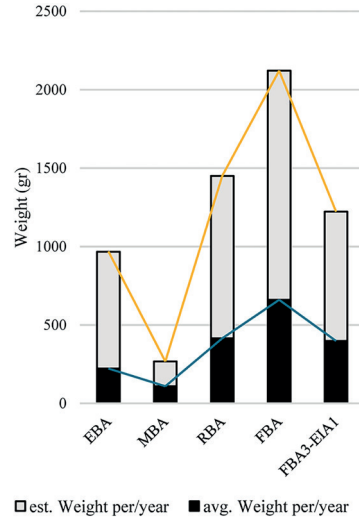


Fig. 3 - On the basis of weighed objects by Italian hoards (312 in EBA; 151 in MBA; 485 in RBA; 1129 in FBA; 347 in FBA3/EIA1), a line trend of average bronze quantity (in gr.) deposited in Italian Bronze Age has been tracked. The average weight per object varies depending on the period (EBA: 390 gr; MBA: 252 gr; RBA: 126 gr; FBA: 131 gr; FBA-EIA1: 114 gr.). The blue line draws the resulting trend with the published weights. The orange line represents the average weight per period, calculated from the un-weighted objects.

narratives. They can demonstrate neither the presence of a weight system nor the intention to break objects in compliance with a weight system.

The attempts done till this moment to test the pre-monetary hypothesis were methodologically flawed. Substantially, attempts to demonstrate the existence of a weight system have taken place, but leave out the main actors – i.e. the balance weights. The only way, at least in part, to demonstrate the occurrence of weight-regulated fragments is a comparable consolidated weight system. The lack of comparative data implies ascription to the following paradox: the debate about the weight of fragments occurred before the one regarding the balance-weight. Systematic studies of European balance-weights have started

in the late 1990s (Cardarelli *et alii* 1997, 2001, 2004; Peroni 2001, 2004; Pare 1999; Ialongo 2019; Ialongo, Rahmstorf 2019), thus the comparison between fragments and weight system may be now possible.

SAMPLE, METHOD, SELECTION CRITERIA AND ANALYSIS

The choice to analyse hoards is mostly determined by the extraordinary quantity of data they possibly supply. Hoards include just about every type of bronze item in circulation at that time. The objects analysed here involve all the hoards already published from the Bronze Age Italian mainland. The Italian hoards are distributed over time as follow: EBA = 69; MBA = 11; RBA = 24; FBA = 53; FBA₃/EIA₁ = 9 (fig. 1). The database consists of 166 hoards and 5706 objects, involving only those that are likely one-time depositions of metal groups, and omitting all those that may not be closed contexts.

The artefacts fragmentation is not always the same; some scholars distinguish between “breaking” or “damaging” (Bradley 2017: 130). The damaging practice includes treatments such as bending, folding, and partial melting. The object’s breaking can be caused either by natural usage – i.e. involuntary - or voluntary, both ritual and utilitarian. Instead, the damaging – intended as all the marks of aimless violence (e.g. Nebelsick 2000; Hansen 1998) - is not consistent with the breaking through the normal use-wear of objects (Rezi 2011: 308). Therefore, it is probably ritually intended. The objects damaged may be either fragmented or complete. In the figure 4, the white columns represent the complete items and the black columns represent the fragmented items, with both combined values equalising 100%. The grey column refers to the rate of damaged objects and

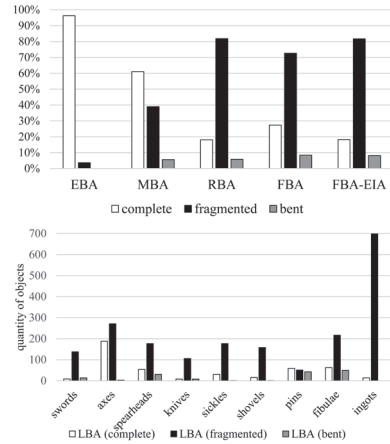


Fig. 4 - Above: fragmentation and damaging rate trend over time. Below: Fragmentation and damaging according to objects classes.

includes both broken and complete objects (fig. 4). The objective pursued here is the recognition and quantification of different kinds of fragmentation. The artefacts have been recorded according to these categories:

- Complete.
- Damaged.
- Fragmented.
- Matching fragments.
- Complete objects reconstituted from more fragments.

The database includes the objects’ individuals weights, when the datum is provided by the literature. Collectively weighed items or fragments, as well as the approximate weight estimations, have been not included⁴. The following aspects of items have been quantified according to chronology: the fragmentation and damaging occurrence; the rate of fragmentation depending on object categories; the presence of more fragments from the same artefact; average weight of fragments. A table reporting classes of

4 The basic bibliography concerning Italian hoards is proposed at the end of text: footnote 5.

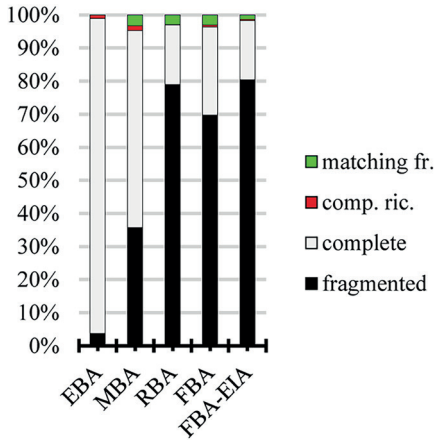


Fig. 5 - Presence of more pieces from the same object.

objects from Italian hoards has also been produced (tab. 1).

MAIN COMPOSITION PATTERNS OF HOARDS

In complete objects hoards, it is presumed that the objects are not randomly selected. There is evidence from sets of selected objects to be deposited as offerings or sacrifices. Especially in the EBA and MBA the so-called single-class hoards – i.e. hoards comprising only objects of the same class (e.g. axes, necklaces, sickles) – should not be considered as random accumulation of bronze items. They appear frequently in the EBA and MBA (Neumann 2015: 107). The occurrence of single-class hoards from 2300/2200 to 1600 BC (EBA following central European chronology) was predominant in the Middle and Upper Danube area (Primas 1997: 118-119) as well as in Italy (e.g. Peroni 1996: 110). Essentially, they are complete objects stored together, and in some cases even unfinished (Bradley 2013: 123), and they are the main hoard-pattern of the EBA. Primarily, groups of axes, sets of daggers or personal ornaments were gathered and buried together (tab. 1). Raw materials such as copper ingots, predominantly complete, already appeared sometimes with

no associated objects; this is well-attested in hoards from Tuscany (Campiglia Maritima, La Spezia, Torrenuova, Val d'Orcia: Tuscany). The recurrence of single-class hoards decreases but does not disappear altogether over time.

Beginning with the MBA and, even more so, the LBA, metallurgical activity developed significantly, with a progressive increase also in the variety of functional categories produced. The MBA is characterised by scanty depositions, mostly pursuing the single-class hoard pattern. Some sets of axes are known (Montello, Pieve Albignola: Lombardy; Rocca di Badolo: Emilia-Romagna; Nemi, Canterano: Lazio). There are probably two panoplies with weapons like spearheads, swords and axes deposited in Oggiono-Ello (Lombardy) (Cardarelli 2018: 363-364). A similar association of objects has been found in Cascina Ranza (Lombardy). The Cascina Ranza's spearheads have been made dysfunctional before the deposition (De Marinis 2018: 105). Regrettably, they were both found by chance and very little is known about the contextual data. According to R. C. De Marinis, the hoard from Cascina Ranza would be the result of reiterated depositions in the same site, placed between two rivers (De Marinis 2012b). The same author in a more recent discussion adopts a less clear-cut position, admitting that the circumstances of the discovery of the Cascina Ranza hoard do not allow to define the nature of the deposit (De Marinis 2018: 105). The Oggiono-Ello hoard was discovered after a mine explosion in a stone quarry. The scepticism about the reliability of the site as a hoard deposition is mostly due to the supposed presence of human bones, later lost. It has been hypothesised that the objects were actually grave goods, but some arguments run into this hypothesis. Indeed, no graves were reported. The bones and objects were probably not originally associated with each other. The presence of human bones

Tab 1

Site	Dating	Gold disc	Sword	Spearhead	Dagger	Other Weapon	Knife	Axe	Sickle	Shovel	Other tool	Pin	Fibula	Torque	Other Ornament	Razor	Bronze sheet	Ingot	Other	% of fragmentation		
Cervara Alfina	EBA				1																0%	
Tirano	EBA				2																	0%
Loreto Aprutino	EBA				12																	8%
Ripatransone	EBA			23/26																		22%
Castione dei Marchesi	EBA				6																	33%
Castel San Giovanni	EBA				2																	50%
San Lorenzo in Noceto	EBA			1/6			3/40								1							0%
Montemerano II	EBA				1	1	3												1			0%
Cotronei	EBA					7	2															22%
Mascion	EBA			2/3			0/2															100%
Santa Fiora	EBA						3															0%
Remedello Sopra	EBA						17															0%
Capestrano	EBA						1/12															0%
Città di Castello	EBA						1															0%
Torbole	EBA						26/27															0%
Acquaviva Picena	EBA						5/30															0%
Torre del Moschetto	EBA						3/7															0%
Burzanella di Camignano	EBA						14															0%
Savignano sul Panaro	EBA						96															0%
Scandiano	EBA						1															0%
Amelia	EBA						1/2															0%
Cetinale	EBA						12															0%
Capalbio	EBA						23/25															0%
Montemerano I	EBA						12															0%
Campiglia d'Orcia-Le Muricce	EBA						41/42															0%
Casale di Governolo	EBA						1															0%
Rocca delle Fene	EBA						1/3															0%
San Fiorano alla Pieve d'Olmo	EBA						1/200															0%
Viadana	EBA						1/5															0%
Verruca	EBA						5/19															0%
Monte Maggio	EBA						2/2															0%
Puglianella	EBA						2/6															0%
San Marcellino	EBA						3/17															0%
Rota	EBA						1															0%
Vinchiatturo	EBA						9															0%
Canne I-II	EBA						6/50															0%
Isolino Virginia	EBA						5															0%
Ercolano	EBA						1/5															0%
Napoli (zona vesuviana)	EBA						1/3															0%
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Cresciano-Osogna	EBA						3/5															0%
Castello Valsolda	EBA						1/8															0%
Colfiorito	EBA						18/22															0%
Paestum	EBA						1/4															0%
Fermignano	EBA						8/23															0%
Alanno	EBA						7/9															0%
Montalto	EBA						4															40%
Ventaroli	EBA						X															nd
Scansano	EBA						0/12															nd
Vetulonia	EBA						0/3															nd
Musei Vaticani	EBA						0/2															nd
"Salerno"	EBA						0/3															nd
Volterra	EBA						0/3															nd

Fragmentation of Metal in Italian Bronze Age Hoards

Site	Dating	Gold disc	Sword	Spearhead	Dagger	Other Weapon	Knife	Axe	Sickle	Shovel	Other tool	Pin	Fibula	Torque	Other Ornament	Razor	Bronze sheet	Ingot	Other	% of fragmentation	
Siena (Maremma)	EBA						0/50														nd
Talada	EBA						0/5														nd
Fondo Vecchio	EBA						7												1		0%
Siena (loc. ignota)	EBA						1/4												0/1		0%
Campiglia d'Orcia-La Casetta	EBA						6												6		0%
Campiglia d'Orcia	EBA						0/12												0/5		nd
Baragalla	EBA						7												2		18%
Campiglia Marittima	EBA																		1/12		0%
La Spezia	EBA																		4/7		0%
Torrenuova	EBA																		6/35		50%
Val d'Orcia	EBA																		0/6		nd
Robbio	EBA						1							2	5						0%
"Lodigiano"	EBA						14/16							6							5%
Torrazzo di Vigevano	EBA													0/1	2/7						0%
Fraore	EBA													4							0%
Brabbia	EBA														1/4						0%
Oleggio Castello	MBA		1	1																	0%
Avigliana	MBA			1			7														0%
Cascina Ranza	MBA		7	32			19														56%
Oggiono - Ello	MBA		2	4	2	1	2										10				67%
Nemi	MBA						2														0%
Montello - Costa Monticelli	MBA						3														0%
Pieve Albignola	MBA						33/37														3%
Rocca di Badolo	MBA						42														5%
Canterano	MBA						7/10														14%
Semiana	MBA				X		X											20			100%
Gropello Cairoli	MBA				1							7			1			4	1		64%
Surbo	RBA		1				3			4											13%
Nago-Torbole	RBA				3		1														25%
Bric del Ciaz	RBA		3	4	1	1										1		1			46%
Corte Lazise	RBA		5	1			1					1				3			5		57%
Pila del Brancòn	RBA		13	54	2	21	1										53		6		84%
Gorzano	RBA				2/3		3/4														0%
Monte Pilastro	RBA						4														0%
Monte Gebolo	RBA				1		7	3										2	1		14%
Tarmassia	RBA			X			2			3	1			1				1			50%
Gerocarne	RBA			2			2												1		60%
Muscoli	RBA		2				2	10										0/1			64%
Castions di Strada 2	RBA			3			4	5		4								0/16		2	71%
Belgrado di Varmo	RBA		1				4	0/1					1						X		80%
Mezzocorona	RBA			1	1		4	3				1					4	33			91%
Castions di Strada 1	RBA		1	1	4		1	2	8						1			1/38			95%
Soncino	RBA			0/1	0/2	0/1		2	8/9						0/1			0/116	0/2		97%
Merlara	RBA		9	5			14	28/29			1							236			99%
Lozzo Atestino	RBA			0/1				0/58										0/179			nd
Cervignano	RBA						1	1		1								1/1			50%
Pinerolo	RBA						2	2		1								1/11	0/12		67%
Monte Battaglia	RBA						1	2	2			3		1	4		5	11	6		78%
Bettola	RBA											1			8						0%
Gualdo Tadino	RBA	2			1					3		3	4	12					23		27%
"Veronese"	RBA				1							2	6	1							80%
Pergine Valsugana	FBA					4															25%
Menaformo	FBA						3														0%
Ortucchio	FBA						2														0%

Site	Dating	Gold disc	Sword	Spearhead	Dagger	Other Weapon	Knife	Axe	Sickle	Shovel	Other tool	Pin	Fibula	Torque	Other Ornament	Razor	Bronze sheet	Ingot	Other	% of fragmentation	
Cerchiaro	FBA						7														14%
Contrada Montenero	FBA						3														33%
Cinigiano	FBA						X														nd
Gargaro	FBA						15														27%
Tragno Crosano	FBA						3	1			1	5									20%
Montichiari	FBA						2	1													33%
Mottola	FBA						4				3/6	1									38%
Pariana	FBA						1	4/5			5				6						60%
Borgo San Zeno	FBA						1	1	2/11		1					1/2			0/3		80%
San Pietro Borgo Valsugana	FBA			1	1		1	2	1												0%
Coste del Marano	FBA					1	1			1	3	4	11	116						7	1%
Reinzano	FBA		0/2				19														5%
Italia Meridionale	FBA		13			4	1/2		1	1								1			14%
Campese	FBA		1			1	4				1		3	1/2/9							14%
Scorrano	FBA		0/1				1	4/6			0/1				0/1					0/3	20%
Malpensa	FBA			4		4	3	3							2			X	X		68%
Monte Primo	FBA		1	4			2	26					4	1	11					1	78%
Limone	FBA		1	2			4	20	4	11		4	25	5	14				6	80%	
Lipari	FBA		86	59	21	1	29	8		7		1		5	6	48			48		93%
Loto	FBA		0/1												1			0/1	0/1		0%
Roca 1	FBA	2	0/2	0/1			5	5/7		6/9		3	5/6	1	5			0/4	0/2/3		45%
San Martino	FBA						1	4					2	10				1/4			64%
Monte Rovello	FBA						19											6			64%
Casalecchio	FBA			2		2	9	11		2		2						2			65%
Monte Ingino	FBA						10				16	34	16	22				1	9/11		65%
Monte Titano	FBA		1				2			23	12	19	4	3	6			2	17		67%
Celò	FBA		1		0/1		9	10/7/8		1		1			0/1			1	13/1/6		71%
Frattesina 4	FBA			2			1	2		8	6	3		2	0/1			4	9		72%
Gabbro	FBA						6				1							22			76%
Santa Lucia	FBA						2											15	1		82%
Rimessone	FBA				1		3	2		1		12					3	4			88%
Poggio Berni	FBA		5	18			8	6	18	1	5	1	7	2		8		7	6		90%
Roca 2	FBA	0/4	0/4				17	90/12/70				0/1		0/2		2/17		4	20/4		92%
Frattesina 3	FBA						5			21	3	1	5	3				4	10		92%
Museo Pigorini - loc. ignota	FBA		2	5			1	6		1		10						19			93%
Frattesina 2	FBA						1	1		24	1	2	3	5	5			21	6		94%
Frattesina 1	FBA			5			1	9	37			4	14	15	7			33	20		95%
Marsia	FBA			1			3	6					3	1	3			3			95%
Piano di Tallone	FBA						1	15	1									36	1		96%
Grotte Santo Stefano	FBA		3				4											12			100%
Manciano-Samprugnano	FBA								2	45	1	3						128			100%
Madriolo	FBA																	61			92%
Campagna Michela	FBA																	16			100%
Chiuse di Frontone	FBA																	2	15		100%
Porpetto	FBA																	X			nd
Zerba	FBA														6/8						0%
Capriano di Renate	FBA											1	1	4/5							0%
Badia Pavese	FBA									3				12/126							39%
Frattesina tesoretto	FBA											1	13	1					41		76%
Forlimpopoli	FBA																				nd
Copertino	FBA-EIA						8														0%
Tolfa	FBA-EIA						5														20%
Isola d'Elba	FBA-EIA			1	1		4					2									25%
Piediluco 1	FBA-EIA		1	7/18			16	26/62/133	13/30	5/9		55			1/10			0/7	3/9		76%
Monte Anciano	FBA-EIA						8	1			7	10	3	5		1		2	1		78%

Site	Dating	Gold disc	Sword	Spearhead	Dagger	Other Weapon	Knife	Axe	Sickle	Shovel	Other tool	Pin	Fibula	Torque	Other Ornament	Razor	Bronze sheet	Ingot	Other	% of fragmentation
Piediluco 2	FBA-EIA		6	13			12	18	6		8	30			2	2	6		16	79%
Goluzzo	FBA-EIA		2	10	1	1	11	28			4	13			1		18	1	2	86%
Capo Cimiti	FBA-EIA			4			21	6			7	1						1	8	96%
Santa Marinella	FBA-EIA		2	7		2	4	11	7	1	2	22			10	1	16	8	6	97%

Tab. 1 - Table of objects. The slash distinguishes the number of published objects (left) from the total amount of objects recovered in the hoard (right).

was not determined by an anthropologist and, unfortunately, there will be no additional chances to do so, therefore their interpretation as human remains is doubtful. Furthermore, at least two axes come from the Oggiono Ello hoard, designated as such due to axes being an uncommon grave goods in the Italian MBA. Regardless, the debate continues to be held.

While in the EBA and MBA the identification of sets (weapons, personal goods, axes, raw materials) of selected objects is easy and intuitive, it becomes very problematic when applied to most of the LBA hoards. Indeed, the complexity of item associations makes it challenging to observe recurring combinations. Furthermore, the complexity of the composition patterns seems to be related to the high fragmentation rate. Since LBA the fragmentation concerns all object categories, so each kind of object in the LBA could have been subject to fragmentation and deposition.

Nevertheless, it is possible to recognize some patterns in the selection of objects. The hoard of complete sickles from Monte Pilastro (Emilia-Romagna) is the only single-class hoard from the RBA. Some sets of personal ornaments and/or prestige goods are attested. Remarkable is the group from Gualdo Tadino (Umbria), where two gold discs are associated with a sword commuted into a dagger, a set of personal ornaments and other items still insufficiently studied. Very little is known about the set of personal ornaments from Bettola (Emil-

ia-Romagna), which consists of 8 armlets and one pin. There are also depositions consisting only of weapons. The deposit of Pila del Brancòn (Veneto) consists of a collection of swords, spearheads, daggers, bronze sheets from helmets, defensive armour, a type-Kurd *situla* and one axe, all probably thrown in the Tartaro River as a votive sacrifice (determination of bronze sheets in: Jankovits 1998-1999). Other groups with a predominance of weapons come from the LBA hoards of Malpensa (Lombardy), Bric del Ciaz (Liguria), Nago-Torbole (Trentino-Alto Adige) and Corte Lazise (Veneto). The latter two were placed in water, in the Garda Lake and an extinct-river, respectively. Corte Lazise could also be a site where more depositions of bronze items took place over the time. Although the majority of items is datable to the final RBA, some objects are probably more recent, dating to the initial FBA. All the other hoards from the RBA present a variegated combination of objects, mostly fragmented. More than half of objects consist of broken ingots (tab. 1).

Most of the bronze deposited during the RBA consists either of raw material or ingots (De Marinis 2019: 284, Tab. 1). The ingot/object ratio, in favour of ingots, does not occur in Italy during other phases of the Bronze Age. It can be inferred that from the RBA onwards, the majority of depositions was not exclusively based on the choice of objects to offer/sacrifice for their evident social or personal significance.

In the FBA (1150/1125-950/925 BC) and the EIA₁ (950/925-850/825 BC), there are only a few single-class hoards consisting of groups of axes (FBA: Cinigiano: Tuscany; Menaforo, Ortucchio: Abruzzo; Contrada Montenero: Apulia; Cerchiara di Calabria: Calabria; EIA₁: Tolfa: Lazio; Copertino: Apulia), sickles (Gargaro: Slovenia), greaves (Pergine Valsugana: Trentino-Alto Adige) and personal ornaments (Zerba: Emilia-Romagna). Sets of personal ornaments come from the bog of Capriano di Renate (Lombardy), the settlement of Badia Pavese (Lombardy) and the settlement of Frattesina (Veneto), where a little group of personal items, so-called “tesoretto”, was found. Notable evidence comes from Coste del Marano (Lazio). Here, three complete bronze-sheet cups were buried with a lot of personal items, ornaments and tools. In the Bronze Age settlement of Roca Vecchia (Apulia), a group of heterogeneous objects has been found buried inside a cult structure that had collapsed after a fire (Roca I, Apulia). Among several fragments of objects and raw materials, two gold discs were also discovered (Maggiulli 2006). There are hoards consisting of raw material, mostly ingots and some pick-axe ingots (Madriolo: Friuli Venezia Giulia; Campagna Michela: Veneto; Chiuse di Frontone: Marche). However, the number of ingots deposited during the FBA, and even more during the EIA, drastically decreases compared to RBA.

In LBA accumulations of objects made unusable are collected together. There is not a recurrent pattern, but rather a random accumulation. Unlike the single-class hoards, variegated hoards – particularly with high-fragmentation rates – seem to suggest a non-selective collection.

FRAGMENTATION AND FRAGMENTS: MAIN RESULTS

There are at least 5706 objects in 166 Italian hoards: 1050 from the EBA (18,4%);

220 from the MBA (3,8%); 1222 from the RBA (21,4%); 2494 from the FBA (43,6%); and 720 from the FBA₃ - EIA₁ (12,6%). It was possible to establish the completeness/fragmentation of 4290 objects. 1450 objects are complete, 2840 are fragments. The individual weight of 2424 objects has been recorded: 312 from the EBA; 151 from MBA; 485 from RBA; 1129 from FBA; 347 from EIA₁.

The quantity of metal deposited in Italian hoards strongly varies depending on the different periods of the Bronze Age. Fragmentation, for example, is almost absent in the EBA record.

In the MBA, a sharp decrease in bronze depositions occurred, also recorded in Central Europe. Changes in value-systems (Primas 1997: 122) or a precise social taboo prescribing an alternative rituality – i.e. deposition of complete objects in water and mountain peaks (Bianco Peroni 1979: 333, Abb. 2; Peroni 1996: 299, fig. 64) – have been proposed as possible explanations of this gap in the archaeological record. Albeit in the MBA the same patterns as in the EBA are still present in hoards, a perceptible fragmentation rate exists.

In the RBA, a huge increase in metal depositions has been recorded and the fragmentation had definitely been established since then. Bronze circulated and was traded in previously unconventional forms, like the broken ingots (fig. 2).

In the FBA and at the beginning of EIA, the ingots tend to vanish. The average quantity of deposited bronze still increased, while the average weight per object decreased. The amount of LBA fragmented items represents 70-80% of the total objects.

The damaging can be compared with fragmentation. Results attested a rather low rate, always below 10% (fig. 4). It does not increase with time and could be, partially, randomly caused by post-depositional conditions, failed attempts of breaking

or the fragile nature of some bronze items (i.e. bronze sheets, needles, pins, etc.). The fragmentation involves all the categories of objects. Every kind of object in the LBA may be fragmented and deposited (fig. 4).

Beginning from the LBA, it is very uncommon that a single hoard contains two or more fragments of the same object. Thus, a very small number of matching fragments is recorded. Even less are those which reconstitute an object entirely (fig. 5). They are, in total, less than 5% of fragments from the same object, and this figure tends to decrease during the advanced phase of the LBA.

DISCUSSION

The quantification of the deposited metal suggests that there is an increasing demand for bronze in the final part of the Bronze Age (fig. 3).

In the EBA the metal circulated in Europe in standardised forms, namely *Ringbarren* and *Spangenbarren* in the Northern Alpine area (Lenerz-de Wilde 1995, 2011, Radivojević *et alii* 2018: fig. 3) and – at least in part – flanged axes (e.g. Peroni 1996: 110). These standardised shapes probably played both the function of ingots, perhaps also performing the purpose of media of exchange. From the Late Bronze Age, fragments of items and bun-ingots probably became the principal metal-medium of trade in Italy and Central-Europe.

Judging by the quantity of bronze deposited in the hoards, the flow of metal seems to share a common trend in the Italian and Central European Bronze Age (Primas 1997: fig. 3). The scarcity of depositions in the MBA is accompanied by the beginning of the fragmentation practice from both north and south of the Alps.

Fragment hoards began to appear in Italy during the MBA as part of the extensive phenomenon of fragmentation occurring in Europe at the very same time, which en-

compasses a wider distribution area ranging from the Carpathian Mountains and the Loire Valley (Hansen 2016: 196).

The scarcity of MBA depositions was followed by massive hoarding in the LBA, and by the definitive adoption of fragmentation as a predominant practice. The ritual fragmentation, partly identifiable in the damaging treatments, appears as a marginal practice (fig. 4), mostly attested in weapons and personal items (i.e. pins, fibulae). On the contrary, from the LBA onwards the simple fragmentation is present on objects of any class. Some of them has probably been broken after the normal use-wear (Roberts, Ottaway 2003; Knight 2020). Their quantification in Italian hoards would require a dedicated study, based on the direct observation of the artefacts. Apparently, artefacts which can no longer be repaired were perhaps put aside for future purpose (re-melting, re-shaping, trading, etc.). Storage of ingots and unusable objects are both a wealth accumulation and a useful founder's supply. They might have been collected either to be traded or recycled.

Ingots represent more than half of the amount of artefacts buried during the RBA (fig. 2), and almost the total mass, at least in northern Italy (De Marinis 2019: 284, Tab. 1). They were likely used as the main portable-medium for trade during the MBA and RBA. The amount of ingots decreased in the transition to the FBA. It would seem as if the fragmented-objects became the main portable-medium. Fragments are already attested during the RBA, but the number of fragmented items represents a minority in comparison with the number of ingots.

According to archaeometallurgical studies, there is no doubt that a considerable phenomenon of bronze recycling did happen during the Late Bronze Age (Delfino 2014; Radivojević *et alii* 2018). The geochemical fingerprints of copper from different copper sources seems to mix up in the al-

loys of single objects, which is an argument in favour of extensive recycling. The lead isotope analysis and trace element composition of artefacts from the Eastern Alpine area demonstrates a more stable geochemical fingerprint in the copper ingots than the metal objects, which can be explained by a lower involvement of ingots in global mixing and recycling processes (Pernicka *et alii* 2016). The utilization of ingots is likely more related to production, as their presence in settlement-hoards – many of which are possibly founders' hoards – may suggest (e.g. Bietti Sestieri, Giardino 2019).

Apparently, there is not a selection of objects to ritually sacrifice/offer in LBA scrap hoards, thus the rituality is not appreciable in composition patterns. The lack of intentional selection has been tested in LBA British hoards by R. Wiseman. The fragments in most LBA hoards can no longer be interpreted as broken artefacts, but as scrap and unused metal material collected randomly. The author concludes that hoards of broken objects could have been intended as temporary storage with no ritual purpose in their deposition, but rather stored for later recycling (Wiseman 2018). All these indications have led several scholars to consider the utilitarian fragmentation inconsistent with the non-temporary, hence ritual deposition of scrap hoards.

However, the ritual intent is very difficult to detect only based on the observation of artefacts, while it should be supported by decisive knowledge of the contextual data of the site. Discovery circumstances provide key information to understand the nature of a deposition. However, the high rate of fragmentation, absence of selection and presence of raw material does not unequivocally imply the storage of a metallurgist. The Roca I hoard (Apulia) illustrates how ingots and fragments of metal objects – usually linked with the metallurgists' activities of recycling – can be found together with two gold

discs, which are supposedly ritual items. Furthermore, they were collected inside a structure interpreted by the excavators as a temple-hut (Malorgio, Maggiulli 2011; Maggiulli 2009). Occurrence of fragments and raw material is also attested in other easily recognizable cult sites. They often present the same apparently random composition patterns, such as in the case of those scrap hoards or founders' hoards (found in settlements) that include raw materials (Monte Battaglia: Emilia-Romagna; Monte Ingino, Monte Ansciano: Umbria; Monte Titano: Republic of San Marino). After all, there is no reason to maintain that scraps are necessarily inconsistent with the ritual offerings.

Despite a possible significance in the choice of the objects to deposit – whose meaning can be either related to the symbolic or to the economic aspect the object performs – all the debate around ritual and non-ritual theories requires a thorough reconsideration. The fact that some objects were originally broken for utilitarian purposes does not exclude the possibility that the same objects were eventually ritually buried (Brandherm 2018). Therefore, it is perhaps more appropriate to consider the object selection simply as one among many aspects of rituality. The dichotomy between the “sacred” and “profane” tends now to be considered as an anachronistic distinction (Bradley 2005: 163-164).

The quantitative analysis here presented (fig. 5) shows that the occurrence of matching fragments in the same hoard is very uncommon. This entails a number of implications. Foremost, in most cases, fragmentation is not related to deposition. Therefore, fragments most likely moved for time and crossed through several hands before being deposited (Bernabò Brea, Cavalier 1980: 738-739). Moreover, fragments similar to LBA scraps have been found among personal equipment in graves, contained in organic containers (Pare 1999: 461-463; Sommerfeld 1994: 406, Taff. 12, 13) and

perhaps even in the Bronze Age battlefield site of Tollense Valley (Uhlig *et alii* 2019). Fragments of metal artefacts were probably transported like personal, circulating value, used and traded daily for other commodities. The beginning of fragmentation could be consistent with the adoption of a standard value system all around Europe during the LBA, possibly a standardized unit of measure (e.g. Pare 2013). Therefore, the fragmentation in most cases is not performed on the occasion of the deposition, but is rather what remains of a daily economic practice. To conclude, fragments are consistent with more than one economic purpose and virtually fulfil more tasks in their life cycle, even the ritual dedication of an economic value.

FINAL REMARKS

- 1) A significant transformation in the object associations within hoards occurred during the LBA as well as in the rate of fragmented objects. These aspects were well known in specialist literature, but have never before been quantified.
- 2) The damaging practices on the objects, probably ritualistic, are attested at a low rate (fig. 4), while most objects have no traces of an alleged ritual treatment. The low rate of matching fragments in the hoards shows

the fragmentation unrelated to the deposition, but had occurred previously.

- 3) The fragments are probably a medium of exchange, circulating in pre-monetary way and were probably weight-regulated. The bronze fragments could be used both for their intrinsic value as well as recycled, as seen in several bronze age settlements (e.g. De Marinis 2006; Bianchi 2018).
- 4) The deposition of fragments deprived of their functional meaning has usually been considered as proof of economic, and therefore non-ritual, practice. However, the bronze fragments may also have been deposited for their economic value as votive offerings. In this sense, some hoards of fragments from ritual places (Monte Battaglia: Emilia-Romagna; Monte Ingino, Monte Ansciano: Umbria; Monte Titano: Republic of San Marino) can be considered. There does not seem to be significant opposition between utilitarian and ritual practices.

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5 The basic bibliography of Italian hoards, collected until early 2020, is listed here: EBA: Baragalla, De Marinis 1976; Torbole, De Marinis 2012a; Burzanella di Camugnano, Bermond Montanari 1975; Savignano sul Panaro, Cardarelli 1997; Crespellani 1884; Scandiano, *Bullettino di Paleontologia Italiana* 1892, *Notizie diverse*, 18: 127.; Castione dei Marchesi, De Marinis 1997; Acquaviva Picena, Amelia, Peroni 1971; Alanno, Peroni 1971, Pellegrini 1908; Cetinale, Montalto, Capalbio, Santa Fiora, Monte Maggio, Sarti 1984; Loreto Aprutino, Cervara Alfina, Ripatransone, Tirano, Mascion, Bianco Peroni 1994; Torrenuova, Pernier 1924; Montemerano II, Campiglia Marittima, Campiglia d'Orcia - La Casetta, Campiglia d'Orcia - Le Muricce, Val d'Orcia, Milani 1907; Montemerano I, Minto 1938; "Iodigiano", De Marinis 2010; Campiglia d'Orcia, Scansano, Siena Maremma, Talada, "Salerno", Ventaroli, Musei Vaticani, Vetulonia, Volterra, unpublished; San Lorenzo in Noceto, Bermond Montanari 1996a; Robbio, Semiana, Pieve Albignola, Pearce 1991; Remedello Sopra, De Marinis 1979; Capestrano, Città di Castello, Rocca delle Fene, Montelius, II, 1, 581; Brabbia, Montelius, I, 51 s; Torrazzo di Vigevano, De Marinis 2006a; Casale di Governolo, Carancini, Peroni 1999; San Fiorano alla Pieve d'Olmo, Montelius, I, 161; Viadana, De Marinis 2012a; Verruca, Bruni 1997; Fraore, Macellari 1997; Siena località ignota, Carancini, Peroni 1999; Sarti 1984; Puglianella, Ciampoltrini, Andreotti 2013; Torre del Moschetto, Canterano, Barker 1971; San Marcellino, Albore Livadie *et alii* 1998; Rota, Carancini 1991-1992; La Speziala. Aranguren, Sozzi 2006; Vinchiaturro, Santone 2009; Cotronei, Bianco Peroni 1994, Tinè 1962-1963; Canne I-II, Gervasio 1939; Isolino Virginia, De Marinis 2009b; Ercolano, Caylus

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