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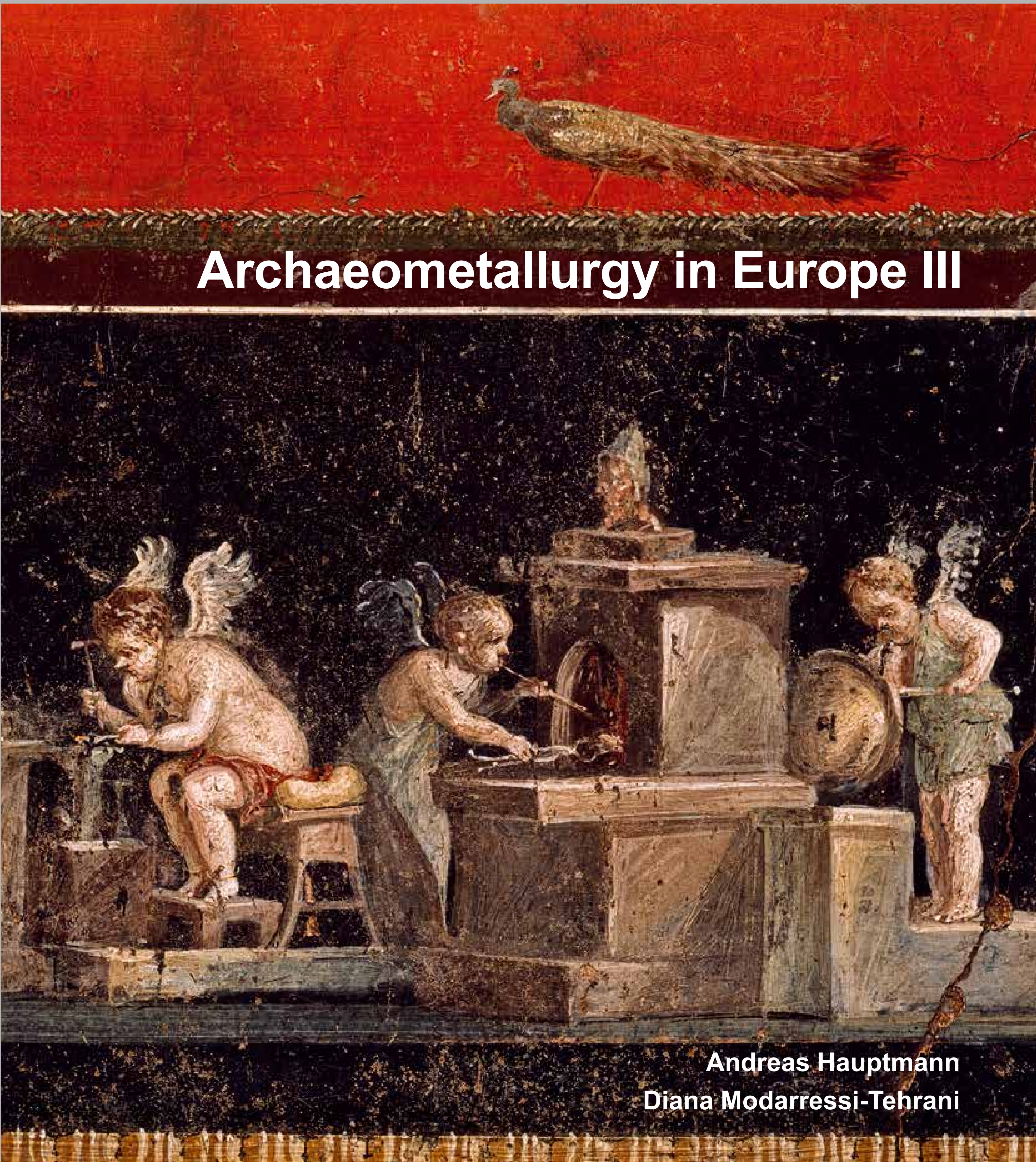
Archaeometallurgy in Europe III



Andreas Hauptmann
Diana Modarressi-Tehrani

Archaeometallurgy in Europe III

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Proceedings of the 3rd International Conference
Deutsches Bergbau-Museum Bochum

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Editors
Andreas Hauptmann
Diana Modarressi-Tehrani

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Cover

Domus Vettiorum / Casa dei Vettii, Pompeii (Campania, Italy, 63-79 BC), which was excavated in 1894. Section of a Pompeii-style scenic fresco showing Erotes and Psyches in a gold assay laboratory. In the left corner, scales for weighing gold are put on a table. Next to it, one of the Erotes is working with a small hammer on an anvil. On the right side, an assay furnace is shown. Another of the Erotes is holding a small crucible with pincers with the right hand while using a blowpipe with his left hand, supplying the fire with air. The large bellow for the assay furnace is driven by the third of the Erotes.

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Archaeometallurgy in Europe III

Editorial

This volume comprises a range of articles, which were submitted and selected from all the presentations given on the International Conference ”Archaeometallurgy in Europe III”, held from the 29th of June to 1st of July 2011 at the Deutsches Bergbau-Museum Bochum, Germany.

The present volume is the third in the series “Archaeometallurgy in Europe” , capturing the spirit of the successful series of international conferences on this special theme of research. The first conference “Archaeometallurgy in Europe” had been organized by the Associazione Italiana di Metallurgia and took place in Milano, Italy, from the 24th to the 26th of September 2003. The second conference was held in Aquileia, Italy, from the 17th to the 21st of June 2007. It was also organized by the Associazione Italiana di Metallurgia.

The splendid idea to launch this conference series, a scientific series of meetings limited to the countries of Europe, came from the late Prof. Dr. Walter Nicodemi, formerly President of the Assoziazione Metallurgia di Italia. Thanks to the efforts of Dr. Alessandra Giumlia-Mair, Merano, these conferences have developed into increasingly productive events with a high scholarly quality. Since then three conferences have taken place and the fourth meeting is at an advanced stage of preparation and will take place in Madrid, Spain, from the 1st to the 3rd June 2015.

The title of the conference series covers a research field which is a distinctive part of archaeometry, and which so far was usually included as one of the topics in the program of the “International Symposium on Archaeometry” (ISA), organized every third year at different locations in Europe and in the United States. However it is our opinion, that in the last decade archaeometallurgy has developed as a very important research field, and we are observing a large number of scholarly activities all over the world. We are convinced that such an important topic needs to be organised and presented in conferences specifically dedicated to this field. Therefore the topic of this conference is the history of metals and metallurgy primarily in Europe, but it also includes other regions of the Old World.

The future prospects of the conference series are promising, especially because “Archaeometallurgy in Europe” constitutes an extremely useful broadening and a regional counterpoint to the well-established and successful conference series “The Beginnings of the Use of Metals and Alloys” (BUMA), which was launched in 1981 by Professors Tsun Ko, Beijing, China, and Robert Maddin, then Philadelphia, USA. The focus of the eight BUMA conferences held so far (the last one was held in Nara, Japan, in 2013) lays on the development of metallurgy in South-East Asia and the Pacific Rim. We firmly belief that the two conferences complement each other very effectively and should therefore continue to exist side by side.

With this special volume of *Der Anschnitt*, we are delighted to publish a selection of the lectures presented at the conference at the Deutsches Bergbau-Museum Bochum in 2011. Many of the authors contributed with very instructive and informative papers, which finally resulted in this volume.

We are very much obliged to all these authors who, with patience and persistence, cooperated with us and helped to shape this volume. We would also like to thank the reviewers who decisively contributed in the improvement of the scientific level of this volume.

Our thanks go first to all those colleagues and friends who helped to organize the conference in 2011. The former director of the Deutsches Bergbau-Museum, Prof. Dr. Rainer Slotta, and the present director, Prof. Dr. Stefan Brüggerhoff encouraged and promoted our efforts to organize this scholarly meeting. Dr. Michael Bode, Dr. Michael Prange, and Prof. Dr. Ünsal Yalçın supported the conference planning and realization in every aspect. Many colleagues of the staff of the Deutsches Bergbau-Museum, and many of the students working in our research laboratory offered their assistance and help.

Finally, our thanks go to Mrs. Karina Schwunk and Mrs. Angelika Wiebe-Friedrich who performed the editorial work, design, and layout for this volume.

Andreas Hauptmann
Diana Modarressi-Tehrani

Contemporaneously to the conference in 2011 a volume with abstracts on every lecture given and every poster presented was published:

2011 HAUPTMANN, Andreas, MODARRESSI-TEHRANI, Diana & PRANGE, Michael (eds.), Archaeometallurgy in Europe III. Abstracts. METALLA, Sonderheft 4, 2011.

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Summary

This paper examines the debate concerning the spread of early copper mining and metallurgy in Europe, in terms both of the *a priori* premises of the scholars concerned and of the actual archaeological evidence. It discusses the development of the diffusionist paradigm exemplified by Childe and Wertime, who argued for a single origin for metallurgical knowledge and practice in the Near East, and the challenge from Renfrew's model of multiple centres of development of copper metallurgy (the Near East, the Balkans and Iberia). Specifically, it critiques the neo-diffusionist model recently proposed by Roberts, Thornton and Pigott (2009), who argue that metallurgy developed in a single region, in the area of eastern Anatolia and northern Iraq, from whence it diffused to other areas.

It is shown that whether or not one agrees with the premises of the argument put forward by Roberts et al. (2009), the single origin diffusionist model for copper metallurgy is unproven on the basis of the available evidence. For example, copper smelting first appears in the Balkans (Belovode, Serbia – 5000-4650 cal BC), Iberia (Cerro Virtud, Almería – 4910-4460 cal BC) and southeastern Iran (Tal-i Iblis – second half of the 6th / first half of the 5th millennium cal BC) rather than in Anatolia or northern Iraq.

The paper also examines the evidence for the earliest copper mining and metallurgy in Italy and southern France in the light of this debate, arguing that the pattern shown by the evidence does not support a simple diffusion from East to West.

A new model is proposed which posits that information flowed throughout Eurasia, and that different technological developments may in fact have first emerged in different areas.

Introduction

Archaeologists who are interested in the earliest phases of copper mining and metallurgy may be divided into two general schools of thought, which in this paper I shall call the 'maximalists' and the 'minimalists': the maximalists tend to accept early dates and evidence for technological change, while on the other hand the minimalists tend to be more sceptical about such claims. It is my contention that archaeologists adhere to one of these two schools of thought on the basis of their *a priori* belief rather than the quality of the evidence itself; they then assess the actual evidence in the light of their preconceptions.

The diffusionist paradigm

The traditional model for the appearance of metallurgy in Europe and the Mediterranean was firmly rooted in the diffusionist paradigm. It is worth briefly noting that this diffusionist model had its origin in the growing dissatisfaction with positivism of the second half of the 19th century. The increase in ethnographic data, concerning societies at various stages of social evolution (in the 19th century sense of that term), ranging from hunter-gatherer 'savagery' to complex societies, led prehistoric archaeologists to doubt the idea of universal evolutionary progress (Trigger 1980: 23 - 26). Observing the effect of European colonisation and trade they instead suggested that new technologies and ideas diffused from 'higher' to 'lower' cultures, and in the case of prehistoric Europe they posited that the source of innovation would have been the more developed societies of the Near East – an idea put forward by Oscar Montelius (1899).

Perhaps the best known proponent of the diffusionist paradigm was Vere Gordon Childe (1892 - 1957; for a detailed discussion of his thought see McNairn 1980 and Trigger 1980). Childe's ideas about the development and diffusion of metallurgical knowledge and practice developed in the late 1920s, and can be best illustrated from two of his key publications, *The Most Ancient East: the Oriental Prelude to European Prehistory* (1928) and *The Bronze Age* (1930).

Childe's basic premise was that cultural developments occurred earlier in the Near East (1928, 221). He believed that because metallurgical processes and techniques were so difficult to master, they could only have been discovered once; he argued that metallurgical knowledge and practice spread across Europe and the Mediterranean from an origin in the Near East and that this was a consequence of the demand for raw materials (1928: 220 - 221; 1930: 10 - 11, 23 - 27; cf. McNairn 1980: 22 - 25; Trigger 1980: 44 - 45; 67 - 70).

A key figure in the development of the diffusionist paradigm in studies of early metallurgy is Theodore Wertime (1919 - 1982). Wertime was an official of the US State Department and Information Agency, where he worked as an editor of the 'Voice of America' and as Cultural Attaché in Iran and Greece; he later became a Research Associate of the Smithsonian Institution (Smith 1984). In 1964 he published 'Man's first encounters with metallurgy'.

This paper does not cite Childe, but it has the same premise, that metallurgical techniques are unlikely to have been discovered more than once (Wertime 1964, 1266). Like Childe, Wertime believed that knowledge of smelting was diffused from its origin (1964: 1266), but whereas Childe had been unsure whether metallurgy had developed in Mesopotamia or Egypt (1930: 23 - 27), Wertime was able to be more precise, putting the discovery in 'an area stretching from western and central Anatolia across the flanks of the Taurus and Zagros mountains to the edge of the central desert of Iran' (1964: 1257).

Later, after Renfrew's (1969; 1970) arguments for the autonomous development of metallurgy in different areas of Europe had been published, Wertime adopted a slighly more nuanced position in another article, 'The beginnings of metallurgy: a new look' (1973). Thus while he continued to state that 'extractive-casting metallurgy was probably discovered in only one center, southwestern Asia' (Wertime 1973: 876), he allowed for 'a process of diffusion and multiple innovation interrelating metallurgical innovation over much of Eurasia …' (Wertime 1973: 886). The mechanism for this was '… a communicational revolution that entailed a diffusion of knowledge in time and space between centers of discovery and between linked technologies' (Wertime 1973: 875).

It is important to note that the diffusionist paradigm is an *a priori* model, preferring a single origin and the transmission of knowledge to the alternative model of parallel evolution. Moreover, since the traditional relative chronologies developed by Montelius and later Childe also depended on diffusionist premises, the diffusionist model for the spread of metallurgy was confirmed by the relative chronological framework in a classic self-reinforcing circular argument.

The multiple centres of development model

When Colin Renfrew (1969; 1970: 306 - 8, Fig. 10) challenged the diffusionist model, and argued that there were multiple centres of development of copper metallurgy (the Near East, the Balkans and Iberia), he did so on two grounds. The first was ideological: he proposed his new model within the context of the New Archaeology, a paradigm which was a return to positivist and evolutionary thought, and had a strong belief in the idea of progress and local development. The second ground was the archaeological evidence itself: the new calibrated radiocarbon chronology provided evidence in support of his hypothesis that metallurgy developed separately in the Balkans and Iberia.

Because it fitted both the new paradigm and was supported by the radiocarbon evidence, Renfrew's model was widely accepted. However it has recently been challenged by a group of scholars who wish to return to a diffusionist model; their ideas have been succinctly expressed in a recent article (Roberts et al. 2009).

The new diffusionism

Benjamin Roberts, Christopher Thornton and Vincent Pigott (2009) reprise the arguments of Childe (1928; 1930) and Wertime (1964; 1973); they state that metallurgy requires 'highly specialised knowledge' (Roberts et al. 2009, 1016), and argue that metallurgy developed in a single region, in the area of eastern Anatolia and northern Iraq, from whence it diffused to other areas 'usually by the acquisition of metal objects as "exotica" and often then by the movement of people possessing metallurgical expertise' (Roberts et al. 2009: 1013). They are categorical that 'There is no evidence to suggest that metallurgy was independently invented in any part of Eurasia beyond Southwest Asia' (Roberts et al. 2009: 1019). Finally they state that 'Given the virtually synchronous appearance of copper smelting throughout Southwest Asia and Southeast Europe, a single central region of invention is far more probable than many parallel independent discoveries…. This core region was probably in Anatolia…' (Roberts et al. 2009: 1014).

There is no doubt that there is much pressure on scholars to come up with revolutionary perspectives, indeed as Anick Coudart has written (1999: 163), '…in the US and Britain … to be academically acknowledged necessarily requires questioning the hypotheses and the results of the scientific establishment. This attitude … systematically leads to throwing away the baby with the bathwater'. Moreover this questioning often takes the form of the ritual murder of intellectual ancestors, a form of academic Oedipus complex (Pearce 2011: 82; cf. Dyson 1993: 196). It might also be commented that the return to idealist and historicist diffusionist perspectives reflects the dominant (at least in the anglophone archaeological community) Post-processual paradigm. However I should like to examine the argument put forward by Roberts and his colleagues in some detail.

Firstly, the reasoning put forward by Roberts et al. (2009) is, to use the terminology which I have proposed, typically 'minimalist' and is certainly sceptical about the capacity of human societies to innovate; in this it explicitly mirrors the standpoint enunciated by Childe and Wertime. However we must realise that such arguments are *a priori*, and I suggest that only if we are aware that such arguments are no more than assumptions can we critically examine their model.

Leaving aside their premises, we must ask whether the data which is available to us really support their hypothesis.

The evidence for early copper metallurgy

The first point that needs to be made is that the first evidence for the smelting of copper ore, around the beginning of the 5th millennium cal BC, is not in Anatolia or northwestern Iran, but is to be found at Belovode, Serbia, at Cerro Virtud, Spain and at Tal-i Iblis, in southeastern Iran.

The earliest mining of copper minerals in Europe seems to take place in the late 6th millennium cal BC; radiocarbon dates from Rudna Glava, Serbia, date this to 5490/5320 -4740/4570 cal BC in the context of the local Vinča Culture (Borić 2009: 194 -207, Tab. 1). The first evidence for the actual smelting of copper ore seems to be found at the Vinča Culture settlement of Belovode, Serbia, at a slightly later date, the beginning of the 5th millennium cal BC – 5000 - 4650 cal BC (Borić 2009: 207 - 209, Tab. 2; Radivojević et al. 2010; Radivojević et al. 2011). At Belovode smelting is documented by slag, fragments of ore and a copper droplet; the site is claimed as the earliest good evidence for copper smelting in the world (Radivojević et al. 2010) and consequently reaffirms the argument for the local development of metallurgy in the Balkans. The manufacture of malachite beads at Belovode reminds us that not all prehistoric mining was undertaken with the purpose of producing metallic copper.

The significance of this early mining and smelting in the Balkans is highlighted by a number of statistics. It is estimated that there are about 4.7 tons of copper artefacts known from southeastern Europe and Hungary dating to the Neolithic and Copper Ages (Pernicka et al. 1997: 41) and Natalja Ryndina has calculated that this equates to some 4300 artefacts, including around 1000 heavy shaft-hole tools, while in the Neolithic-Eneolithic Near East there are no more than 300 copper artefacts (Ryndina 2009, 5). Although this massive disparity may reflect differing depositional practice (Svend Hansen, pers. com., 10 February 2012), what is striking is the vast amount of metal circulating in the Neolithic and Copper Age Balkans and Danube area. Moreover, we may reasonably assume that many more objects were in circulation at the time and have been lost or recycled.

It should also be noted that the use of copper minerals and native metal dates back to the early Neolithic in the Balkans (Borić 2009: 191; Radivojević et al. 2010: 2777), so that we should not be surprised by such early dates for the smelting of copper ore.

The first evidence for the smelting of copper ore in Iran may be datable as early as the second half of the 6th millennium cal BC, and smelting had certainly begun there by the first half of the 5th millennium cal BC: it is documented by fragments of crucibles, copper ore and charcoal at the site of Tal-i Iblis, in southeastern Iran (Dougherty & Caldwell 1966; Evett 1967: 252 - 254; Thornton 2009: 308 - 310; Frame 2012). Lesley Frame's (2004; 2012) analyses of the prills and slags adhering to these crucibles demonstrate that they were used for the smelting of ore rather than simply the melting of copper metal.

Along with the Balkans, Colin Renfrew (1967; 1970: 292 - 293, 308) also posited the independent origin of metallurgy in Iberia, and it has been argued that the first evidence for copper smelting in Iberia may also be dated to the first half of the 5th millennium cal BC. At the site of Cerro Virtud (Almería) in southeastern Spain a potsherd with slag adhering to it was found 'in the lower part of the Neolithic level about 9 to 15 cm above [the layer below]' (Ruiz-Taboada & Montero-Ruiz 1999, 900); organic material from this layer is dated 5830 ± 90 BP (Beta-118936) which calibrates at 2σ to 4910 - 4460 cal BC (Reimer et al. 2009). There is at present no further evidence for copper metallurgy in Iberia for over a millennium (Ruiz-Taboada & Montero-Ruiz 1999: 897) and consequently this early date for copper smelting so far west is doubted by Roberts (2008: 360), who as we have seen is a 'minimalist', but it is accepted by other workers, such as Salvador Rovira (2002: 8). The excavators emphasise that the site is close to a copper ore source at Herrerías, and that a copper awl was found at La Cocina cave (Valencia) whose stratigraphic context is compatible with the radiocarbon date for Cerro Virtud (Ruiz-Taboada

& Montero-Ruiz 1999: 902), suggesting that metallurgy may have been more widespread than the present evidence attests.

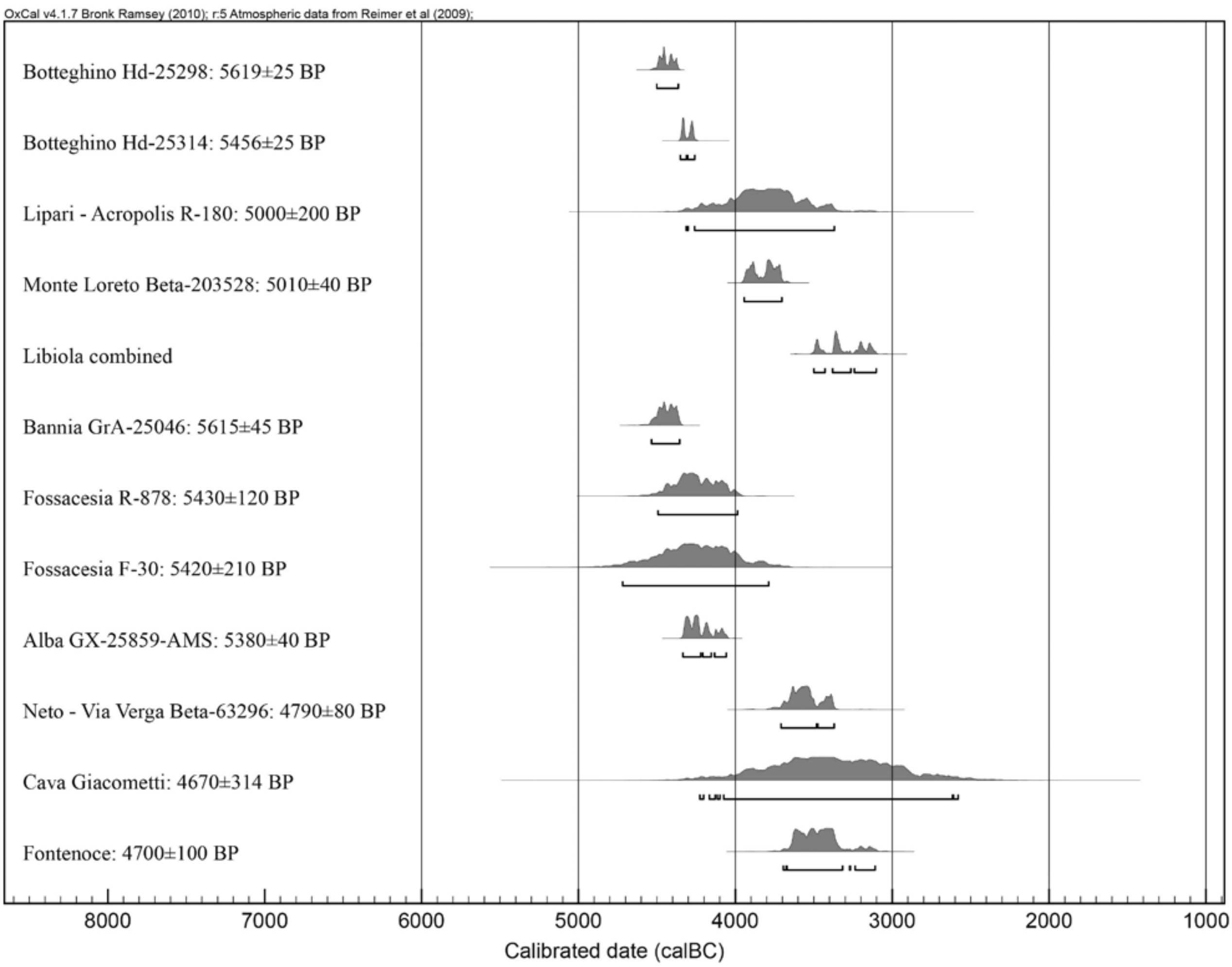
Early copper metallurgy and metalwork in Italy

Independent support for such an early date is now provided by the site of Botteghino (Parma), in northwestern Italy, where smelting, documented by smelting slag and a crucible fragment, can be dated to around 4300 cal BC (Fig. 1). The metallurgical activity is from a Chassey-Lagozza culture context and two copper awls were also found (Mazzieri & Dal Santo 2007). This early date from the Po plain confirms the early evidence from Brixlegg (Inn Valley – Austria), where fahlore smelting has been dated 3960 - 3650 cal BC, but may in fact be earlier as it is associated with late 5th millennium Münchshöfener material in a layer that has been radiocarbon-dated to 4500 - 4160 cal BC (Höppner et al. 2005; but cf. the comments on the stratigraphy in Gleirscher 2007: 102 - 106, Fig. 5).

It is singular that the earliest copper smelting in Italy should be found in the north west, rather than in the south east, where one would predict its occurrence if metalworking spread from the Near East, as the diffusionist model holds. Equally striking is the distribution of the earliest evidence for metalworking in Italy and the neighbouring islands; this has a primarily western distribution rather than an eastern one (Fig. 2). In fact, as well as at Botteghino, evidence for early smelting or at least the melting of copper may be found at a number of other sites:

- In Tuscany, an awl, a crucible, slag and one or more metalworking hearths have been found at Neto – Via Verga (Sesto Fiorentino – Firence) in horizon 5, which

Fig. 1: Calibration plot for radiocarbon dates for early Italian metallurgy and metalwork generated using OxCal 4.1.7 (Bronk Ramsey 2009; Reimer et al. 2009); the Libiola combined plot was generated from the two determinations for the Libiola oak pick-handle (GIF-7213 – 4490±90 and Bln-3367 – 4610±50: Pearce 2007, 62 - 63; Maggi et al. 2011, tab. 1). Radiocarbon determinations: Botteghino – Mazzieri & Dal Santo 2007; Lipari – Alessio et al. 1980, 840; Monte Loreto – Maggi et al. 2011, 285; Bannia – Giumlia-Mair & Visentini 2006, 1418; Fossacesia – Pessina & Radi 2002, 153 - 154; Alba – Venturino Gambari 2002, 410; Neto – Sarti & Volante 2002, 441; Cava Giacometti – Sarti & Volante 2002, 444; Fontenoce – Sarti & Volante 2002, 444.



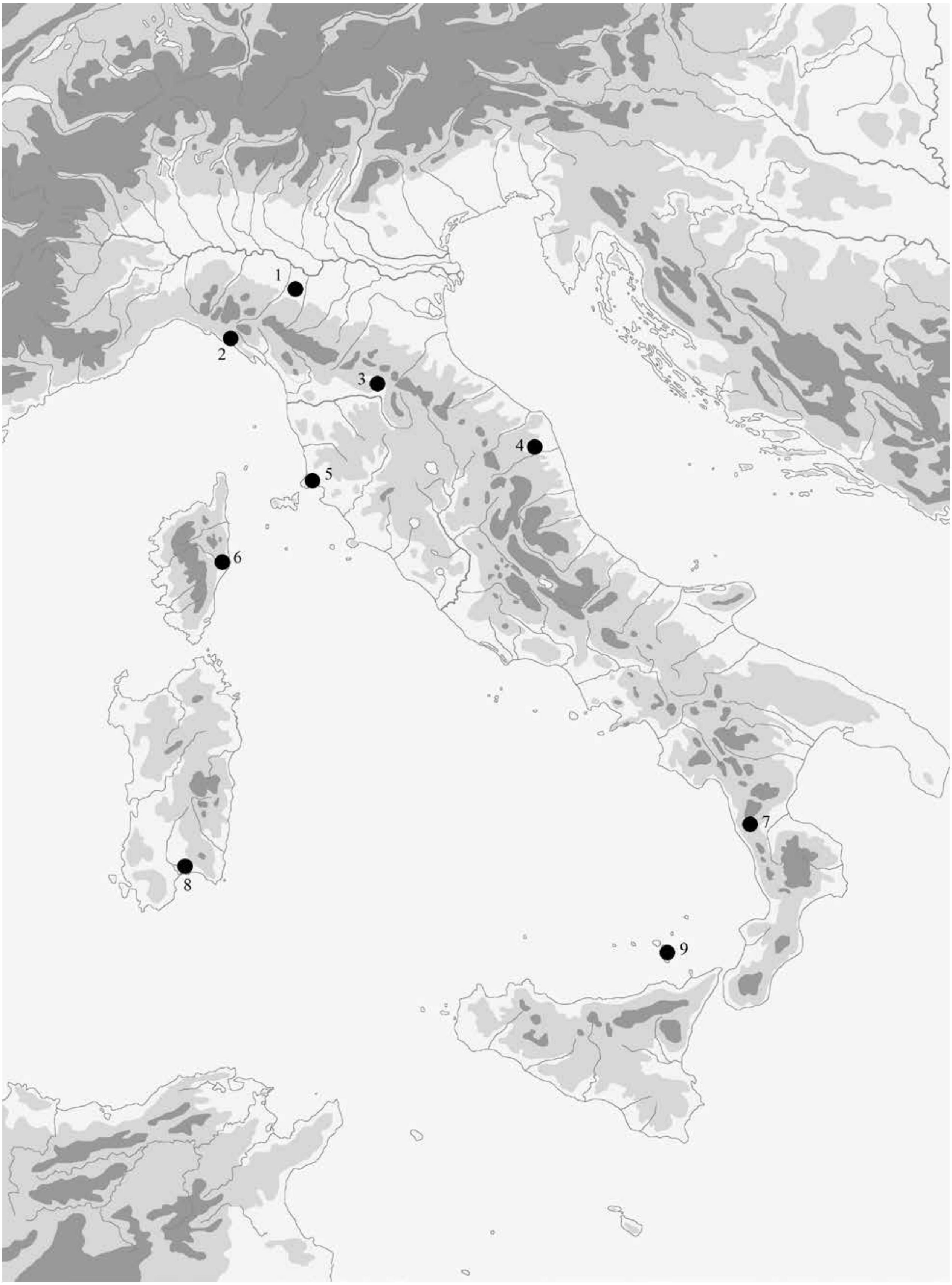


Fig. 2: Findspots of evidence for early copper mining and metallurgy in Italy and adjacent islands: 1. Botteghino (Parma); 2. Libiola (Sestri Levante – Genova) and Monte Loreto (Castiglione Chiavarese – Genova); 3. Neto – Via Verga (Sesto Fiorentino – Firence); 4. Santa Maria in Selva (Treia – Macerata); 5. Orti Bottagone (Piombino – Livorno); 6. Terrina site IV (Aléria – Haute Corse); 7. Grotta della Monaca (Sant'Agata di Èsaro – Cosenza); 8. Su Coddu (Selargius – Cagliari); 9. Lipari – Acropolis (Messina).

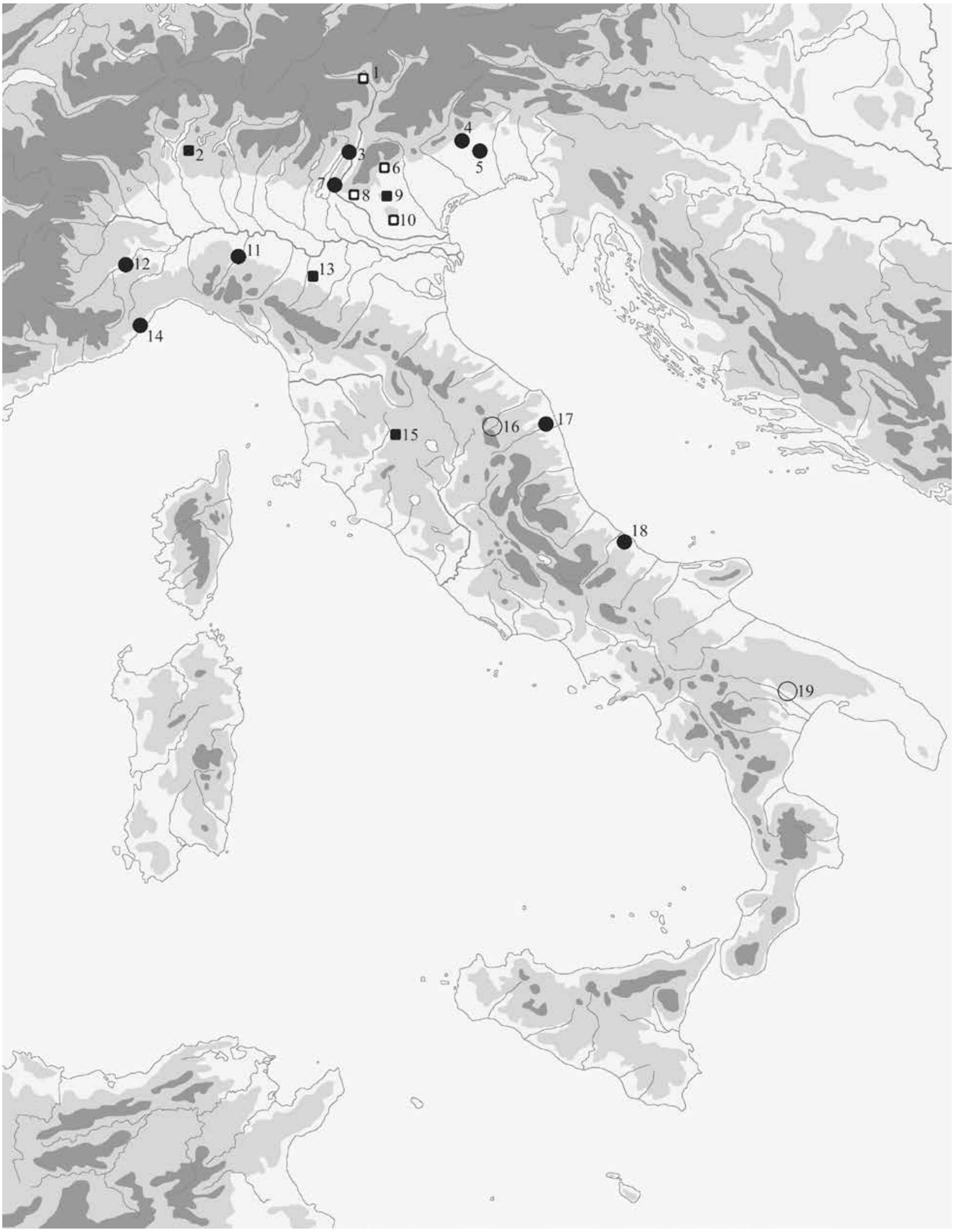


Fig. 3: Findspots of early copper artefacts: mid fifth millennium axes (?) – squares, Type Bocca Lorenza, Gurnitz or Szakálhát axes – open squares, awls – filled circles, indeterminate – open circles; 1) Lana (Bolzano/Bozen); 2. Pizzo di Bodio (Bodio Lomnago – Varese); 3. Isera (Trento); 4. Palù di Livenza (Caneva – Pordenone); 5. Bannia, Palazzine di Sopra (Fiume Veneto – Pordenone); 6. Bocca Lorenza (Santorso – Vicenza); 7. Rocca di Rivoli (Rivoli Veronese – Verona); 8. San Briccio di Lavagno (Verona); 9. Valle Fontega (Arcugnano – Vicenza); 10. Marendole (Monselice – Padova); 11. Sant'Andrea di Travo (Piacenza); 12. Alba – Scuola G. Rodari (Cuneo); 13. Campegine (Reggio Emilia); 14. Arene Candide cave (Finale Ligure – Savona); 15. San Gimignanello (Rapolano Terme – Siena); 16. Cava Giacometti, Attiggio (Fabriano – Ancona); 17. Fontenoce di Recanati (Macerata) and Santa Maria in Selva (Treia – Macerata); 18. Fossacesia (Chieti); 19. Contrada Matinelle, Malvezzi (Matera).

is datable to 3710 - 3370 cal BC (Fig. 1; Volante 2003, 378, 487, 499; Sarti & Volante 2002: 441, 444); at Orti Bottagone (Piombino – Livorno), slag and crucible fragments may be associated with a late Ripoli phase Neolithic settlement, but the presence of Bronze Age material means that we should be cautious about this site (Fedeli 1999);

- In the Marche, copper slag is reported from the site of Santa Maria in Selva (Treia – Macerata) which seems to be dated to the first half of the 4th millennium cal BC (Silvestrini et al. 2002: 458);
- On Sardinia metallurgy is documented by copper slag and artefacts in Ozieri phase levels (end 5th – first half of the 4th millennium cal BC: Melis 2009: 83) at Su Coddu (Selargius – Cagliari) (Ugas et al. 1985: 13; Melis 2005: 558 - 559, fig. 4; Melis 2007: 259, fig. 8; 2009: 85 - 86, figs 1.2, 3.1);
- On Lipari some slag fragments were found during excavations on the Acropolis in trench AP, spit 10, dated to 4315 - 3370 cal BC (Fig. 1; Bernabò Brea & Cavalier 1980: 337, 339, 490; tav.CV,5; Alessio et al. 1980: 840); unfortunately they have never been analysed;
- On Corsica metallurgy seems to begin somewhat later, after 3300 cal BC, and is documented at Terrina site IV (Aléria – Haute Corse) by fragments of 25 crucibles, a tuyère, copper fragments, an awl, slag and fragments of burnt daub (Camps 1988: 82 - 83, 239 - 250, 256; 1992; Pearce 2013).

The oldest copper mines in Italy are likewise situated in northwest Italy, at Monte Loreto (Castiglione Chiavarese – Genova), which was exploited from the early 4th millennium cal BC (earliest date Beta-203528: 3940 - 3700 cal BC – Fig. 1), and at Libiola (Sestri Levante – Genova), which was in use in the mid 4th millennium cal BC (Maggi & Pearce 2005; Pearce 2007: 62 - 71; Maggi et al. 2011). Early mining is also attested in Calabria, in the southern tip of Italy, at Grotta della Monaca (Sant'Agata di Èsaro – Cosenza), but this seems to be for extracting minerals for use as pigments: firstly goethite, in the late 5th and in the first half of the 4th millennium cal BC, with copper minerals, primarily malachite, being exploited in the course of the 4th millennium cal BC (Larocca (ed.) 2005; 2011).

It may be argued that a number of copper axes from northern Italy may be tentatively dated to the mid 5th millennium cal BC: these skeuomorphs of polished stone axes were found at Campegine (Reggio Emilia), Valle Fontega (Arcugnano – Vicenza), and Pizzo di Bodio (Bodio Lomnago – Varese), but unfortunately all are without secure contexts (see discussion in Pearce 2007: 40 - 42). An axe from San Gimignanello (Rapolano Terme – Siena) in Tuscany has a similar form, with castling wrinkles like the Campegine and Pizzo di Bodio axes, but is likewise without a secure context (Carancini 1993: 126; Giardino 2013: 10 - 20, figs. 2 & 3). Again, the distribution is in north and western central Italy (Fig. 3).

In the late-final Neolithic of Italy there are two classes of copper artefact in circulation: axes and awls or points. The axes, of Type Bocca Lorenza, Gurnitz or Szakálhát, are found in north-east Italy and the karst hinterland of Trieste, and they are distributed in the eastern Alps and middle Danube region, and the Carpathian basin: their Italian findspots (Fig. 3) are Bocca Lorenza (Santorso – Vicenza) – 3 axes, Lana (Bolzano/Bozen), San Briccio di Lavagno (Verona) and Marendole (Monselice – Padova), and they may be dated to around 4000 - 3800 cal BC (Pearce 2007: 42 - 46, figs 3.1 - 3, tables 3.5 - 7; Gleirscher 2007: 99 - 102, figs.3 - 4; Klassen 2010: 41 - 42, figs.7 - 8).

Awls are found largely in northern parts of Italy and all come from settlement contexts (Fig. 3; Pearce 2007: table 3.8):

- In the northeast at the open-air sites of Isera (Trento) phase 2 (c. 4000 - 3800 cal BC) and phase 3 (c. 3800 - 3600 cal BC), Palù di Livenza (Caneva – Pordenone) (c. 4350 - 3350 cal BC), Bannia, Palazzine di Sopra (Fiume Veneto – Pordenone) (c. 4540 - 4360 cal BC – Fig. 1), and Rocca di Rivoli (Rivoli Veronese – Verona) (c. 4350 - 3650 cal BC);
- In the northwest at the open-air sites of Alba – Scuola G. Rodari (Cuneo) (c. 4340 - 4060 cal BC – Fig. 1) and Sant'Andrea di Travo (Piacenza) (c. 4500 - 3900 cal BC) and the Arene Candide cave (Finale Ligure – Savona) (c. 4200 - 3700 cal BC);
- In east central Italy, at the open-air sites of Fossacesia (Chieti) (c. 4490 - 3990 cal BC – Fig. 1), Santa Maria in Selva (Treia – Macerata) (first half 4th millennium cal BC) and Fontenoce di Recanati (Macerata) (3700 - 3110 cal BC – Fig. 1).

Undeterminable copper fragments are further known from the open-air settlement at Cava Giacometti, Attiggio (Fabriano – Ancona) (c. 4230 - 2580 cal BC – Fig. 1) and a cist grave at Contrada Matinelle, Malvezzi (Matera) (c. 4400 - 3500 cal BC).

This rapid survey of the distribution of the evidence for early copper artefacts and metalworking in Italy does not support a simple diffusionist model, such as that proposed by Roberts et al. (2009); there is some support for the transmission of metallurgical knowledge and artefacts across the eastern Alps and Trieste/Slovene karst from the middle Danube and Carpathians – as provided, for example, by the Type Bocca Lorenza, Gurnitz or Szakálhát axes –, but other evidence seems to suggest that many metallurgical developments are first found in the northwest – the first smelting at Botteghino, or the first copper mining at Monte Loreto and Libiola. Roberto Maggi and I have noted that that there seems to be a connection between the opening up of the uplands for pastoralism in the context of the late 5th/early 4th millennium cal BC Chassey culture and the activation of new mineral resources (Maggi & Pearce 2010); indeed copper awls are known from Chassey contexts at Alba, Sant'Andrea di Travo and the Arene Candide, and the smelting at Botteghino also has a Chassey context (see above). We cannot however look to Provence for the origin of this knowledge or these artefacts: copper use and mining is documented from the end of the 4th / beginning of the 3rd millennium BC in Languedoc – that is to say to the west of the Rhone –, with developments east of the Rhone in Provence coming later (Mille & Carozza 2009).

Conclusions

As we have clearly seen, the new diffusionism is an *a priori* model based on a minimalist interpretation of the evidence. In fact, on the basis of the present evidence, the single origin model for copper metallurgy is unproven. It should however be admitted that the multiple independent centres of metallurgical development may be an illusion created by the discontinuous archaeological evidence – after all, the old archaeological adage 'absence of evidence is not evidence of absence' is regularly proved right as new discoveries are made that revolutionise our knowledge.

I believe that we can develop a new model which posits that information flowed throughout Eurasia, both from east to west and west to east, and that different technological developments may in fact have first emerged in different areas; in a sense this is close to Wertime's (1973, 886) 'process of diffusion and multiple innovation interrelating metallurgical innovation over much of Eurasia …'. Such a model has the advantage that it fits the available data.

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