BOLLETTINO DEL CENTRO POLESANO
DI STUDI STORICI
ARCHEOLOGICI ED ETNOGRAFICI
ROVIGO

PADVSA

Anno XXXVII Nuova Serie · 2001

ISTITUTI EDITORIALI
E POLIGRAFICI
INTERNAZIONALI®

PISA · ROMA

Amministrazione e abbonamenti:
ISTITUTI EDITORIALI E POLIGRAFICI INTERNAZIONALI®
Casella postale n. 1, succursale n. 8, I-56123 Pisa
Tel. **39-050-878066 (5 linee), Fax **39-050-878732
E-mail: iepi@iepi.it

Uffici di Pisa: Via Giosuè Carducci 60 · I-56010 Ghezzano · La Fontina (Pisa)
Uffici di Roma: Via Ruggero Bonghi 11/b (Colle Oppio) · I-00184 Roma

Rivista annuale
Prezzi di abbonamento:
Italia €. 41,32 (privati), €. 51,65 (Enti); estero US$ 80 (individuals), US$ 95 (institutions)

I pagamenti possono essere effettuati tramite versamento c.c.p. n. 13137567 o tramite carta di credito (*Visa, Eurocard, Mastercard, American Express*)

Stampato in Italia · Printed in Italy

ISSN 0393-0149

FRATTESINA AND ADRIA: REPORT OF SCIENTIFIC ANALYSES OF EARLY GLASS FROM THE VENETO

Andrew Towle, Julian Henderson, Paolo Bellintani, Giovanna Gambacurta

1. Introduction

The study of ancient glasses can involve a range of different aspects. These can include an analysis of the range of artefact types, their concentrations in the landscape which may be a reflection of the existence of production centres, the socio-economic contexts in which the artefacts were made and used, ethnographic parallels for their production, the industrial evidence for their production and the scientific investigation of the glass objects and industrial debris related to their production. The scientific investigation of glass can reveal not only the kind of technology involved, and, by inference, the range of raw materials used to make the glass, but also whether the technology identified is exceptional in some way in a regional or inter-regional context. If the technology used to make the glass is exceptional in some way, then a range of interesting inferences about the use of the material in society and potentially about trade relations within and between different zones can result. However, the majority of ancient glass compositions falls into a category known as soda-lime-silica (Henderson 2000, p.50). This glass was made from an alkali, calcium oxide and silica. The alkali used was either a plant ash or a mineral evaporite source. For the latter there are few possible sources, the most likely being natron; for the former plants of the genus *Salicornia* which are common in maritime or desert environments are thought to have been used. Indeed Brill (1970) showed that by fusing silica with the ashes of such plants it was possible to produce glass of the appropriate 'ancient' composition – even though there was some inevitable variation in the chemical composition of the plants and their ashes. Some of the most ancient glasses that have been chemically analysed, such as Mesopotamia, Egyptian and Mycenean have turned out to be of a soda-lime-silica composition characterised by elevated levels of potassium and magnesium oxides indicative of the use of a plant ash source of alkali. The earliest glass is thought to date to around the 24th century BC and is considered to have been produced somewhere in northern Syria. There is also now a limited amount of evidence for the occurrence of low magnesia soda-lime glasses in the second millennium BC suggesting that natron may have been used as the alkali source.

Given this somewhat predictable ancient glass technology, it was therefore all the more surprising that a new kind of bronze age glass composition was discovered. In the first instance, at least, it was found to have been concentrated in northern Italy. The first to have been analysed was found at Frattesina, near Rovigo (Bietti-Sestieri 1997) where evidence for glass-working had been found (Biavati 1983, Henderson 1988a and 1988b; Verità, Biavati 1989, Brill 1992, Bietti Sestieri *et Alii*, forthcoming). This kind of glass was found to be characterised by low magnesia and high potassium oxide (LMHK) – with low soda. These compositional characteristics show a clear break from the common soda-lime glass technology and indicate that a markedly different alkali source was involved in making the glass. Another characteristic of the glass is that it contains relatively low levels of calcium oxide. Although initially the glass of this composition was found to be concentrated in northern Italy, it has now also been found in other part of Italy (Santropadre, Verità 1995, Bellintani, Biavati 1997, Bellintani *et Alii* 1998 and Santropadre Verità 2000) and as far west as Ireland (Henderson 1988a), but also in England (Henderson 1988a), France (Guilaine *et Alii* 1991 and Gratuze *et Alii* 1998), Germany (Hartmann *et Alii* 1997) and Switzerland (Henderson 1993a). It also occurs as far east as northern Greece (Henderson 1993b). In addition, whilst the glass which was chemically analysed at first all dated to the 12th century or later, it is now clear that this kind of glass was also being made as early as the middle bronze age (Santropadre, Verità 2000).Thus it is clear that, although the glass was being worked at Frattesina in the late bronze age, it must have been made earlier elsewhere. From this discussion it might be suggested that the glass is mainly found in Italy and areas to the north and west. However, the occurrence of glasses of this composition on the island of Thasos

in northern Greece (HENDERSON 1993b) and its occurrence in middle bronze age contexts illustrates that the picture that we have is now far from simple.

Perhaps one of the more intriguing points about the place of its manufacture amongst ancient vitreous materials is that, in spite of the fact that there are a relatively large number of chemical analyses of 15th and 14th century B.C. Egyptian glasses (TURNER 1954, LILYQUIST, BRILL 1993, SHORTLAND 2000 and HENDERSON 2000b), not a single example of the LMHK has been encounered amongst them. The evidence for the first easily identifiable mass production of glass vessels dating to the time of the 18th Dynasty Pharaoh Akhenaten (1352-1336) at Tel-el Amarna in Egypt involved the use of a High magnesia soda-lime glass, not LMHK. Given the volume of glass that has been found at Tel-el Amarna, this is the one ancient site where one might expect to find LMHK technology if it was generally more widely in use. Flowing from this are a number of clear cultural/ socio-economic inferences about glass production during the second half of the second millennium BC, the principle one being that, with the data currently at our disposal, the introduction of LMHK still appears to be independent of technological influences from areas such as Egypt, the Middle East and Mycenaean Greece (HENDERSON 1988). Behind this, of course, one should attempt to provide socio-cultural reasons for its introduction and for its invention somewhere in Europe during the middle bronze age or earlier. This is not the place for such a discussion.

Not only is the glass now thought to occur further east than was originally suspected, though none has yet been found in the Middle East, it is now clear that it was made earlier than initially suspected. A third interesting characteristic of the material is revealed by its examination under the scanning-electron microscope which shows that it can contain many silica crystals. This then begs the question about what precisely it is in terms of its physical structure.

While it has been described as glass in several publications, the presence of silica crystals accounts for high silica content (up to c. 80%)in some chemical analyses. Such silica levels would create a very high melting point if the material was pure glass and certainly its presence as crystals provides an explanation. These levels of silica would also have the effect of diluting the levels of other components - such as calcium oxide- though not sufficiently to account for the significantly lower calcium oxide levels encountered when compared to the levels found in soda-lime glasses of around 7%-8%. In any case the physical mixture of silica crystals and glass suggests that, in some instances, the silica formed part of glassy faience rather than pure glass and also that it was added to the existing glass (SANTROPADRE, VERITÀ 2000), perhaps to increase its brilliance. This consideration of the physical structure of LMHK does not, in any way, exclude the material as basically being a glass; the chemical analysis of faience and glassy faience from Egypt, for example (TITE, FREESTONE, BIMSON 1983; SHORTLAND, TITE 1998; SHORTLAND 2000) and from Italy (SANTROPADRE, VERITÀ 2000), reveals different characteristics, irrespective of the suggested production techniques involved – the same is true for European bronze age/ iron age faience. None of the structural and analytical investigations carried out on these vitreous materials has revealed the chemical characteristics found in LMHK, especially when levels and types of alkalis and calcium oxide levels are compared (see, for example SHORTLAND 2000, Tables 3-10, 3-12 for the compositions of Egyptian faience and 'frits').

This paper is a preliminary report of scientific analyses of glass objects from a number of sites from the Po Valley. The paper addresses issues relating to the production of glass in Final Bronze Age and Iron Age of Northern Italy.

J.H.

2. TECHNOLOGICAL BACKGROUND

As mentioned above early glasses of a broadly similar chemical composition have been characterised by a number of writers as high magnesium, soda-lime-silica glasses (see Table 1). (SAYRE, SMITH 1961, HENDERSON 1988a and 1988b). The composition of these glasses is consistent with the production of glass using a plant ash, rich in soda as the fluxing agent (see above and BRILL 1992).

High magnesium soda lime silica glass (soda-rich plant ash)	High MgO	2.5-6 %
	Re. High K_2O	2.5-3.5%
	High Na_2O	14-17%
Low magnesium, soda lime silica glass (natron)	Low K_2O	1%
	Low MgO	1%
	High Na_2O	14-17%
Mixed alkali glass	High K_2O	6.5-14%
	Low MgO	0.4-1%

Table 1 - Key characteristics of 2nd and 1st Millenium BC glasses.

The picture of one "Mediterranean" tradition displacing another has been supplemented by the identification of an apparently unique European compositional category in the Late Bronze Age (i.e. 1100 – 900 BC) and earlier (SANTROPADRE, VERITÀ 2000).

BIAVATI (1983), closely followed by GUIDO *et Alii* (1984) published the first qualitative and quantitative compositional analyses respectively of European Bronze Age mixed-alkali glass artefacts. The former paper examined material from Frattesina, Northern Italy, and the latter from Wilsford, Southern England. Both of these papers discussed the role of plant ashes as the source of the alkali components, and distinguished the respective compositions from contemporary glass production in the Eastern Mediterranean. However, it was not until a larger number of Bronze Age European glasses had been analysed that the mixed alkali composition was identified as a specifically European Bronze Age phenomenon (HENDERSON 1988a, 439). This hypothesis has been underpinned by additional analyses of Bronze Age glasses, and, as mentioned above, there is now a body of compositional data on mixed alkali glasses from Europe.

This glass is characterised by a high potassium oxide, low magnesium content (mixed alkali glass). The composition is the subject of some discussion (see BIAVATI 1983, HENDERSON 1988b, BRILL 1992, HARTMAN *et Alii* 1997 and SANTROPADRE, VERITÀ 2000). There is no clear consensus on the exact manufacturing process responsible for the distinct composition, except that it originates in the flux source which probably includes terrestrial plant ashes. The key chemical characteristics of 2nd and 1st millennia BC glasses are shown in Table 1. The archaeological implications of a specifically European glass type are significant: previously it had been assumed that glass had been made in the Eastern Mediterranean region and traded into Europe as either finished artefacts or raw glass for working into local forms. The adoption of localised manufacture implies a very different structure for the organisation of production and exchange (HENDERSON 1988a). The date of the first use of the mixed alkali glass has not been clearly defined, and recent analyses undertaken in France suggest that it may have been in use as early as the Chalcolithic (GUILAINE *et Alii* 1991 p 259, and also GRATUZE *et Alii* 1998). It is of great interest to identify when this glass type was first developed, and to explore any antecedents.

One of the earliest mixed-alkali glassy materials identified in the studies was faience, rather than glass. The faience bead from the Tumulus of Run-ar-Justicou (GRATUZE *et Alii* 1998), is dated from the Early Bronze Age to the beginning of the Middle Bronze Age. This faience bead is a very important artefact, since it offers a bridge between the faience and glassmaking technologies, with its mixed-alkali composition substantiating the hypothesis of the independent development of mixed-alkali glass in Europe. The separate trajectory of faience to glass, independent of the Eastern Mediterranean vitreous technologies is a significant contribution to the discussion of high temperature industries. Clearly the dating of individual glass (and faience) artefacts is fundamental to any debate on this. The faience bead from the Tumulus of Run-ar-Justicou, is dated on the basis of comparison to an assemblage from another cave site in Brittany (how this was dated is not specified) (GRATUZE *et Alii* 1998 p 11). The excavation was undertaken in 1881, and the possibility of artefact contamination cannot be excluded: other beads from this study were assigned later dates following compositional analysis (for example faceted bead 87391-52/7 from La Grotte de Rancogne). A similar bead to the faience bead, from the Chalcolithic site of Le Peyere is cited as a parallel, unfortunately this too has had to be re-dated (see note on page 23 of GRATUZE *et Alii* 1998).

This leaves a single mixed-alkali glass bead dated to before the Middle Bronze Age: a fragment of blue glass from Gord, Compeigne, Oise. A calibrated C^{14} date has been assigned to the context of its discovery (2895 - 2420 BP) (GUILAINE *et Alii* 1991, p 259).

Whilst a number of glass beads have been recovered from Early Bronze Age deposits (Grotte au Collier, GRATUZE *et Alii* 1998), these are high magnesia, soda-lime-silica glasses typical of the Eastern Mediterranean region, and are likely to be imports. The next earliest identified mixed-alkali glasses from France are from the Middle Bronze Age site of Grotte de Bringairet, Armisson, Aude (GUILAINE *et Alii* 1991, p 259 and 263). The suggested Chalcolothic origin of the mixed alkali glasses currently hinges on the single example from Gord, which is followed by a hiatus until the beginning of the Middle Bronze Age. Clearly additional well dated glasses need to be analysed to be able to confidently assert the production of mixed alkali glasses prior to the Middle Bronze Age.

The recent discussion of conic buttons from Central and Northern Italy (BELLINTANI 2001, BELLINTANI *et Alii* 1998, BELLINTANI BIAVATI 1997 and earlier: BARFIELD 1978) integrate analysis of typology, chronology, distribution and chemical analysis. These studies locate the manufacture of the conic buttons in the beginning of the Middle Bronze Age, with the possibility of localised variation in form out of a regionally distinct glass type

(i.e. the mixed-alkali glass. A consensus is now emerging for the widespread use of the mixed alkali glass in the Middle Bronze Age and before the development of the site of Frattesina). It would seem most likely that Frattesina represents the continuity of this particular industrial tradition into the Final Bronze Age (BELLINTANI 2001).
Glass from the Northern Italian site of Frattesina in the Po valley was included in the first study defining the European type glass (HENDERSON 1988), and a more detailed report on this material is currently in preparation (BIETTI SESTIERI, HENDERSON, PONTING *forthcoming*).

Since a distinct European glassmaking tradition has been identified, a number of questions can be addressed:

• Is the Frattesina glass composition, as characterised by the earlier studies, the only European glass type being produced or is it possible to demonstrate a diverse range of localised glassmaking traditions? A number of contemporary sites in the Po valley also have evidence of glassworking- are they using similar glass?

• For how long does the local tradition of glass manufacture continue?

• Can the indigenous glassmaking tradition be related to unique forms of glass recovered from Etruscan contexts to the south west?

In an attempt to address these questions, samples have been recovered from collections held at Adria (from the sites of Mariconda di Melara, Canal Bianco and Ca' Cima and Ca' Garzoni), Rovigo (from the site of Frattesina), Montagnana (from Borgo S. Zeno), Este (from Necropoli Muletti Prosdocimi, Benvenuti, Rebato), Liverpool (findspot unknown, probably Etruscan), Lincoln (from Chiusi) and Cambridge (from Cumae, Chiusi, Orvieto and Pozzuoli).
This paper is only concerned with the results of chemical analysis of material from Mariconda di Melara, Frattesina, Canal Bianco, Ca' Garzoni, Ca' Cima and Chiusi[1] : the conclusions drawn from the results presented here are therefore provisional, and will undoubtedly be modified in light of the data from the remaining sites.
A brief description of the type and range of artefacts from each of the different sites is given here.

A.T.

3. The Archaeological Sites, The Artefacts And Their Typology

3.1. Frattesina, Rovigo

The site of Frattesina of Fratta Polesine (the province of Rovigo) is about 80 kilometres SW of Venice. The settlement was situated to the south of the then major ramification of the river Po, known as the Po of Adria, 40 kilometres from the Adriatic. It dated from the XII -IX century BC, that is from the Final Bronze Age to the beginning of the Iron Age. Two cemeteries connected with the site have been found at 'Fondo Zanotto', about 600 metres to the SE and at Narde about 600 metres to the N.
A series of settlements dating to the transition from Late Bronze Age to Early Iron Age have been found on the southern banks of the old river course over a distance of 9 kilometres. Of these, Frattesina is by far the largest occupying an area of over 8 acres.[2]
The central western area of the site has the most evidence for artisan activity. This was the zone where most of the archaeological excavation, surface surveying and also where the earth stripping was concentrated. There are many examples of antler working, of elephant ivory (some dozen examples) and of bronze metallurgy (3 storage pits containing deteriorated objects and pick-shaped ingots). The importance of metallurgy at Frattesina is shown by the exceptional number of moulds, about 70 found all over the site. The quality and quantity of artefacts of prestige value, manufactured on site often from raw materials of distant origin, are well documented by the so-called 'tesoretto', a hoard containing bronze brooches, ivory combs and

[1] **The Samples.** The artefacts from which samples have been removed were comprehensively recorded. In addition to a written description and categorisation, each sample was "photographed" using a flatbed scanner - the precise methodology is outlined elsewhere (ASHTON TOWLE 1999). A catalogue of all the samples is under construction, and sample images are included below. The samples were removed using a scalpel blade: a small fragment was removed by pressure flaking (1-2 mm^2).

[2] For a generalised picture of Frattesina and a preliminary publication of the excavation of the settlement see BIETTI SESTIERI 1981 and 1996 bibl.; for the cemetery of Fondo Zanotto: DE MIN 1986; for the cemetery of Narde: SALZANI 1990 and 1992; for particular aspects of Frattesina and its population: BELLINTANI 2000 bibl.

necklaces in amber and glass. Fragments of ostrich eggs and sherds of late Mycenean pottery have also been found in the excavation and the surface surveying. These demonstrate articulated trade and exchange over long distances, either directly or through intermediaries over a vast area from transalpine Europe to the eastern Mediterranean to central and western Italy. The stone weights, recently recognised among the lithic finds of the surveys, are probably related to the activities of production and trade (CARDARELLI *et Alii* 2001).
A 1974 survey has identified traces of glassworking together with domestic activity; the area dedicated to glassworking does not seem to be a proscribed zone within or just outside the settlement. The principle finds related to glass production are: fragments of crucible/ ceramic platform covered in glass (Cat. nn. 1-3), fragments of glass ingots mainly coloured dark blue and translucent blue with a red surface (Cat. nn. 4-10) and fragments of glass working waste (Cat. nn. 11-27).
At the moment, Frattesina is the Late Bronze Age site with the largest number of finds connected to glassworking in central and western Europe. Other minor evidence of glassworking have been found in other sites of the Veneto region such as Mariconda di Melara (SALZANI 1986), Fondo Paviani (BIANCHIN CITTON 1984 p. 618-619), Montagnana (DE MIN 1984, p. 645), Caorle (BIANCHIN CITTON 1996, p. 176;179, n. 27) and from central Italy Sorgenti della Nova (NEGRONI CATACCHIO 1984).

3.2. Mariconda di Melara (Rovigo)

It is probable that this site, 35 kilometres W of Frattesina, lay alongside an old ramification of the Po. The archaeological data and relative documentation are not as comprehensive as that of Frattesina. A small excavation in 1967 identified a stratigraphic sequenze of the Final Bronze Age (XII-X century BC, SALZANI 1986). The transition phase to Early Iron Age is not present. Relatively few finds demonstrate artisan activity on site (some sawn antlers); other finished artefacts in pottery, bronze and amber are characteristic of Final Bronze Age sites in north- east Italy.
Particularly interesting are those concerning glassworking (Cat. nn. 28-35): glass ingots broken ready for re-use, glass working waste and pottery objects/crucible fragments (SALZANI 1986, tab. 5, n. 15).
All the glass products found at Mariconda are comparable with that of Frattesina: annular beads of blue translucent glass and dark blue opaque glass, blue globular beads and blue barrel shaped beads decorated with a spiral form trail of white glass (Cat. nn. 36-45).

3.3. Frattesina and the "*Pfahlbauperlen*"

The typology of its glass found at the settlement of Frattesina and their two cemeteries is mostly small annular beads and a lesser number of more complex and larger beads (Cat. nn. 16-25)[3]. A detailed examination of the typology of glass of this site and a comparison with other similar finds in Italy and transalpine Europe is not the aim of this work, where only some examples of the wider production of Frattesina are considered[4]. The vast range of glass products is best demonstrated by the grave goods from the cemeteries at Fondo Zanotto and Narde (*tab.* 1).
As mentioned above, the glass production of Frattesina has revealed two main types of beads, monochrome and polychrome. The latter group, although numerically inferior, permit some considerations on the origins of the use of these beads by many populations in central western Europe between the end of the 2nd and the start of the Ist millennia BC.
In particular, we shall consider the diffusion of two main typological groups: barrel shaped beads with spiral decoration and beads with an eye motif, starting in phase Ha A but mostly present in phase Ha B. These are types that do not appear in Europe during the previous phases of the Bronze Age, where the presence of glass is fairly limited in comparison to that of faience[5].
The barrel shaped beads are known in the north of the

[3] A few examples of one of the forms that is not included in this study are the five pottery sherds belonging to carenated bowls glazed with pale blue glass and white drops from the cemetery at Narde: (SALZANI 1992 fig. 59, nn. 10 and 13) and a sherd from the settlement of Frattesina glazed with blue glass and white drops (BIETTI SESTIERI 1997a, fig. 450). In both cases the pottery seems to be classifiable in phase 3 of the settlement, that is the transition phase BF-1 FE.

[4] A more specialised study in this sense is being carried out by the author on the glass products of Frattesina, present in the museums of Rovigo, Fratta Polesine and Adria. This is part of a larger project on ancient glass products in northern Italy (co-ordinated by Dr. Paolo Bellintani-Ufficio Beni Archeologici of Trento archeometric analysis by Prof. Gilberto Artioli- University and C.N.R. of Milan).

[5] As regards this see the considerations and the related bibliography presented by Julian Henderson in the first part of this paper and also VENCLOVA 1990.

Alps as *Pfahlbauperlen*, the name first used by Vogt in 1934 for the glass beads found at lacustrine sites of the Late Alpine Bronze Age. This definition was better defined by T. E. Haevernick as *Pfahlbautönnchenperlen mit Spirale*. In 1978, she published a paper on about 300 of these types of beads particularly concentrated around the Swiss lakes, notably Neuchatel and extending towards the central eastern alpine region, the middle Danube basin and the ambit of Lausitz to Mecklembourg. She suggested a local origin for the manufacture of *Pfahlbauperlen* as she had not recognised similar examples in the Egyptian museums or in the" East" (HAEVERNICK 1951 and 1978)[6]. This differed from the then current opinion (for example Gessner and Reinecke). The discovery of barrel-shaped beads with spiral decorationat Frattesina, above all with evidence of glassworking, was therefore the first major confirmation of her hypothesis.

Similar considerations are also valid for the other group known as *Pfahbaunoppenperlen*, that is rounded or horned beads with 3-4 stratified eyes. In this case Haevernick did not exclude a possible link with types of beads with eye motif found in Egypt and Crete from the 16th century BC onwards. The diffusion of the *Pfahbaunoppenperlen* is similar to the beads with spiral form decoration and in general to that of a third group; the small annular beads. Whilst these are not considered a "fossil guide" like the other two, they could present characteristics of glassworking (glass coloured blue or translucent blue similar to those of the beads pile-dwelling -palafitte- sites, formed by winding around a rod etc.) that could distinguish them clearly from similar products in faience (cylinder shaped beads), which were present in fewer numbers in the same contexts (for example the hoard of Allendotf).

Naturally after the research conducted by Haevernick new data has come to light (fig. xxx) that does not seem however to modify spatially the diffusion: for example France does not seem to have any significant cases (GRUET *et Alii* 1997). Quantitatively, a substantial novelty has come from the "palafitte" site of Hauterive Champreveyres: about 180 beads with spiral form decoration, 26 of various typology with eye motif and 30 annular beads (RYCHNER FARAGGI 1993). Despite the notable number of objects (there are many more beads with spiral form decoration compared to those known at Frattesina), no trace of glassworking was documented on site. Richner Faraggi on the basis of these considerations together with the chemical composition of the glass (LMHK) and the presence of other material common to southern alpine sites such as amber necklace beads (of the *Allumiere* type), antler discs decorated with dots and bronze knives (of the *Fontanella* type)[7], has theorised that the glass could have been imported from north eastern Italy; However it is difficult to think that, given the quantity and widespread diffusion of the finds, that there were not production centres to the north of the Alps.

In a detailed examination of prehistoric vitreous material in Bohemia, Natalie Venclovà has outlined the high percentage of barrel shaped beads and beads with an eye motif at Lusazian and Velatice sites (VENCLOVÀ 1990). This could be due to the elevated economic level of this region given its geographic position along the so-called trade routes for amber. The hypothesis that along the so-called Adriatic amber route the presence of glass beads could be objects of exchange coming from the south as opposed to the amber from the north is not without foundation and should be evaluated better within the complex systems of trade and exchange that begin in the late Bronze Age in mainland Europe (and that certainly doesn't regard only metallurgy). This is emerging also from the research conducted on Italian glass from the Middle and Late Bronze Age (ANGELINI, ARTIOLI, BELLINTANI, forthcoming).

As far as I know, there are not additional data for the Aegean and eastern Mediterranean other than the 12 beads "of the palafitte" from the child's tomb at Tirinto mentioned by Haevernick (HAEVERNICK 1978 (1981) p. 383), and an imprecise number of beads from the shipwreck of Capo Gelidonya (BASS 1991). At the moment we can only add a few considerations; even in recent studies of the Mycenean production of faience

[6] A significant exception (HAEVERNICK 1978) are the beads of this type found in the shipwreck near Cape Gelidonya (Turkey) dated to about 1200 BC.

[7] As regards the connections between central northern Italy and the Alpine region, it is worth recording the observations made by Bietti Sestieri on the distribution of typically Italian metal objects (Protovillanovian) such as the pick shaped ingots with a cannon shaped handle towards the north east (Hungary), but also to the north west (France and Germany) (BIETTI SESTIERI 1997b). At Frattesina there are also two bronze pins of a northern Alpine form, the Mehrkopfnadeln type, that come from the richest burial at the cemetery of Narde, tomb 227 (SALZANI 1990, p. 16-17; fig. 16, 10) and the Velemszentuid type from tomb 36/1984 of the Fondo Zanotto cemetery (DE MIN 1986, p.147; tab. 2,3).

and glass (for example NIGHTINGALE 1998), there are no specific comparisons between the decorated beads from central western Europe of the Late Bronze Age and those associated with the major production of the Aegean workshops (LH III A e B). However globular and oblong beads with spiral form trails of contrasting glass are not unknown in the Aegean (NIGHTINGALE 1998, fig. 2, 18; BLEGEN 1937, fig. 284 and 406) and these together with other types that are of a more obvious Mycenean origin for typology and compositional characteristics are similar to several examples known at settlements and funerary sites in southern and northern Italy from the final part of the Middle Bronze Age to Recent Bronze Age and sporadically also from contemporary sites in Bavaria and Bohemia (ANGELINI *et Alii* c.s.). It is possible that these products were imitated to the south and even to the north of the Alps at the end of the 2nd millennium BC, when the Aegean and Near East production started to falter. Another theory (not alternative but complementary) is based on the presumable Western European origins for LMHK glass. We now know that this type of glass is present in northern and central Italy from at least the Middle Bronze Age (BELLINTANI, BIAVATI 1997 - BELLINTANI, RESIDORI forthcoming), an example are the conical buttons from Emilian "terramare" sites. One can assume that the glass products from Frattesina are derived from the "terramare" tradition of the Middle Bronze Age. However the study of glass products from northern Italy in the successive phase of the Recent Bronze Age has emphasised the similarity both in terms of technology and typology with the Aegean production. We will finish with a quick glance at the presence of glass beads in Italy[8]. In central northern Italy the present knowledge of the diffusion of glass products plus the evidence of glassworking seems to point to the pre-eminence of Frattesina. A number of other sites in the Venetian and eastern Lombard region have revealed glass products and traces of glassworking but to a minor extent.(Mariconda di Melara, Fondo Paviani, Montagnana, Sabbionara, Desmontà di Veronella, Caorle, Goito, Casalmoro - BELLINTANI, PALLECCHI, ZANINI 2000). In the northern Apennine area glass ornaments are present at the sites of S. Michele di Valestra (CREMASCHI 1997) and Bismantova (CATARSI DALL'AGLIO 1997). At this last site the tomb XXXI revealed over 300 beads mostly annular but also some with eye motifs and others not common at Frattesina. A detailed examination of central Italy has recently been presented by Alessandro Zanini (BELLINTANI, PALLECCHI, ZANINI 2000). A certain number of glass beads, several dozen and almost exclusively annular, are present in settlements and funerary contexts in Etruria (Elceto, Scarceta, San Giovenale, Grotta Tufarina, Poggio la Pozza, Poggio della Capanna and Monte Ingino) and on the Adriatic side (Pianello di Genga). Their distribution seems more or less to coincide with that of other better known products in metal[9] that have been used to indicate commercial exchange between Tyrennian central Italy and central northern Italy and could be another useful indicator for trade connections. Southern Italy has less examples; types similar to Frattesina are noted above all at Torre Castelluccia (Puglia), Timmari (Basilicata) and Lipari - Piazza Monfalcone. The first was probably a hoard within a settlement (GORGOGLIONE *et Alii*, 1993) dated 1100-1000 BC. Together with flint, bronze and bone/antler instruments and ornaments (amongst which two spacer plates) there were 6 amber beads, some of which were biconical and similar to the Tirinto form, and a non specified number[10] of annular beads in a blue glass matrix and shell. Annular monochrome beads were present in at least 7 graves at the Protovillanovian cemetery of Timmari, also together with spacer plates in bone/antler (QUAGLIATI, RIDOLA 1906). More data is available from Lipari where glass beads are known at both the levels of settlement that interest our study (Ausonio II) and at the contemporary cemetery of Piazza Monfalcone (BERNABÒ BREA, CAVALIER 1980). Here the best example is the wealthy tomb 31, with a large number of beads in amber (including the Tirinto form) and in glass of various typology. The annular beads of blue opaque and dark blue translucent glass and the barrel shaped beads with white spiral form trails can be compared to those of Frattesina, whilst others such as the globular beads of opaque glass with

[8] For this purpose I have been helped by the bibliographical research in the unpublished doctorate thesis by Giovanna Residori "Northern Italian Bronze Age Glass" An analysis of the documented evidence of the production and circulation of glass products between the eastern Mediterranean and Europe (University of Verona 1998-9; examiner Prof. A. Guidi, vice -examiners dr. G.M. Facchini, dr. P. Bellintani).

[9] See note 6.

[10] From the photograph published in GORGOGLIONE 1993, tab. LVIII, 1, one would say not less than 400. The beads have been reassembled in a necklace with 4 turns closed at the extremities by two spacer plates with 4 perforations found together with the beads.

polychrome bands decoration do not seem similar to the north Italian production; but seem closer to earlier types produced in the Aegean.

3.4. Adria: the sampled beads, an evaluation of the archaeological sites

The ancient town of Adria was situated alongside one of the main northern ramifications of the river Po, near to the lagoon and the Adriatic coast. The hydrographical situation now is very different given that the city is now 25 kilometres from the coast and is now crossed by the Canal Bianco/ river Tartaro. Several ancient sources speak of this town as the most important port on the northern Adriatic. The port of Greek origin according to almost unanimous tradition, would have had a significant participation of the Veneti even if of minor importance and also of the Etruscans that became pre-eminent in the course of the 5th century BC when Adria shared control of the Adriatic maritime traffic with Spina (Fogolari, Scarfì 1970; De Min 1984).
The archaeological research at Adria has been severely limited, one by the presence of the modern town and also by the fact that the earliest archaeological levels are at over 7 metres of depth below thick layers of sediment. Hence, the archaeology of the earlier levels, buried at greater depth are less known.
The finds come mostly from burial grounds, either from precise funerary contexts, important for the possibility of a more exact chronology, or from sporadic finds; some others come from collections or are only connected vaguely with the territory of Adria without a specific source of origin. There are three cemeteries that are partially interested by this paper: the Canal Bianco, Ca' Garzoni and Ca' Cima (1993 and 1995 excavations)[11].
The cemetery of Canal Bianco was discovered during the cutting of a new course for the canal to the south of Adria in the years 1938-1940; about 400 graves were excavated dating from the start of the V century BC to the II century BC, testifying a notable continuity of occupation through to Roman times, even given a change in the burial ritual. The late archaic classical tombs and the late Etruscan tombs of the Hellenistic epoch are inhumations whilst the Roman burials are cremations (Fogolari 1940).
The Ca' Garzoni cemetery is also to the south of Adria but further to the west of that of the Canal Bianco and was excavated in the sixties and early seventies. The burials are mostly late Etruscan inhumations of the Hellenistic age and some Roman cremations; a total of about 200 tombs from III-II century BC, that reflect the change in burial ritual noted in the Canal Bianco cemetery[12].
The Ca' Cima cemetery is situated in the north eastern suburbs of Adria. It was discovered and partially excavated in the Seventies and then systematically excavated from 1993-1995. About 200 tombs dating from VI-II century BC; ranging from classical and archaic burials using both inhumation and cremation rites, also late Etruscan inhumations of the Hellenistic Age and Roman inhumation and cremation burials. the burial ritual of this cemetery seems to differ from the other two for the early adoption of cremation rites together with the continuing rite of inhumation[13].
The significant quantity of glass products , although without a direct confirmation of a local production, permits a tentative hypothesis of Adria in the Polesine as a direct successor of the Final Bronze Age - start of the Iron Age traditions of Frattesina.

PB

3.5. Adria: the typology of the sampled beads

Monochrome beads

Only one sample has been taken from a monochrome glass bead of opaque yellow colour (Cat. nn. 83). It is a relatively common type, slightly less frequent than the blue ones; the opaque yellow bead have a slight deformation perhaps due to an error in the production process, or perhaps later after being exposed to heat. In fact, deformations of this type are known above all in examples that come from funerary contexts. The yellow colour is not often found in monochrome beads, but is more usually associated with eye motifs or zigzag patterns[14].

[11] All the information regarding the cemeteries of Adria are courtesy of Simonetta Bonomi, who I thank for the constant help with this paper.

[12] Mangani 1982; the cemetery is still partially unpublished.

[13] Dallemulle, Marzola 1977; the 1970 excavation is now being published by I. Borghero. The archaic period tombs are being published by S. Bonomi.

[14] Gambacurta 1987, p. 194-195, type A, fig. 1 and fig. 2 for the colours.

Beads with zigzag decorations

Of all the beads examined only two have zigzag decoration patterns [15] (Cat. 77 and 79): the first is coloured blue with a rather irregular decoration, that is not now visible because of a fairly common process of degradation. The irregularity of the decoration is confirmed by an asymmetrical motif with a single eye decoration that doesn't seem coherent with the zigzag pattern.
The second example is of a less common colour, a white glass with an insertion of brown opaque glass with zigzag pattern.
The two examples come from tombs from the cemetery of Ca' Cima, excavated in 1995, in particular the blue bead is part of the grave goods of tomb 13 together with a rather rare goat's head glass pendant. The tomb is dated 510-490 BC; the second example comes from tomb 12 in which there are also two beads with eye motif that do not take part of this study, the tomb is dated in its complex to 500-470 BC.
The typology of beads with zigzag decoration are present at Adria with simple and with complex crossed zigzags even though they aren't one of the more common decorations at this centre. The type of beads with zigzag decoration in fact seem to have their greatest diffusion in central east of the Veneto region and the basin of the Piave together with a particular presence of this typology in Slovenia GAMBACURTA 1987, fig. 4. It was in the area of Slovenia that Haevernick proposed the principle area of production for these type of beads dated from the V-III century BC[16].

Beads with eye decorations

A small number of the beads with eye decoration have been analysed; the motif presents varying degrees of complexity from a simple eye cut into a monochrome base to an eye formed of an iris of clear glass in which the central point is surrounded by one or more concentric circles; alongside other examples more complex with compound eyes. These two types are defined by Haevernick as A and B; where A is probably imported and B is produced locally, generally thought to be in Veneto area[17].
Only two examples refer to the more simple type, with traces of eyes cut into a monochrome base (Cat. 81 and 80); both are beads of green glass; the first is more transparent and with a white decoration and in the second case the white part that formed the eyes with two borderings has been almost completely lost leaving only the base behind, a degrading process that is common to these beads. Following the loss of the inserted coloured glass that formed the eye motif, there remains just an apparent monochrome bead with a few circular incisions. The two beads come from the tomb 16 of the Ca' Cima cemetery (1993 excavation), together with another example of turquoise colour with stratified eyes. The burial is dated to 500 - 480 BC.
The typology of these beads is already present in the Veneto where they seem to be present in much earlier periods; there are examples for instance from the cemetery of Saletto of Montagnana from a burial dated to the mid-VII century (*Adige Ridente* 1998, p. 214, fig. 125, 30). A slightly more recent case is some beads from Oderzo, coming from a cemetery of which only a tiny part has been investigated and has been dated to the mid VI century BC[18]. Examples from a burial at Altino which has been dated between the end of the VI to the benning of the V century BC have a similar green colour[19]. Beads of this type have been found at Vadena in a rich burial of the late V-IV century BC (DAL RI 1992, p. 500, fig. 13, 21-23.) and recently in higher Friuli at the cemetery of Misincinis di Paularo, in funerary contexts dated to the late VII-VI century BC (CORAZZA, VITRI 2001, p. 31, fig. 29). The evidence that is developing points to a precocious appearance but also non continuous and a wide territorial diffusion in not only the eastern and western areas of the Veneto but also Retic-alpine regions.
The other beads with eye motif are of a more complex typology in which the iris and the central point are different from the glass base (GAMBACURTA 1987, type F) and they can be structured with different bordering and accessory decorations such as applied horns of glass of contrasting colour.
The three examples (Cat. nn. 51, 53 and 83) have

[15] GAMBACURTA 1987, p. 194-195, type D, Fig.1-2, 4 and 10.

[16] 18. HAEVERNICK *and Alii* 1983; and ZEPEZAUER 1993, p. 77, 79 and 83 for the yellow, blue and brown beads with zigzag motif, the proposed dating is between LT C1 and C2; fig. 10, p. 10-14 and 26-27. For some important contexts in Slovenia, Libna and Novo Mesto see GUZTIN 1976, p. 52, tab.4, 8; p. 62, tab. 14, 10-11; p. 65, tab. 17, 19; p. 97, tab. 49, 21; p. 121, tab. 73, 8; Novo Mesto V 2000, p. 72, C; tab. 31, tomb 49, 2; tab. 43, tomb 72, 3.

[17] HAEVERNICK 1981 (1972), p. 234-244; for the Veneto see Gambacurta 1987, p. 205 and fig. 21.

[18] *Sile Tagliamento* 1996, p. 170, n. 178. 4, fig. 32; (n.b. the bead for error appears at n. 178.3).

[19] GAMBACURTA 1987, type E, tomb Fornasotti 2; TOMBOLANI 1987, p. 171, fig. 2, 9-12.

simple decoration in the ambit of this type; the first two have a blue base with eyes of white opaque and dark blue glass, the third has a blue base and eyes of opaque turquoise and dark blue; all three beads have just three eyesbeads in a single band. The first two examples come from the cemetery of Canal Bianco, the first from tomb 391 which also contained an anthropomorphic pendant which has also been analysed; the second from tomb 240. The third bead was part of the grave goods from tomb 16 of the cemetery of Ca' Cima, together with two beads with incised eyes already mentioned above. The dating of these pearls is about 500-480 BC. The number 57 from the catalogue can be attributed to this typology; three samples have been taken from each of the three different colours of the bead and of the applied horns, from the three stratified eyes of white and blue glass on a blue base and from the horns of white and yellow opaque glass.

Some beads have a dark profile around the pupil, then stratified eyes with two clear and two dark fields one of which is central. Two examples (Cat. nn. 49 and 50), significantly coming from the same burial, are marked by an irregular disposition of the eyes on the body of the bead; the decorations in fact appear to be matched with difficulty and in the end partially superimposed and the eye motif becomes asymmetric. They are from the grave goods of tomb 25 of the Canal Bianco cemetery that is dated to the first half of the III century BC.

The motif with just one profile but which is present in two bands is apparent on the bead (Cat. nn. 84), a blue bead with eyes of dark blue and white glass. The bead (Cat. nn. 86) is probably similar, of turquoise colour with white and blue eyes, although in this case the decoration seems to dissolve which could be due to a manufacturing error. The beads nn. 88-89 are more complex with two profiles around the pupils, both coloured blue with eyes of blue opaque and dark blue glass; whilst the nn. 85 is a yellow coloured bead which has blueand white eyes with two borderings matched on the body of the bead. It is notable that the irregularities on some beads could be due to faulty production[20].

The beads with eyes characterised by an iris of differing colour from the base and an nucleus encircled by one or more profiles are of a more complex type that present many variables both in the composition of the eyes and in the placing of the eyes on the surface of the bead and for the eventual enrichment with other decorations such as applied horns or a tendency for a notable protrusion of the decorative motif sometimes to the extent of deforming the bead into triangular or quadrangular shapes; the base colour of these beads are normally yellow, blue or turquoise.

This typology is relatively common from the V -IV century BC especially in the Veneto[21] and the adjoining northern Etruscan contexts (*Etruschi a Nord del Po* 1986-1987, p. 236-237, fig. 140-141.), but also known in the Eastern Veneto and the Isonzo basin, in particular at S. Lucia di Tolmino (Marchesetti 1993, tab. IX, 4) a sort of bridgehead towards the area of Slovenia that is indicated as a crucial area for the concentration of finds and for the identification of productive areas[22].

The beads with an exaggerated decorative syntax with a tendency to protrusion and to the deformation of the bead's shape sometimes as far as dissolving itself into a spiral form, are probably from later contexts, associated with the middle La Tène phases.

This is the case of the bead fragments with a brown base and yellow and turquoise eyes (Cat. nn. 91). This is a typology that was popular in the Celtic world between LT C2 and D1 (Zepezauer 1993, p. 95, tab. 6-9.) and is only present in the Veneto with a few examples, coming from the settlements in the northern arts of the Vicenza and Verona provinces, from Santorso, Trissino, Montebello and Montesei di Serso[23]. In particular the example of Santorso was found in a room of a house/hut dated with a certain precision to the end of the IV century BC. In the example of Adria that was sampled of brown coloured glass with brown, white and turquiose eyes, the eye motif is still well represented.

Beads with compound eyes, variants A and B

An example of variant A, half a compound eye bead, has been found at Adria (Cat. nn. 91) and has been sampled; this typology was identified by T.E. Haevernick and she indicated only 7 examples in Italy and

[20] For an example of irregularity, Gambacurta 1987, p. 207, fig. 20 top left.

[21] For the Veneto in general, Gambacurta 1987, fig. 5, 11-13 and 18-20.

[22] As an example the rich documentation of the cemetery of Novo Mesto, *Novo Mesto* III 1993, p. 28 and passim; *Novo Mesto* V, 2000, p. 14 and passim.

[23] For the diffusion in Veneto: Lora, Ruta Serafini 1992, p. 260, fig. 9, 2; for Montebello, Ruta Serafini 1986, fig. A34 e p. 84; for the bead of Montesei di Serso, Perini 1965, 174, fig. 17.

suggested that they were manufactured in the area of the Black Sea and the Caucasus (HAEVERNICK 1972). Other than these seven, an eighth has been pointed out at Altino even though it is of uncertain origin (GAMBACURTA 1987, fig. 1, type G, fig. 21, p. 207). The diffusion of this pearl is distributed on a east-west axis along the main stages of the silk route as far as the tombs of the Hallstatt princes. The circulation of these beads, considered particularly prestigious and perhaps associated with apotropaic magic powers which probably led to the increased complexity of the decoration with the multiplication of the eye motif, seems therefore to imitate in reverse that of the silk and valuable spices that came from the east to the central European Hallstatt courts, and that in the area to the north of the Black Sea intersected with that of the important horse trading route with China.

Examples of this type of bead are known at Adria and Spina and, together with the bead at Altino, make for a particularly rich presence in the Veneto of this rare typology along the trade routes towards the transalpine markets (PAULI 1987, fig. 200; 202.). It seems probable that properly in the Veneto it is possible to identify the production of the variant of this bead with the compound eye, known a B[24]; characterised by a smaller body, a colour less opaque, compound eyes but with a simple motif and protruding horns applied to the surface and around the opening. This local imitation shows a decorative taste slightly more copious because of the applied horns. The beads in question (Cat. nn. 54 and 57), both come from the cemetery of the Canal Bianco, the first from a burial dated around 500 BC, the second with no precise funerary context.

Even though the analysis does not indicate any major differences in the composition, either quantitatively or qualitatively, of the glass matrix of these beads, it still seems plausible the hypothesis that the Variant A examples could be considered an importation.

Spindle Whorls

Two spindle whorls in a glass matrix (Cat. nn. 56 and 59) have been analysed; both are a transparent green colour one of which has an applied decoration in opaque yellow glass.

The glass spindle whorl most probably represents the transformation of a functional object normally of pot, into one that is precious and perhaps apotropaic, these are quite common in female graves where they are role indicators. The glass version of the spindle whorl could indicate a rich burial, not just an indicator of role but also of rank, probably not functional but strongly symbolical.

Several glass spindle whorls, with and without decoration are known at Altino, unfortunately without context (GAMBACURTA 1987, type L, fig. 8; 23) and at Este above all in some rich burials dated to the start of the III century BC[25]. An earlier example, classified as a pendant or pear-shaped bead, but similar to spindle whorls, with its zigzag decoration comes from a rich burial from via Tiepolo a Padova, dated to the first half of the VI century BC (RUTA SERAFINI (ed.) 1988, p. 128, fig. 84, 22).

The examples from Adria both come from the cemetery of the Canal Bianco, in particular the bead decorated with the motives in a yellow glass matrix come from a burial dated to the second half of the III century BC (FOGOLARI, SCARFI 1970, fig. 49, p. 76).

Cylinder shaped beads with applied decorations

These are cylindrical beads in which the form becomes unrecognisable due to a rich decoration of applied drops that give the beads an irregular pimple type form (Cat. nn. 60-76). All the beads analysed at Adria come from the Ca' Garzoni cemetery; a group from tomb 29 and another from tomb 47, both dated to the II century BC; they were probably both part of two necklaces, the first white, blue and green and the second all white. Although it is not a common typology there are certain similarities to Este, with the famous tomb of the so-called Nerka dated to the first decades of the III century BC, a context in which there are also glass spindle whorls (CHIECO BIANCHI 1987, p. 201, fig. 17, 23, 30-32). A more convincing confrontation is with Slovenia and the Isonzo basin where beads of this type have been found at S. Lucia di Tolmino (MARCHESETTI 1993, tab. IX, 5) and in the Illyrian ambit at Novo Mesto[26].

On the whole this type of bead with external protruding and applied decorations seems to be favoured in the areas of Celtic influence, in an earlier period as testified by the large ceramic beads coated with a blue

[24] HAEVERNICK 1972 (1981), p. 239; and GAMBACURTA 1987, fig. 6 and finally an example from a particularly high ranking burial at Este, noted also for its prestigious elements of Celtic influence, *Adige Ridente* 1998, tomb 126, p. 208, fig. 115-116; dated to the IV century BC.

[25] CHIECO BIANCHI 1987, p. 213, fig. 32, 91 with a file of analytical comparison.

[26] *Novo Mesto* V 2000, tab. 22, grab V/35, 15.

glass matrix found at Montebello Vicentino in a high ranking burial known for its large perforated iron belt hook dated to the first decades of the IV century BC[27] and in a more recent phase LT C1-2.

Beads decorated with bands and chevrons

The ovoid or barrel shaped beads with simple and complex band decorations are not very common. The bands of differing colours applied to the surface of the bead create various decorations, for example zigzag or criss-cross. There is only one example at Altino and it is ovoid shaped, its original context is unknown.

Tomb 36 of the Canal Bianco cemetery has provided examples from Adria (Cat. nn. 46), dated to the end of the III century-start of the II century BC (MANGANI 1982, p. 105-106). Another Adria example is from tomb 41 of the Ca' Garzoni cemetery, dated to the II century BC. The beads with chevrons seem to be the continuation of an older tradition, that is often found on glass unguent bottles imported from the Phoenician territory, dated from the mid V century BC onwards. Some examples have been found at Adria one of which from the tomb Campelli 8, datable to the beginning of the III century BC (FOGOLARI, SCARFI 1970, fig. 43, p. 73 and fig. 50, p. 77). A similar decoration appears on the famous glass cups from S. Lucia di Tolmino (MARCHESETTI 1993, tab. VIII, 1-2; tav. IX, 1). A barrel shaped bead with chevron decoration has also been found at the Libna cemetery, well known for other types of glass beads (GUZTIN 1976, p. 65, tab. 17, 18). The barrel shaped examples that have been analysed (Cat. nn. 47-48) come from tomb 363 of the Canal Bianco cemetery. Decorations are mostly found on cylindrical beads.

At Altino, the beads with a more pronounced cylindrical shape and that are without a known context are probably more recent and perhaps even Roman (GAMBACURTA 1987, fig. 24).

Ringperlen

There are three examples of annular beads, two of which in transparent glass (Cat. nn. 58 and 55), and the other in amber coloured translucent glass decorated with alternate bands of yellow and white opaque glass (Cat. nn. 93). The two beads in pale green glass come from the Canal Bianco cemetery, in particular n. 55 from a burial dated to the end of the III century BC (tomb 27). The two beads in transparent glass are probably part of a typology that is more generalised and of longer duration than that of the beads with alternate bands which are part of the Ringperlen tradition that are widely diffused in LT D1-2.

An annular bead in transparent glass, used probably as a central pendant of a necklace is known from the tomb Fornasotti 2 of Altino, datable to the end of the VI century BC and characterised by other elements associated with late Hallstatt culture[28] This large transparent bead was probably originally covered in gold leaf. The Ringperlen with spiral form or alternate band decoration and a wide range of colours are widely diffused in the Veneto, where many are found at Altino and also in the Cenomani territory[29]. The two examples of Altino are of a plurideposited rich grave datable from the mid II -mid I century BC (GAMBACURTA 1999, p. 119, fig. 10, 4). The examples from the Cenomani territory come from the burials at Casalandri di Isola Rizza, Vigasio and S. Maria di Zevio and are referible to LT D1-2[30].

Pendants

Two glass pendants have been analysed. the first was zoomorphic with a goat's head of opaque white glass decorated with eyes of opaque yellow and mouth of clear green glass, and came from tomb 13 of the Cà Cima cemetery (Cat. nn. 78), and the pendant in the form of a small amphora of clear glass (Cat. nn. 94) of which there are two similar examples at Adria.

The zoomorphic pendant was found in a burial dating to 510-490 BC along with another bead with a zig-zag decoration that can be considered to be of Phoenician origin dating to the VII-VI century BC[31]. A comparison can be made with similar examples from the cemetery of Novo Mesto in Illyria where there are many examples of various colours[32].

[27] For the globular examples of Montebello, RUTA SERAFINI 2001, p. 200-201; fig. 3, 16.

[28] GAMBACURTA 1987, type H and p. 212, cat. 75; and GAMBACURTA 1986, fig. 1,c.

[29] GAMBACURTA 1986, fig. 1,c; GAMBACURTA 1987, p. 212, cat. 75.

[30] SALZANI 1984, fig. a p. 801; for Isola Rizza SALZANI 1998, tab. IIB, 1-2; there is also a bead with zigzag decoration from Isola Rizza, comparable with a known example from Altino of a typology less common than that of decoration at spiral or alternate bands, SALZANI 1998, tab. XLIX B, 9B, tomb 104; SALZANI 1996, tab. XXVIC 7, tomb 63.

[31] SEEFRIED 1982, type E 1b, tab. III; for the definition of the type p. 10; for the dating of the type, fig. 44 and p. 30-31.

[32] For Novo Mesto, *Novo Mesto* V 2000, p. 51 C; p. 106, tab. 20, tomb 31, 1, a-d; p. 110, tab. 24, tomb 35, 16; p. 112, tab. 26, tomb 40, 2; p. 133, tab. 47, 7.

An interesting diffusion pattern is also emerging for the anthropomorphic pendants where again there are similarities with the Illyrian territory in the area of Sava, at Novo Mesto, from where they spread to the internal areas of Moravia and the Carpathian basin[11]. A trade route for these beads associated with the diffusion of coral in the area of the Sava has already been proposed and the presence of these beads in the territory of Adria is an interesting Adriatic confirmation of this hypothesis (*I Celti* 1991, p. 279).

G.G.

3.6. Etruscan vessel forms (cat. 96 - 97).

In addition samples have been taken from two Etruscan artefacts held in English collections. These here are representative of a core-formed glass vessel type unique to Etruscan contexts. Initially identified by Haevernick in 1959, the "stachelflaschen" (scale decorated vessels) have since been studied on typological grounds by a number of scholars (Haevernick 1959, 1961, Harden 1968, Giuntoli 1996, Martelli 1994). Most are held in collections in Italy, and many are of poor provenance. Those from secure contexts have been dated to the period 650 – 550 BC. No previous chemical analysis has been performed on this group, and this study is the first attempt to characterise the glass employed in their manufacture.
Although the underlying form, whether oinochoe, alabastron or aryballos, may have an eastern origin, the decoration is known only from Etruscan material suggesting they were produced within the Etruscan world. Given the established earlier glass making tradition in the Po valley it is useful to explore the relationships between the technology of the Etruscan glass vessels and the Final Bronze Age European glassmaking tradition.

A.T.

4. Glassworking Tools

Both Frattesina and Mariconda have whole or fragmentary ceramic plates, in addition to conventional crucible forms with glass adhering to them. These artefacts are not shallow crucibles, but represent a previously unreported tool type associated with bead forming. This artefact type consists of purpose-made ceramic plates (e.g. catalogue 2) and re-used pottery (e.g. cat. 28). Their common characteristic is that the flat plates have had molten glass on one surface. Their presence at both Frattesina and Mariconda permits inferences concerning the glass technology at both sites.
The nearest parallel in the glass literature is a flat iron plate recovered with beadmaking material from 8th Century AD contexts at Ribe in Denmark (Gam 1990). Copies of the Ribe plates have been employed in experimental beadmaking at Lejre for preheating, as a working surface and finally annealing after bead fabrication. However, these functional analogies are inappropriate for understanding the role of the flat ceramic plates recovered from Mariconda and Frattesina. The ceramic plates from Mariconda and Frattesina have been used in a different manner, since they have been designed for use with molten glass.
The re-used oinochoe lid from Mariconda (see cat. 28) has had a retaining rim of clay added prior to the glass being deposited. Clearly this was fabricated with the knowledge that the glass on its upper surface would be molten. This observation has implications for not only the manner in which the beads were manufactured, but also the nature of the pyrotechnology employed at Mariconda. The form is curious- if the glassworker intended the object to simply act as a reservoir for molten glass, then the under side of the lid would have been more appropriate, since it already has a projecting lip for locating the lid in an oinochoe jar. It is suggested that the selection of the flat side was to avoid the deep recess (10.5 mm), since an essentially flat surface was required: perhaps for the gathering of hot glass on a mandrel/pontil at a very low angle.
There is no direct evidence of glass making at Mariconda, and it has been assumed that the glass has simply been heated and worked. Glassworking as opposed to glassmaking, can be a much lower temperature activity: beads and similar artefacts can be formed from softened glass rather than from "liquid" glass. The implication of this is that whilst glassworking is an activity requiring a high degree of skill and technical ability, it is distinct from the more specialised activity of glassmaking, which requires higher temperatures and empirical "knowledge" of glass chemistry. However, the presence of the oinochoe lid with its lip designed to retain the molten glass, demonstrate the

[11] *I Celti* 1991, p. 273-276 and p. 273, for the Moravia; p. 277-285 and fig. a p. 278 for the Carpathian basin. For the examples from Novo Mesto, *Novo Mesto* V 2000, fig. 72, A; p. 124, tav. 38, tomb 63, 9.

technical capacity of the Mariconda workers to achieve temperatures appropriate for glassmaking. The deliberate high temperatures in use at Mariconda demonstrate the possibility of sophisticated high temperature processes like glassmaking and colouring.
The assemblages from Frattesina and Mariconda also included a large number of fragments of flattish glass disks. From the edge fragments, it is possible to suggest that these have a consistent diameter, approx. 8-10 cm, and are between 0.6 and 1.5 cm thick. These disks appear to have been poured onto a flat surface, and on occasion manipulated (there are tool marks on the upper surface) whilst soft. It is suggested that the disks represent a convenient form for the storage of unworked glass and are therefore ingots.

A.T.

5. Analytical procedure

Chemical analysis of the samples was undertaken using electron-probe microanalysis. This has a number of clear advantages over other instrumental techniques. Only micro samples are required- a fragment 1-2 mm^2 is sufficient, which proves to be minimally intrusive upon the artefact, requiring less intervention than the cleaning of an area for X-ray fluorescence analysis (XRF). The technique can simultaneously detect and quantitatively analyse 22 oxide components. The technique is well established for the analysis of silica-rich materials (i.e. both, geological samples and archaeological glasses - Henderson 1988 (a) and (b)).
The analyses of the micro samples were undertaken using a Cambridge microscan 9 system, at the Dept. of Earth Sciences at the University of Oxford. The individual samples were mounted in epoxy resin blocks and polished flat to remove weathering layers and present a flat surface for analysis.
The samples were analysed at 20 kV, with a beam current of 40 nA, and a defocused beam of 80 micron diameter. The analyses were quantified using glass standards supplied by Dr Robert Brill of the Corning Museum of Glass. The analytical procedure has been published in greater detail elsewhere (Henderson 1988b).

Scale 1:1

Figure 1 - Polished epoxy resin with samples embedded ready for analysis.

A.T.

6. Results

The compositional data is summarised below in tabular form. A full review of the errors is not included here. A number of results have been excluded, because they were analyses of weathered material, or inclusions unrepresentative of the glass matrix. Typically these are analyses of weathered areas or unfused raw material, with silica contents of 90 %. Other more varied compositions have been excluded if the total composition lies outside of 100 % +/- 5%. These results outside the accepted range reflect the problems associated with analysing archaeological materials in contrast with laboratory-prepared standards. The inhomogeneity of the material is discussed further below.

A.T.

7. Discussion

The results from the Final Bronze Age material are consistent with those previously published (see Tables 2 and 3 below).
However, three of the Frattesina glasses are significantly different from the general pattern: they contain such a low soda content that they should be categorised as potash glasses (i.e. glasses in which the significant alkali is potash alone). Samples 236 - cat.23; 235 - cat.27 and 294 - cat.3, all blue translucent glasses, contain less than 2 % Na2O (1.3, 0.96 and 1.76 % respectively). These glasses may reflect the variability observed in plant ash composition (eg Brill 1970, Bezberodov 1975 and Sanderson, Hunter 1981), but the soda contents of all the Final Bronze Age glasses do not reflect a continuum from the lowest to the highest, but are bi-modally distributed suggesting two distinct glass compositions.
The contemporary adjacent site of Mariconda is using

	Frattesina (n=25)		Mariconda (n=19)		Previous studies (n=68)*	
	Average	range	Average	range	average	range
Low Na_2O	5.12	0.96-8.83	5.92	4.79-6.73	5.96	3.07-8.8
High K_2O	10.62	6.24-17.3	9.50	6.99-12.03	9.26	5-13.09
Low MgO	0.80	0.50-1.9	0.82	0.46-1.76	0.65	0.4-1.3

Table 2 - The soda, potash and magnesia contents of mixed alkali glasses from this study compared with earlier work, values in weight percent.

			Na_2O	K_2O	MgO
Rathgall (n=16)	9th-7th C. BC	average	7.7	8.47	0.68
		range	3.3-8.8	7.3-10.3	0.6-0.80
Kassell (n=4)	12th-8th C. BC	average	4.6	10.6	0.58
		range	3.07-5.6	8.97-13.9	0.54-0.63
Frattesina (Brill) (n=6)	12th-9th C. BC	average	5.63	9.91	0.58
		range	4.85-6.91	8.71-12.30	0.43-0.7
Frattesina (B+V) (n=3)	12th-9th C. BC	average	6.06	9.43	0.82
		range	5.0-7.4	8.5-9.9	0.7-0.9
Frattesina (Biavati) (n=3)	12th-9th C. BC	average	5.15	7.82	0.62
		range	3.79-6.12	6.77-8.96	0.59-0.64
Grotte de Bringairet (n=10)	16th-12th C. BC	average	6.72	8.78	0.75
		range	4.3-8.0	6.5-11.8	0.64-0.88
Grotte de Sindou (n=2)	12th-10th C. BC	average	6.5	8.35	0.6
		range	6.0-7.0	7.8-8.9	0.4-0.8
Billy le Theil (n=11)	12th-10th C. BC	average	4.4	10.8	0.6
		range	3.5-4.8	9.1-11.3	0.5-0.6
Le Fort-Harrouard (n=4)	1500-1100 BC	average	4.75	8.18	0.55
		range	3.4-6.3	5-10.2	0.4-0.7
Le Depot de Reallon (n=4)	1200-900 BC	average	4.98	9.48	0.65
		range	3.5-6	8.7-10.7•	0.4-1.3
Rancogne (n=2)	1200-900 BC	average	4.65	8.6	0.7
		range	4.5-4.8	7.8-9.4	0.6-0.8
Gord (n=1)	2895-2420 BC(?)	1 sample	7.7	9.2	0.6
Vicofertile (n=1)	1500-1100 BC	1 sample	5	10.5	0.58
Quingento (n=1)	1500-1100 BC	1 sample	6.6	9.5	0.5
all mixed alkali (n=68)	2895(?) - 600 BC	average	5.96	9.26	0.65
		range	3.07-8.8	5-13.09	0.4-1.3

Table 3 - Values of soda, potash and magnesia from earlier studies of prehistoric mixed alkali glasses. Values taken from: Rathgall (Henderson 1988b, 16 analyses), Kassel (Hartman et Alii 1997, 4 analyses), Frattesina (Brill 1992, 6 samples) (Verità, Biavati 1989, 3 analyses) (Biavati 1983, 3 samples), Grotte de Brinairet, Grotte de Sindou, Gord (Guilaine et Alii 1991), Billy le Theil, Rancogne, Le Fort-Harrouard, Le Depot de Reallon (Gratuze et Alii 1998), Vicofertile and Quingento (Bellintani et Alii 1998).

a similar mixed alkali glass (see Table 2 above). The distinctive mixed alkali glass is not being employed in the later material from the sites of Ca' Cima and Canal Bianco - these glasses are all from the later, Mediterranean tradition of low magnesia, soda-lime-silica glasses.

	Ca' Cima		Canal Bianco		Ca' Garzoni	
	average	range	average	range	average	range
Na_2O	16.82	14.73-19.37	16.23	12.96-18.09	16.22	13.82-17.94
K_2O	0.31	0.06-0.36	0.77	0.38-1.11	0.68	0.35-0.56
MgO	0.53	0.42-0.68	0.65	0.35-1.14	0.44	0.53-0.82

Table 4. Values for the soda, potash and magnesia compositions in glasses from the sites of Ca' Cima, Canal Bianco and Ca' Garzoni.

On the basis of these analyses, one can argue that the tradition of mixed alkali glass production use does not continue until the 6th – 4th Centuries BC in the Po valley. However, several other factors should be considered. The cultural context of the archaeological artefacts are very different: the Late Bronze Age material from Mariconda/Frattesina and the later 6th-4th Centuries BC assemblages from Ca' Cima/Canal Bianco. The former sites' glass originated in domestic and industrial contexts compared with funerary contexts for the latter. The necropolis at Canal Bianco is associated with a Greek colonial settlement, and therefore the glass assemblage may be less likely to consist of locally produced material. Nonetheless, there is a distinct dislocation in the type of glass being used in the Po Valley across this (rather long) chronological period: an argument for continuity of production cannot be made.

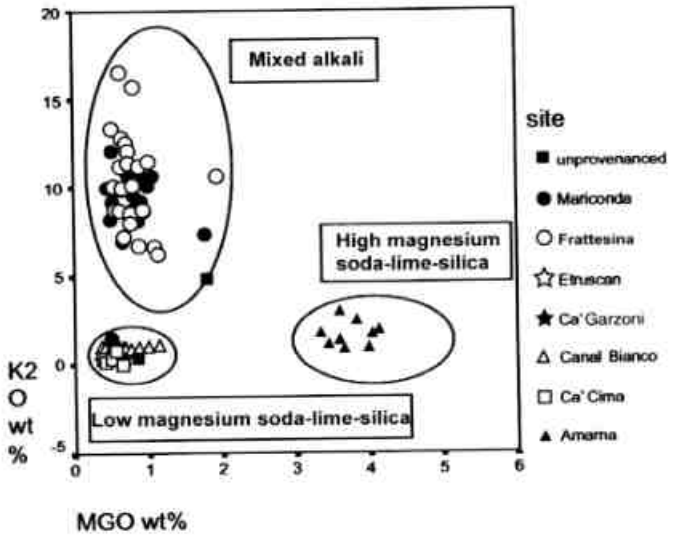


Chart 1 - Magnesia vs potash content for 2nd and first Millenium BC glasses, data from this study and from Lilyquist and Brill (1993).

7.1. Mixed Alkali and Soda-Lime-Silica Glasses

None of the final Bronze Age or the later 1st Millennium BC glasses sampled to date are from the early Mediterranean tradition of high magnesium soda-lime-silica glasses, such as those from Egypt analysed by Lilyquist and Brill (1993). This glass type does occur in European Final Bronze Age contexts, for example in France at La Colombine (Champlay) and at Fort Harrouard where it was recovered alongside mixed alkali glass (Gratuze *et Alii* 1998, p 19 - 20). A convenient way of reviewing the distinct glassmaking traditions is to plot them in terms of their principal discriminating components, in the form of a scatterplot of potash against magnesia content (after Henderson 1988a, fig. 3). In Chart 1 (see above) the magnesia and potash components of the analysed samples can be used to distinguish between the mixed alkali and soda-lime-silica glasses. To demonstrate the difference between the two soda-lime-silica glass types, a number of examples of high magnesium, soda lime silica glasses from 14th C. BC Egyptian contexts (Amarna) have been included (from Lilyquist, Brill 1993).

7.2. Colourants

Both the Frattesina and Mariconda assemblages contained blue translucent, red opaque and red-blue glasses. The red and blue colouration is principally derived from

the copper content and is dependent upon its oxidation state. Where the glasses are blue coloured the copper is present as cupric oxide (CuO), in the case of the red coloration, the copper is likely to have been reduced to cuprous oxide (Cu_2O) and/or particles of metallic copper. In finished items such as the beads, this indicates a final heat treatment in a reducing atmosphere (which may be an accident of the annealing process). The red ingots suggest that they also have been subject to a similar process. The ingots may have been annealed after their formation indicating that a value was placed in their not fracturing before re-melting, alternatively the ingots have been reheated (accidentally?) in a reducing environment after being made. There is no clear correlation between the glass colour (either ingots or beads) and the copper content of individual samples. The difference between red and blue glasses was achieved by control of the oxidation state of the glasses. What does appear significant is that the ingots contain more copper (mean of 4.09 wt.%), compared with a completed-bead average of 2.09 wt.%. This suggests that the ingots may be specifically produced with the intention to colour other glasses. It is not possible to definitely establish at which point the colourants were introduced into the glass- either during the initial fusion of the raw components, or at a later stage after a basic glass had been formed. The presence of clear or faintly coloured glasses amongst the assemblages means that it is possible that there was a distinct two stage process.

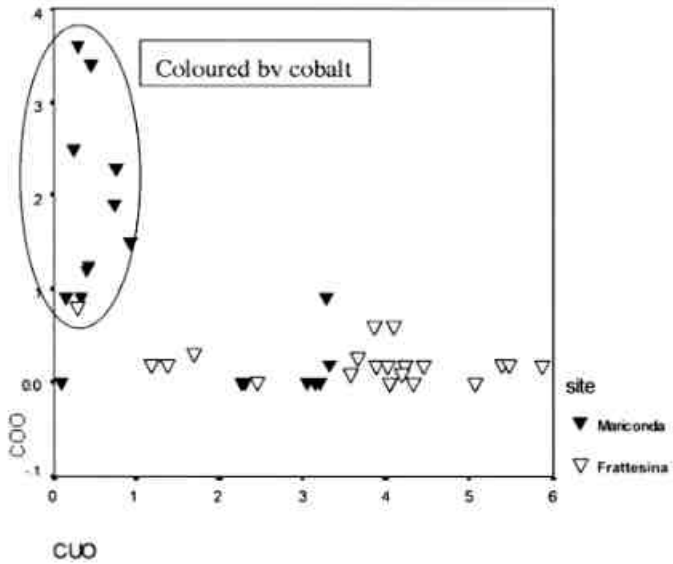


Chart 2 - Copper oxide vs cobalt oxide content in blue glasses from Mariconda and Frattesina, note the low levels of cobalt required to colour the glasses.

Although copper is the dominant colourant for all of the blue Bronze Age glasses, a number of the Mariconda glasses and a single example from Frattesina are coloured by cobalt. This may indicate variation in the primary glass production, or that the glasses are being coloured away from the primary source, and in the case of Mariconda and Frattesina, in different ways. The negative correlation between copper and cobalt contents (see Figure 2 above, and Table 5 below) demonstrates the degree of technical control employed in coloration. Cobalt is not simply being introduced into the glass melt as a contaminant in the copper ore, since it is being selected as an alternative to an increased copper content and added as a tiny component.

The identification of cobalt sources in glass, faience and glazes has been the subject of discussion by a number of authors who have linked the association between cobalt and other elements to specific geological sources. Associated components include: alumina, copper, manganese, iron, nickel, zinc, arsenic, antimony and lead (Rehren 1998, p 246; Brill 1988; Farnsworth Ritchie 1938, p 158 – 165; Kazmarzyck 1987, Sayre 1963; Geilman 1961; Henderson 1985, p 280 and 1989, p 33-36, Garner 1956, Young 1956, Dayton 1981, p 57, Biron *et Alii* 1990, Gratuze et *Alii* 1998, p. 23). Whilst it is beyond the scope of this paper to comprehensively review the existing literature on cobalt in glasses, it is important to discuss the associated components in the glasses analysed here (further discussion will be published in the near future).

Table 5 is a correlation matrix between variables that have previously been associated with cobalt. As noted above, there is a negative correlation between copper and cobalt, indicating that the copper colourant in the blue glasses is not derived from a cobalt-rich copper ore. The cobalt is positively correlated with iron, nickel and arsenic. Cobalt in these samples is not correlated with lead, alumina, manganese, zinc or antimony. The fact that copper is negatively correlated to arsenic, antimony, iron and nickel reinforces the interpretation of these components not being associated with the copper colourant, but with their introduction alongside cobalt.

Associations with alumina have been linked to cobalt sources from Egypt (Farnsworth, Ritchie 1938, p. 158 -165; Kazmarzyck 1987). Associations with zinc have been suggested for Iranian cobalt sources (Henderson 1985 and 1989,) but its presence in Mycenean and Egyptian glasses contrasted with its absence in Mesopotamian glasses (Henderson 1989 and Sayre, Smith 1967); amongst cobalt coloured enamels from Limoges, zinc was present in increased quantities only amongst

		COO	AL2O3	MNO	FEO	NIO	CUO	ZNO	AS2O5	SB2O5	PB2O5
COO	Pearson Correlation	1.000	.145	-.024	.486**	.754**	-.608**	.087	.497**	.293	-.230
AL2O3	Pearson Correlation	.145	1.000	-.095	.487**	.110	-.069	-.086	.064	-.014	.185
MNO	Pearson Correlation	-.024	-.095	1.000	.060	-.159	-.052	-.073	-.074	.002	-.260
FEO	Pearson Correlation	.486**	.487**	.060	1.000	.505**	-.625**	.013	.356**	.441**	.086
NIO	Pearson Correlation	.754**	.110	-.159	.505**	1.000	-.605**	.057	.821**	.588**	-.112
CUO	Pearson Correlation	-.608**	-.069	-.052	-.625**	-.605**	1.000	-.180	-.426**	-.323**	.164
ZNO	Pearson Correlation	.087	-.086	-.073	.013	.057	-.180	1.000	-.027	-.029	.088
AS2O5	Pearson Correlation	.497**	.064	-.074	.356*	.821**	-.426**	-.027	1.000	.724**	-.149
SB2O5	Pearson Correlation	.293	-.014	.002	.441**	.588**	-.323*	-.029	.724**	1.000	.010
PB2O5	Pearson Correlation	-.230	.185	-.260	.086	-.112	.164	.088	-.149	.010	1.000

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

Table 5 - Correlation values between key oxides, all blue glasses from Mariconda and Frattesina.

later material (1200 – 1350, rather than the earlier assemblage 1100 – 1200). Manganese has been noted as a chronological marker for cobalt colourants in Chinese glazes with increased manganese content after 1400, seen as the use of local cobalt sources (GARNER 1956). There is a widespread presence of cobalt minerals in Germany, Austria, Switzerland, Czech and Slovakia (HENDERSON 1985, p 280) making it difficult to locate a likely source for these samples, but associations with nickel and arsenic have been noted for cobalt mineral skudderite in the Blackforest (HENDERSON 1989). Both GEILMAN (1961) and HENDERSON (1989) recommend caution when attempting to locate specific cobalt sources: at present it is safest to distinguish the Frattesina and Mariconda samples from known Egyptian, Iranian and Chinese cobalt sources, and suggest that Central Europe is a most likely origin.

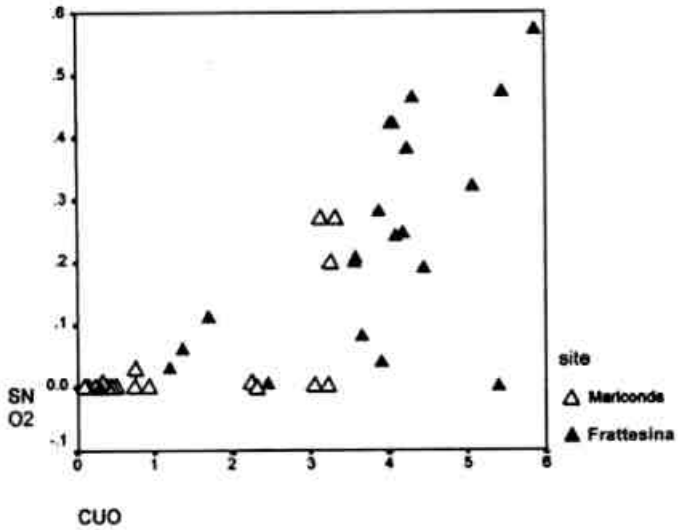


Figure 3 - Copper and Tin oxide contents of Final Bronze Age Blue glasses.

The copper employed as a colourant cannot be readily related to a specific bronze composition, since there is not a simple correlation between the copper and tin components in the glass. However, the two oxides are positively correlated:

		CUO	SNO2
CUO	Pearson Correlation	1.000	.752**
SNO2	Pearson Correlation	.752**	1.000

** Correlation is significant at the 0.01 level (2-tailed).

Table 6 - Correlation between copper oxide and tin oxide content of blue glasses from Mariconda and Frattesina.

There is a tendency amongst the Frattesina blue glasses for the copper and tin contents to increase together – but this is not an exclusive relationship. A number of high – copper glasses from both bronze age sites contains little tin, suggesting pure copper is available, and the glassmakers are not simply reliant on secondary use of copper alloy materials for their colourant. This observation demonstrates that the glassmakers were sufficiently familiar with metallurgy to recognise the role of copper alone as a colourant, and to be able to gain access to the pure metal.

7.3. Opacification

The Bronze age glasses are not opacified with calcium antimonate as found in earlier Egyptian glasses, and as are the later glasses –see below, but by the inclusion of unfused silica-rich crystals. This observation was originally made by VERITÀ, BIAVATI (1989), and can be confirmed with reference to Figure 4 below.
The different phases in the sample can be readily identified in the backscattered SEM image (in which the colour density reflects the relative average atomic number of the sample): the pale area is the glassy matrix, and the darker grey areas are silica rich. This difference of composition was confirmed using semi-quantitative energy dispersive analysis on discrete zones of the sample surface.
A number of features are worthy of note. Firstly, there is a weathered zone on the surface of the glass, where the action of ground water has leached away the alkali, leaving behind a silica-enriched area. Beneath the weathered zone is an area of almost pure glass, some 600µm deep. It is suggested that this area, being close to the surface of the glass whilst last in use, was hotter than the main body of the glass, and therefore is completely vitrified. The main body of the sample is made up of glassy matrix containing silica rich inclusions, the shape of which are echoed by cracks caused by differential thermal contraction during cooling. These cracks have left a relatively porous structure, and weathering similar to that at the surface has taken place in which the alkali has been preferentially removed.

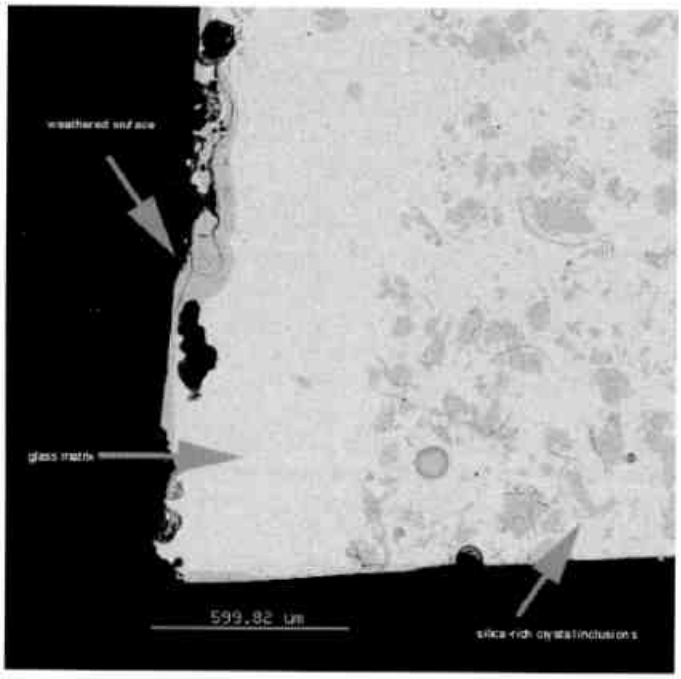


Figure 4 - SEM image of sample 221 (glass removed from a crucible).

7.4. Analysis of Etruscan vessels and data

Although three samples from two artefacts do not represent a comprehensive survey of Etruscan glass vessels, the results are worth commenting upon. Firstly it is interesting to note that despite their separate provenance, the two vessels have a remarkably similar chemistry.

	Etruscan glass vessels 650-550 BC	
	average	Range
Na_2O	17.9	17.62-18.08
K_2O	0.33	0.31-0.36
MgO	0.42	0.4-0.42

Table 7 - Key components of Etruscan glasses.

The Etruscan glass vessels are fabricated from low magnesia soda-lime-silica glass: they have a low phosphate content (avg. = 0.02 wt.%), and raised chlorine and sulphur levels associated with the use of either natron or a soda-rich plant ash.
They are separated by their colouring agents: both contain copper (1.04 and 1.99 wt.% respectively). The

darker, more densely coloured vessel also contains 0.11 wt.% cobalt oxide, sufficient to give the piece its hue. Most importantly, these analyses demonstrate no link whatsoever between the North Italian mixed alkali glassmaking tradition and the Etruscan core-formed glass vessels.

7.5. Ca' Cima

The glass from Ca' Cima is a small group of 7th –6th Century BC glasses (7 samples), but represents a range of colours. All are low magnesia, soda-lime silica glasses, with significantly higher calcium oxide than the Final Bronze Age material, and also slightly higher than the other Iron Age material. Since the magnesia and soda levels are consistent with a natron-type glass, this glass has probably been made with a highly calcerous sand.

Frattesina	Mariconda	Ca' Cima	Canal Bianco	Ca' Garzoni
2.10	2.14	9.16	7.95	6.47

Table 8 - Mean calcium oxide content of glasses from the different sites (in wt%)

Four of the samples are opaque (one blue: sample 265 - cat.83, and four white samples: 267, 269, 270 - cat.78; 80) and all have correspondingly high antimony and calcium contents indicating that calcium antimonate is the opacifying agent. This would also account in part for the raised calcium levels. The blue translucent glass is coloured with cobalt oxide alone (sample 268: 0.11 % CoO, 0.26 % CuO), compared with the opacified blue glass (sample 265: CoO undetected and 3.45% CuO).

A.T.

Conclusions

Whilst this report is concerned with work in progress, a number of initial conclusions can be drawn:

- The mixed alkali glass identified in earlier studies is also being worked outside of Frattesina in the Po valley in the final Bronze Age. The polity of Frattesina does not have sole control over the working of glass. The identification of this compositional type in both glass and faience across Europe during the Middle Bronze Age (and possibly earlier) demonstrates the existence of a well established regional tradition.

- The broad distribution and longevity of the tradition throw up an apparent contradiction: the processes involved in the production must have been carefully controlled to generate such a consistent composition, yet the knowledge is not apparently restricted to a single place or period. Models of the control of technical knowledge need to be developed to take account of this pattern.

- There may be localised variation in the use of colouring agents, but the basic glass is the same. Further analysis of the published data is necessary to explore internal differences, which may indicate subtle localised variation within the tradition.

- Generally speaking, there is no indication of continued mixed alkali glassmaking tradition into the 6th and 5th C. BC.

- The Etruscan glass vessels cannot be linked to the earlier mixed alkali tradition of N. Italy. More samples are required to fully characterise these glasses.

As work progresses, and the number of analyses increases, it will become increasingly possible to evaluate the internal differences within the mixed alkali tradition, and further elaborate the technological characterisation of this glass type. Additional samples of material from sites contemporary to Frattesina and Mariconda will help delineate the use of this glass, and establish the range of typological forms employed. It is particularly important to undertake further analyses of earlier glasses from European contexts. It is also hoped that further analysis of the compositions in comparison with data from work on copper-alloy and geological material will elucidate the relationship between the glass and metal industries. It may be possible to relate the glass colourants to shifting use of metal ores in the Late Bronze Age.

Acknowledgements. Many thanks to a number of people who have assisted with this project: including Dr Armando De Guio, University of Padua, Dr Simonetta Bonomi, Director of Adria Museum, Dr Mark Pearce, University of Nottingham, Prof. Roger Wilson, University of Nottingham and Dr Norman Charnley, University of Oxford.

APPENDIX 1.: SAMPLE CATALOGUE

Fratta Polesine
Abitato di Frattesina e necropoli di Fondo Zanotto

1
Location: M.A.N. Adria
Site: Frattesina - surface find
Dating: 1200-850 B.C.
Invent.: IG 32893
Description: fragment of crucible with irregular spread of translucent aqua glass adhering to upper surface. Marked as IG 31893, but published as IG 32893. Crucible form is of a shallow bowl with straight-sided sloping sides. Fabric is grey and coarse with large crystalline inclusions.
Dimensions: Base of crucible 14 mm thick, sides taper from base to 6 mm at undecorated rim. Glass an irregular spread 50 mm x 35 mm up to 4 mm thick. De Min 1986, p. 126 and 138.
Sample 221

2
Location: Mus.Civ.Rovigo
Site: Frattesina - surface find
Dating: 1200-850 B.C.
Invent.: 272079
Description: irregular fragment of a crucible/ceramic platform with translucent blue glass adhering to one, slightly convex surface. Glass includes swirls of opaque red glass. Ceramic plate, red fabric, used as working platform in beadmaking.
Dimensions: width 34 mm x 48 mm, 8 mm thick. Glass covers an area of approx. 25 x 28 mm and is 1.5 mm thick.
Sample 295 = translucent blue glass.
Sample 296 = red swirl within blue glass.

3
Location: Mus.Civ. Rovigo
Site: Frattesina - surface find
Dating: 1200-850 B.C.
Invent.: none
Descriprion: fragment of crucible with translucent blue glass adhering to the inner surface. The crucible fabric has been overheated on the outside and begun to melt, and has two distinct zones: a dark reddish brown exterior and a yellowish, reduced interior.
Dimensions: The crucible fragment is 30 mm wide and 50 mm long and up to 15 mm thick. The glass is an irregular spread up to 1 mm thick.
Sample 294

4
Location: M.A.N. Adria
Site: Frattesina - surface find
Dating: 1200-850 B.C.
Invent.: IG 32893
Description: fragment of a disk ingot of dark blue opaque glass. Fragment includes a rounded edge and is twisted from being manipulated whilst hot and plastic. Upper surface has the indications of trails of hot glass which have incompletely fused with the main body of glass. These trails are from either the drawing off of glass from the ingot, or the formation of the disk. Matrix is heavily seeded.
Dimensions: Width 58 mm, length 75 mm, thickness up to 16 mm.
De Min 1986, p. 126 and 138.
Sample 222

5
Location: M.A.N. Adria
Site: Frattesina - surface find
Dating: 1200-850 B.C.
Invent.: IG 80883
Description: fragment of a disk ingot of dark blue opaque glass with large area of red coloured surface. Fragment includes a rounded edge and is twisted from being manipulated whilst hot and plastic. The red surface is on the underside, and is probably due to the localised reduction of the copper content, which otherwise colours the glass blue. Possibly from the annealing of the disk in hot ashes.
Dimensions: Width 43 mm, length 58 mm, thickness up to 11 mm.
De Min 1986, p. 126 and 138.
Sample 223

6
Location: M.A.N. Adria
Site: Frattesina - surface find
Dating: 1200-850 B.C.
Invent.: IG 80883
Description: Irregular fragment of a disk ingot of dark blue opaque glass. Twisted, and showing signs of having been pinched by a tool whilst hot and plastic. Matrix is heavily seeded.
Dimensions: Width 44 mm, length 65 mm, thickness up to 13 mm.
De Min 1986, p. 126 and 138.
Sample 224

7
Location: M.A.N. Adria
Site: Frattesina - surface find
Dating: 1200-850 B.C.
Invent.: IG 80883
Description: irregular fragment of a disk ingot of dark blue translucent glass. Fragment includes a rounded edge and is twisted from being manipulated whilst hot and plastic. Matrix is heavily seeded.
Dimensions: Width 36 mm, length 50 mm, thickness up to 12 mm.
De Min 1986, p. 126 and 138.
Sample 225

8
Location: Mus. Civ. Rovigo
Site: Frattesina - surface find
Dating: 1200-850 B.C.
Invent.: none
Description: fragment of flat disc of blue translucent glass with red patches on the (reduced) surface. Smooth rounded outer edge. Ingot fragment.
Dimensions: Width 29.5 mm, length 44.5. Thickness 10-14.5 mm. Estimated original diameter of disc: 100 mm.
Sample 293.

9
Location: Mus. Civ. Rovigo
Site: Frattesina - surface find
Dating: 1200-850 B.C.
Invent.: 272059
Description: fragment of flat disc of green translucent glass. Heavily seeded. Smooth rounded outer edge. Ingot fragment.
Dimensions: Width 15 mm, length 19 mm.
Sample 300

10
Location: Mus. Civ. Rovigo
Site: Frattesina - surface find
Dating: 1200-850 B.C.
Invent.: IG 17319
Description: irregular fragment of disk of blue translucent glass, covered with a red (reduced) surface. Ingot fragment.
Dimensions: Thickness varies from 6.5 to 11.5 mm. Width 46 mm, length 74 mm.
Sample 292

11
Location: M.A.N. Adria
Site: Frattesina - surface find
Dating: 1200-850 B.C.
Invent.: IG 80883
Description: irregular fragment of working wasre, possibly the edge of a disk ingot, of translucent aqua glass. Upper surface has signs of trails which are not fused fully into the body of the glass after working formation of the piece.
Dimensions: Width 30 mm, length 42 mm.
De Min 1986, p. 126 and 138.
Sample 226

12
Location: M.A.N. Adria
Site: Frattesina - surface find
Dating: 1200-850 B.C.
Invent.: IG 80883
Description: irregular fragment of working waste, possibly the edge of a disk ingot, of opaque blue glass with large area of red coloured surface. The red surface is probably due to the localised reduction of the copper content, which otherwise colours the glass blue.
Dimensions: Width 21 mm, length 30 mm, thickness 12mm.
De Min 1986, p. 126 and 138.
Sample 227

13
Location: M.A.N. Adria
Site: Frattesina - surface find
Dating: 1200-850 B.C.
Invent.: IG 80883
Description: irregular fragment of working waste, possibly the edge of a disk ingot, of opaque blue glass with small area of red coloured surface. The red surface is probably due to the localised reduction of the copper content, which otherwise colours the glass blue. Upper surface very uneven from being manipulated whilst hot and plastic.
Dimensions: Width 27 mm, length 38 mm, thickness up to 4 mm.
De Min 1986, p. 126 and 138.
Sample 228

14
Location: Mus. Civ. Rovigo
Site: Frattesina - surface find
Dating: 1200-850 B.C.
Invent.: 272059
Description: irregular fragment of waste glass - a fused lump including fragments of stratified eye beads (white eyes on green matrix), blue translucent glass and green translucent glass.
Sample 297 = green translucent glass.
Sample 298 = white opaque glass.
Sample 299 = blue translucent glass.

15
Location: Mus. Civ. Rovigo
Site: Frattesina - surface find
Dating: 1200-850 B.C.
Invent.: IG 272059
Description: pinched trail of pale green translucent glass, from the working of hot glass.
Dimensions: Width 6 mm, length 20 mm.
For experimental parallels see Gamm 1990.
Sample 301

16
Location: Mus. Civ. Rovigo
Site: Frattesina - surface find
Dating: 1200-850 B.C.
Invent.: IG 32865
Description: annular bead of blue translucent glass with red patches on the surface. From a group of 240 similar beads.
Dimensions: Width 4 mm, length 2 mm.
De Min 1986, p. 126 and 138.
Sample 290

17
Location: Mus. Civ. Rovigo
Site: Frattesina - surface find
Dating: 1200-850 B.C.
Invent.: IG 32865
Description: Annular bead of blue translucent glass with red patches on the surface. From a group of 240 similar beads.
Dimensions: Width 4 mm, length 2 mm.
De Min 1986, p 126 and 138.
Sample 291

18
Location: M.A.N. Adria
Site: Frattesina - surface find
Dating: 1200-850 B.C.
Invent.: IG 32888/32890
Description: fragment of annular bead from blue translucent glass.
Dimensions: Width approx. 15 mm, length 5 mm.
De Min 1986, p 126 and 138.
Sample 230

19
Location: M.A.N. Adria
Site: Frattesina - surface find
Dating: 1200-850 B.C.
Invent.: IG 32890
Description: fragment of annular bead from blue translucent glass.
Dimensions: Width approx. 16 mm, length 4 mm.
De Min 1986, p 126 and 138.
Sample 231

20
Location: M.A.N. Adria
Site: Frattesina - surface find
Dating: 1200-850 B.C.
Invent.: IG 80881d
Description: fragment of elliptical bead of translucent blue glass. Horizontal striations in otherwise smmoth surface suggest it was formed by winding a glass trail around a rod. Matrix heavily seeded.
Dimensions: Width 14.5 mm, length 17 mm.
De Min 1986, p 126 and 138.
Sample 232

21
Location: M.A.N. Adria
Site: Frattesina - surface find
Dating: 1200-850 B.C.
Invent.: IG 80881c
Description: half an ellipsoidal bead from translucent blue glass decorated with a single band of red opaque glass (<1 mm wide) wound 6 times around the bead.
Dimensions: 10.5 mm wide, 16 mm long.
Salzani 1986, p 109 and 115.
Sample 233

22
Location: M.A.N. Adria
Site: Frattesina - surface find
Dating: 1200-850 B.C.
Invent.: IG 32870
Description: tapered, cylinder shaped bead from opaque blue glass, decorated with a single band of opaque white glass wrapped 12x around the bead. Band dragged into chevrons.
Dimensions: Width 6-9.5 mm, length 25 mm.
De Min 1986, p 126 and 138. Gambacurta 1987, p 199 fig. 9, p 211 fig. 24 and p 212. Type "M": Perle cilindriche con decorazione a piuma d'uccello e a zig-zag incrociato.
Sample 234

23
Location: M.A.N Adria
Site: Necropoli di Fondo Zanotto
Dating: 1100-850 BC
Invent.: IG 80914
Description: core-formed glass vessel, in Alabastron form, from opaque blue glass, with collar below rim. Miniature.
Dimensions: diameter 8-15 mm, height 30 mm.
De Min - Gerhardingher 1986, p156 and 168.
Sample 236

24
Location: Mus. Civ. Rovigo
Site: Frattesina - surface find
Dating: 1200-850 B.C.
Invent.: IG 17319
Description: anthropomorphic figure, head and neck only, formed on a rod from translucent blue glass.
Dimensions: max width 11.5 mm, max length 19 mm.
Verità Biavati 1989.
Sample 289

25
Location: M.A.N. Adria
Site: Frattesina - surface find
Dating: 1200-850 B.C.
Invent.: none
Description: fragment of rod-formed anthropomorphic (?) figure of opaque blue glass, torso only. Glass matrix heavily seeded.
Note with object: "Perla framm Antropomorfa (?). Da Fratta Polesine raccolta di superficie, sequestro carabineri 1995".
Dimensions: Width, 18 mm, length 17.5 mm.
Sample 220

26
Location: M.A.N. Adria
Site: Frattesina - surface find
Dating: 1200-850 B.C.
Invent.: IG 32888/32890
Description: Fragment of annular bead of translucent blue glass.

Dimensions: Width 16 mm. Length 5 mm.
De Min 1986, p 126 and 138.
Sample 229

27
Location: M.A.N. Adria
Site: Necropoli di Fondo Zanotto
Dating: 1100-850 BC
Invent.: IG 80919
Description: annular bead of translucent blue glass. Formed by winding around a rod- not smoothed.
Dimensions: Width 6.5 mm, length 4 mm.
De Min - Gerhardinghier 1986, p156 and 168.
Sample 235

Mariconda di Melara
abitato

28
Location: M.A.N. Adria
Site: Mariconda di Melara
Dating: 1250-950 B.C.
Invent.: IG 147000
Description: ceramic lid to oinochoe jar, with translucent blue glass adhering to upper (slightly concave side. Lid has a lip of additional clay added to retain molten glass one one side (applied before glass). Used as working platform in beadmaking. Also see sample 201 below.
Dimensions: 130 mm in diameter, and up to 25 mm thick (including ridge to locate in top of oinochoe jar). Glass is an irregular spread 95 x 75 mm, up to 5 mm thick.
Salzani 1986, p. 109 and 115.
Sample 200

29
Location: M.A.N. Adria
Site: Mariconda di Melara
Dating: 1250-950 B.C.
Invent.: IG 147001
Description: twisted ceramic plate, with translucent blue glass on upper surface. Irregular broken edges except for a short (50 mm) curved edge, suggesting the plate was originally circular. Possibly used as a working platform in beadmaking. Also see sample 200 above.
Dimensions: length l00 mm, width 75 mm, thickness 9 mm. Glass is an irregular spread 55 x 45 mm up to 6.5 mm thick.
Salzani 1986, p. 109 and 114.
Sample 201

30
Location: M.A.N Adria
Site: Mariconda di Melara
Dating: 1250-950 B.C.
Invent.: IG 147015
Description: irregular fragment of opaque blue glass broken from a much larger piece ("raw glass"). None of the edges deformed by heat.
Dimensions: 19 x 23.5 x 15 mm.
Salzani 1986, p. 109 and 115.
Sample 208

31
Location: M.A.N. Adria
Site: Mariconda di Melara
Dating: 1250-950 B.C.
Invent.: IG 147014
Description: irregular fragment of opaque blue glass. Rounded heat-deformed edges, heavily weathered with iridescent surface. Possible working waste.
Dimensions: 16 mm x 10 mm x 10 mm.
Salzani 1986, p. 109 and 115.
Sample 203

32
Location: M.A.N Adria
Site: Mariconda di Melara
Dating: 1250-950 B.C.
Invent.: IG 147017
Description: irregular fragment of translucent blue glass. Working waste. Appears "black", but actually intensely coloured blue.
Dimensions: Length 19 mm, width 8.5 mm.
Sample 209

33
Location: M.A.N. Adria
Site: Mariconda di Melara
Dating: 1250-950 B.C.
Invent.: IG 147018
Description: irregular fragment of translucent blue glass. Working waste. Appears "black", but actually intensely coloured blue. Matrix heavily seeded.
Dimensions: Width 8.5 mm, length 10 mm.
Salzani 1986, p. 109 and 115.
Sample 211

34
Location: M.A.N. Adria
Site: Mariconda di Melara
Dating: 1250-950 B.C.
Invent.: IG 147011
Description: incomplete annular bead of translucent blue glass. Possibly a waster- the bead is twisted which must have taken place whilst hot and plastic.
Dimensions: Width 4 mm, length 2.5 mm.
Salzani 1986, p. 109 and 115.
Sample 202

35
Location: M.A.N. Adria
Site: Mariconda di Melara

Dating: 1250-950 B.C.
Invent.: IG 147016
Description: irregular fragment of glassy material, consisting of three layers: blue glass (sample 204), white opaque glassy material (sample 205), grey opaque crystalline material (sample 206). Possibly a fragment of faience.
Dimensions: Length 15 mm, width 7 mm, thickness 7mm.
Sample 204-206

36
Location: M.A.N. Adria
Site: Mariconda di Melara
Dating: 1250-950 B.C.
Invent.: IG 147013
Description: Annular bead of translucent blue glass. Clearly made by trailing glass around a rod. Not marvered or smoothed by heating.
Dimensions: Width, 5.5 mm, length, 2 mm.
SALZANI 1986, p. 109 and 115.
Sample 217

37
Location: M.A.N. Adria
Site: Mariconda di Melara
Dating: 1250-950 B.C.
Invent.: IG 147009
Description: wound annular bead from blue translucent glass.
Dimensions: Width 10 mm, length 2 mm.
SALZANI 1986, p. 109 and 115.
Sample 218

38
Location: M.A.N. Adria
Site: Mariconda di Melara
Dating: 1250-950 B.C.
Invent.: IG 147010
Description: annular bead of dark blue opaque glass. Smooth finished surface.
Dimensions: Width 6.5 mm, length 3.5 mm.
SALZANI 1986, p. 109 and 115.
Sample 219

39
Location: M.A.N. Adria
Site: Mariconda di Melara
Dating: 1250-950 B.C.
Invent.: IG 147007
Description: fragment of annular bead of translucent blue glass.
Dimensions: Width 12 mm, length 4 mm.
SALZANI 1986, p. 109 and 115.
Sample 207

40.
Location: M.A.N. Adria
Site: Mariconda di Melara
Dating: 1250-950 B.C.
Invent.: IG 147002
Description: half of a globular bead from opaque blue glass. Wound bead? - horizontal striations, matrix heavily seeded.
Dimensions: Width 15 mm, length 15.5 mm.
Sample 210

41
Location: M.A.N. Adria
Site: Mariconda di Melara
Dating: 1250-950 B.C.
Invent.: IG 147005
Description: half a barrel shaped bead of translucent blue glass decorated with 4 horizontal bands of opaque white glass.
Dimensions: Width 8 mm, length 11 mm.
SALZANI 1986, p. 109 and 115.
Sample 212

42
Location: M.A.N. Adria
Site: Mariconda di Melara
Dating: 1250-950 B.C.
Invent.: IG 147006
Description: half a barrel shaped bead of translucent blue glass decorated with a band of opaque white glass wrapped around the bead.
Dimensions: Width 8 mm, length 11 mm.
SALZANI 1986, p. 109 and 115.
Sample 213

43
Location: M.A.N. Adria
Site: Mariconda di Melara
Dating: 1250-950 B.C.
Invent.: IG 147004
Description: Barrel shaped bead of translucent blue glass decorated with a single trail of opaque white glass wrapped 4 x @ the bead. Asymmetrical pinched and deformed whilst hot and plastic- possible waster.
Dimensions: Width 9 mm, length 12 mm.
SALZANI 1986, p. 109 and 115.
Sample 214

44
Location: M.A.N. Adria
Site: Mariconda di Melara
Dating: 1250-950 B.C.
Invent.: IG 147009
Description: barrel shaped bead of translucent blue glass decorated with a single trail of opaque white glass wrapped 5 x @ the bead.
Dimensions: Width 6.5 mm, length 11 mm.
SALZANI 1986, p. 109 and 115.
Sample 215

45
Location: M.A.N. Adria
Site: Mariconda di Malera
Dating: 1250-950 B.C.
Invent.: IG 147008
Description: half a globular bead of translucent blue glass decorated with a single trail of white opaque glass wrapped 3 x @ the bead.
Dimensions: Width 8.5 mm, length 8 mm.
SALZANI 1986, p 109 and 115.
Sample 216

Adria
Necropoli del Canal Bianco

46
Location: M.A.N. Adria
Site: Canal Bianco, tomb 36
Dating: 225-175 BC
Invent.: IG 469
Description: Tapered cylinder bead of "black" glass decorated with two horizontal bands of white opaque glass. Matrix heavily seeded.
Dimension: Width 70.5 mm, length 4.5 mm.
Sample 246

47
Location: M.A.N. Adria
Site: Canal Bianco, tomb 363
Dating: 500-300 BC
Invent.: IG 4919/9168
Description: Barrel shaped bead of brown (weathered) glass decorated with a single band of white opaque glass wrapped 6 x @ the bead and combed into chevrons. A band of red and white opaque glass wrapped around the perforations. All decoration marvered flush.
Dimension: Width 14 mm, length 19.5mm.
Sample: 239

48
Location: M.A.N. Adria
Site: Canal Bianco, tomb 363
Dating: 500-300 BC
Invent.: IG 4919/9168
Description: Barrel shaped bead of brown (weathered) glass decorated with a single band of white opaque glass wrapped 6 x @ the bead and combed into chevrons. A band of red and white opaque glass wrapped around the perforations. All decoration marvered flush.
Dimension: Width 14.5 mm, length 17.5mm.
Sample 240

49
Location: M.A.N. Adria
Site: Canal Bianco, tomb 25
Dating: 300-250 BC
Invent.: IG 9169
Description: Globular bead of blue translucent glass decorated with 8 stratified eyes (white opaque around blue around white opaque around blue). Eyes are inserted canes.
Dimension: Width 13.5 mm, length 12 mm.
Sample 241

50
Location: M.A.N. Adria
Site: Canal Bianco, tomb 25
Dating: 300-250 BC
Invent.: IG 9169
Description: Globular bead of blue translucent glass decorated with 7 stratified eyes (white opaque around blue around white opaque around blue). Eyes are inserted canes.
Dimension: Width 13.5 mm, length 9.5 mm.
Sample 242

51
Location: M.A.N. Adria
Site: Canal Bianco, tomb 391
Dating: 300 BC
Invent.: none
Description: Annular bead of translucent blue glass decorated with six stratified eyes (opaque white around blue translucent glass).
Dimension: Width 11.5 mm, length 7 mm.
Sample 257

52
Location: M.A.N. Adria
Site: Canal Bianco, tomb 391
Invent.: none
Description: Anthropomorphic pendant of clear glass (slight yellowish tinge).
Dimension: Width 5.5 – 12.5 mm, length 17 mm. Also see sample 237.
Sample 258

53
Location: M.A.N. Adria
Site: Canal Bianco, tomb 240
Dating: 500-300 BC
Invent.: K037
Description: Fragment of a globular bead of blue translucent glass decorated with two stratified eyes constructed from white opaque and blue translucent glass.
Dimension: Width 22 mm, length 20.5 mm.
Sample 263

54
Location: M.A.N. Adria
Site: Canal Bianco, tomb 333
Dating: 500 BC
Invent.: none

Description: Globular bead of dark opaque glass, decorated with 3 compound eyes and 9 opaque yellow horns. The compound eyes are made up of white opaque glass around a dark opaque matrix into which are set two types of eye decoration: a single yellow opaque glass around translucent blue eye surrounded by 6 white opaque around translucent blue eyes.
Dimension: Width 14.5 mm, length 13.5 mm.
Also see GAMBACURTA 1987, Type "G", Perle ad occhi compositi, p. 212, p. 207, fig. 21.
Sample 302-304.

55
Location: M.A.N. Adria
Site: Canal Bianco, tomb 27
Dating: 225-200 BC
Invent.: IG 358
Description: Annular bead of pale green translucent glass.
Dimension: Width 30.5 mm, length 10.5 mm.
Sample 244

56
Location: M.A.N. Adria
Site: Canal Bianco, tomb 157
Dating: 250-200 BC
Invent.: IG 2019
Description: Rod-formed spindle whorl of pale green opaque glass decorated with: yellow opaque glass horns around the base, yellow opaque glass trail around the body, yellow opaque glass zig-zag decoration around the head on the base. Cold worked around the perforations.
Dimension: Width at base 28 mm, length 26 mm.
Also see FOGOLARI and SCARFI 1970, p. 76,77 and plate 49.
Sample 247 = yellow opaque decoration. Sample 248 = matrix.
Sample 247 and 248

57
Location: M.A.N. Adria
Site: Canal Bianco Necropoli
Invent.: none
Description: Annular bead of blue translucent glass decorated with 3 stratified eyes (white opaque @ blue translucent), 6 horns of white opaque glass and 6 horns of yellow opaque glass.
Dimension: Width 13 mm, length 9 mm.
Sample 254, 255 and 265 - Sample 254 = sample of blue matrix, sample 255 = opaque yellow decoration, sample 256 = white opaque decoration.

58
Location: M.A.N. Adria
Site: Canal Bianco Necropoli
Invent.: IG 9170
Description: Globular bead of clear glass.
Dimension: Width 20 mm, length 14 mm.
Sample 243

59
Location: M.A.N. Adria
Site: Canal Bianco Necropoli
Invent.: 9113
Description: Rod-formed spindle whorl of clear glass decorated around the waist with 7 bosses of translucent aqua glass.
Dimension: Width at base of 28 mm, length 22 mm.
Sample 249-250 - Sample 249 = aqua glass decoration. Sample 250 = matrix.

Adria
Necropoli di Ca' Garzoni

60
Location: M.A.N. Adria
Site: Ca' Garzoni 1966, tomb 47
Dating: 200-100 BC
Invent.: IG 11.305
Description: Cylinder shaped bead of white opaque glass with moulded or drawn surface to give a decoration of 15 "knops" arranged alternately singly and in vertical pairs. Gives a granulated appearance.
Dimension: Width 6 mm, length 6 mm.
Also see Beck1926, p26-27.
Sample 272

61
Location: M.A.N. Adria
Site: Ca' Garzoni 1966, tomb 47
Dating: 200-100 BC
Invent.: IG 11.305
Description: Cylinder shaped bead of white opaque glass with moulded or drawn surface to give a decoration of 15 "knops" arranged alternately singly and in vertical pairs. Gives a granulated appearance.
Dimension: Width 6 mm, length 6 mm.
Sample 273

62
Location: M.A.N. Adria
Site: Ca' Garzoni 1966, tomb 47
Dating: 200-100 BC
Invent.: IG 11.305
Description: Cylinder shaped bead of white opaque glass with moulded or drawn surface to give a decoration of 15 "knops" arranged alternately singly and in vertical pairs. Gives a granulated appearance.
Dimension: Width 5 mm, length 6 mm.
Sample 274

63
Location: M.A.N. Adria

Site: Ca' Garzoni 1966, tomb 47
Dating: 200-100 BC
Invent.: IG 11.305
Description: Cylinder shaped bead of white opaque glass with moulded or drawn surface to give a decoration of 18 "knops" arranged alternately singly and in vertical pairs. Gives a granulated appearance.
Dimension: Width 7 mm, length 6 mm.
Sample 275

64
Location: M.A.N. Adria
Site: Ca' Garzoni 1966, tomb 29
Dating: 200-100 BC
Invent.: IG 11.041
Description: Cylinder shaped bead of white opaque glass with moulded or drawn surface to give a decoration of 18 "knops" arranged alternately singly and in vertical pairs. Gives a granulated appearance.
Dimension: Width 6.5 mm, length 6 mm.
Sample 276

65
Location: M.A.N. Adria
Site: Ca' Garzoni 1966, tomb 29
Dating: 200-100 BC
Invent.: IG 11.041
Description: Cylinder shaped bead of white opaque glass with moulded or drawn surface to give a decoration of 15 "knops" arranged alternately singly and in vertical pairs. Gives a granulated appearance.
Dimension: Width 6 mm, length 6 mm.
Sample 277

66
Location: M.A.N. Adria
Site: Ca' Garzoni 1966, tomb 29
Dating: 200-100 BC
Invent.: IG 11.041
Description: Cylinder shaped bead of white opaque glass with moulded or drawn surface to give a decoration of 15 "knops" arranged alternately singly and in vertical pairs. Gives a granulated appearance.
Dimension: Width 6 mm, length 6 mm.
Sample 278

67
Location: M.A.N. Adria
Site: Ca' Garzoni 1966, tomb 29
Dating: 200-100 BC
Invent.: IG 11.041
Description: Cylinder shaped bead of white opaque glass with moulded or drawn surface to give a decoration of 15 "knops" arranged alternately singly and in vertical pairs. Gives a granulated appearance.
Dimension: Width 5.5 mm, length 5.5 mm.
Sample 279

68
Location: M.A.N. Adria
Site: Ca' Garzoni 1966, tomb 29
Dating: 200-100 BC
Invent.: IG 11.041
Description: Cylinder shaped bead of white opaque glass with moulded or drawn surface to give a decoration of 15 "knops" arranged alternately singly and in vertical pairs. Gives a granulated appearance.
Dimension: Width 6 mm, length 6 mm.
Sample 280

69
Location: M.A.N. Adria
Site: Ca' Garzoni 1966, tomb 29
Dating: 200-100 BC
Invent.: IG 11.041
Description: Cylinder shaped bead of white opaque glass with moulded or drawn surface to give a decoration of 15 "knops" arranged alternately singly and in vertical pairs. Gives a granulated appearance.
Dimension: Width 7 mm, length 6 mm.
Sample 281

70
Location: M.A.N. Adria
Site: Ca' Garzoni 1966, tomb 29
Dating: 200-100 BC
Invent.: IG 11.041
Description: Cylinder shaped bead of white opaque glass with moulded or drawn surface to give a decoration of 15 "knops" arranged alternately singly and in vertical pairs. Gives a granulated appearance.
Dimension: Width 6 mm, length 6 mm.
Sample 282

71
Location: M.A.N. Adria
Site: Ca' Garzoni 1966, tomb 29
Dating: 200-100 BC
Invent.: IG 11.041
Description: Cylinder shaped bead of white opaque glass with moulded or drawn surface to give a decoration of 15 "knops" arranged alternately singly and in vertical pairs. Gives a granulated appearance. Indistinct zone on this bead may indicate that it was made using a two-piece mould.
Dimension: Width 6 mm, length 6 mm.
Sample 283

72
Location: M.A.N. Adria
Site: Ca' Garzoni 1966, tomb 29
Dating: 200-100 BC
Invent.: IG 11.041
Description: Cylinder shaped bead of weathered blue opaque glass with moulded or drawn surface to give a decoration of six or more "knops" arranged alternately singly and in

vertical pairs. Gives a granulated appearance.
Dimension: Width 6 mm, length 5.5 mm.
Sample 284

73
Location: M.A.N. Adria
Site: Ca' Garzoni 1966, tomb 29
Dating: 200-100 BC
Invent.: IG 11.042
Description: Cylinder shaped bead of blue opaque glass with moulded or drawn surface to give a decoration of 15 "knops" arranged alternately singly and in vertical pairs. Gives a granulated appearance.
Dimension: Width 6 mm, length 5.5 mm.
Sample 285

74
Location: M.A.N. Adria
Site: Ca' Garzoni 1966, tomb 29
Dating: 200-100 BC
Invent.: IG 11.042
Description: Cylinder shaped bead of blue opaque glass with moulded or drawn surface to give a decoration of 15 "knops" arranged alternately singly and in vertical pairs. Gives a granulated appearance.
Dimension: Width 7 mm, length 6 mm.
Sample 286

75
Location: M.A.N. Adria
Site: Ca' Garzoni 1966, tomb 29
Dating: 200-100 BC
Invent.: IG 11.042
Description: Cylinder shaped bead of blue opaque glass with moulded or drawn surface to give a decoration of 15 "knops" arranged alternately singly and in vertical pairs. Gives a granulated appearance.
Dimension: Width 7 mm, length 6 mm.
Sample 287

76
Location: M.A.N. Adria
Site: Ca' Garzoni 1966, tomb 29
Dating: 200-100 BC
Invent.: IG 11.043
Description: Cylinder shaped bead of green opaque glass with moulded or drawn surface to give a decoration of 15 "knops" arranged alternately singly and in vertical pairs. Gives a granulated appearance.
Dimension: Width 7 mm, length 6 mm.
Sample 288

Adria
Necropoli di Ca' Cima, scavi 1995

77
Location: M.A.N. Adria
Site: Ca' Cima, tomb 13/95
Dating: 510-490 BC
Invent.: IG 9577
Description: Annular bead of blue translucent glass, heavily pitted weathering on the surface. Decoration has weathered away leaving behind a depression in the surface: a zig-zag horizontal band and a single eye.
Dimension: Width 13.5 mm, length 10 mm
Sample 268

78
Location: M.A.N. Adria
Site: Ca' Cima, tomb 13/95
Dating: 510-490 BC
Invent.: IG 9578
Description: Rod –formed animal head pendant (goat's head) of opaque white glass decorated with eyes of opaque yellow around green glass and nostrils and mouth of green translucent glass.
Dimension: Width 16.5 mm, length 31 mm, height 17 mm. Also see STERN and SCHLICK-NOLTE, 1994, p. 190-191 and references. Also see Tatton-Brown in Lerje book.
Sample 267

79
Location: M.A.N. Adria
Site: Ca' Cima, tomb 12/95
Dating: 500-470 BC
Invent.: 9599
Description: Annular bead of white opaque glass decorated with a zig-zag horizontal band of bark brown translucent glass.
Dimension: Width 13 mm, length 9 mm.
Sample 269

80
Location: M.A.N. Adria
Site: Ca' Cima, tomb 16/93
Dating: 500-480 BC
Invent.: IG 9387
Description: Annular bead of badly weathered green glass decorated with 4 stratified eyes which have eroded away leaving the matrix behind.
Dimension: Width 18.5 mm length 10 mm.
Sample 266

81
Location: M.A.N. Adria
Site: Ca' Cima, tomb 16/93
Dating: 500-480 BC
Invent.: IG 9388
Description: Globular bead of heavily weathered green translucent glass decorated with three stratified eyes : white opaque around green translucent.
Dimension: Width 10 mm, length 8 mm.
Sample 264

82
Location: M.A.N. Adria
Site: Ca' Cima, tomb 16/93
Dating: 500-480 BC
Invent.: IG 9386
Description: Annular bead of blue opaque glass decorated with three stratified eyes: turquoise opaque around blue opaque and one unstratified eye of turquoise opaque glass. All decoration marvered flush with the surface of the bead.
Dimension: Width 12 mm, length 11.5 mm.
Sample 265

Adria

83
Location: M.A.N. Adria
Site: unknown
Invent.: none
Description: Globular bead of yellow opaque glass. Squeezed into two lobes.
Dimension: Width 13 mm and 8 mm, length 9 mm.
Sample 262

84
Location: M.A.N. Adria
Site: unknown
Invent.: 21971
Description: Globular bead of opaque blue glass decorated with 8 stratified eyes (white opaque around blue translucent around white opaque around blue translucent). Matrix heavily pitted.
Dimension: Width 17.5 mm, length 16 mm.
Sample 251

85
Location: M.A.N. Adria
Site: unknown
Invent.: IG 22034
Description: Fragment of globular bead of yellow opaque glass decorated with two stratified eyes: white opaque around blue opaque around white opaque around blue opaque.
Dimension: Width 24 mm, length 25 mm.
Sample 259

86
Location: M.A.N. Adria
Site: Pavanello
Invent.: K013
Description: Fragment of cylinder (?) bead of opaque turquoise glass decorated with 6 stratified eyes: white opaque around blue opaque around white opaque around blue opaque. Deformed whilst hot and plastic- two of the eyes merge and a deep incision dragged through both the decoration and the matrix. The eyes not marvered flush with the matrix. Possible waster.
Dimension: Width 13 mm, length 12 mm.
Sample 260

87
Location: M.A.N. Adria
Site: unknown
Invent.: K043
Description: Globular bead of translucent blue glass decorated with seven stratified eyes: white opaque glass around dark brown translucent glass around white opaque glass around blue translucent glass.
Dimension: Width 27 mm, length 23 mm.
Sample 307 (brown, white and blue) - Analysed as "307(brown)", "307(white)" and "307(blue)".

88
Location: M.A.N. Adria
Site: unknown
Dating: 600-400 BC
Invent.: 9114
Description: Annular bead of blue opaque glass decorated with 8 stratified eyes arranged in vertical pairs (white opaque around blue translucent and white opaque around blue translucent around white opaque around blue translucent).
Dimension: Width 10 mm, length 5.5 mm.
Sample 252

89
Location: M.A.N. Adria
Site: unknown
Dating: 600-400 BC
Invent.: 9114
Description: Globular bead of opaque blue glass decorated with seven stratified eyes (opaque white around blue translucent around opaque white around blue translucent around opaque white around blue translucent).
Dimension: Width 10 mm, length 7 mm.
Sample 253

90
Location: M.A.N. Adria
Site: unknown
Invent.: none
Description: Fragmentary annular bead of heavily weathered brown (?) glass decorated with three stratified eyes (white opaque around brown opaque around turquoise opaque, and three unstratified eyes of white opaque or turquoise opaque glass. None of the decoration has been marvered flush with the surface of the glass.
Dimension: Width 16 mm, length 11 mm.
Sample 261

91
Location: M.A.N. Adria
Site: unknown
Invent.: none

Description: Globular bead of blue opaque glass decorated with four compound eyes of blue and white opaque glass.
Dimension: Width 21.5 mm, length 23 mm.
Sample 305

92
Location: M.A.N. Adria
Site: unknown
Invent.: 9202
Description: Dome – shaped pin or brooch head of white opaque glass formed on an iron rod- the remains of which can be seen embedded in the base. The glass has been grozed around the rod to finish it. Decorated with nine horns of blue translucent glass.
Dimension: Width 13.5 mm, length 9.5 mm.
Sample 270 and Sample 271 - Sample 270 = white opaque glass matrix, sample 271 = blue translucent glass decoration.

93
Location: M.A.N. Adria
Site: unknown
Invent.: Bocchi collection 2907
Description: Incomplete annular bead of amber coloured translucent glass decorated with alternate bands of yellow opaque and white opaque glass.
Dimension: Width 28 mm, length 12 mm.
Also see GAMBACURTA 1987, Type "I", p. 198- 200, p. 210, fig. 22, p. 212.
Sample 245

94
Location: M.A.N. Adria
Site: unknown
Dating: 400-200 BC
Invent.: IG 9167
Description: Anthropomorphic pendant of clear glass (slight yellowish tinge).
Dimension: Width 4 – 11.5 mm, length 20 mm.
Sample 237
Also see sample 258.

95
Location: M.A.N. Adria
Site: unknown
Invent.: IG 21970
Description: Cylinder bead of white opaque glass decorated with virtical stripes of red opaque glass.
Dimension: Width 6.5 mm, length 18.5 mm.
Sample 238

96
Location: M.A.N. Adria
Site: unknown
Invent.: K041
Description:Annular bead of blue opaque glass decorated with four swirled eyes of white opaque glass trailed onto and marvered into the surface of the bead.
Dimension: Width 29 mm, length 19 mm.
Sample: 306

97
Location: Liverpool
Site: unknown
Invent.: 10159M
Dating: 650-550 BC
Description: Core formed glass vessel of blue opaque glass. Oinochoe form decorated with "scales" ("stachelflaschen"). Heavily restored and gap-filled.
Dimensions: 85 mm high, base diameter 22 mm, body max diameter 38 mm.
HAEVERNICK 1959, 1961, HARDEN 1968, MARTELLI 1994 and GIUNTOLI 1996.
Sample: 10

98
Location: Lincoln
Site: Chiusi
Invent.: M1926.657
Dating: 650-550 BC
Description: Core formed glass vessel of blue opaque glass. Oinochoe form decorated with "scales" ("stachelflaschen"). Sample 11 from a decorative scale on the body, sample 12 from the base.
Dimensions: 67 mm high, base diameter 23 mm, body max diameter 32 mm.
HAEVERNICK 1959, 1961, HARDEN 1968, MARTELLI 1994 and GIUNTOLI 1996.
Samples 11 and 12.

sample	200	201	202	203	204	205	206	207	208	209	210	211	212
Na2O	5,5	5,11	5,88	6,26	5,56	0,68	5,8	5,77	6,21	4,79	5,53	6,29	5,57
MgO	0,73	0,95	0,55	0,83	1,76	0,49	0,65	0,79	0,91	1,04	0,73	0,65	0,83
Al2O3	1,86	2,475	3,58	2,35	4,26	1,44	1,85	2,19	1,99	2,77	1,84	2,07	3,89
SiO2	80,33	80,07	81,88	74,94	74,59	94,72	85,14	80,94	79,47	74,7	74,62	79,97	73,87
P2O5	0,2	0,195	0,12	0,19	0,17	0,1	0,17	0,15	0,2	0,19	0,17	0,17	0,15
SO3	0	0,015	0,03	0	0,03	0	0,03	0,03	0,03	0	0,03	0	0,33
Cl	0,04	0,03	0,06	0,11	0,06	0,09	0,06	0,07	0,05	0,04	0,05	0,05	0,21
K2O	10,92	10,535	9,17	9,48	7,34	1,34	6,99	9,58	9,19	10,53	10,75	9,82	8,57
CaO	1,94	3,025	1,78	2,18	1,68	1,15	1,66	2,09	2,42	3,19	1,9	1,8	2,42
TiO2	0,06	0,08	0,04	0,07	0,13	0,04	0,06	0,07	0,06	0,09	0,06	0,06	0,07
Cr2O3	0	0,03	0	0	0,02	0,02	0,03	0,02	0	0	0,02	0,02	0,02
MnO	0,03	0,025	0,01	0,04	0,1	0,01	0,03	0,04	0,03	0,03	0,01	0,04	0,01
FeO	0,49	0,9	0,79	1,01	1,3	0,47	0,56	0,88	0,63	0,98	0,48	0,67	0,9
CoO	0	0,125	0,09	0,23	0	0	0	0,19	0,02	0,09	0	0	0
NiO	0,03	0,15	0,01	0,56	0,01	0	0	0,39	0,01	0,21	0,02	0,03	0,03
CuO	2,3	0,42	0,13	0,76	0,08	0,09	1,04	0,74	3,33	0,32	2,26	3,06	3,2
ZnO	0	0,025	0	0	0	0	0	0,02	0	0	0	0	0,05
As2O5	0	0,035	0	0,15	0	0	0	0,18	0	0,02	0	0	0
SnO2	0	0	0	0,03	0	0,01	0,01	0	0,27	0,01	0,01	0	0
Sb2O5	0,02	0,02	0	0,15	0	0,02	0	0,11	0	0,02	0	0,08	0,06
BaO	0,05	0,04	0,01	0,01	0,04	0,02	0,05	0,05	0,04	0,04	0,02	0,05	0,02
PbO2	0	0,01	0,01	0,01	0	0	0,04	0,01	0,03	0,06	0	0,01	0,03
Total	104,5	104,265	104,14	• 99,36	97,13	100,69	104,17	104,31	104,89	99,12	98,5	104,84	100,23
site	Mariconda	Mariconda	Mariconda	Mariconda	Mariconda	Mariconda	Mariconda	Mariconda	Mariconda	Mariconda	Mariconda	Mariconda	Mariconda
n.cat.	28	29	34	31	35	35	35	39	30	32	40	33	41
colour	blue trans.	blue trans.	blue trans.	blue trans.	blue trans.	white op.	white op.	blue trans.	blue op.	blue trans.	blue op.	blue op.	blue trans.

sample	*213*	*214*	*215*	*216*	*217*	*218*	*219*	*220*	*222*	*223*	*224*	*225*	*226*
Na2O	6,29	6,46	6,25	5,83	6,63	6,42	6,25	4,245	6,54	4,73	5,51	7,13	8,83
MgO	0,52	0,9	0,46	1	0,92	0,86	0,48	0,745	0,66	0,94	1,07	0,59	0,84
Al2O3	2,41	2,94	3,49	2,94	2,03	2	3,59	3,66	4,19	5,22	7,19	1,41	1,88
SiO2	79,97	78,5	75,37	78,42	73,52	70,91	76,8	69,91	74,48	65,25	62,12	74,2	74,05
P2O5	0,12	0,22	0,1	0,25	0,17	0,24	0,1	0,14	0,15	0,14	0,22	0,05	0,15
SO3	0,03	0,03	0,03	0,03	0,03	0,03	0,03	0,045	0,27	1,67	4,33	0,03	0,03
Cl	0,07	0,07	0,1	0,09	0,06	0,07	0,16	0,03	0,06	0,15	0,01	0,1	0,2
K2O	12,03	10,86	9,87	10,07	8,58	8,11	8,19	11,505	7,29	8,76	6,62	8,78	6,78
CaO	1,51	2,29	1,7	2,79	2,29	2,21	1,74	1,925	1,41	2,05	2,66	1,02	1,96
TiO2	0,06	0,07	0,06	0,07	0,07	0,04	0,06	0,06	0,06	0,07	0,09	0,06	0,06
Cr2O3	0	0,02	0	0	0	0	0,12	0,015	0,05	0,03	0,03	0	0
MnO	0,01	0,03	0,05	0,03	0,01	0,16	0	0,01	0	0,04	0,01	0,01	0,01
FeO	0,66	1,02	0,69	1,12	0,68	0,51	0,93	0,65	0,61	0,66	0,83	0,55	0,69
CoO	0,12	0,34	0,25	0,15	0	0,09	0,36	0,01	0,08	0	0,02	0,02	0
NiO	0,28	0,17	0,12	0,32	0,03	0	0,42	0,01	0,32	0	0,04	0	0,02
CuO	0,4	0,45	0,23	0,92	3,16	3,29	0,29	3,57	0,29	5,08	5,46	4,25	0,14
ZnO	0,05	0	0,06	0	0,05	0	0	0	0	0	0	0	0
As2O5	0,07	0,03	0	0,17	0	0	0,04	0	0,13	0	0	0	0
SnO2	0	0	0	0	0,27	0,2	0	0,2	0	0,32	0,47	0,38	0,01
Sb2O5	0,04	0,02	0	0,34	0,02	0,02	0,02	0	0,06	0	0	0,04	0
BaO	0,02	0,04	0,01	0,05	0,02	0,01	0,05	0,05	0,04	0,05	0,06	0,04	0,05
PbO2	0	0	0,01	0,03	0,06	0	0,01	0,035	0,01	0,01	0,07	0	0,01
Total	104,66	104,46	98,85	104,62	98,6	95,17	99,64	96,815	96,7	95,17	96,81	98,66	95,71
site	Mariconda	Mariconda	Mariconda	Mariconda	Mariconda	Mariconda	Mariconda	Fratte.	Fratte.	Fratte.	Fratte.	Fratte.	Fratte.
n.cat.	42	43	44	45	36	37	38	25	4	5	6	7	11
colour	blue trans.	blue trans.	blue trans.	blue trans.	blue trans.	blue trans.	blue op.	blue op.	blue op.	blue op.	blue op.	blue trans.	aqua

sample	227	228	230	233	234	235	236	237	238	239	240	241	242
Na2O	5,4	6,52	4,075	6,535	7,46	0,96	1,3	18,73	10,095	14,15	14,18	17,58	17,36
MgO	0,56	0,65	0,66	0,75	0,8	0,61	0,83	0,455	1,795	0,76	1	0,72	0,68
Al2O3	1,03	1,61	2,405	2,5	4,57	2,84	2,105	3,13	1,865	2,25	2,28	2,17	2,14
SiO2	75,33	74,58	73,655	73,17	69,87	67,96	71,965	65,915	61,87	61,97	64,51	66,76	67,67
P2O5	0,12	0,15	0,19	0,11	0,07	0,21	0,25	0,05	0,75	0,12	0,14	0,05	0
SO3	0,09	0,06	0,015	0,03	0	0,03	0,06	0,375	0,295	0,21	0,18	0,3	0,36
Cl	0,04	0,34	0,03	0,07	0,11	0,01	0,01	1,195	1,33	0,85	1	0,98	1,04
K2O	10,01	10,03	12,8	9,955	8,54	16,53	17,3	0,82	4,875	0,73	0,88	0,63	0,66
CaO	1,35	1,68	1,79	1,605	1,26	2,05	3,34	7,135	11,97	8,31	9,27	7,3	7,27
TiO2	0,04	0,04	0,04	0,07	0,07	0,06	0,13	0,03	0,065	0,05	0,04	0,06	0,02
Cr2O3	0,02	0	0,02	0,01	0	0	0,01	0,01	0,01	0,02	0	0	0,02
MnO	0,03	0,01	0,04	0,005	0,03	0,05	0,05	0,035	0,235	0,83	3,72	1,49	1,56
FeO	0,31	0,43	0,505	0,575	0,7	0,43	0,605	0,36	0,595	8,63	1,23	0,77	0,79
CoO	0,02	0,02	0	0,025	0,06	0,02	0,01	0,045	0,02	0,03	0,02	0,06	0,11
NiO	0,01	0,01	0,01	0,02	0	0	0,015	0,01	0,015	0	0,01	0	0,02
CuO	5,86	4,03	2,46	3,665	3,88	5,39	3,585	0,02	0,01	0,06	0,05	0,1	0,17
ZnO	0	0	0,02	0	0	0	0,015	0	0,03	0,02	0,02	0	0,02
As2O5	0	0	0	0	0	0	0	0	0,065	0	0	0	0
SnO2	0,57	0,42	0,005	0,08	0,28	0	0,205	0,035	0,03	0,05	0,03	0,03	0
Sb2O5	0	0	0,03	0,01	0		0,01	2,685	5,22	0,11	0,02	0,06	0,02
BaO	0,04	0,02	0,04	0,045	0,06		0,05	0,04	0,035	0,05	0,05	0,06	0,06
PbO2	0	0,03	0,025	0,02	0,01		0,03	0,035	0,115	1,11	0,89	0,08	0,09
Total	100,83	100,63	98,815	• 99,25	97,77	97,5	101,875	101,11	101,29	100,31	99,52	99,2	100,06
site	Fratte.	Fratte.	Fratte.	Fratte.	Fratte.	Fratte.	Fratte.	unprovenanced	unprovenanced	Canal Bianco	Canal Bianco	Canal Bianco	Canal Bianco
n.cat.	12	13	18	21	22	27	23	94	95	47	48	49	50
colour	blue op.	blue trans.	blue trans.	blue trans.	blue op.	blue trans.	blue op.	clear	white op.	brown op.	brown op.	blue trans.	blue trans.

sample	243	244	245	246	247	248	249	250	251	252	253	254	255
Na2O	17,67	16,36	18,48	18,09	15,02	16,34	17,07	17,19	15,73	14,64	15,7	16,22	12,96
MgO	0,7	0,88	0,63	0,6	0,48	0,88	0,36	0,41	0,47	0,46	0,39	0,65	0,35
Al2O3	2,32	2,2	2,35	2,35	2,14	2,65	2,61	2,63	1,32	2,12	1,88	1,14	1,91
SiO2	67,93	63,42	67,54	64,16	63,17	66,12	69,13	70,47	69,46	70,21	71,63	73,89	54,52
P2O5	0,05	0,12	0,07	0,07	0,05	0,07	0,05	0,02	0,05	0,05	0,02	0,07	0,02
SO3	0,21	0,27	0,18	0,33	0,24	0,24	0,3	0,27	0,15	0,18	0,24	0,12	0,26
Cl	0,86	0,61	1,36	0,96	1,04	0,91	0,91	0,93	1,4	1,02	0,95	1,35	0,82
K2O	0,78	0,8	0,8	0,94	0,72	0,58	0,95	0,94	0,29	0,7	0,64	0,38	0,6
CaO	9,11	12,08	8,11	6,94	6,9	8,73	5,8	5,87	8,14	7,59	7,02	6,74	5,32
TiO2	0,04	0,04	0,02	0,04	0,04	0,06	0,06	0,04	0,04	0,04	0,06	0,09	0,06
Cr2O3	0	0	0,04	0	0	0,02	0,02	0	0,02	0	0,02	0,03	0
MnO	0	1,25	0,04	3,62	0,61	0,01	0,01	0,03	0,03	0,01	0,04	0,94	0,04
FeO	0,35	0,31	0,29	0,61	0,71	0,66	0,29	0,42	0,8	0,48	0,34	0,72	1,99
CoO	0	0,02	0,02	0	0	0	0	0	0,03	0,05	0,03	0,11	0,04
NiO	0,02	0	0	0,08	0,01	0	0	0,02	0	0	0	0,02	0
CuO	0,04	0,01	0	0,03	0,1	0	1,09	0	1,97	1,01	0,84	0,13	0
ZnO	0,02	0	0	0,02	0,02	0	0	0	0,05	0,05	0	0,11	0,09
As2O5	0	0	0	0	0	0,02	0	0	0	0	0	0	0
SnO2	0,03	0	0,04	0,03	0,01	0,05	0,03	0,01	0,13	0,06	0,05	0	0,01
Sb2O5	1,2	0,41	0,02	0,39	0,71	3,29	0,93	0,84	0,06	0,63	0,06	0	2,55
BaO	0,05	0,06	0,04	0,13	0,06	0,04	0,06	0,05	0,07	0,05	0,04	0,05	0,02
PbO2	0	0,02	0,05	0,25	9,3	0,01	0,47	0,56	0,19	0,23	0	0,01	20,52
Total	101,38	98,86	100,08	* 99,64	101,33	100,68	100,14	100,7	100,4	99,58	99,95	102,77	102,08
site	Canal Bianco	Canal Bianco	unprovenanced	Canal Bianco	Canal Bianco	Canal Bianco	Canal Bianco	Canal Bianco	unprovenanced	unprovenanced	unprovenanced	Canal Bianco	Canal Bianco
n.cat.	58	55	93	46	56	56	59	59	84	88	89	57	57
colour	clear	green trans.	brown trans.	"black"	yellow op.	green op.	aqua	clear	blue op.	blue op.	blue op.	blue trans.	yellow op.

sample	256	257	261	263	264	265	266	267	268	269	270	272	273
Na2O	17,24	15,34	17,1	16,1	14,73	15,59	15,85	18,3	19,37	17,08	16,81	15,37	14,505
MgO	0,39	0,66	0,84	1,14	0,64	0,45	0,68	0,53	0,57	0,42	0,42	0,42	0,385
Al2O3	1,66	2,11	1,15	2,51	0,7	0,65	0,52	1,61	2,27	2,41	2,44	2,49	2,41
SiO2	65,92	67,3	64,9	66,07	66,04	67	64,58	67,51	61,57	66,34	67,32	59,425	66,545
P2O5	0,07	0,02	0,1	0,12	0,05	0,02	0,1	0,05	0,05	0,05	0,02	0,085	0,02
SO3	0,42	0,33	0,18	0,24	0,27	0,15	0,18	0,24	0,54	0,18	0,18	0,71	0,375
Cl	0,97	0,85	1,03	0,95	1,37	1,05	1,18	1,53	1,02	1,45	1,56	0,66	0,785
K2O	0,58	0,91	0,39	0,97	0,06	0,2	0,07	0,35	0,77	0,36	0,36	0,525	0,555
CaO	7,7	8,98	10,61	9,84	10,17	9,26	10,72	8,88	8,56	8,2	8,31	8,23	5,64
TiO2	0,06	0,04	0,04	0,04	0,13	0,07	0,06	0,06	0,06	0,06	0,04	0,05	0,04
Cr2O3	0,02	0,02	0	0	0	0,03	0,02	0,04	0,02	0	0,02	0,01	0
MnO	0,03	0,1	0,01	0,68	0,03	0,03	0,04	0,05	0,08	0,01	0,01	0,275	0,02
FeO	0,75	1,25	7,84	1,17	7,16	0,6	5,73	0,34	1,2	0,34	0,32	0,355	0,325
CoO	0	0,12	0,02	0,16	0	0	0,05	0	0,11	0,03	0,05	0	0,01
NiO	0,03	0	0	0,01	0,01	0	0	0	0	0	0,01	0,02	0,005
CuO	0	0,32	0,01	0,22	0	3,45	0	0	0,26	0,05	0	0,005	0,005
ZnO	0	0	0,02	0,03	0,02	0	0	0,02	0	0,09	0	0	0
As2O5	0,02	0	0	0	0	0,03	0	0,03	0	0,02	0,02	0,14	0,01
SnO2	0,06	0,01	0,03	0,03	0,01	0,05	0,04	0,04	0,06	0	0,01	0,06	0,02
Sb2O5	5,16	0,2	0,18	0,07	0	3,24	0,02	3,73	1,7	3,18	3,75	8,54	3,365
BaO	0,04	0,04	0,01	0,06	0,05	0,05	0,01	0,04	0,06	0,05	0,05	0,055	0,045
PbO2	0,07	1,53	0	0,18	0	0,11	0,09	0,06	1,91	0	0,01	2,39	6,21
Total	101,19	100,13	104,46	100,59	101,44	102,03	99,94	103,41	100,18	100,32	101,71	99,815	101,275
site	Canal Bianco	Canal Bianco	unprovenanced	Canal Bianco	Ca' Cima	Ca' Cima	Ca' Cima	Ca' Cima	Ca' Cima	Ca' Cima	Ca' Cima	Ca' Garzoni	Ca' Garzoni
n.cat.	57	51	90	53	81	82	80	78	77	79	92	60	61
colour	white op.	blue trans.	brown trans.	blue trans.	green trans.	blue op.	"black"	white op.	blue trans.	white op.	white op.	white op.	white op.

sample	*274*	*276*	*277*	*278*	*279*	*280*	*281*	*282*	*283*	*284*	*285*	*286*	*287*
Na2O	13,88	16,63	16,67	16,81	17,46	16,29	13,82	16,42	16,89	14,42	17,94	17,48	17,56
MgO	0,55	0,35	0,38	0,4	0,46	0,38	0,36	0,35	0,35	0,55	0,51	0,55	0,51
Al2O3	2,42	2,37	2,4	2,29	2,47	2,59	2,4	2,36	2,37	2,44	2,4	2,61	2,4
SiO2	67,06	66,29	67,13	66,11	66,19	67,08	63,12	67,55	66,7	67,82	67,01	66,83	66,15
P2O5	0,07	0,05	0,05	0,05	0,05	0,05	0,05	0,07	0,05	0,07	0,07	0,07	0,07
SO3	0,51	0,54	0,48	0,57	0,54	0,45	0,41	0,45	0,48	0,33	0,45	0,39	0,42
Cl	0,94	0,86	0,89	0,84	0,88	0,82	0,59	0,86	0,86	0,95	0,95	0,96	0,91
K2O	0,68	0,67	0,73	0,67	0,61	0,73	0,54	0,69	0,67	0,76	0,8	0,78	0,82
CaO	7,4	5,89	6,01	6,04	7,24	5,97	5,78	5,82	5,99	6,98	6,72	6,76	6,75
TiO2	0,06	0,04	0,06	0,04	0,04	0,06	0,04	0,04	0,04	0,04	0,04	0,04	0,06
Cr2O3	0,02	0	0	0	0	0,02	0	0	0,02	0	0,02	0	0
MnO	0,47	0,59	0,67	0,61	0,25	0,57	0,05	0,57	0,63	1,15	1,11	1,24	1,15
FeO	0,35	0,32	0,38	0,37	0,43	0,37	0,38	0,37	0,38	0,72	0,66	0,78	0,7
CoO	0	0,02	0,03	0,02	0,02	0,03	0	0,03	0	0,09	0,11	0,09	0,09
NiO	0	0	0,01	0	0	0	0	0	0	0,01	0,02	0	0
CuO	0	0,01	0	0,01	0	0	0	0	0,01	0,19	0,14	0,21	0,13
ZnO	0	0	0,03	0	0	0,05	0	0	0	0,02	0	0	0,06
As2O5	0,02	0,04	0,02	0,08	0,02	0,06	0,06	0,04	0,02	0	0	0	0
SnO2	0,01	0,05	0,04	0,04	0,05	0,05	0,03	0,04	0,03	0,01	0,03	0,03	0,01
Sb2O5	3,91	5,53	5,11	5,53	4,61	6,02	6,14	5,46	5,42	2,38	2,05	2,05	2,13
BaO	0,04	0,04	0,05	0,04	0,05	0,04	0,04	0,05	0,04	0,06	0,06	0,06	0,06
PbO2	0,05	0,26	0,19	0,2	0,01	0,23	8,8	0,24	0,26	0,05	0	0,15	0,53
Total	98,44	100,55	101,33	100,72	101,38	101,86	102,61	101,41	101,21	99,04	101,09	101,08	100,51
site	Ca' Garzoni	Ca' Garzoni	Ca' Garzoni	Ca' Garzoni	Ca' Garzoni	Ca' Garzoni	Ca' Garzoni	Ca' Garzoni	Ca' Garzoni	Ca' Garzoni	Ca' Garzoni	Ca' Garzoni	Ca' Garzoni
n.cat.	62	64	65	66	67	68	69	70	71	72	73	74	75
colour	white op.	white op.	white op.	white op.	white op.	white op.	white op.	white op.	white op.	blue op.	blue op.	blue op.	blue op.

sample	288	289	290	291	292	293	294	295	296	298	299	300	301
Na2O	17,32	6,78	4,57	4,73	5,755	3,3	1,76	5,32	4,96	4,735	5,61	5,64	6,29
MgO	0,56	0,76	0,7	0,73	0,675	0,5	0,77	0,65	0,98	0,87	0,63	1,1	1,9
Al2O3	2,28	2,03	2,91	1,17	1,635	1,52	1,5	1,57	3,21	3,82	1,25	2,66	5,41
SiO2	66,22	74,61	66,58	73,93	76,985	78,43	77,47	82,6	79,14	71,925	75,71	74,69	68,97
P2O5	0,02	0,07	0,14	0,15	0,185	0,2	0,14	0,07	0,15	0,18	0,15	0,15	0,24
SO3	0,39	0,03	0,06	0,03	0,03	0,03	0,09	0,03	0,03	0,03	0,03	0	0,03
Cl	1,03	0,05	0,01	0,01	0,05	0,02	0,01	0,06	0,07	0,08	0,02	0,11	0,01
K2O	0,58	8,09	12,47	11,9	9,955	13,27	15,67	8,68	11,36	11,225	11,07	6,24	10,63
CaO	6,27	1,36	3,67	1,79	1,71	1,16	3,15	1,37	1,82	2,18	1,76	3,94	3,56
TiO2	0,04	0,04	0	0,04	0,04	0,04	0,07	0,04	0,09	0,075	0,04	0,07	0,19
Cr2O3	0	0	0,02	0,03	0,015	0	0	0	0	0,01	0	0	0,03
MnO	0,35	0,03	0,04	0,05	0,03	0,01	0,07	0,04	0,03	0,025	0,01	0,01	0,04
FeO	0,49	0,68	0,44	0,47	0,465	0,41	0,61	0,43	0,99	0,875	0,47	0,87	1,98
CoO	0	0,02	0,06	0	0,01	0	0,02	0,02	0,03	0,01	0,02	0	0,03
NiO	0	0	0,04	0,01	0,03	0	0	0	0,01	0,005	0	0	0
CuO	0,91	3,91	4,1	4,07	4,19	4,32	1,18	1,36	1,69	5,015	4,46	3,4	0,05
ZnO	0	0	0	0,02	0,01	0	0,02	0	0	0	0,03	0,03	0,02
As2O5	0	0	0,11	0	0	0	0	0	0	0	0	0	0
SnO2	0,05	0,04	0,24	0,42	0,245	0,46	0,03	0,06	0,11	0,255	0,19	0	0
Sb2O5	0,52	0	0	0,02	0	0	0,02	0,02	0,04	0,03	0	0,09	0
BaO	0,05	0,05	0,06	0,04	0,05	0,05	0,05	0,04	0,04	0,055	0,05	0,06	0,06
PbO2	4,04	0	0	0	0	0,08	0,04	0,01	0,04	0,025	0,03	0,18	0,02
Total	101,12	98,55	96,22	99,61	102,065	103,8	102,67	102,37	104,79	101,425	101,53	99,24	99,46
site	Ca' Garzoni	Fratte.	Fratte.	Fratte.	Fratte.	Fratte.	Fratte.	Fratte.	Fratte	Fratte.	Fratte.	Fratte.	Fratte.
n.cat.	76	24	16	17	10	8	3	2	2	14	14	9	15
colour	green op.	blue trans.	blue op.	red op.	blue trans.	blue trans.	blue trans.	blue trans.	red op.	white op.	blue trans.	green trans.	clear

sample	*302*	*304*	*305*	*307(brown)*	*307(white)*	*307 blue*
Na2O	15,75	17,47	15,96	17,57	12,96	17,44
MgO	0,49	0,48	0,79	0,5	0,38	0,505
Al2O3	3,38	2,51	3,19	1,15	0,9	1,235
SiO2	69,07	69,96	69,46	74,67	75,8	72,015
P2O5	0,05	0,02	0,02	0,02	0,02	0,035
SO3	0,42	0,52	0,345	0,15	0,46	0,09
Cl	0,82	0,57	1,075	1,39	0,86	1,375
K2O	0,61	1,11	0,535	0,3	0,47	0,52
CaO	9,35	7,55	9,03	4,77	6,01	4,815
TiO2	0	0,04	0,065	0,07	0,04	0,07
Cr2O3	0	0	0	0,03	0,02	0,01
MnO	0,03	0,01	0,035	0,94	0,01	1,04
FeO	0,56	0,24	0,415	1,7	0,43	1,72
CoO	0,2	0,02	0,01	0,37	0,02	0,41
NiO	0	0	0,01	0	0,01	0,015
CuO	0,04	1,15	1,325	0,29	0	0,49
ZnO	0	0	0,025	0	0	0
As2O5	0	0	0,025	0	0,08	0
SnO2	0	0,01	0,095	0,03	0,01	0,045
Sb2O5	0,02	0,09	1,085	0,02	3,53	0,03
BaO	0,05	0,05	0,055	0,04	0,02	0,04
PbO2	0,04	0	0,295	0,06	0,27	0,025
Total	100,88	101,8	103,845	104,07	102,3	101,925
site	Canal Bianco	Canal Bianco	unprovenianced	unprovenianced	unprovenianced	unprovenianced
n.cat.	54	54	91	87	87	87
colour	blue op.	blue op.	blue op.	blue op. brown trans.	white op.	blue trans.

APPENDIX 2: Contesti di rinvenimento e tipologia dei materiali

Frattesina (RO)

L'insediamento di Frattesina di Fratta Polesine (provincia di Rovigo), è situato a circa 80 km a SW di Venezia. Tra il XII e il IX sec. a.C., ovvero tra il Bronzo finale e l'inizio dell'età del Ferro, questo abitato sorgeva sulla riva destra del principale ramo padano dell'epoca, il cosiddetto "Po di Adria", e a 40 km dal mare Adriatico. Ad esso sono state riferite le necropoli, quasi esclusivamente a rito crematorio, delle località Fondo Zanotto, circa 600 m a SE, e di Narde, circa 600 m a N.

Con la sua estensione, superiore ai 20 ettari, Frattesina è il più grande di una serie di nuclei insediativi che si susseguono per circa 9 km lungo la sponda meridionale del paleoalveo padano e che si datano prevalentemente al momento di passaggio all'età del Ferro[14].

Per quanto rinvenute su tutta l'area dell'abitato, le principali evidenze delle numerose attività di artigianato specializzato di Frattesina si concentrano nel settore centro – occidentale, ovvero quello maggiormente interessato sia dai lavori di sbancamento che dalle ricerche di scavo e di *survey* archeologico. Da qui provengono indicatori di lavorazione del corno di cervo (molto abbondanti), dell'avorio di elefante (qualche decina di frammenti) e del bronzo (3 ripostigli costituiti da oggetti deteriorati e frammenti di pani a piccone). L'importanza della metallurgia a Frattesina è indicata anche dal numero eccezionale di matrici, una settantina, rinvenute su tutta l'area dell'abitato. La qualità e la quantità di oggetti di prestigio lavorati in loco da materie prime soprattutto esotiche è ben documentata dal cosiddetto "tesoretto", un ripostiglio costituito da fibule in bronzo, pettini in avorio, collane in vetro e ambra ecc. Inoltre sono stati rinvenuti, sia in scavo che nei *surveys*, frammenti di uovo di struzzo e di ceramica di tipo tardo miceneo. Tutto ciò ha permesso di ipotizzare un sistema di scambi su lunga distanza

[14] Per un inquadramento generale di Frattesina e per i risultati preliminari degli scavi condotti nell'abitato si vedano Bietti Sestieri 1981 e 1996 e bibl. rel.; per la necropoli di Fondo Zanotto: De Min 1986; per la necropoli di Narde: Salzani 1990 e 1992; per gli aspetti insediativi e l'evoluzione del popolamento nel territorio di Frattesina: Bellintani 2000 e bibl. rel.

- diretti o mediati - piuttosto articolato e che interessava un'area molto vasta: dall'Europa transalpina, al Mediterraneo orientale, all'Italia centrale tirrenica. Alle attività di produzione e scambio dovrebbero riferirsi anche i vari tipi di pesi in pietra recentemente riconosciuti tra i materiali litici dell'abitato (CARDARELLI *et Alii* 2001).
Per quanto riguarda l'artigianato del vetro, un *survey* condotto nel 1974 ha permesso di individuare tracce di probabili officine associate ad indicatori di attività domestiche, ovvero sembra che le lavorazioni non avvenissero in zone a loro specificamente dedicate e lontane dall'abitato. I principali indicatori di lavorazione a Frattesina sono: crogioli ed altri presumibili strumenti in ceramica ricoperti da vetro (Cfr. catalogo nn.1; 2; 3), blocchetti di vetro prevalentemente blu, azzurro o a superficie rossa, interpretabili come frammenti di pani (nn. 4-10), e vari scarti di lavorazione (nn. 11 - 15). Attualmente Frattesina è il sito che presenta la più cospicua serie di indicatori di lavorazione del vetro nell'Europa centro - occidentale della tarda età del Bronzo. Alcuni blocchetti di vetro da rifondere, scorie e/o scarti di lavorazione sono stati segnalati anche in altri siti del Veneto come Mariconda di Melara (SALZANI 1986 e *infra*), Fondo Paviani (BIANCHIN CITTON 1984, pp. 618-9), Montagnana (DE MIN 1984, p. 645), Caorle (BIANCHIN CITTON 1996, p. 176; 179, n. 27) e dell'Italia centrale (Sorgenti della Nova; NEGRONI CATACCHIO 1984).

P.B.

Mariconda di Melara (RO)

È probabile che anche questo insediamento, posto a circa 35 km ad ovest di Frattesina, fosse in relazione ad un antico corso del Po. I dati archeologici e la relativa documentazione sono per questo sito di gran lunga inferiori a quelli di Frattesina. Un piccolo saggio di scavo condotto nel 1967 ha permesso di verificare una sequenza stratigrafica d'abitato riferibile al Bronzo finale (XII - X sec. a.C. - SALZANI 1986 e bibl. rel). Non compare la fase di passaggio all'età del Ferro.
Sono pochi, in generale, gli indicatori di lavorazioni artigianali individuati tra i materiali di scavo (qualche pezzo di corno di cervo segato); gli oggetti finiti in ceramica, bronzo e ambra rientrano nel tradizionale repertorio dei siti del Bronzo finale dell'Italia nord orientale.
Di particolare interesse sono quelli relativi alla lavorazione del vetro (cat. nn. 28 - 35): blocchetti di vetro frantumati da rifondere, scarti di lavorazione ed alcuni presumibili strumenti in ceramica (SALZANI 1986, tav. 5, n. 15).
Tutti i prodotti in vetro rinvenuti a Mariconda (SALZANI 1986, tav. 5, n. 14) rientrano nel repertorio formale delle manifatture conosciute anche a Frattesina: perline anulari azzurre o blu, perla ad anello blu, perla globulare azzurra, perle a botticella blu con decorazione spiraliforme generalmente bianca (cat. nn. 36-45).

P.B.

Frattesina: cenni sulla tipologia dei materiali vetrosi e sui possibili confronti in ambito europeo: le "perle delle palafitte"

La tipologia dei prodotti rinvenuti nell'abitato e nelle due necropoli di Frattesina è costituita prevalentemente da piccole perle anulari monocrome e un numero più ridotto di perle di forme più complesse e di maggiori dimensioni (catalogo nn. 16-25)[35]. Una disamina dettagliata della tipologia dei materiali vetrosi di questo sito e dei confronti che essi trovano in Italia e nell'Europa transalpina non rientra negli scopi del presente lavoro, per il quale sono stati presi in esame solo alcuni dei tipi qui prodotti[36]. Un esempio indicativo della vasta gamma delle produzioni di Frattesina è fornito dai materiali editi dei corredi funerari delle necropoli di Fondo Zanotto e Narde.
Il gruppo delle perle policrome, di gran lunga inferiore per numero di esemplari rispetto agli anellini blu, azzurri o rossi, è però quello che ci consente qualche considerazione in ordine all'origine di questa moda nel costume di molte popolazioni dell'Europa centro - occidentale tra la fine del II e l'inizio del primo millennio a.C. In particolare ci riferiamo alla diffusione che a partire dalla fase Ha A, ma prevalentemente in Ha, B ebbero due grandi famiglie tipologiche: le perle a botticella con decorazione spiraliforme e le perle ad occhi. Si tratta di tipi che non compaiono in Europa nelle precedenti fasi dell'età del Bronzo, peraltro caratterizzate da una presenza di materiali in vetro piuttosto contenuta, mentre diverso è il caso delle cosiddette "faience"[37].
Le perle a botticella sono note a nord delle Alpi come

[35] Tra le forme che compaiono in pochi esemplari e che non sono state incluse nel presente studio vanno ricordati i 5 frammenti ceramici riferibili a scodelle carenate ricoperti da vetro azzurro a pastiglie bianche, rinvenuti nella necropoli di Narde (SALZANI 1992, fig. 59, nn. 10 – 13) ed un frammento di parete ricoperto da vetro blu a pastiglie bianche rinvenuto in abitato (BIETTI SESTIERI 1997a, fig. 450). In entrambi i casi i materiali sembrano riferibili al passaggio BF - I Fe (fase 3 dell'abitato).

[36] Un'indagine in questo senso più specifica sui materiali di Frattesina presenti nelle collezioni dei Musei di Rovigo, Fratta Polesine e Adria è in corso da parte dello scrivente nel quadro di progetto di ricerca sui più antichi materiali vetrosi dell'Italia del nord (coordinamento: dr. Paolo Bellintani – Ufficio Beni Archeologici di Trento; analisi archeometriche: prof. Gilberto Artioli - Università Statale e C.N.R. di Milano).

[37] A questo proposito si rimanda alle considerazioni ed alla bibliografia indicate da Julian Henderson nella prima parte del presente lavoro ed inoltre a VENCLOVA 1990.

Pfahlbauperlen, termine coniato da Vogt nel 1934 per indicare le perle in vetro presenti negli insediamenti lacustri del tardo Bronzo nord alpino. Tale definizione è stata ripresa e diffusa da Thea Helisabett Haevernick, che per il tipo in esame propose la definizione di *Pfahlbautönnchenperlen mit spirale*. Nel 1978 la studiosa rilevava la presenza di circa 300 esemplari di queste perle in un areale che vede una particolare concentrazione attorno ai laghi svizzeri (in particolare Neuchâtel) e si espande verso l'arco alpino centro - orientale, il bacino del medio Danubio e l'ambito di Lausitz fino al Mecklembourg. Contrariamente all'opinione prevalente (ad esempio: Gessner e Reinecke) ne ipotizzò la manifattura locale sulla base del fatto che le *Pfahlbauperlen* non erano presenti, se non in modo sporadico, nei musei egiziani o in "Oriente" (HAEVERNICK 1951 e 1978)[18]. La scoperta a Frattesina di materiali tipo *Pfahlbauperlen*, ma soprattutto dei relativi indicatori di lavorazione, fu pertanto la prima sostanziale conferma di questa ipotesi.

Considerazioni analoghe valgono anche per il gruppo delle *Pfahlbaunoppenperlen* (perle "a noduli"), che identificherebbe diversi tipi di perle globulari schiacciate con tre o 4 "occhi" costituiti da gocce di vetro sovrapposte, di colore distinto dalla matrice; in taluni casi gli "occhi" sono delle vere e proprie protuberanze. Per queste non viene negato un possibile legame con tipi di perle ad occhi attestati in Egitto e a Creta dal XVI sec. a.C. La distribuzione delle *Pfahlbaunoppenperlen* corrisponde a quella delle perle con decorazione spiraliforme e, in buona sostanza, anche a quella di un terzo gruppo: le piccole perle anulari. Queste, pur non potendo essere considerate come le prime due un "fossile guida", presenterebbero delle caratteristiche di lavorazione (vetro di colore "acquamarina" o "blu" simile a quello delle perle delle palafitte, tecnica ad avvolgimento per singola perla ecc.) che le distinguerebbero abbastanza nettamente da simili prodotti in faience (perle a dischetto) anch'essi circolanti, per quanto in minor numero, nei medesimi contesti (ad esempio il ripostiglio di Allendorf).

Rispetto alle ricerche condotte da Haeverick, si sono ovviamente aggiunte altre nuove segnalazioni (*fig. 7*) che tuttavia non sembrano modificare il quadro in senso spaziale: ad esempio la Francia non sembra essere interessata in modo significativo da questo fenomeno (GRUET *et Alii* 1997). Una sostanziale novità in senso quantitativo è rappresentata dai materiali provenienti dagli scavi della palafitta di Hauterive Champreveyres: circa 180 perle con decorazione spiraliforme, 26 di varie tipologie riferibili al gruppo "ad occhi" e 30 perline anulari (RICHNER, FARAGGI 1993). Nonostante il notevole numero di oggetti (soprattutto le perle con decorazione spiraliforme, nettamente superiore rispetto a quelle note a Frattesina) non sono state individuate tracce di lavorazione del vetro in loco. Richner Faraggi ha ipotizzato una possibile provenienza dei vetri dall'Italia nord - orientale sulla base di tale considerazione, nonché della composizione chimica (vetri LMHK) e della presenza di altri materiali che rimandano all'ambito sud alpino, come i vaghi d'ambra tipo Allumiere, le rotelle in corno di cervo decorate ad occhi di dado e i coltelli in bronzo tipo Fontanella[19]. È tuttavia difficile, data la quantità e la fitta distribuzione dei rinvenimenti, non pensare alla possibile presenza di centri di lavorazione anche nella regione nord alpina.

In un'accurata disamina dei materiali vetrosi protostorici della Boemia, Natalie Venclovà ha potuto constatare la relativamente alta frequenza di perle a botticella e ad occhi nei contesti Lusaziani e Velatice (VENCLOVÀ 1990). Ciò sarebbe dovuto all'alto livello dell'economia e delle attività di scambio di questa regione che, data la posizione geografica, doveva essere in relazione ad una delle cosiddette "vie dell'ambra". L'ipotesi che lungo la "via adriatica" dell'ambra circolassero anche perle di vetro come prodotto proveniente da sud contro ambra proveniente da nord non è priva di fondamento e andrebbe meglio valutata sia alla luce del complesso sistema di scambi che si attiva con la tarda età del Bronzo in buona parte del continente europeo (e che certamente non doveva riguardare solo la sfera della metallurgia), sia di quanto sta emergendo nelle ricerche in corso sui materiali vetrosi italiani dell'età del Bronzo media e recente (ANGELINI, ARTIOLI, BELLINTANI c.s.). Per quanto riguarda i possibili confronti con l'ambito egeo e mediterraneo orientale, non sono a mia conoscenza dati ulteriori rispetto a quanto segnalato da Haevernick che indica la presenza di 12 perle "delle palafitte" da una tomba infantile da Tirinto (HAEVERNICK 1981b, p. 383), e un numero imprecisato di perle nel carico della nave di Capo Gelidonya (BASS 1991). A ciò possiamo al momento aggiungere solo alcune considerazioni. Anche in recenti disamine delle produzioni micenee di faience e vetro (ad es. NIGHTINGALE 1998), non vi sono specifici confronti tra le perle decorate dell'Europa centro - occidentale della tarda età del Bronzo e quelle caratteristiche delle fasi di maggiore attività delle

[18] Una significativa eccezione (HAEVERNICK 1978) sarebbe costituita della presenza di perle del tipo in esame nel carico della nave rinvenuta presso Capo Gelidonya (Turchia), datato attorno al 1200 a.C.

[19] A questo proposito, ovvero sulle relazioni tra l'Italia centro – settentrionale e l'ambito transalpino nel corso del Bronzo finale, vale la pena richiamare le osservazioni espresse da Bietti Sestieri sulla distribuzione di manufatti metallici tipicamente italiani (protovillanoviani) come i pani a piccone e le palette con immanicatura a cannone sia verso NE (Ungheria) ma anche verso NW (Germania e Francia) (da ultimo BIETTI SESTIERI 1997b). A Frattesina, inoltre, compaiono anche 2 spilloni in bronzo che rimandano al versante nord delle Alpi: il tipo *Mehrkopfnadeln*, presente nel più ricco corredo funerario fino ad ora rinvenuto nelle necropoli del territorio di Frattesina: quello della Tb 227 Narde (SALZANI 1990, p. 16-17; fig. 16, 10) e il tipo Velemszentuid pertinente al corredo della tomba 36/1984 della necropoli di Fondo Zanotto (DE MIN 1986, p. 147; tav. 2, 3).

officine egee (Mic. III A e B). Tuttavia il motivo delle bande o spirali di colore contrastante su perle globulari o di forma oblunga non è sconosciuto in ambito egeo (NIGHTINGALE 1998, fig. 2, 18); BELGEN 1937, fig. 284 e 406) e a queste produzioni rimandano, sia per tipologia che per caratteristiche composizionali, non pochi esemplari provenienti da contesti d'abitato e funerari del meridione e dal nord Italia delle fasi BM3 - BR e sporadicamente anche da siti coevi della Baviera e della Boemia (ANGELINI *et Alii* c.s.). È possibile che tali prodotti siano stati poi imitati a sud e, forse, a nord delle Alpi alla fine del II millennio a.C., ovvero quando le manifatture egee e vicino orientali entrano in crisi. Non è affatto da escludere, infine, che in più accurate ricerche nei contesti del TE IIIC si possano rinvenire ornamenti in vetro prodotti nel nord est d'Italia, analogamente ad altri materiali di sospetta o molto probabile provenienza occidentale, come, nell'ordine, le ambre tipo Tirinto e Allumiere e il pettine d'avorio, tipico delle produzioni di Frattesina, rinvenuto a Enkomi - Cipro.

Concludiamo con un rapido sguardo alle presenze di perle in vetro nel Bronzo finale italiano[40].
Per quanto riguarda l'Italia centro settentrionale, l'attuale distribuzione tanto dei manufatti che degli indicatori di lavorazione sembra confermare il ruolo preminente di Frattesina. Un numero ben più limitato di elementi di entrambe le catergorie è attestato in alcuni siti veneti e della Lombardia orientale (Mariconda di Melara, Fondo Paviani, Montagnana, Sabbionara, Desmontà di Veronella, Caorle, Goito, Casalmoro - BELLINTANI, PALLECCHI, ZANINI 2000).
Sul versante nord appenninico ornamenti in vetro sono presenti a S.Michele di Valestra (CREMASCHI 1997) e Bismantova (CATARSI DALL'AGLIO 1997). Da quest'ultimo sito, in particolare dalla tomba XXXI, provengono oltre 300 perle, per la maggior parte anulari, ma anche dei tipi ad occhi ed altri non comuni alle produzioni di Frattesina. Una disamina specifica sulla situazione dell'Italia centrale è stata recentemente effettuata da Alessandro Zanini (BELLINTANI, PALLECCHI, ZANINI 2000). Un certo numero di perle in vetro, nell'ordine di qualche decina e quasi esclusivamente di tipo anulare, sono presenti in diversi contesti d'abitato e funerari dell'Etruria (Elceto, Scarceta, San Giovenale, Grotta Tufarina, Poggio la Pozza, Poggio della Capanna, Monte Ingino) e del versante adriatico (Pianello di Genga). La distribuzione di questi materiali sembra grosso modo coincidere con quella di altri più conosciuti indicatori di contatti tra l'area del Tirreno centrale ed il versante adriatico centro – settentrionale, ovvero i metalli[41], e potrebbe costituire un ulteriore indicatore di questo circuito di scambio. Più rarefatto apparentemente è il panorama dell'Italia meridionale dove tipi analoghi a quelli di Frattesina sono attualmente segnalati soprattutto a Torre Castelluccia (Puglia), Timmari (Basilicata) e Lipari – Piazza Monfalcone. Nel primo caso si tratta di un probabile ripostiglio rinvenuto in un contesto di abitato (GORGOGLIONE 1993) datato tra XI e X sec. a.C. Assieme a strumenti ed ornamenti in bronzo, osso/corno (tra cui due placchette multiforate o distanziatori) e selce, compaiono 6 vaghi d'ambra, di cui alcuni biconici ed avvicinabili al tipo Tirinto, ed un numero imprecisato[42] di perle anulari in pasta vitrea azzurra e conchiglia. Sempre perline anulari monocrome caratterizzano almeno 7 corredi della necropoli protovillanoviana di Timmari, in cui ricorre ancora l'associazione con elementi distanziatori in osso/corno (QUAGLIATI, RIDOLA 1906). Più articolato il caso di Lipari, dove perline in vetro compaiono sia nei livelli d'abitato pertinenti alla fase in esame (Ausonio II) sia nella coeva necropoli di Piazza Monfalcone (BERNABÒ BREA, CAVALIER 1980). Qui il caso maggiormente rappresentativo è quello del ricco corredo della tomba 31, che presenta un considerevole numero di perle di ambra (tra cui il tipo "Tirinto") e in vetro di varia tipologia. Le perline azzurre / blu anulari e quelle a botticella blu con decorazione spiraliforme bianca possono essere confrontate con quelle di Frattesina, mentre altre come quelle globulari di vetro opaco a bande policrome non sembrerebbero riconducibili alle produzioni nord italiane, ma ricordano piuttosto tipi di ambito egeo di tradizione più antica.

P.B.

Adria: inquadramento del contesto di provenienza delle perle campionate

L'antico centro di Adria sorgeva lungo un antico ramo settentrionale del Po, non distante dalla zona lagunare prospiciente l'Adriatico. La situazione idrografica si può ritenere considerevolmente mutata, visto che la città dista oggi dal mare circa 25 km ed è attraversata dal Tartaro-Canal Bianco. Diverse fonti antiche parlano di questo centro, sentito come il più importante porto dell'Adriatico settentrionale, sempre in riferimento al Po e allo sbocco a mare. Il porto, di origine greca secondo una tradizione pressochè unanime, dovette avere una componente venetica, anche se forse minoritaria, ed una sicura componente etrusca, che diventa emergente

[40] Per tale scopo mi sono avvalso della ricerca bibliografica condotta nell'ambito della tesi di Laurea inedita di Giovanna Residori " Vetri dell'età del Bronzo dell'Italia settentrionale. Analisi della documentazione nel quadro delle produzioni e della circolazione dei materiali vetrosi tra Mediterraneo orientale ed Europa" (UniVR a.a.1998 – 1999; rel. Prof. A.Guidi; correl.: dr. G.M. Facchini, dr. P.Bellintani).

[41] Cfr nota 6.

[42] Dalla foto pubblicata in GORGOGLIONE 1993, tav. LVIII, 1, si direbbero non meno di 400. Le perle sono state ricomposte in collana a 4 giri fermati alle estremità da due placchette in osso con 4 fori trasversali, rinvenute assieme alle perle.

con il V sec. a.C., quando Adria divide il controllo dei traffici adriatici con Spina (FOGOLARI, SCARFÌ 1970; DE MIN 1984a) Le ricerche archeologiche ad Adria sono fortemente limitate, oltre che dal persistere dell'insediamento fino ai nostri giorni, dalle condizioni di interramento, in quanto gran parte delle testimonianze più antiche si trovano ad oltre 7 metri di profondità, al di sotto di pesanti coltri di origine esondativa. Le conoscenze archeologiche sono dunque limitate soprattutto per le fasi più antiche, interrate a maggior profondità. I reperti provengono in gran parte dall'area delle necropoli, sia da precisi contesti funerari, importanti riferimenti per l'inquadramento cronologico, sia come materiali sporadici; alcuni campioni provengono da esemplari di collezione o solo genericamente riferibili al territorio di Adria senza ulteriori specificazioni. Tre sono le necropoli toccate dalle campionature di questo studio: Canal Bianco, Ca' Garzoni e Ca' Cima (scavi '93 e '95)[43].

La necropoli del Canal Bianco fu rinvenuta nel corso dello scavo del nuovo alveo dell'omonimo canale a sud di Adria, negli anni tra il 1938 e il 1940; il contesto funerario ha restituito circa 400 sepolture inquadrabili tra gli inizi del V sec. a.C. e il II sec. d.C., denunciando quindi una significativa continuità di occupazione tra l'epoca preromana e la romana, pur con un cambiamento nel rituale funerario. Le tombe di età tardoarcaica, classica e quelle tardoetrusche di età ellenistica sono ad inumazione, mentre in epoca romana viene adotatta l'incinerazione (FOGOLARI 1940).

Pure a sud di Adria, ma più ad ovest rispetto al nucleo delle sepolture del Canal Bianco si trova la necropoli di Ca' Garzoni, scavata tra la fine degli anni '60 e i primi anni '70. Si tratta di una necropoli composta essenzialmente di tombe tardoetrusche di età ellenistica ad inumazione e di alcune sepolture romane ad incinerazione; circa 200 tombe coprono un arco cronologico dal III sec. a.C. al II sec. d.C., riproponendo il modello del cambiamento di rituale in epoca romana già sottolineato per la necropoli precedente[44].

Differente l'ubicazione della necropoli di Ca' Cima, situata alla periferia nord-orientale di Adria. La necropoli, individuata e parzialmemnte indagata negli anni '70 è stata sottoposta a scavi sistematici dal 1993 al 1995. Ha restituito circa 200 tombe che si datano dal VI sec. a.C. al II sec. d.C. Si tratta di sepolture di età arcaica e classica sia ad inumazione che ad incinerazione, tombe tardoetrusche di età ellenistica ad inumazione e tombe romane ad incinerazione ed inumazione. Il panorama rituale restituito da questa necropoli sembra differenziarsi dalle due precedenti per una precoce adozione di biritualismo[45].

La significativa quantità di reperti in pasta vitrea, pur non consentendo a tutt'oggi una sicura identificazione del sito come centro di produzione, pure ne consente l'ipotesi. In questo caso Adria verrebbe a porsi come erede diretta della tradizione di Frattesina e dell'area del medio Polesine tra Bronzo finale e prima età del Ferro.

La Tipologia delle Perle Campionate

Perle monocrome

Solo un campione è stato prelevato da una perla monocroma di colore giallo opaco (cat. 83). Si tratta di una tipologia piuttosto diffusa, anche se più comune in pasta vitrea blu; la perla giallo opaco mostra una deformazione forse dovuta ad un difetto di fabbrica, se non ad un momento secondario di riesposizione a calore; deformazioni di questo genere, infatti, sono note soprattutto per gli esemplari che provengono da contesti funerari. Il colore giallo non si riscontra facilmente in perle monocrome, ma risulta maggiormente attestato quale base di perle con decorazione ad occhi o a zig-zag[46].

Perle con decorazione a zig-zag

Nella campionatura solo due esemplari sono attribuibili al tipo con decorazione a zig-zag[47] (cat. 77 e 79): il primo ha una base blu in cui era inserita una decorazione piuttosto irregolare, ormai perduta, secondo una modalità di degrado abbastanza frequente. L'irregolarità della decorazione viene ribadita dalla presenza di un motivo asimmetrico a "occhio"semplice, che non sembra coerente con la sintassi a zig-zag.

Il secondo esemplare è di un colore meno comune, con base in pasta vitrea bianca e zig-zag inserito in pasta vitrea marrone opaco.

I due esemplari provengono da contesti funerari della necropoli di Ca' Cima, scavati nel 1995, in particolare la perla con base blu fa parte del corredo della tomba 13, in associazione ad un pendente in pasta vitrea zoomorfo a testa di ariete di tipologia piuttosto rara. La tomba si data con precisione tra il 510 e il 490 a.C.; l'esemplare con base bianca e zig-zag marrone proviene dalla tomba 12 ed è associato a due perle con decorazione ad occhi che non sono oggetto di questo studio; il corredo si data nel suo complesso tra il 500 e il 470 a.C.

La tipologia a zig-zag è peraltro attestata ad Adria sia con esemplari a zig-zag semplice, che con esemplari a zig-zag

[43] Tutte le notizie relative alle necropoli di Adria sono dovute alla cortesia e disponibilità di Simonetta Bonomi, che ringrazio per la costante attenzione prestata a questo lavoro.

[44] Cfr. MANGANI 1982; la necropoli è in parte ancora inedita.

[45] Cfr. DALLEMULLE, MARZOLA 1977; lo scavo del 1970 è in corso di edizione da parte di I. Borghero. La edizione delle tombe di età arcaica è in corso da parte di S. Bonomi.

[46] Cfr. GAMBACURTA 1987, pp. 194-195, tipo A, fig. 1 e fig. 2 per i colori.

[47] Cfr. GAMBACURTA 1987, pp. 194-195, tipo D, figg. 1-2, 4 e 10.

complesso, del tipo incrociato, anche se non risulta una delle decorazioni più comuni in questo centro. Il tipo di perla con decorazione a zig-zag infatti sembra aver avuto la sua massima diffusione nell'ambito veneto centro orientale e lungo l'asse plavense in corrispondenza non casuale con una particolare presenza di questa tipologia in area slovena (GAMBACURTA 1987, fig. 4). Proprio nell'area slovena la Haevernick individua il principale ambito di produzione di questa manifattura, che ben si inquadra tra il V e il III sec. a.C.[48].

Perle con decorazione ad occhi

Sono state sottoposte a campionatura perle con decorazione ad occhi in cui il motivo decorativo presenta diversi gradi di complessità: dal motivo semplicemente enucleato su di un fondo monocromo, a quello dell'occhio formato da un'"iride" chiara in cui il punto centrale è contornato da uno o più cerchi concentrici; accanto a questi sono presenti esemplari più complessi chiamati ad occhi compositi, nelle due varianti definite da T.E. Haevernick A e B, la variante A, probabilmente di importazione, e la variante B di cui si suppone un'origine locale, genericamente attribuibile all'ambito veneto[49].

Solo due esemplari campionati si riferiscono al tipo più semplice, con occhi enucleati su di un fondo monocromo (cat. 81 e 80); entrambi hanno base verde, il primo più trasparente e con decorazione bianca; nel secondo caso la parte bianca, che formava occhi con due profilature, è andata totalmente perduta secondo un processo di degrado tipico di queste perle. In seguito alla perdita dell'inserimento di pasta vitrea di diverso colore che forma il motivo dell'occhio, si conserva solo una perla apparentemente monocroma con una o più incisioni circolari. I due esemplari provengono dalla tomba 16 della necropoli di Ca' Cima (scavo 1993), in associazione ad un altro esemplare ad occhi stratificati di colore turchese. Il contesto si data tra il 500 e il 480 a.C.

Si tratta di una tipologia già nota nel Veneto, dove sembra attestata a partire da un periodo piuttosto antico; ne sono noti, infatti, esemplari dalla necropoli di Saletto di Montagnana, in una sepoltura datata alla metà del VII sec. a.C. (*Adige ridente* 1998, p. 214 ss., fig. 125, 30). Ad un orizzonte un poco più recente rimandano esemplari da Oderzo, provenienti da una necropoli di cui è stato indagato solo un lacerto, complessivamente riferibile al pieno VI sec. a.C.[50], mentre ad una datazione tra la fine del VI e gli inizi del V sec. a.C. è attribuibile la sepoltura da cui provengono gli esemplari di Altino[51], simili anche nel colore verde di base. Alcune perle di questo tipo sono state rinvenute a Vadena, in una ricca sepoltura riferibile al tardo V-IV sec. a.C. (DAL RI' 1992, p. 500 ss., fig. 13, 21-23) e recentemente anche nell'alto Friuli, nella necropoli di Misincinis di Paularo, in contesti databili tra il tardo VII e il VI sec. a.C. (CORAZZA, VITRI 2001, p. 31, fig. 29). Il quadro che se ne delinea è quello di una apparizione precoce, ma anche di una durata senza soluzione di continuità e di una diffusione territoriale piuttosto ampia che coinvolge non solo il Veneto occidentale ed orientale, ma anche l'ambito retico-alpino.

Le altre perle con decorazione ad occhi rientrano in una tipologia più complessa in cui iride e punto centrale non coincidono con la pasta vitrea di base (GAMBACURTA 1987, tipo F) e possono essere strutturate con più profilature e decorazioni accessorie come ad esempio gocce sporgenti applicate in pasta vitrea di colore contrastante rispetto al fondo e agli occhi stessi.

Gli esemplari nn. 51, 53 e 83 presentano una decorazione semplice nell'ambito di questo tipo; i primi due sono blu con occhi bianchi e blu scuro, il terzo ha fondo blu e occhi turchese opaco e blu scuro; tutte e tre le perle hanno solo tre occhi disposti su di un unico registro. I primi due esemplari provengono dalla necropoli del Canal Bianco, il primo dalla tomba 391, in cui era associato con un pendente antropomorfo, pure sottoposto ad analisi; il secondo dalla tomba 240. La terza perla faceva parte del corredo della tomba 16 della necropoli di Ca' Cima, assieme a due esemplari con occhi enucleati dal fondo, già citati sopra. Il contesto di queste ultime perle si data tra il 500 e il 480 a.C. Può essere riferito a questa tipologia anche l'esemplare n. 57 del catalogo da cui provengono tre prelievi differenziati in relazione ai diversi colori della perla e delle gocce applicate: ai tre occhi semplici di colore bianco e blu su fondo blu si aggiungono gocce gialle e bianche opache applicate sul corpo della perla.

Alcune perle presentano una profilatura scura attorno alla pupilla, quindi occhi stratificati con due campi chiari e due scuri, uno dei quali centrale. Due esemplari (cat. 49 e 50), significativamente provenienti dalla medesima sepoltura, si contraddistinguono per una disposizione irregolare degli occhi sul corpo della perla; le decorazioni infatti risultano appaiate con difficoltà fino ad essere sovrapposte in parte e lo stesso motivo dell'occhio risulta asimmetrico. Provengono dalla tomba 25 del Canal Bianco che si data alla prima metà del III sec. a.C.

[48] Cfr. HAEVERNICK *et Alii* 1983; inoltre, cfr. ZEPEZAUER 1993, p. 77, p. 79 e p. 83 per le perle a zig-zag su base gialla, blu e marrone; la datazione proposta è tra il LT C1 e C2; taf. 10, 10-14 e26-27. Per alcuni significativi contesti sloveni, Libna e Novo Mesto, cfr. GUŠTIN 1976, p. 52, tav. 4, 8; p. 62, tav. 14, 10-11; p. 65, tav. 17,19; p. 97, tav. 49,21; p. 121, tav. 73,8; *Novo Mesto* V 2000, p. 72, C; tav. 31, tomba 49,2; tav. 43, tomba 72,3.

[49] Cfr. HAEVERNICK 1981 (1972), pp. 233-244; per il Veneto, cfr. GAMBACURTA 1987, p. 205 e fig. 21.

[50] Cfr. *Sile Tagliamento* 1996, p. 170, n. 178.4, fig. 32; (n.b. la perla compare al n. 178.3 per errore).

[51] Cfr. GAMBACURTA 1987, tipo E, tomba Fornasotti 2; TOMIOLANI 1987, p. 171, fig. 2, 9-12.

Il motivo con una sola profilatura, ma rappresentato su due registri è presente sulla perla n. 84, con fondo di colore blu e occhi bianchi e blu scuro; forse assimilabile è la perla n. 86, con fondo turchese e occhi bianchi e blu, anche se in questo caso il motivo decorativo sembra dissolversi, forse per un difetto di fabbricazione.
Una maggior complessità, con due profilature attorno alla pupilla, mostrano le perle nn. 88-89, entrambe con base blu, occhi blu opaco e blu scuro; occhi a due profilature, ma appaiati sul corpo della perla, sono quelli dell'esemplare n. 85, con fondo giallo e occhi bianchi e blu.
Si può notare che alcuni casi presentano "irregolarità" che possono far pensare ad imperfezioni di fabbrica[52].
Le perle con occhi caratterizzati da iride diversa dal fondo e nucleo cerchiato da una o più profilature sono una delle tipologie più complesse, che presentano numerose varianti sia nella composizione dell'occhio che nella disposizione degli occhi sul corpo della perla e per l'eventuale arricchimento con altre decorazioni come ad esempio l'aggiunta di gocce o una forte tendenza alla sporgenza del motivo decorativo, fino alla deformazione del profilo della perla che tende ad assumere forma triangolare o quadrangolare; il colore di base è in genere giallo, blu, turchese.
La tipologia risulta piuttosto comune tra V e IV sec. a.C. e ben diffusa tanto in ambito veneto[53], quanto nei finitimi contesti etrusco-settentrionali (*Etruschi a Nord del Po* 1986-1987, pp. 236-237, figg. 140-141), ma attestata anche nel comparto veneto orientale ed isontino, in particolare a S. Lucia di Tolmino (Marchesetti 1993, tav. IX, 4), testa di ponte verso quell'ambiente sloveno che viene indicata come area nodale per la concentrazione dei rinvenimenti e forse per l'identificazione di aree produttive[54].
Probabilmente a contesti più tardi, corrispondenti alle fasi dell'orizzonte medio-La Tène vanno attribuiti gli esemplari in cui la sintassi decorativa è esasperata e tende a diventare sporgente e a deformare il profilo della perla, a volte dissolvendosi in un motivo a spirale.
È il caso della perla in frammenti con base marrone ed occhi bianchi e turchese (cat. 90).
Si tratta di una tipologia che conosce una certa fortuna in ambiti celtici, tra il LT C2 e D1 (Zepezauer 1993, p. 95 e tavv. 6 - 9) ed è presente in Veneto solo in pochi esemplari, provenienti dagli abitati dell'alto vicentino e veronese, da Santorso, Trissino, Montebello e Montesei di Serso[55]. In particolare l'esemplare di Santorso proviene dal vano di una struttura abitativa, datato con una certa precisione sullo scorcio del IV sec. a.C. Nell'esemplare di Adria sottoposto a campionatura, di colore marrone con occhi bianchi, marrone e turchese, il motivo ad occhi risulta ancora ben rappresentato.

Perle con decorazione ad occhi compositi, varianti A e B

È presente ad Adria ed è stato sottoposto a campionatura un esemplare (cat. 91), spezzato a metà di compound-eye-bead, variante A, tipologia identificata da T.E Haevernick, che ne indica solo sette esemplari in Italia, e identifica per questa perla una produzione nell'area a nord del Mar Nero e del Caucaso (Haevernick 1972 (1981)). Oltre ai sette esemplari indicati, un ottavo è stato segnalato ad Altino, anche se di provenienza non certa (Gambacurta 1987, fig. 1, tipo G, fig. 21, p. 207). La diffusione di queste perle si disloca su di un percorso da est ad ovest, lungo le tappe fondamentali della via della seta, fino a raggiungere le tombe dei principi hallstattiani. La circolazione di queste perle, considerate di particolare prestigio, nelle quali probabilmente l'aumentata complessità della decorazione che comporta il moltiplicarsi del motivo dell'occhio veniva asssociata ad un maggior potere magico-apotropaico, sembra ricalcare quindi quella che portava tessuti e spezie di pregio da oriente alle corti hallstattiane centroeuropee, che nell'area a nord del Mar Nero si incrociava con un pregiato mercato di cavalli che partivano alla volta della Cina.
Esemplari di questo tipo di perla sono attestati ad Adria e a Spina e, unitamente all'esemplare di Altino, il panorama veneto risulta particolarmente ricco di presenze di questa tipologia piuttosto rara, lungo una direttrice portante verso i mercati transalpini (Pauli 1987, figg. 200 e 202).
Proprio nel Veneto sembra possibile individuare l'ambito di produzione della variante di questa perla ad occhi compositi, identificata come B[56], caratterizzata da corpo più piccolo, colore spesso opaco, occhi compositi, ma con motivo semplice, e gocce sporgenti, applicate sulla superficie e intorno al foro. Questa imitazione locale mostrerebbe un gusto decorativo più ridondante, per la presenza delle gocce applicate. Si tratta degli esemplari nn. 54 e 57, entrambi provenienti dalla necropoli del Canal Bianco, il primo da una sepoltura databile attorno al 500 a.C., il secondo privo di contesto funerario di riferimento
Anche se le analisi non sembrano individuare sensibili differenze nella composizione qualitativa/quantitativa nella

[52] Per un esempio di "irregolarità" cfr. Gambacurta 1987, p. 207, fig. 20 in alto a sinistra.

[53] Per il Veneto in generale, cfr. Gambacurta 1987, fig. 5, figg. 11-13 e 18-20.

[54] Cfr. solo a titolo esemplificativo, cfr. la ricca documentazione dalle necropoli di Novo Mesto, *Novo Mesto* III 1993, p. 28 e *passim*; *Novo Mesto* V 2000, p. 14 e *passim*.

[55] Per la diffusione in Veneto, cfr. Lora, Ruta Serafini 1992, p. 260, fig. 9, 2; per l'esemplare da Montebello, cfr. Ruta Serafini 1986, fig. A34 e p. 84; per la perla da Montesei di Serso, cfr. Perini 1965, 174, fig. 17.

[56] Cfr. Haevernick 1972 (1981), p. 239; cfr. inoltre Gambacurta 1987, fig. 6 e da ultimo un esemplare da una sepoltura di Este, in un contesto di particolare prestigio, contraddistinto anche da elementi del costume di gusto esotico celtizzante, cfr. *Adige ridente* 1998, tomba 126, p. 208, fig. 115, 16; la tomba si data sullo scorcio del IV sec. a.C.

pasta vitrea delle perle in oggetto, non sembra da sottovalutare l'ipotesi che l'esemplare identificato come variante A sia da considerare di importazione.

Fusaiole

Sono state sottoposte a campionatura anche due fusaiole in pasta vitrea (cat. 56 e 59), entrambe in pasta vitrea verde trasparente, una delle quali con decorazione in pasta vitrea gialla opaca applicata.

La fusaiola in pasta vitrea rappresenta con ogni probabilità la redazione in versione preziosa e forse apotropaica di un oggetto funzionale, generalmente fittile, piuttosto comune nelle sepolture femminili, considerato un indicatore di ruolo. La versione in pasta vitrea potrebbe connotare sepolture di rilievo, come indicatore non solo di ruolo, ma anche di rango, probabilmente non funzionale, ma fortemente simbolico.

Sono note alcune fusaiole in pasta vitrea decorate e non ad Altino, purtroppo mai conservate nei contesti di appartenenza (Gambacurta 1987, tipo L, fig. 8 e fig. 23), a Este, soprattutto in alcune sepolture di prestigio, databili agli inizi del III sec. a.C.[37]. Un esemplare più antico, considerato come una perla piriforme o pendente, ma assimilabile alle fusaiole, anche per la decorazione a zig-zag, proviene da una sepoltura di rilievo di via Tiepolo a Padova, datata nell'ambito della prima metà del VI sec. a.C. (Ruta Serafini - a cura di - 1988, p. 128, fig. 84, 22.).

Gli esemplari adriesi provengono entrambe dalla necropoli del Canal Bianco, in particolare quello ornato con motivi in pasta gialla è stato rinvenuto in una sepoltura databile alla seconda metà del III sec. a.C. (Fogolari, Scarfì 1970, fig. 49, p. 76).

Perle tubolari con decorazione applicata

Si tratta di perle a conformazione cilindrica in cui la morfologia viene in qualche modo obliterata da una ricca decorazione applicata a gocce, che conferisce agli esemplari un profilo molto irregolare "a bitorzoli" (cat. 60 - 63 e 64 - 76).

Le perle di Adria sottoposte a campionatura provengono tutte dalla necropoli di Ca' Garzoni, un gruppo dalla tomba 29 e un gruppo dalla tomba 47, entrambe databili al II sec. a.C.; formavano probabilmente due collane, la prima bianca, blu e verde e la seconda tutta bianca.

Pur non essendo una tipologia comune, si trovano assonanze a Este, nella famosa tomba c.d. di "Nerka" datata ai primi decenni del III sec. a.C., contesto in cui si sono indicate anche le fusaiole in pasta vitrea (Chieco Bianchi 1987, p. 201, fig. 17, 23, 30-32.). Altri più convincenti confronti portano verso l'areale isontino e sloveno, per la presenza di perle di questo tipo sia a S. Lucia di Tolmino (Marchesetti 1993, tav. IX, 5), sia in ambito illirico a Novo Mesto[38].

Complessivamente il gusto per questo tipo di decorazione sporgente ed applicata sembra avere maggior fortuna negli orizzonti celtizzanti, sia nel periodo antico, come documenterebbero le grosse perle fittili rivestite in pasta vitrea blu rinvenute a Montebello Vicentino in una sepoltura di prestigio connotata da un grande gancio da cintura traforato in ferro, datata ai primi decenni del IV sec. a.C.[39], sia nelle fasi più recenti, corrispondenti al LT C1-2.

Perle con decorazione a fascia e con decorazione a piuma

Le perle con decorazione a fascia semplice o complessa su profilo ovoidale o a botticella non sono molto comuni. Le fasce di diverso colore che si dispongono sul corpo formano a volte campi diversamente decorati, ad esempio ad intreccio o a zig-zag. Solo un esemplare a profilo tondeggiante è presente ad Altino, privo di contesto di rinvenimento.

Gli esemplari di Adria provengono dalla tomba 36 del Canal Bianco (cat. 46), databile alla fine del III-inizi II sec. a.C. Un altro esemplare adriese proviene dalla tomba 41 della necropoli di Ca' Garzoni, datata al II sec. a.C. (Mangani 1982, pp. 105-106.)

Le perle con decorazione a piuma sembrano rifarsi ad un motivo di tradizione antica, che si rinviene comunemente sui balsamari in pasta vitrea di importazione dall'area fenicia, datati dalla metà del V sec. a.C. in poi; ne sono presenti alcuni esemplari ad Adria, uno dei quali nella tomba Campelli 8, databile agli inizi del III sec. a.C. (Fogolari, Scarfì 1970, fig. 43, p. 73 e fig. 50, p. 77). Una decorazione simile compare anche sulle famose tazzine in pasta vitrea da S. Lucia di Tolmino (Marchesetti 1993, tavv. VIII, 1-2; tav. IX, 1); una perla con profilo a botticella e decorazione a piuma è attestata nella necropoli di Libna, già nota per altri rinvenimenti di tipi di perle in pasta vitrea (Gušin 1976, p. 65, tav. 17, 18). Gli esemplari campionati (cat. 47 - 48) ad Adria, con profilo a botticella, provengono dalla tomba 363 della necropoli del Canal Bianco. Il motivo decorativo si ritrova su perle per lo più di conformazione cilindrica.

Probabilmente più recenti e forse attribuibili ormai ad età romana gli esemplari di Altino, più marcatamente cilindrici, privi di contesto di rinvenimento (Gambacurta 1987, fig. 24).

Ringperlen

Tre esemplari sono riferibile al tipo della perla ad anello, due dei quali in pasta vitrea trasparente (cat. 58 e 55) e uno in pasta vitrea color ambra con decorazione a graticcio gialla e bianca (cat. 93). Le due perle in vetro verde chiaro provengono dalla necropoli del Canal Bianco, in particolare il n. 55 da un contesto tombale databile alla fine del III sec.

[37] Cfr. Chieco Bianchi 1987, p. 213, fig. 32, 91, con confronti analitici nella scheda.

[38] Cfr. *Novo Mesto* V 2000, tav. 22, grob V/35, 15.

[39] Per gli esemplari globulari da Montebello cfr. Ruta Serafini 2001, pp. 200-201; fig. 3, 16.

a.C. (tomba 27). Le due perle in pasta vitrea trasparente si possono probabilmente inquadrare in una tipologia di lunga durata e più generica rispetto a quella con decorazione a graticcio, che fa capo in modo più puntuale alle ringperlen, tipologia ampiamente diffusa nel LT D1-2.
Una perla ad anello in pasta vitrea trasparente, usata probabilmente come pendente centrale di una collana è nota dalla tomba Fornasotti 2 di Altino, databile alla fine del VI sec. a.C. e caratterizzata da altri elementi di gusto tardo-hallstattiano[60]. La grande perla trasparente di questa collana era in origine probabilmente coperta da una foglia d'oro.
Le Ringperlen con decorazione a spirale o a graticcio sono ben diffuse in ambito veneto, dove compaiono tanto ad Altino, quanto nell'area cenomane, con una buona variabilità di colori[61]. I due esemplari di Altino fanno parte di una ricca sepoltura plurideposizionale databile tra la metà del II e la metà del I sec. a.C. (GAMBACURTA 1999, p. 119, fig. 10, 4). Gli esemplari di ambito Cenomane sono attestati nelle sepolture del La Tène D 1-2 da Casalandri di Isola Rizza, Vigasio e S. Maria di Zevio[62].

Pendenti

Sono stati sottoposti a campionatura alcuni pendenti in pasta vitrea, uno zoomorfo a testa di ariete, di colore bianco opaco con occhi giallo opaco e bocca verde chiaro, proveniente dalla tomba 13 della necropoli di Ca' Cima (cat. 78) e uno in pasta vitrea trasparente a forma di anforetta (cat. 94), del quale tipo esistono ad Adria altri 2 esemplari.
Il pendente zoomorfo si trova in un contesto tombale riferibile agli anni tra il 510 e il 490, in associazione ad una perla a zig-zag, si può considerare attribuibile ad una produzione fenicia, datata tra il VII e il VI sec. a.C.[63]; trova confronti assimilabili in ambito illirico nella necropoli di Novo Mesto, dove gli esemplari appaiono anche quantitativamente rilevanti e differenziati nel colore[64].
Una interessante distribuzione si delinea anche per gli esemplari ad anfora, che, attestati ad Adria, trovano buoni riscontri ancora in ambito illirico, nella zona della Sava, a Novo Mesto, da dove si sono poi diffusi fino alle aree interne della Moravia e della conca carpatica[65]. Una via di penetrazione di queste perle legata alla diffusione del corallo proprio attraverso la zona della Sava è stata già proposta e trova un interessante corrispondente adriatico proprio nelle presenze Adriesi (*I Celti* 1991, p. 279).

G. G.

RIASSUNTO

Il presente lavoro prende in esame le analisi chimiche effettuate su un campione di vetri dell'età del Bronzo finale e dell'età del Ferro della pianura padana orientale (Frattesina; Mariconda di Melara; Adria - RO).
La disamina tipologica ed archeometrica dei materiali è condotta soprattutto in relazione alla problematica dei vetri "ad alcali misti" dell'età del Bronzo europea. Alla luce degli odierni risultati non vi sono evidenze di continuità di questa tradizione artigianale nell'età del Ferro.

ABSTRACT

This article discusses the data from the chemical analysis of a group of glasses from Final Bronze Age and Iron Age sites in the Po Valley. The analyses are critically examined in light of recent publications concerning mixed alkali glasses produced in Bronze Age Europe. The issue of continuity of this glassmaking tradition is explored by reference to the Iron Age material: there is currently no evidence to suggest that the mixed alkali glass production continued beyond the Final Bronze Age.

[60] Cfr. GAMBACURTA 1987, tipo H; e p. 212, cat. 75; inoltre GAMBACURTA 1986, fig. 1,e.

[61] Cfr. GAMBACURTA 1986, fig. 1,c; GAMBACURTA 1987, p. 212, cat. 75.

[62] Cfr. SALZANI 1984, figg. a p. 801; per Isola Rizza cfr. anche SALZANI 1998, tav. II B, 1-2; da Isola Rizzza proviene anche un esemplare con decorazione a zig-zag a rilievo, confrontabile con un esemplare noto da Altino, di una tipologia meno comune di quelle con decorazione a spirale o a graticcio, cfr. SALZANI 1998, tav. XLIX B, 9b, tomba 104; SALZANI 1996, tav. XXVI C 7, tomba 63.

[63] Cfr. SEEFRIED 1982, tipo E Ib, tav. III; per la definizione del tipo, cfr. p. 10; per la datazione del tipo, cfr. fig. 44 e pp. 30-31.

[64] Per Novo Mesto, cfr. *Novo Mesto* V 2000, p. 51 C; p. 106, tav. 20, tomba 31, 1, a-d; p. 110, tav. 24, tomba 35, 16; p. 112, tav. 26, tomba 40, 2; p. 133, tav. 47, 7.

[65] Cfr. *I Celti* 1991, pp. 273-276 e fig. a p. 273, per la Moravia; pp. 277-285 e fig. a p. 278 per il bacino dei Carpazi. Per gli esemplari da Novo Mesto, cfr. *Novo Mesto* V 2000, fig. 72, A; p. 124, tav. 38, tomba 63, 9.

REFERENCES

Adige ridente 1998, Bianchin Citton E. Gambacurta G. Ruta Serafini A. (a cura di), *..."presso l'Adige ridente"... Recenti rinvenimenti archeologici da Este a Montagnana* (Cat. Mostra), Padova.

Angelini I. Artioli G. Bellintani P. c.s., *Progetto: "Ambre e materiali vetrosi protostorici della Valle dell'Adige nel quadro delle coeve attestazioni dell'Italia del nord". Capitolo 1: le ambre*, in: Atti convegno "Le Alpi prima delle frontiere" (UniTn - Mus.Trid.Sc.Nat; Trento 25 - 27 / 10 / 2001).

Angelini I. Artioli G. Bellintani P. Diella V. Polla A. Residori G. c.s., *Chemical analyses of Bronze Age glasses from Frattesina di Rovigo, Northern Italy*. "Journal of Archaeological Science", submitted.

Angelini I. Artioli G. Bellintani P. Diella V. Polla A. Recchia G. Residori G. c.s., *Materiali vetrosi da Grotta Manaccora e Coppa Nevigata: inquadramento archeologico e archeometrico nell'ambito dell'età del Bronzo italiana*, in Atti II Convegno Multidisciplinare *"Il vetro in Italia meridionale e insulare"*, Napoli 5-7 dicembre 2001.

Angelini I. Artioli G. Bellintani P. Diella V. Polla A. Residori G. c.s., *Project "glass materials in the protohistory of north italy": a first summary*, in Atti 2° Congresso Nazionale AIAr, Bologna, 29 Gennaio-1 Febbraio 2002.

Ashton M. Towle A. 1999, *Electronic Scanning: an alternative to Photographing Glass Beads and other small archaeological artefacts*, in "Bead Study Trust Newsletter", 33, p4 – 5. ISSN: 1463 – 9602. (reproduced at: http://www.shef.ac.uk/~assem/5/towle.html.)

Barfield L. 1978, *North Italian Faience Buttons*, in "Antiquity", 52, no. 205, pp. 150-153.

Bass G.F. 1991, *Evidence of Trade from Bronze Age Shipwrecks*, in *Bronze Age Trade in the Mediterranean*, edited by N.H. Gale, pp. 69-82. *Studies in Mediterranean Archaeology* 90.

Bellintani P. 1997, *Frattesina: l'ambra e la produzione vitrea nel contesto delle relazioni transalpine*, in *Ori Delle Alpi* (Cat. Mostra 1997), Edited by Endrizzi L. and Marzatico F., 6 Quaderni della Sezione Archeologica Castello del Buonconsiglio. Provincia autonoma di Trento - Servizio Beni Culturali.

Bellintani P. 2000, *Il Medio Polesine tra la tarda età del Bronzo e l'inizio dell'età del Ferro*, in *"Il protovillanoviano al di qua e al di là dell'Appennino"*, Atti della giornata di studio - Pavia, Collegio Ghislieri, a cura di Harari M. e Pearce M. 17 06 1995, pp. 47-83.

Bellintani P. 2001, *I bottoni conici ed altri materiali vetrosi delle fasi non avanzate della media età del Bronzo dell'Italia settentrionale e centrale*", in "Padusa", XXXVI, N.S. a.2000, pp. 95-110.

Bellintani P. Biavati A. 1997, *Ornamenti in materiale vetroso* in Bernabò Brea, Cardarelli, Cremaschi 1997, pp. 610-613.

Bellintani P. Biavati A. Verità M. 1998, *Alcune considerazione su materiali vetrosi da contesti dell'età del bronzo media e recente dell'Italia settentrionale*, in *Il vetro dall'antichità all'età contemporanea: aspetti tecnologici, funzionali e commerciali* atti 2° giornate nazionali di studio AIHV – comitato nazionale Italiano, 14 - 15 Dicembre 1996, Milano.

Bellintani P. Pallecchi P. Zanini A. 2000, *Materiali vetrosi nell'età del Bronzo italiana*, in Atti del IV Incontro di Studi di Preistoria e Protostoria in Etruria (*L'Etruria tra Italia, l'Europa e Mondo Mediterraneo. Ricerche e scavi*), settembre 1997, pp. 83-96.

Bellintani P. Residori G. forthcoming, *Quali e quante conterie. Materiali vetrosi dell'età del Bronzo del nord Italia e loro relazioni con il Mediterraneo e l'Europa transalpina*, Atti XXXV R.S. I.I.P.P. Lipari, 2-7 giugno 2000.

Bernabò Brea M. Cardarelli A. Cremaschi M. 1997 (a cura di), *Le Terramare. La più antica civiltà padana* (Cat. Mostra Modena 1997), Electa ed.

Bernabò Brea L. Cavalier M. 1980, *Meligunis Lipàra*, Vol. IV, Palermo.

Besborodov M.A. 1975 *Chemie und Technologie der antichen und Mittelalterlichen Gläser*. Philip Von Zabern, Mainz.

Bianchin Citton E. 1984, *Il Bronzo finale*, in: *Il Veneto nell'antichità. Preistoria e protostoria*, Vol. II, Verona, pp. 617-630.

Bianchin Citton E. 1996, *Caorle. Il sito umido di San Gaetano - Casa Zucca*, in *La Protostoria tra Sile e Tagliamento. Antiche genti tra Veneto e Friuli* (Cat. Mostra Concordia Sagittaria 1996; Pordenone 1997), Esedra Ed., Piazzola sul Brenta (PD), pp. 174-182.

Biavati A. 1983, *L'arte vetraria nella civiltà protovillanoviana di Frattesina di Fratta Poloesine (RO). analisi chimica dei reperti archeologici*, in Padusa, XIX, p. 59-63.

Bietti Sestieri A.M. 1981, *Lo scavo dell'abitato protostorico di Frattesina di Fratta Polesine (Rovigo). I. La sequenza stratigrafica del quadrato U6*, in: B. P. I. 1975-1980, pp. 221 sgg.

Bietti Sestieri A.M. 1996, *Protostoria. Teoria e pratica*. N.I.S., Roma.

Bietti Sestieri 1997a, *Il territorio padano dopo le terramare*, in Bernabò Brea, Cardarelli, Cremaschi 1997, pp. 757-767.

Bietti Sestieri A.M. 1997b, *Italy in Europe in the Early Iron Age*, in *Proceedings of the Prehistoric Society* 63, 1997, pp. 371-402.

Bietti Sestieri A.M. Henderson J. Ponting M. forthcoming, *The scientific investigation of glass and glass-production from Frattesina, Italy*.

BIRON I. DANDRIDGE P. WYPYSKI M.T. 1990, *Enamels of Limoges 1100 - 1350*, The Metropolitan Museum of Art, New York.
BLEGEN C.W. 1937, Prosymna. *The Helladic Settlement Preceding the Argive Heraeum*, Vol. I-II, London.
BRILL R.H. 1970, *The chemical interpretation of the texts*, in OPPENHEIM A.L. BRILL R.H. BARAG D. VON SALDERN A., *Glass and Glassmaking in Ancient Mesopotamia*, Corning: The Corning Museum of Glass.
BRILL R. 1988, *Scientific Investigations of the Jalame glass and related finds*, in *Excavations at Jalame: site of a glass factory in Late Roman Palestine*, edited by Weinberg, GD. University of Missouri Press, Columbia.
BRILL R.H. 1992, *Chemical Analyses of Some glasses from Frattesina*, in "Journal of Glass Studies", 34, pp. 11-22.
CARDARELLI A. PACCIARELLI M. PALLANTE P. BELLINTANI P. 2001, *Pesi e bilance dell'età del Bronzo italiana*, in *Pondera. Pesi e misure nell'antichità* (Cat. Mostra Campogalliano MO), pp. 33-58.
CATARSI DALL'AGLIO M. 1997, *Campo Pianelli di Bismantova*, in BERNABÒ BREA M. CARDARELLI A. CREMASCHI M. 1997, pp. 768-770
(I) Celti 1991 (Cat. Mostra), Milano.
CHIECO BIANCHI A.M. 1987, *Dati preliminari su nuove tombe di III secolo da Este*, in *Celti ed Etruschi nell'Italia centro-settentrionale dal V secolo a.C. alla romanizzazione*, Atti del Colloquio Internazionale, Bologna 1985, Imola, pp. 191-236.
CORAZZA S. VITRI S. 2001, *La necropoli di Misincinis dopo lo scavo. Primi risultati delle indagini 1995-1997*, Sequals (PN).
CREMASCHI M. 1997, *Il sito d'altura di San Michele di Valestra*, in BERNABÒ BREA M. CARDARELLI A. CREMASCHI M. 1997, pp. 285-286.
DALLEMULLE U. MARZOLA E. 1977, *Una tomba di II sec. a.C. da Adria: la 45 Ca' Cima*, in Padusa, XIII, pp. 3-53.
DAL RI L. 1992, *Note sull'insediamento e sulla necropoli di Vadena (Alto Adige)*, in *Die Räter, I Reti*, Bolzano, pp. 475-522.
DAYTON J.E. 1981, *Geological evidence for the discovery of cobalt blue glass in Mycenean times as a by-product of silver smelting in the Schneeberg area of the Bohemian Erzebirge*, in "Revue D'Archeometrie", Actes du XX Symposium International D'Archeometrie (Symposium for Archaeometry) Paris 26 – 29 Mars 1980, Bulletin de Liason du Groupe des Methodes Physiques et Chimiques de l'Archaelogie, Volume III, pp. 57-61.
DE MIN M. 1984, *Montagnana (PD). L'abitato protostorico di Borgo S. Zeno*, in *Il Veneto nell'antichità. Preistoria e Protostoria*, Verona, pp. 642-650.
DE MIN M. 1984a, *Adria antica*, in *Il Veneto nell'antichità. Preistoria e Protostoria*, II, Verona, pp. 809-830.
DE MIN M. 1986, *Frattesina di Fratta Polesine. La necropoli protostorica*, in *L'Antico Polesine: testimonianze archeologiche e paleoambientali* (Cat. Mostra Adria e Rovigo 1986), edited by De Min M. and Peretto R., p. 143-170.
DE MIN M. GERHARDINGHER E. 1986, *Frattesina di Fratta Polesine. L'abitato protostorico*, in *L'Antico Polesine: testimonianze archeologiche e paleoambientali* (Cat. Mostra Adria e Rovigo 1986), edited by De Min M. and Peretto R., p. 117-142.
(Gli) Etruschi a Nord del Po 1986-1987 (Cat. Mostra), Mantova.
FARNSWORTH M. RITCHIE PD. 1938, *Spectrographic studies on Ancient Glass*, in *Technical Studies in the field of the Fine Arts*, Vol 6 no 3, pp. 155–173.
FOGOLARI G. 1940, *Scavo di una necropoli preromana e romana presso Adria*, in StEtr, XIV, pp. 431-442, tavv. XL-XLIII.
FOGOLARI G. SCARFI B.M. 1970, *Adria antica*, Venezia.
GAM T. 1990, *Prehistoric Glass Technology - experiments and analyses*, in "Journal of Danish Archaeology", 9, pp. 203-213.
GAMBACURTA G. 1986, *Prime osservazioni sulle perle in pasta vitrea di età protostorica provenienti da Altino*, in AqN, LVII, cc. 165-184.
GAMBACURTA G. 1987, *Perle in pasta vitrea da Altino (Venezia): proposta di una tipologia e analisi della distribuzione areale*, in "Quaderni di Archeologia del Veneto", III, 1987, pp. 192-216.
GAMBACURTA G. 1999, *Aristocrazie venete altinati e ritualità funeraria in un orizzonte di cambiamento*, in *Vigilia di romanizzazione. Altino e il Veneto orientale tra II e I sec. a.C.*, Atti del Convegno, Venezia 1997, Roma, pp. 97-120.
GARNER H. 1956, *The use of imported and nativecobalt in Chinese blue and white*, in *Oriental Arts*, Vol 2, part 3, pp. 48-50.
GEILMAN W. 1961, *Cobalt as a colouring Agent*, in "Glasstechnische Berichte", 35, 4.
GIUNTOLI S. 1996, *Balsamari etruschi in vetro di età orientalizzante e arcaica*, in NOTARIANNI G.M. AND FERRARI (eds), "I Quaderni del Giornale Economico: Il vetro dall'antichità all'età contemporanea", Venezia, 2 dicembre 1995, pp. 13-16.
GORGOGLIONE M.A. FIORENTINO G. CORRIDI C. SADORI L. PANETTA P. 1993, *La capanna 7 di Torre Castelluccia (Pulsano, Taranto) dalle ultime fasi dell'età del Bronzo all'età del Ferro*, in "Taras", XIII (1-2), pp. 25-114.
GRATUZE B. LOUBOUTIN C. BILLAUD Y. 1998, *Les perles protohistorique en verre du Musée des Antiquités nationales*, in "Antiquités Nationales", 30, pp. 11-24.
GRUET M. ROUSSOT-LARROQUE J. BURNEZ C. 1997, *L'Âge du Bronze dans la Grotte de Rancogne (Charente)*, «Antiquités nationales», Mémoire 3.
GUIDO M. HENDERSON J. CABLE M. BAYLEY J. BIEK L.

1984, *A Bronze Age Glass Bead from Wilsford*, Wiltshire: Barrow G. 42 in the Lake Group. Proceedings of the Prehistoric Society 50: 245-254.
GUILAINE J. GRATUZE B. BARRANDON J.-N. 1991, *Les perles de Verre du Chalcolithiique de l'age du bronze. Analyses d'examplaires trouvés en France*, in *L'Âge du Bronze Atlantique*, Actes du 1er colloque du parc archéologique du Beynac, 10-14th Sept 1990, Ed. de l'association des Musées du Sarladais, Beynac et Cazenac.
GUŠTIN M. 1976, *Libna*, Brežice.
HAEVERNICK T.E. 1951 *Einige Glasperlen aus Graebern der Lausitzer Kultur in Sachsen*, ripubblicato in: *Beitraege zur Glasforschung. Die wichtigsten aufsaetze von 1938 bis 1981*, Mainz 1981, pp. 14-17.
HAEVERNICK T.E. 1959, *Beitrage zur geschichte des antiken glases: I Zu den Glasbugelfibeln, II Stachelflaschen*, in "Jahrbuch des Romisch-Germanischen Zentralmuseums Mainz", 6, pp. 57-65.
HAEVERNICK T.E. 1961, *Beitrage zur geschichte des antiken glases: VII Zu den Stachelflaschen*, in „Jahrbuch des Romisch-Germanischen Zentralmuseums Mainz", 8, pp. 137-138.
HAEVERNICK T.E. 1972 (1981), *Perlen mit zusammengesetzten Augen ("compuond-eye-beads")*, in "Prähistorische Zeitschrift" 47, pp. 78-93, (in *Beiträge zur Glasforschung*, Mainz am Rhein, pp. 233-244).
HAEVERNICK T.E. 1978, *Urnenfelderzeitlische Glasperlen*, ripubblicato in: *Beitraege zur Glasforschung. Die wichtigsten aufsaetze von 1938 bis 1981*, Mainz 1981, pp. 375-383.
HAEVERNICK T.E. 1981, *Ausgrabungen in Tiryns 1977*, in: *Beitraege zur Glasforschung. Die wichtigsten aufsaetze von 1938 bis 1981*, Mainz, pp. 404-410.
HAEVERNICK T.E. FREY O.H. MATTHÄUS H. BRAUN CH. 1983, *Glasperlen der Vorrömischen Eisenzeit I*, Mainz am Reihn.
HARDEN D.B. 1968 *Ancient Glass I: Pre Roman*. Archaeological Journal 125: 46-72.
HARTMANN G. KAPPEL I. GROTE K. ARNDT B. 1997, *Chemistry and Technology of Prehistoric Glass from Lower Saxony and Hesse*, in "Journal of Archaeological Sciences", 24, pp. 547-559.
HENDERSON J. 1985, *The raw materials of early glass production*, in "Oxford Journal of Archaeology", 4, 3, pp. 267-91.
HENDERSON J. 1988a, *Glass Production and Bronze Age Europe*, in "Antiquity", 66, pp. 435-51.
HENDERSON J. 1988b, *Electron Probe Microanalysis of mixed alkali glasses*, in Archaeometry 30 (1), pp. 77-91.
HENDERSON J. 1989, *The use of colourants in mixed alkali and soda-lime silica prehistoric glass*, in "Archaeometry: Proceedings of the 25th International Symposium", edited by Maniatis Y.
HENDERSON J. 1993a, *Chemical analysis of the glass and faience from Hauterive-Champréveyres, Lake Neuchâtel, Switzerland*, in RYCHNER-FARRAGI 1993, pp. 111-118
HENDERSON J. 1993b, *The scientific analysis of vitreous materials from Kestria and Theologos-Tsiganadika Tombs*, in *Proto-Historic Thasos* by C. Kowkouli-Chrysanthaki. Athens.
HENDERSON J. 2000a, *The Science and Archaeology of Materials*, London and New York: Routledge.
HENDERSON J. 2000b, *Chemical analysis of ancient Egyptian Glass and its interpretation*, in P. Nicholson and J. Shaw (eds.) *Ancient Egyptian Materials and Technology*, Cambridge: Cambridge University Press, pp. 206-224.
KAZMARZYCK A. 1986 *The Source of Cobalt in Ancient Egyptian Pigments*. Olin, J.S. and Blackman, M.J. (editors) IProceedings of the 24th International Archaeometry Symposium, 1984, Washington DC: 369-376.
LILYQUIST C. BRILL R.H. 1993, *Studies in Early Egyptian Glass*, New York: The Metropolitan Museum of Art.
LORA S. RUTA SERAFINI A. 1992, *Il gruppo Magrè*, in *Die Räter, I Reti*, Bolzano, pp. 247-268.
MANGANI E. 1982, *Adria (Rovigo) - Necropoli in loc. Ca' Garzoni. Prima campagna di scavo, 1966*, in NSc, pp. 5-107.
MARCHESETTI C. 1993, *Scritti sulla necropoli di S. Lucia di Tolmino*, Trieste.
MARTELLI M. 1994, *Sulla Produzione di Vetri Orientalizzanti*, in Martelli M. (ed) *Tyrrhenoi Philotechnoi*, Gruppo Editoriale Internazionale, Roma, pp. 77-103.
NEGRONI CATACCHIO N. 1984, *Rapporto tra l'area alto-adriatica e quella medio-tirrenica durante il Bronzo finale*, in Padusa, XX, n. 1,2,3,4, pp. 515-528.
NIGHTINGALE G. 1998 *Mycenaean glass beads: jewellery and design* in Annales du 14° Congrès de l'Association Internationale pour l'Histoire du Verre, Italia/Venezia-Milano 1998, pp. 6-10.
Novo Mesto III 1993, KNETZ T. 1993, *Novo Mesto* III, Ljubljana.
Novo Mesto V 2000, KRITŽ B. 2000, *Novo Mesto* V, Ljubljana.
PAULI L. 1987, *La società celtica transalpina nel V secolo a.C.*, in *Etruschi a nord del Po*, II, pp. 18-30.
PERINI R. 1965, *Risultato dello scavo di una capanna dell'orizzonte retico nei Montesei di Serso (Pergine)*, in "Rendiconti della Società di Cultura Preistorica Tridentina", 3, pp. 32-67.
Protostoria e Storia del Venetorum angulus 1999, Atti del XX Convegno di Studi Etruschi ed Italici, Portogruaro-Quarto d'Altino-Este-Adria, 16-19 ottobre 1996, Pisa-Roma.
QUAGLIATI Q. RIDOLA D. 1906, *Necropoli arcaica ad incinerazione presso Timmari nel Materano*, in *Mon. Ant. Lic.* XVI, coll. 5-166.
REHREN TH. PUSCH E. HEROLD A. 1998, *Glass Colouring within a copper-centred industrial complex in Late Bronze Age Egypt*, in *The Prehistory and History of Glassmaking Technology*, edited by McCray P. and Kingery. Ceramics and Civilisation, Volume III.
RUTA SERAFINI A. 1986, *A36*, in *Museo ritrovato* (Cat. Mostra), Milano, pp. 46, 85.

RUTA SERAFINI A. (a cura di) 1988, *La necropoli paleoveneta di via Tiepolo a Padova. Un intervento archeologico nella città* (Cat. Mostra), Padova.
RUTA SERAFINI A. 2001, *Il celtismo in area veneta: nuovi dati*, in *I Celti in Carnia e nell'arco alpino centro orientale*, Atti della Giornata di Studio, Tolmezo, 30 aprile 1999, Trieste, pp. 197-210.
RYCHNER FARAGGI A.M. 1993, *Hauterive-Champréveyres, 9. Métal et parure au Bronze final.* Neuchatel, Musée cantonal d'archéologie (Archéologie neuchateloise, 17).
SALZANI L. 1984, *Il territorio veronese durante il I millennio a.C.*, in *Il Veneto nell'antichità. Preistoria e Protostoria*, II, Verona, pp. 777-808.
SALZANI L. 1986, *Abitati preistorici e protostorici dell'alto e del medio Polesine* in *L'Antico Polesine: testimonianze archeologiche e paleoambientali* (Cat. Mostra Adria e Rovigo 1986), edited by De Min M. and Peretto R., pp. 103-116.
SALZANI L. 1990, *Necropoli dell'Età del Bronzo Finale alle Narde di Fratta Polesine. Prima nota*, in Padusa, XXV, 1989, pp. 5-42.
SALZANI L. 1992a, *Necropoli dell'età del Bronzo finale alle Narde di Fratta Polesine. Seconda nota*, in Padusa, XXVI - XXVII, 1990-1991, pp. 125-206.
SALZANI L. (a cura di) 1996, *La necropoli gallica e romana di S. Maria di Zevio (Verona)*, Mantova.
SALZANI L. (a cura di) 1998, *La necropoli gallica di Casalandri a Isola Rizza (Verona)*, Mantova.
SANDERSON D.C.W. HUNTER J.R. 1981, *Compositional variability in vegetable ash*, in "Science and Archaeology", No. 23, pp. 27-30.
SANTROPADRE P. VERITÀ M. 1995, *Le Perle di Prato di Frabulino (Farnese, VT): indagini analitiche*, in: "Preistoria e Protostoria in Etruria". Atti del Secondo Incontro di Studi, pp. 111-117.
SANTROPADRE P. VERITÀ M. 2000, *Analyses of the production technologies of Italian vitreous materials of the Bronze Age*, in "Journal of Glass Studies", 42, pp. 25-40.
SAYRE E.V. 1963, *The International use of antimony and manganese in ancient glasses.* In F.R. Matson and G.E. Rindone (editors) *VI International Congress on Glass.* 263-282.
SAYRE E.V SMITH R.W. 1961, *Compositional categories of ancient glass*, "Science", 133, pp. 1824-1826.
SAYRE E.V. SMITH R.W. 1967, *Some materials of glass manufacturing*, in "Antiquity" In M. Levey (ed) Archaeological Chemistry, Philadelphia, pp. 279-311.
SEEFRIED M. 1982, *Les pendentifs en verre sur moyan des pais de la Méditerranée antique*, Roma.
SHORTLAND A.J. 2000, *Vitreous Materials at Amarna*, BAR International Series 827.
SHORTLAND A. TITE M.S. 1998, *The Interdependence of Glass and Vitreous Faience Production at Amarna*, in D. Kingery and P. McCray (eds.) *The Prehistory and History of Glass and Glass technology*, Ceramic and Civilisation, Columbus, Ohio: The American Ceramic Society: 331-48.
Sile Tagliamento 1996, *La Protostoria tra Sile e Tagliamento. Antiche genti tra Veneto e Friuli* (Cat. Mostra Concordia Sagittaria - Pordenone 1996/97), Ed. Esedra, Piazzola sul Brenta (PD).
STERN E.M. SCHLICK-NOLTE B. 1994, *Early Glass of the Ancient World 1600 BC – AD 50, Ernesto Wolfe Collection*, Verlag Hatje, Ostfildern, Germany.
TITE M.S. FREESTONE I.C. BIMSON M. 1983, *Egyptian faience: an investigation of the methods of production*, in "Archaeometry", 25, pp. 17-27.
TOMBOLANI M. 1987, *Materiali di tipo La Tène da Altino (Venezia)*, in *Celti ed Etruschi nell'Italia centro-settentrionale dal V secolo a.C. alla romanizzazione*, Atti del Colloquio Internazionale di Studi, Bologna, 1985, Imola, pp. 171-189.
TURNER W. E. S. 1954, *Studies of ancient glass and glassmaking processes. Part I: Crucibles and melting temperatures employed in Ancient Egypt at about 1370 B.C.*, "Journal of the Society of Glass Technology", 38, 436T-444T.
VENCLOVÀ N. 1990, *Prehistoric glass in Bohemia*, Praga.
VERITÀ M. BIAVATI A. 1989, *The Glass from Frattesina, a glassmaking centre in the Late Bronze Age*, in "Rivista Stazione Sperimentale Vetro", 19 (4), pp. 295-299.
YOUNG S. 1956, *An analysis of Chinese blue and white*, in "Oriental Art", Vol. 11, pp. 43-47.
ZEPEZAUER M.A. 1993, *Glasperlen vorrömischen Eisenzeit* III, Marburg.

ANDREW TOWLE
10 Argo Road Waterloo
LIVERPOOL L22 ONW United Kingdom

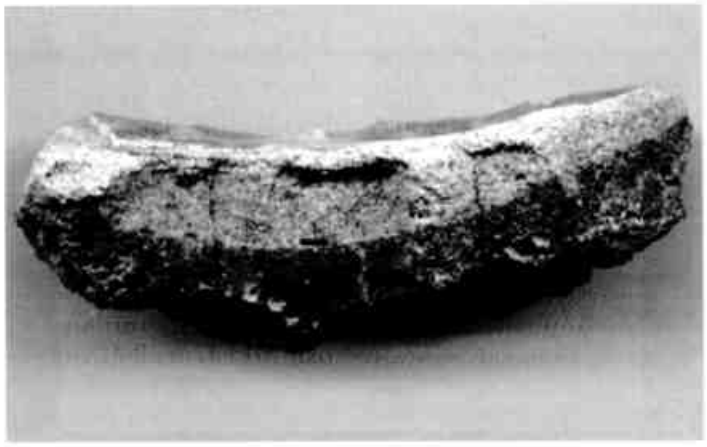
HENDERSON PH. D. JULIAN
Dept. of Archeology - University of Nottigham
University Park Nottingham
NOTTINGHAM NG7 2RD United Kingdom

DOTT.SSA GIOVANNA GAMBACURTA
Via Ferrazzi Masrcantonio, n. 3
35125 PADOVA PD

DOTT. PAOLO BELLINTANI
Ufficio Beni Archeologici
Castello del Buonconsiglio
38100 TRENTO
paolo.bellintani@libero.it
archeologia@biblio.infotn.it

1

2



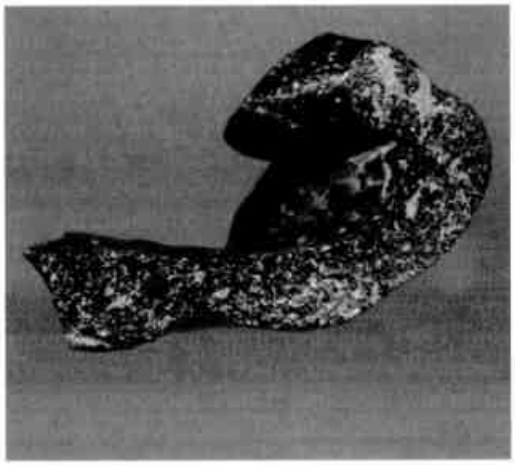
3

Fig. 1 - Frattesina di Fratta Polesine. Fragments of crucible. Cat. 1 - 3.

4

5

6



7

8

9

Fig. 2 - Frattesina di Fratta Polesine. Fragments of glass disk ingots. Cat. 4 - 9.

10

11

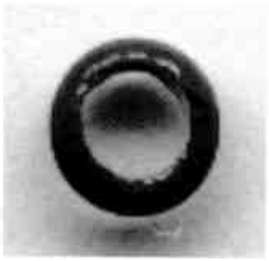
12

13

14

15

Fig. 3 - Frattesina di Fratta Polesine. Fragments of disk (Cat. 10); working wastes (Cat. 11 - 14); pinched trail (Cat. 15).


16


17


18


19


20


21


22


23


24


25

Fig. 4 - Frattesina di Fratta Polesine. Glass beads (Cat. 16 - 22); core - formed glass vessel (Cat. 23); anthropomorfic figures (Cat. 24 - 25).

28

29

Fig. 5 - Mariconda di Melara. Glass working tools (Cat. 28 - 29).


30


31


32


33


34


35


36


37


38


39


40


41


42


43


44


45

Fig. 6 - Mariconda di Melara. "Raw glass" (Cat. 30); working wastes (Cat. 31 - 34); glassy material - faience (Cat. 35); beads (Cat. 36 - 45).

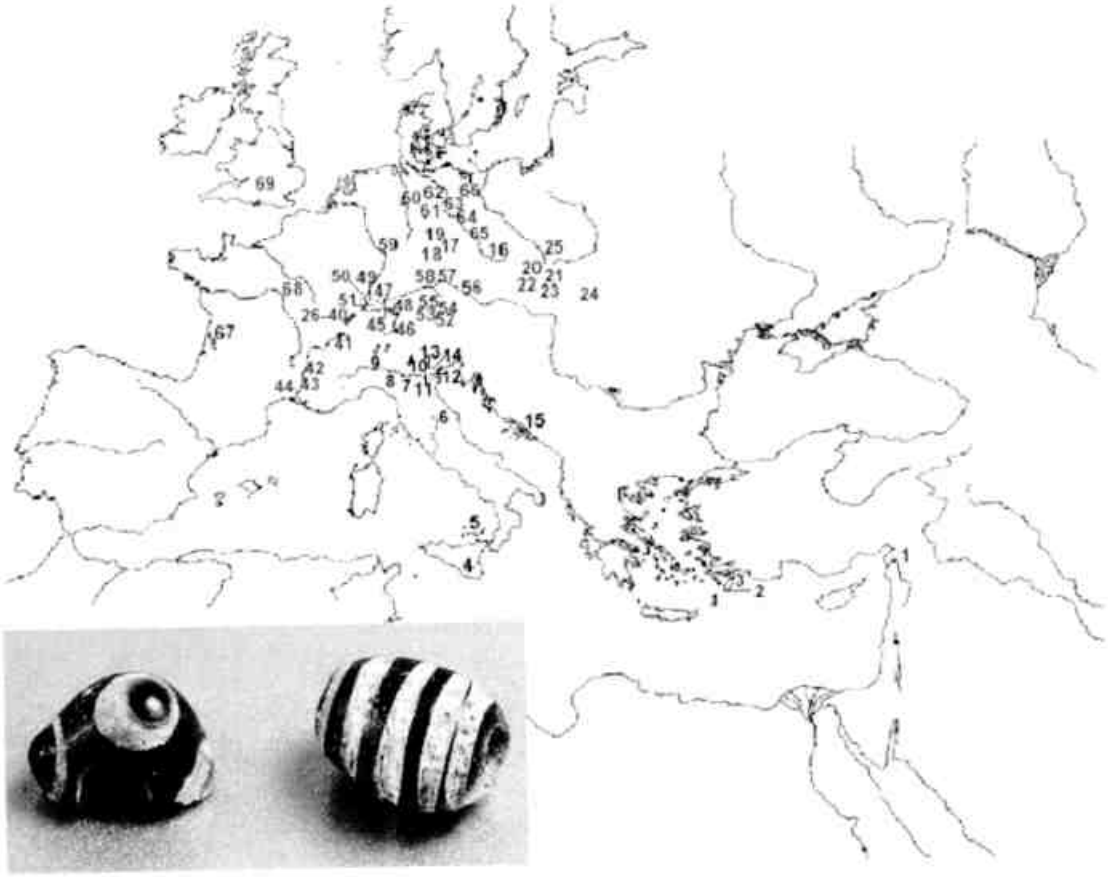


Fig. 7 - Eye beads and barrel shaped beads with spirrally wound lines in the Late Bronze Age of Europe. N.11: Mariconda di Melara. N.12: Frattesina di Fratta Polesine (by BELLINTANI RESIDORI forthcoming).


46


47


48


49


50


51


52


53


54

55


56


57


58


59

Fig. 8 - Glass beads from Adria - Canal Bianco (Cat. 46 - 59).

Fig. 9 - Glass beads from Adria - Ca' Garzoni (Cat. 60 - 76); Adria - Ca' Cima (Cat. 77 - 82); Adria - unknown site (Cat. 83 - 89).

90

91

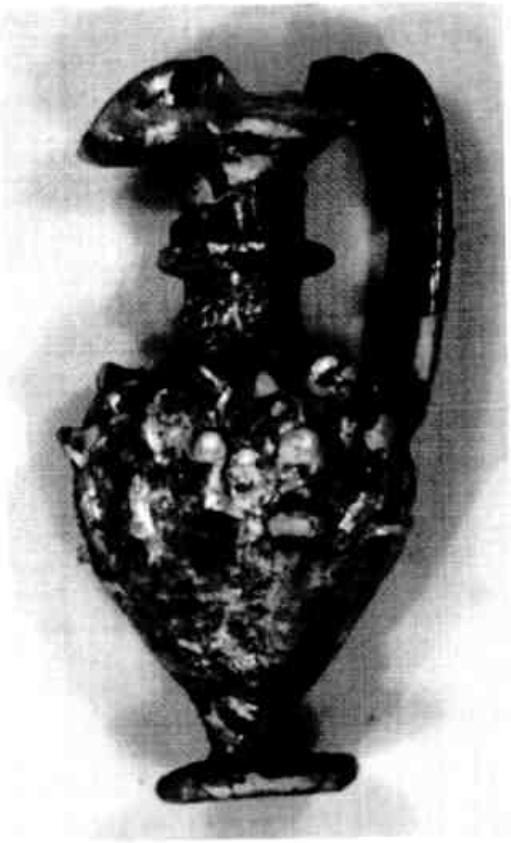
92

93

94

95

Fig. 10 - Glass beads from Adria - unknown site (Cat. 90 - 95).



97

98

Fig. 11 - Etruscan core formed vessels of blue opaque glass - unknown site (Cat. 97 - 98).