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## Major Questions Concerning Celtic Glass from the Eastern Regions of the La Tène Culture

Glass-making is one of those processes requiring high temperatures that were mastered by man relatively early. Together with ceramic and metal finds, glass and its derivatives such as faience and glaze are uncovered in most archaeological sites dating from the Early Bronze period. Unlike both ceramic and metal products, however, glass served for a long time as the raw material for ornamental artefacts and other products that were not functional directly. This role of glass as a “luxury” product had prevailed in the archaeological European cultures – outside the Mediterranean basin – for a long time, to be precise, up to the Roman period, namely, when the blowpipe was invented and in many regions – even longer.

La Tène Culture glass jewellery, which had been of only secondary importance to researchers interested in the late Iron Age, became a subject of detailed study during the last a quarter of a century (see mainly: Venclová 1980; 1990; Gebhard 1989; Zepezauer 1993; Schäfer 2003; Karwowski 2004)<sup>1</sup>. The characteristic glass bracelets, ring-beads and tiny rings (*Fingerringe*) turned out not only to be good chronological determinants but also indicators of broad changes within La Tène Culture in the mid-third century B.C. Those changes finally shaped the nature of the La Tène settlement in central-eastern Europe. That was the beginning of an increase in the economic development of the region. New technologies were adopted and trade contacts reorganised. Among the signs of the coming changes to La Tène Culture sites was the appearance of glass bracelets – only a few at the beginning, which with the passage of time finally became a quite characteristic element among the archaeological finds dated to the Middle-La Tène Period.

Bracelets belong to the most typical glass artefacts of La Tène Culture (Fig. 1). They are common examples of ornaments used in La Tène Culture, most certainly having their roots in the Hallstatt tradition. Bronze and, more rarely, iron bracelets have been found in graves dating to the Early La Tène Period. The number of grave finds of this type considerably decreases in the late phase of Middle- and in Late La Tène

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<sup>1</sup> The fundamental source to base research on La Tène glass still remains the dated work by Th. E. Haevernick (1960), whose source materials mostly relate to research from before World War Two.



Fig. 1. Glass bracelets of Group 8a from Kleinreiprechttsdorf (above) and Group 14a from Mannersdorf am Leithaberge (below), both in Lower Austria.

Periods. This is connected with a sudden disappearance of archeologically traceable Celtic burial grounds. It is lignite and glass bracelets that have been found to be characteristic to that period of La Tène Culture. In the times corresponding to Middle- and Late La Tène Periods, both in the cultures remaining under the influence of La Tène Culture and the neighbouring lands, bracelets as a form of ornament were not used that commonly.

La Tène glass bracelets have been found in a relatively small number of graves, mostly in skeleton ones. These artefacts can be more often found on La Tène Culture settlements. Practically on nearly all larger settlements dated to Middle- and Late La Tène Periods bracelets have been found. Glass bracelets usually constituted the most numerous non-ceramic category of archaeological finds. Big concentrations of glass bracelet finds, however, have occurred on only a few sites, mainly in *oppida* (Fig. 2).

Another category of La Tène Culture finds made of glass are massive, often coloured, ring-beads (Fig. 3). Like the bracelets, they have been

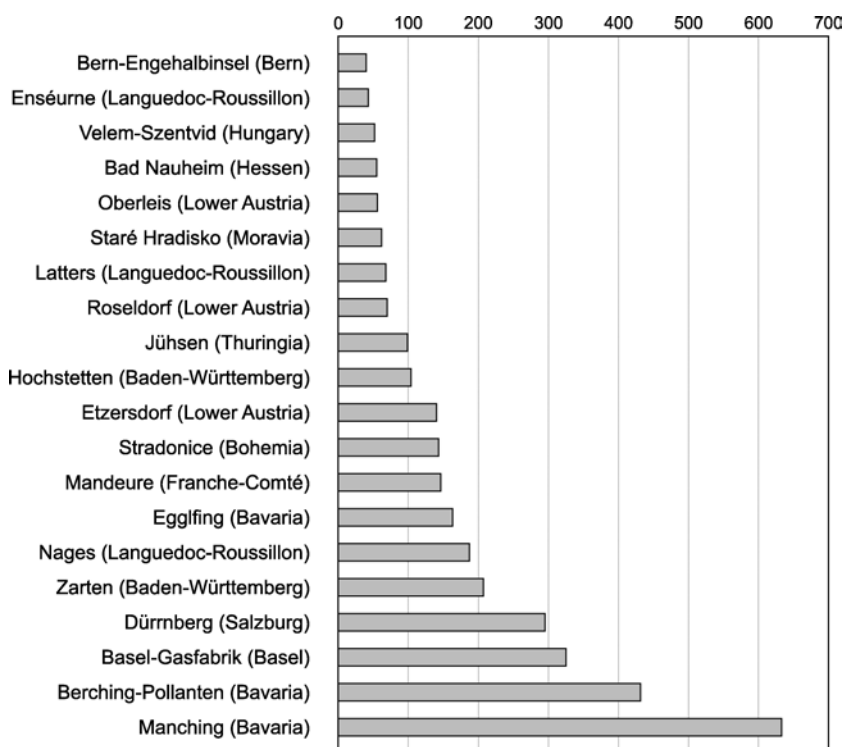


Fig. 2. The largest collections of glass bracelets in La Tène Culture. *Oppida* and open settlements.

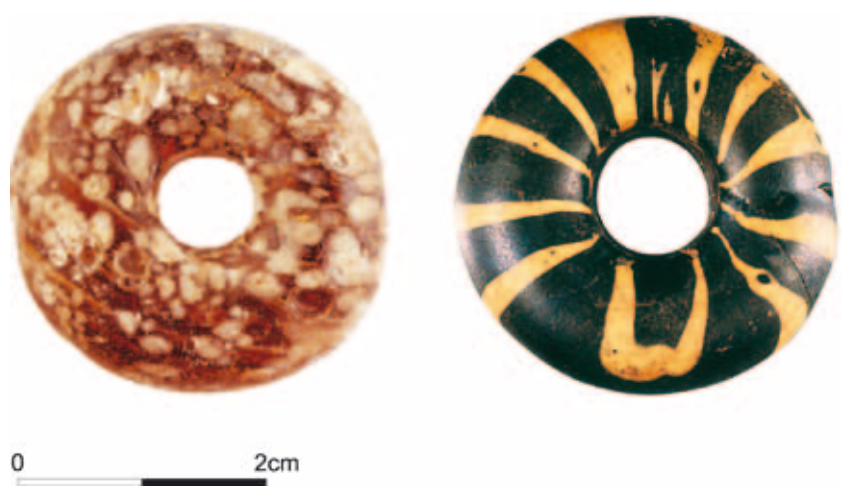


Fig. 3. Glass ring-beads of Group 24 from Altenburg in Lower Austria (left) and Group 23 from Błonie in Poland (right).

found on most of La Tène Culture settlements – predominantly in *oppida* (Fig. 4). They have also been found in graves, sometimes forming necklaces made up of over twenty separate pieces.

The third category of glass finds typical for La Tène Culture are tiny rings (*Fingerringe*). These artefacts are much smaller than and not as ornamental as ring-beads. They might be in a sense described as minia-

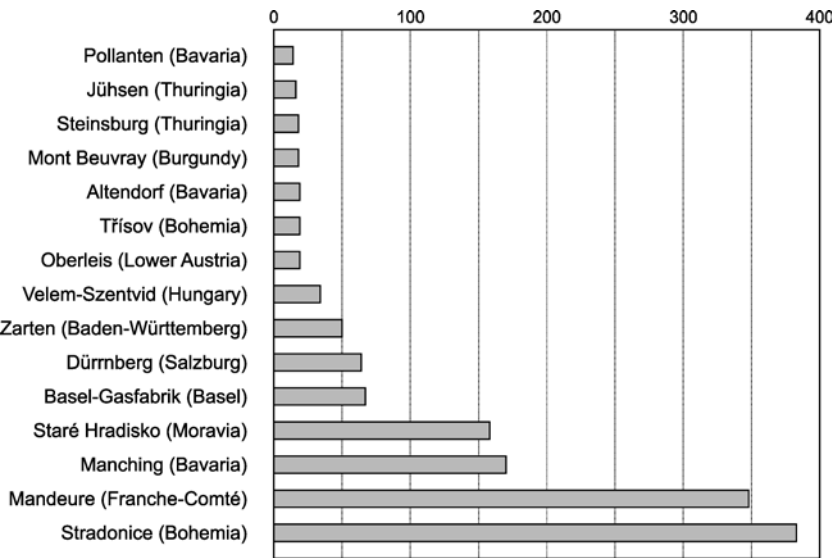


Fig. 4. The largest collections of glass ring-beads in La Tène Culture. *Oppida* and open settlements.

ture glass bracelets (Fig. 5). The relatively small number of finds coming nearly exclusively from the settlements do not allow us to unambiguously decide whether they were worn on fingers or were used as elements of necklaces as it was the case of ring-beads.

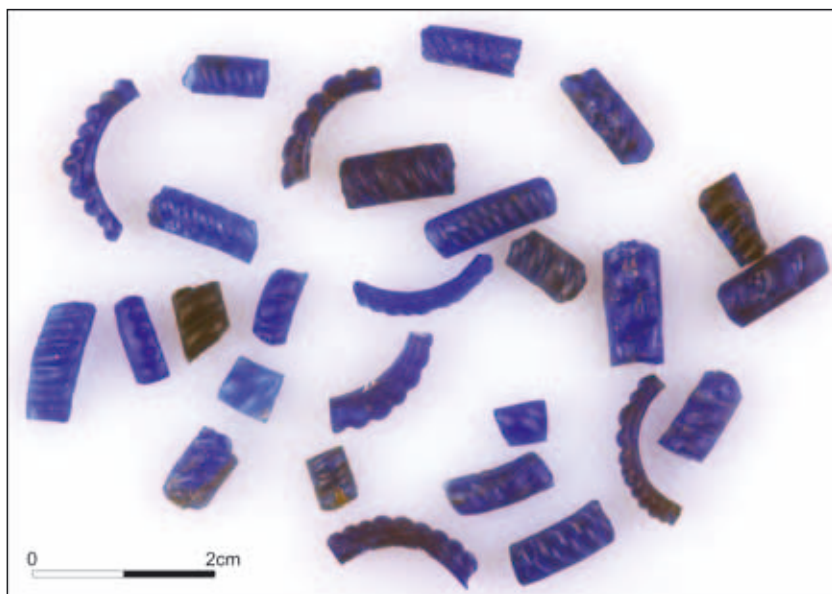


Fig. 5. Fragments of tiny glass rings (*Fingerringe*) from Etzersdorf in Lower Austria.

It is much more difficult to determine whether the tiny glass beads or pendants quite numerous occurring on La Tène Culture sites, even if they are additionally decorated (e.g. “eye-beads” and “mask-beads”), can be classified as examples of “La Tène glass”. These ornaments occur within a quite broad chronological range and over vast expanses of land stretching well beyond the areas embraced by La Tène Culture.

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Glass bracelets, ring-beads and tiny rings have been found on La Tène Culture sites in Middle- and Late La Tène (LT C and LT D) Periods. As a result of the growing interest in these artefacts mentioned above, they gradually became a chronological determinant of trans-regional importance. This mainly concerns glass bracelets. Glass ring-beads and tiny *Fingerringe* are also used for this purpose, though to a smaller degree.

The chronology of glass bracelets in La Tène Culture has already been described in detail (Venclová 1980; 1990, 115–135; Gebhard 1989, 46–134; lately also: Karwowski 2004, 63–80). Despite some differences

in opinions concerning the dating of some bracelets, the general chronological tendencies remain the same or at least similar. The main problem the researchers encounter while attempting to determine the chronological positions either of single items or of whole typological groups of glass bracelets is a relatively small number of well dated grave finds. Only in the case of a few groups of bracelets is it possible to define a set of artefacts that coexist with them and can therefore be placed in a specific time horizon. Another problem is caused by the regional character of burial inventories and a lack of grave finds from a large part of central-eastern Europe, where, starting from the LT C2 phase, new ways of burying the dead became common, for which archaeological evidence is unavailable. A very small number of glass bracelets have been found in only a few local graves coming from that period. The great majority of glass bracelet finds come from settlements and *opidda*. Settlement finds do not offer a wealth of artefacts belonging to other categories. Nor do they present such great importance to researchers into chronological studies as do closed grave complexes. Therefore, it is mainly the ceramic material and, to a smaller extent, pieces made of metal, mainly iron, that are used in the dating process of Middle-La Tène settlements. It is worth noting that a great number of Celtic coins, particularly East-Celtic ones, cannot be easily dated. The chronological system worked out for the areas in which grave finds have been documented cannot be automatically applied to areas “grave finds free”, because, as a rule, it cannot be supported by the local archaeological material. Middle-La Tène ceramics are regionally varied; therefore, it is impossible to find correctly-dated analogies. There is evidence that trans-regional finds, such as some forms of bronze fibulae, are considerably more reliable. Glass bracelets so often found in Middle-La Tène settlement sites might play a similar role. This naturally concerns only bracelets occurring in big areas, known from correctly dated closed complexes and are free of distinct local stylistic features.

Research on the chronology of La Tène glass ring-beads is much less advanced than that on glass bracelets (Gebhard 1989, 174–180; Venclová 1990, 135–142; Zepezauer 1993, 94–99; Karwowski 2004, 73–80). The main problem again is a small number of glass ring-beads finds from graves and/or its complete lack in many La Tène Culture areas, especially in the east. The question of dating this category of artefacts is closely connected with the much broader problem of chronology. This is the question of pointing to a clear dividing line between phase LT C1 and LT C2, separating the material from phase LT C2 and LT D1 and dating the decline of phase LT D1. The problem is that glass ring-beads were made just in this chronologically “problematic” period of La Tène Culture.

In terms of chronology, the last category of La Tène glass jewellery – tiny glass *Fingerringe* – are the least researched (see: Zepezauer 1993, 87; Karwowski 2004, 77–80). On the outside these artefacts look like miniatures of glass bracelets, mainly from Group 3, 6 and 8, according to Th. E. Haevernick's (1960, 45–57) typology. This stylistic similarity allows an assumption that they might have been produced in the same period.

Chronologically, La Tène Culture ornaments made of glass occurred throughout the Middle-La Tène Period and the early phase of the Late-La Tène Period. The quantitative “boom” in their production coincides with developed the Middle-La Tène Period. The evidence to this mainly being the finds dated to phase LT C1b and/or LT C1b and LT C2 combined. The finds dated to phase LT C2 exclusively and to the Late La Tène Period (LT D1) are slightly less numerous, while the smallest number of archaeological pieces found are from the earliest phase, i.e. LT C1a.

The earliest dated glass bracelets found on some La Tène Culture settlements allows us to make a conjecture that those sites were already settled from the beginning of the Middle La Tène Period rather than, as it is often stipulated, from as late as phase LT C2. It is also worth mentioning that within many of these settlements such early chronological horizon is not clearly represented by other category of finds<sup>2</sup>. As mentioned before, those finds mainly comprise ceramic or iron material, often representing local stylistic forms. Because of a nearly total lack of compact grave complexes dated to Middle- and Late La Tène Periods within the vast expanses of eastern *Celtica*, it is nearly impossible to determine the exact dating of such archaeological material. Therefore in many cases the early glass bracelet items found on settlements are dated to a later time, and consequently, the sites are dated to a later time, too (see: Venclová 1980, 83; 1990, 144–154). As it has already been pointed out by R. Gebhard (1989, 56), it seems that it is necessary to move backwards the dating of when the settlement of those sites began. A wide variety of glass bracelet designs and their obvious fragility means that the claim of the long-term nature or durability of the items it is questionable.

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<sup>2</sup> For example, when comparing the collection of glass bracelets, ring-beads and tiny rings from Oberleiserberg in Lower Austria with the collection of La Tène iron and bronze fibulae from the same site, it is clearly noticeable that the majority of the fibulae represent later phases, though they fall within a similar chronological time bracket (see: Karwowski 1999, 118, Fig. 12, footnote 22).

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Both the number of finds and the quality of the material the glass ornaments were made of may be indicative of a specialist system of glass-working or even glass-making present within La Tène Culture. The development of this kind of “industry” so suddenly and over such a short period of time must have been related not only to the new technologies that had been adapted to suit the local needs and tastes but presumably also to the influx of qualified foreign craftsmen. A far reaching unification of bracelet designs covering vast areas under the influence of La Tène Culture has been noted. That relates even to the earliest and rare examples of this kind of personal ornaments. Simultaneously, the characteristic style demonstrated in the earliest glass bracelets is indicative of distinct aesthetic tendencies displayed by La Tène craftsmen. Design similarities between items found on sites quite distant from each other allows us to make the claim that, like in bronze fibulae, the variety of glass ornament designs reflected the stylistic trends embracing the entire La Tène Culture. It is also worthy of note that the style and ornamentation of some earliest glass bracelets draw on the then out-of-date plastic style motifs of Early Celtic art. Only a relatively small number of glass bracelets and its ornaments dated to the earliest phase seem to display local stylistic features. The fact that these finds are concentrated in small areas within La Tène Culture implies the hypothetical production sites and distribution zones. The number of such finds dated to the developed Middle-La Tène Period is considerably smaller.

From among various types of La Tène Culture glass bracelets a most rare kind occurring in eastern *Celtica* exclusively are the bracelets classified in Th. E. Haevernick's (1960, 63) typology as Group 15 (see also: Čižmář 2003, 44–45; Březinova 2004, 148–149). They belong to the group of most richly ornamented La Tène Culture glass jewellery (Fig. 6). The most characteristic element of these bracelets are finely modelled nodules decorated with stripes forming a spiral pattern. Bracelets belonging to this group are known from 18 findings only (Fig. 7), mostly from Slovakia (9 items), Moravia (3 items), Upper Silesia (2 items), west Małopolska (a single item) and Vojvodina (2 items). A well preserved complete bracelet of Group 15, unfortunately of unclear origins, was put up for auction at the Dorotheum Auction House in Vienna a couple of years ago (Fig. 6). The bracelets mentioned here should be dated to the early phase of the Middle-La Tène Period (LT C1) as they have been found on chronologically well determined burial and settlement sites. A couple of well preserved complete items (including the one put up for auction at the Dorotheum) must have come from skeleton graves, which undoubtedly is an argument for their early dating.



0 3cm

Fig. 6. Glass bracelet of Group 15 from Dorotheum Auction House in Vienna (after: Dorotheum 1999).

Another feature that is characteristic of the eastern La Tène Culture province is the occurrence of glass bracelets featuring a specific kind of ornamentation, the so-called *Schleifenverzierung* (Karwowski 2004,

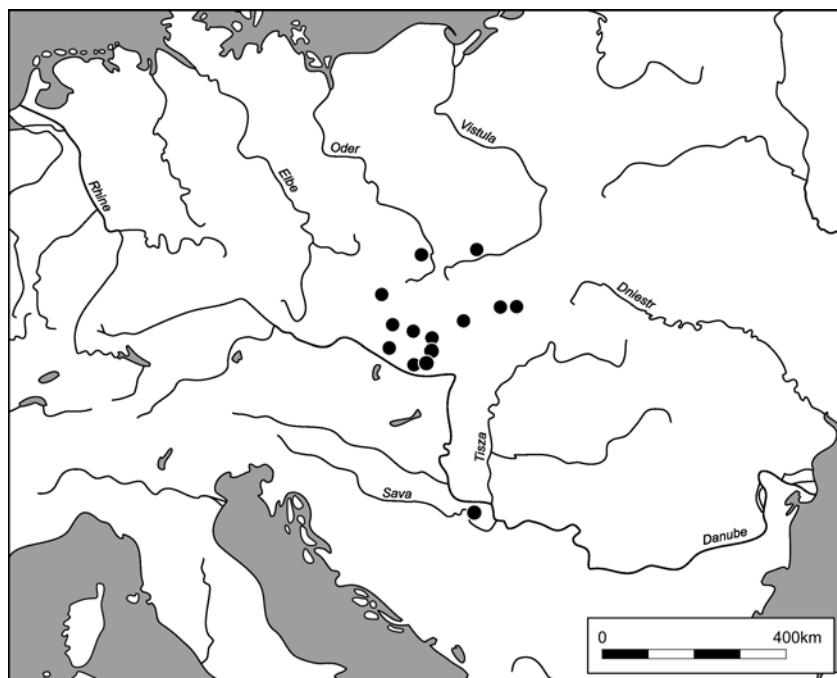


Fig. 7. Distribution of glass bracelets of Group 15.

51–54, Fig. 12; 2004b, 155, Fig.3). The ornamentation consists of stripes made of white or yellow opaque glass forming more or less regular 8-shaped loops (Fig. 8). The *Schleifenverzierung* was mainly applied to Group 6b bracelets, according to Th. E. Haevernick's (1960, 50) typology. In some cases, however, it appeared in bracelets belonging to other groups as well. Bracelets of Group 6b decorated with the *Schleifenverzierung* have been mainly found along the middle course of the Danube River basin (Fig. 9). The biggest number, that is 19 items decorated in this way, have been found in eastern Austria (Lower Austria and Burgenland), followed by a comparable find of 15 items in Slovakia. Hungary and Moravia both boast finds of three such items, while two have been found in Silesia and one in Małopolska, and another one in Transcarpathian Ukraine. The occurrence of bracelets of Group 6b decorated with the *Schleifenverzierung* in regions lying further west is less numerous. Bavaria boasts twelve such bracelets (most found in the *oppidum* of Manching), three in Salzburg, two in Switzerland, two in Thuringia and a single item in Bohemia. It also needs to be emphasised that bracelets of Group 6b are the most widespread type of La Tène Culture glass bracelets both chronologically and geographically. Items of this group decorated with the *Schleifenverzierung* belong however to the finds dated to the earliest period in the development of the La Tène Culture glass processing craft. They have been found in grave complexes together with the inventory dated to the earliest phase of the Middle-La Tène Period or even to the Early-La Tène Period. In some cases where the *Schleifenverzierung* occurred on items found outside eastern *Celtica*, the pattern seems to be stylistically slightly different and might be chronologically dated to a later time.

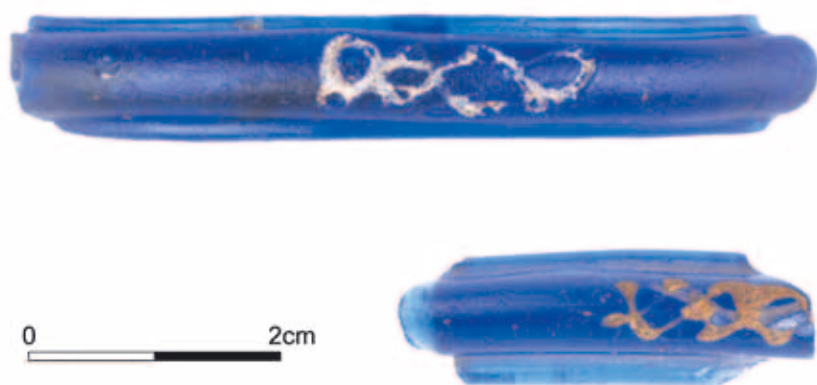


Fig. 8. Fragments of glass bracelets of Group 6b with *Schleifenverzierung* from Etzersdorf (above) and unknown site (below), both in Lower Austria.

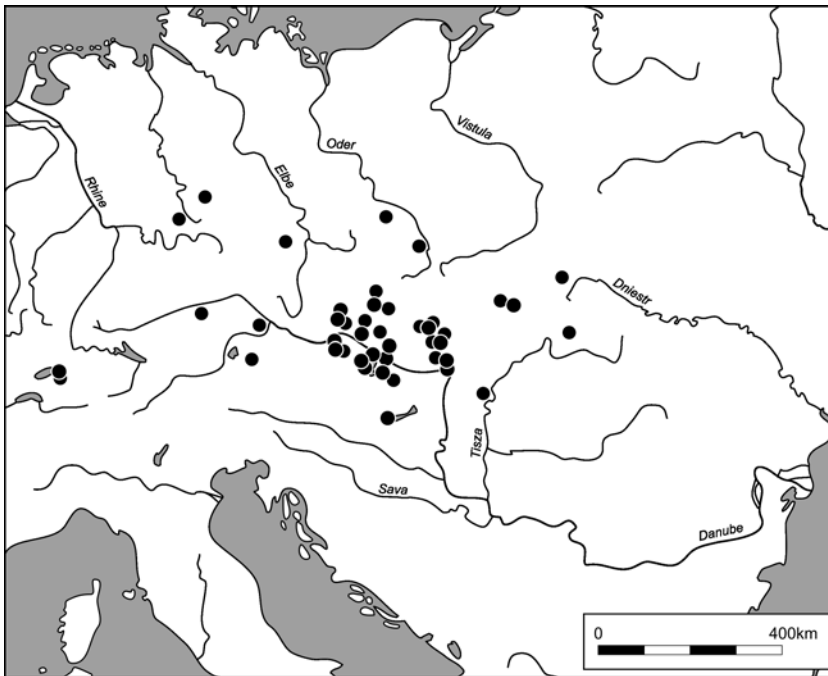


Fig. 9. Distribution of glass bracelets of Group 6b with *Schleifenverzierung*.

Also tiny glass rings (*Fingerringe*) found on several archaeological sites can be linked to eastern *Celtica* (Fig. 10; Karwowski 2004, 49–51, Fig. 11; 2004a, 172–173, Fig. 9–10). These finds are clearly concentrated in east Austria (Lower Austria and Burgenland) – 64 items (including 45 items found in the settlement of Etzendorf). Outside this area several items have been found in Bavaria, a couple in Salzburg and Slovakia and single items in Slovenia and Upper Silesia. Designs that are specific to Lower Austria are rings made of blue glass with notched surface (46 finds, most of them coming from the site of Etzendorf mentioned above; Fig. 5) and items featuring three ribs (a mere three finds). Part of the notched rings found within the settlement of Etzendorf seems to be carelessly manufactured, which allows us to conclude that they are faulty items being a kind of production discard.

It is worth mentioning here that glass bracelets from Group 8a of Th. E. Haevernick's (1960, 53–54) typology that do not have marked off edges, the notched *Fingerringe* being quite similar to this group, belong to very rare La Tène Culture items. They have been quite frequently found on a number of archaeological sites located in north-eastern Austria, however.

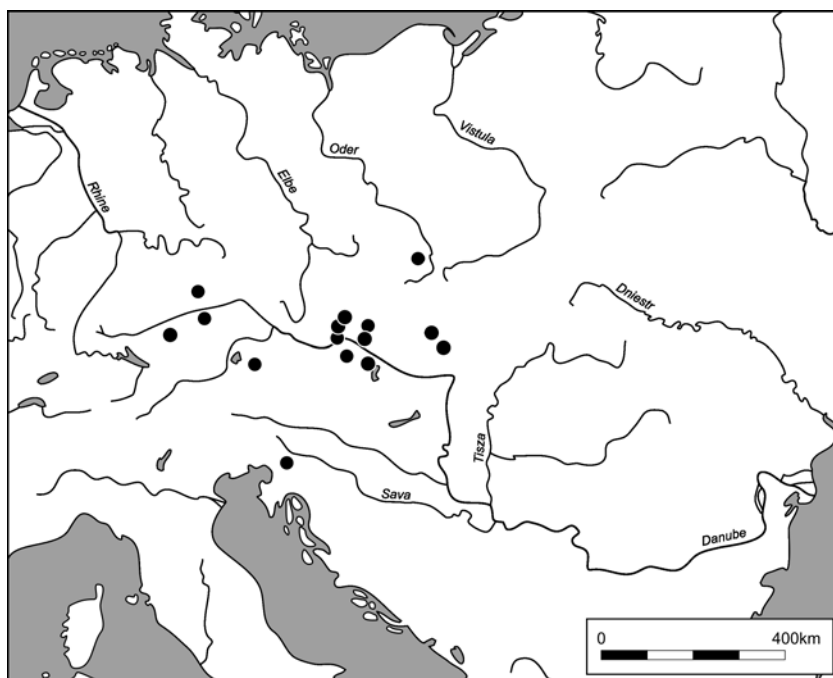


Fig. 10. Distribution of tiny glass rings (*Fingerringe*).

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So far neither the question the location of the La Tène glass-works nor whether glass was ever produced within La Tène Culture boundaries have been unequivocally answered. The difference between the skill of glass-making (melting) and that of ready-made glass-processing seems to be huge and can be compared to the difference between iron smelting and smithery. In both cases the production processes demand much higher qualifications. This does not concern the technological difficulties alone but also the ways of acquiring and selecting raw material. La Tène Culture archaeological material available so far shows no trace that might provide evidence to glass production, such as buildings, kilns, furnaces, tools, raw material or production discards located within a single, concrete archaeological site. The majority of researchers are inclined to agree that glass might have been imported to this culture from Mediterranean glass-works as a half-finished product in the shape of glass lumps or bars (compare: Henderson 1989, 44–47; Venclová 1990, 143). Only a few such lumps of glass have been found on La Tène Culture sites (see: e.g. Gebhard 1989, 148; 1997, Fig. 1; Karwowski 2004, 93, Fig 37; compare: Brand 2002, 110).

There is supposed however, that in local La Tène Culture workshops glass could have been chemically modified, i.e. hued, decoloured or opacified. Such advanced processing techniques require expertise and experience, access to suitable raw materials and, above all, deep insight into the complex processes occurring in molten glass. Such a hypothesis may be supported by both the results of research on the chemical composition of La Tène glass and the chronological value of some glass colours. There is little doubt, however, that glass was shaped into finished artefacts in La Tène Culture glass workshops, the evidence of which is the characteristic La Tène designs and their clear concentration observed on a number of archaeological sites.

Many researchers agree that glass workshops were located in more important *oppida*, such as Manching in Bavaria and Stradonice in Bohemia. It is also generally accepted that glass-processing was practised in some important open centres, such as Dürrnberg in Salzburg. However, this theory is mainly, though not only, based on quantitatively big concentrations of glass artefacts there. On the basis of this concentration of finds, N. Venclová (1990, 156–157) points to a number of La Tène Culture sites and regions in which glass workshops could have functioned (Fig. 11). In eastern *Celtica* the most probable

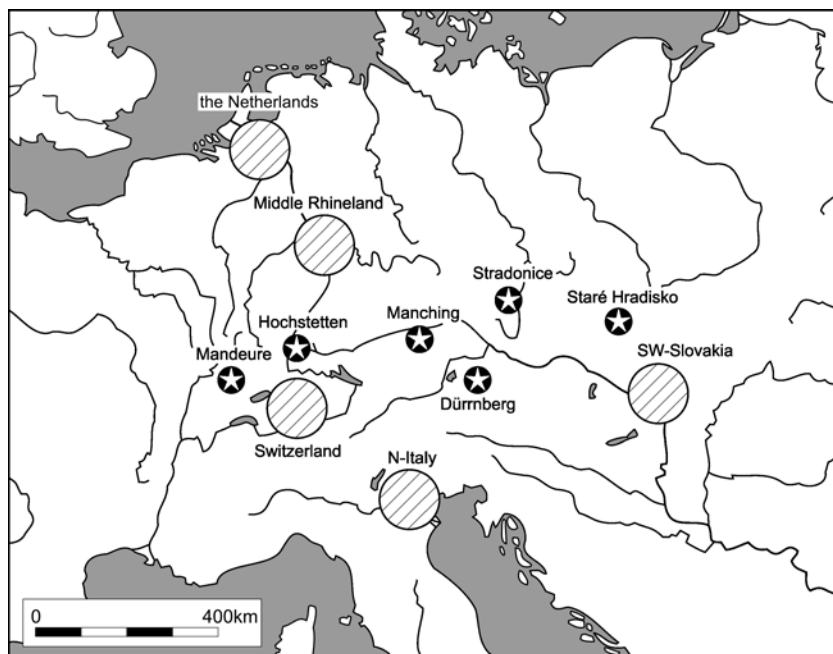


Fig. 11. Presumed glass workshops producing „Celtic“ glass. Sites and regions (according to: N. Venclová 1990).

area where glass craftwork could have been practiced is south-western Slovakia. Another probable site where glass artefacts were produced is the *oppidum* of Stare Hradisko in Moravia. The most numerous collection of production discards, unfinished and faulty products, however, has been found on the settlement of Eggfling in Bavaria (Uenze 2000, 17–20). It is worthwhile mentioning here that A. Cofta-Broniewska (1977; 1979, 121–122) suggested the possibility of the existence of a Celtic glass-processing workshop in the settlement of Przedbojowice in Kujawy in northern Poland. However, the author based her claim on a questionable surface find of a small number of molten glass fragments, discards and half-finished products. The nature of the archaeological finds makes it impossible to date this site. There is also no further evidence as to the possibility that a glass-processing industry existed in Kujawy in the pre-Roman period.

So far no conclusive evidence has been produced that points to glass production (or even processing) on a specific archaeological site of La Tène Culture. It should be noted that the archaeological interpretation of well-preserved traces of glass-works is relatively easy, while it is much more difficult to interpret the remains of glass-processing workshops, particularly when the analysed material consists of items representing only the final stages of the production process. It is often absolutely impossible to determine the type of workshop and the character of the activity performed there.

The glass workshop uncovered in the Celt-Dacian stronghold Malaya Kopana in the Upper Tisa River region in Transcarpathian Ukraine (Fig. 12; Kotigroshko 1989, 187–191) presents a unique example of an archeologically recognised construction unquestionably connected with glass-processing and also, quite possibly, with glass-making. The site might date from around the 1st century B.C., which was a period of intensive mutual influences between La Tène and Dacian Cultures. Like in the case of La Tène Culture, apart from the workshop at Malaya Kopana, no other traces have been found testifying to the existence of Dacian glass-making workshops functioning in the pre-Roman period. There are several premises that might point to their existence, however. Basing his claim on the chemical analyses of a series of glass items found on settlements in Mutenia, Transylvania and Moldova, E. Iaroslavschi (1997, 99–100) put forward a suggestion that glass could have been made in local workshops. However, as the chronology of these finds is unclear and most of them may be dated to the Dacian Wars, i.e. also to the 1st century A.D., this means that these finds might be much later than the La Tène Culture material.

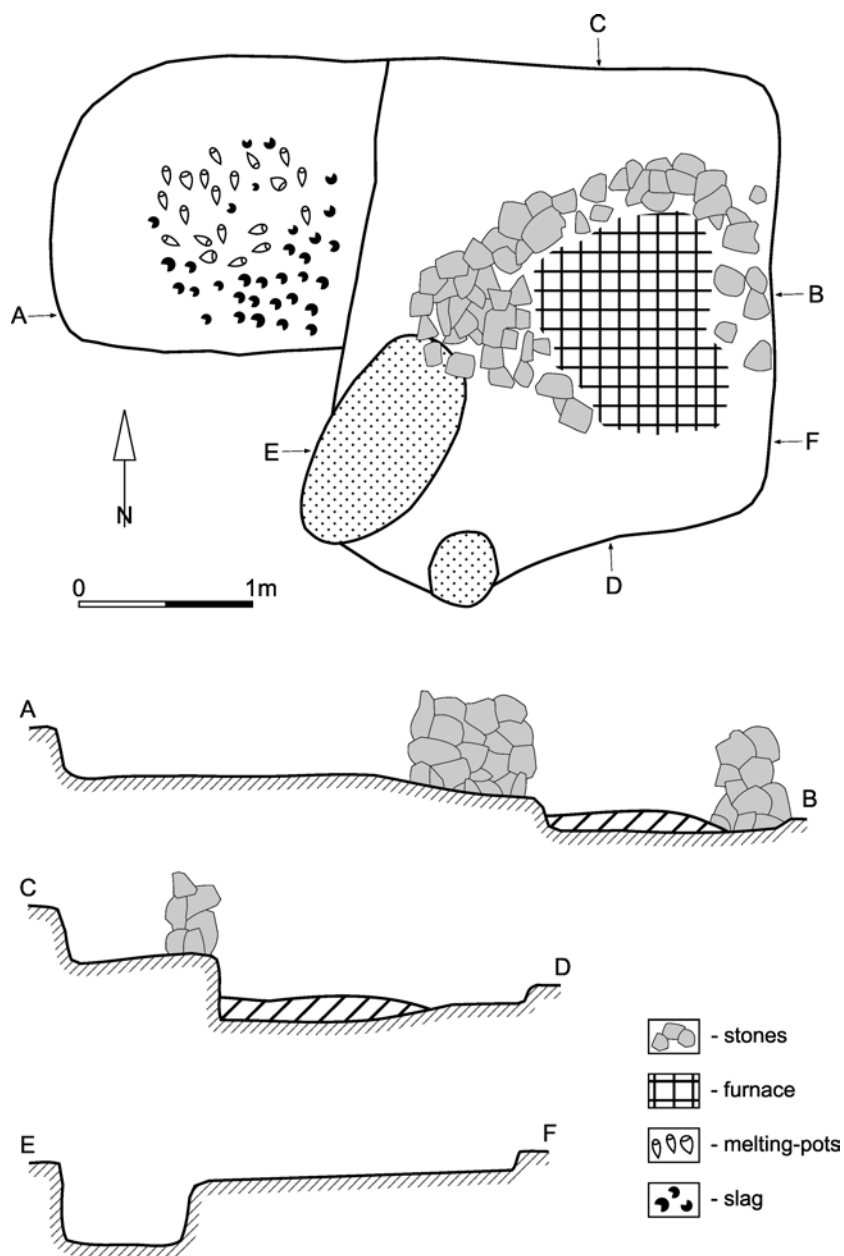


Fig. 12. Glass workshop from Malaya Kopana in Transcarpathian Ukraine (according to: Kotigroshko 1989).

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Chemical analyses, which in fact constitute a separate field of archaeological research, have become vital to studies on archaeological glass, La Tène glass included. Researchers employ a variety of analytical techniques and make use of various methods to interpret their results. On the one hand, this often means that research results are sometimes difficult to compare. On the other hand, research methods are becoming more and more advanced and researchers find new solutions to interpret the data available. The discussion on both archaeological and technical issues related to archaeological glass, La Tène Culture finds included, concentrates around three main research trends (see: Henderson 1989, 30–31). The first consists in identifying the raw materials used in glass production and their origin through chemical analyses. The second main trend aims at the reconstruction of the techniques employed to modify the glass colour through the atmosphere in the kiln and the heating time. The third trend deals with the chemical characteristics of glass products in relation to their place of origin. Such research is based on the premise that chemical composition of glass might reveal the information not only related to the time of origin but also to the place the given glass artefact was produced because of the application of a specific set of raw materials used by ancient glass makers. Since the 1960s more and more effective, accurate, faster and, consequently, cheaper research methods have been employed. In research on La Tène glass the following methods have been successfully employed: X-ray fluorescence analysis (Gebhard 1989, 148–167; Frána, Maštalka 1994; Braziewicz *et al.* 1996; Wobrauschek *et al.* 2000; Jakubonis *et al.* 2003; Karwowski 2004, 94–135), neutron activation analysis (Frána, Maštalka 1984; 1990; 1994; Frána *et al.* 1987; Gebhard 1989, 148–167) and spectral-chemical methods (Hahn-Weinheimer 1960; Girdwoyń 1987). Recently an attempt was made to interpret the analytical data using sophisticated computational methods (Grudziński *et al.* 2003; Grudziński, Karwowski 2005).

The abovementioned research on the chemical composition of La Tène glass artefacts showed particularly interesting results related to the connection between the concentrations of some elements in the basic composition of the glass items with their chronological position. The substances added to influence the glass properties must have been changing together with the growing experience of the glass-makers, better access to raw materials and the changes in tastes related to glass appearance. Those changes could have been taking place very slowly because the glass-making and/or the glass-processing craft could have been mastered by only a few artisans. It can be concluded that the concentration

level and proportion of the substances used in glass evolved in time and that their presence might reveal their connection with the chronology of the glass items established through archaeological methods.

From among the examples of La Tène glass found mainly in eastern Austria, but also in Dürrenberg in Salzburg and in Poland, examined through the use of the X-ray fluorescent analysis method (Karwowski 2004, 94–135; Karwowski *et al.* 2005), the most distinct group chemically comprises the earliest glass items, dated to the very beginning of the Middle-La Tène Period (LT C1a). Their uniqueness is most strongly manifested by the proportion of strontium and zirconium (Fig. 13). It is not yet clear what role these elements played in the production processes used in ancient glass-making. Most probably they had found their way into the glass quite accidentally, together with other components used in the process. Also different concentrations of chemical glass decolourants, such as manganese and antimony seem to be of similar importance to studies on the chronology of items examined (compare: Frána, Maštalka 1994, 590–592). One can determine a clear tendency to gradually increase the concentration of manganese in glass coloured with cobalt (blue). Moreover, the content proportions of iron and cobalt in glass coloured with cobalt seem to be related to the chronology of the items (Fig. 14). In the earliest glass pieces coloured with cobalt (LT C1a) low cobalt content corresponds to high iron content. With the passage of time a gradual increase in the cobalt content resulted in a decrease in the iron content (compare: Gebhard 1989, 160–165). This tendency might be due to the gradual advancement in glass-making skills, which resulted in the production of glass that was more clear because the craftsmen used colorants that were less tainted with iron compounds. Also comparing the relations between the tin and lead concentration could indicate another chronologically important tendency (Fig. 15). Our observations made it possible to distinguish a homogeneous group embracing the majority of the material studied where a distinctly increased level of tin concentration corresponds to an increased lead concentration level. These two elements found in glass usually serve as opacifiers, although they are found in translucent glass as well. From among the glass pieces that clearly exemplify this tendency it is possible to distinguish a Late-La Tène (LT D1) group of ornamental ring-beads. This case might be indicative not only of a chronological trend but of a trend of regional importance as well. Taking into account the distribution of ornamental ring-beads in central Europe, one might conclude that a vast majority of them originated in the *oppidum* of Stradonice in Bohemia.

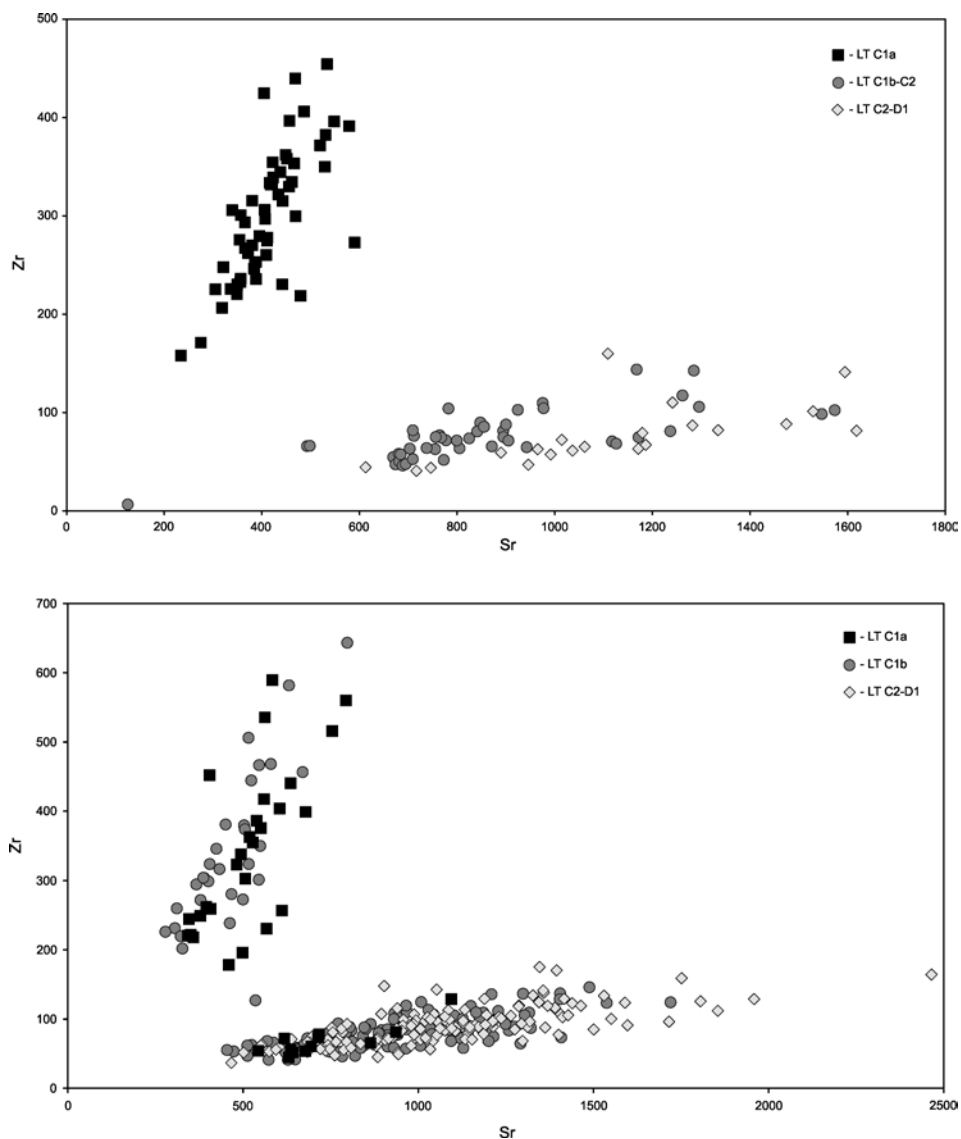


Fig. 13. Dependence of the Zr-Sr concentrations in colourless and iron-coloured (above), and cobalt-coloured glasses (below).

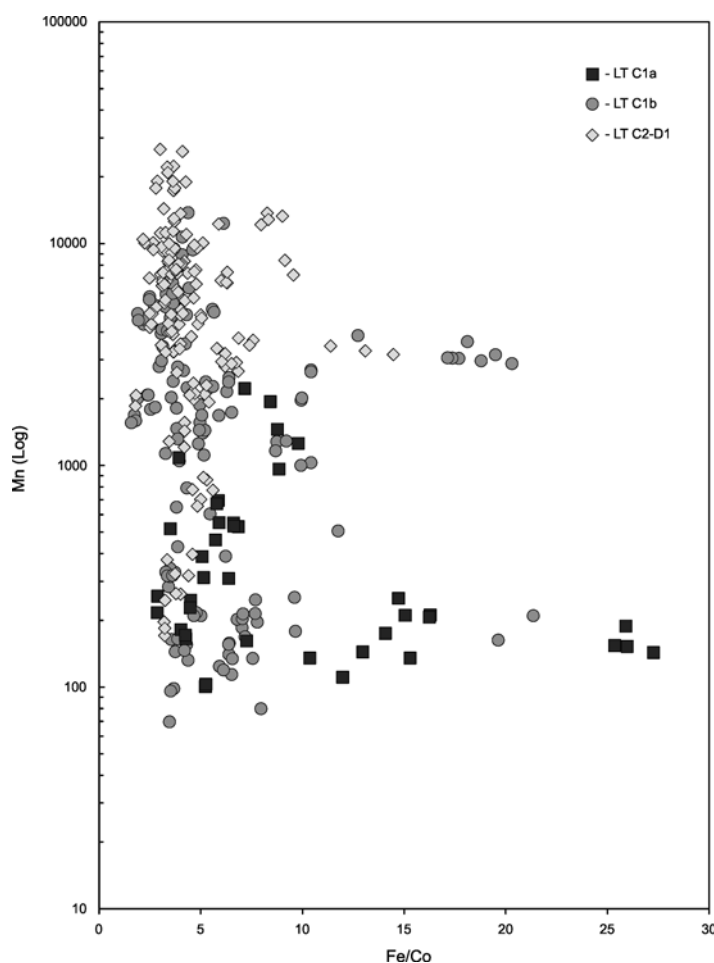


Fig. 14. Dependence of the Mn-Fe/Co concentrations in cobalt-coloured glasses.

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Research on La Tène glass makes it possible not only to typologically classify glass bracelets, ring-beads and tiny *Fingerringe* (often only partially preserved) but it proves that these glass artefacts are precise chronological determinants. Numerous finds of ornamental glass pieces provide the basis for the conjecture that in Middle- and Late La Tène Periods they were commonly used everywhere in the areas where La Tène Culture prevailed, while in the environment of the neighbouring cultures they were used as a barter commodity. The typological variability of ornamental glass items corresponds with the chemical variability of the glass from which they were made. Studies

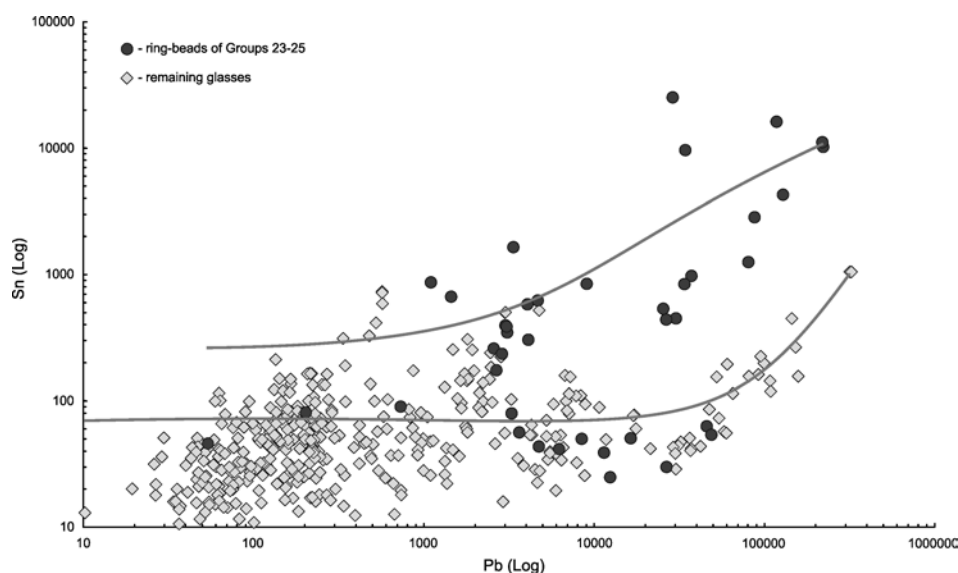


Fig. 15. Dependence of the Sn-Pb concentrations in all studied glasses.

on the basic chemical composition of these items not only allow us to follow the technological changes that were taking place in the La Tène glass-processing craft but they also help us determine the chronology of the given artefacts.

Although the results of archaeological research conducted so far have not been conclusive enough to unequivocally confirm the existence of glass-processing workshops on La Tène Culture sites, the evident concentration of glass finds in some areas or even on individual sites allows us to advance the thesis that they did exist also in the period prior to the establishment of *oppida*. The existence of glass bracelets dated to the earlier phase of the Middle-La Tène Period (LT C1) support the claim that such small-scale production must have been practiced also in open settlements.

Closer examination of La Tène glass and the glass-processing craft shows that many questions still remain unanswered. This concerns both the La Tène ornamental glass finds themselves and the overall role that glass played in La Tène Culture.

It is of the utmost importance to thoroughly reconsider the nature of La Tène glass typology. Research on this category of finds is advanced enough to arrive at a detailed typology of the material found in the La Tène Culture domain. It seems there is a growing need to separate the rare and untypical forms, though occurring in vast areas, from the forms of local importance. This requires large-scale studies of quan-

titatively rich and stylistically varied material, however. Th. E. Haevernick's typology (1960), created half a century ago, is becoming more and more limiting. On the other hand, the system drawn up by R. Gebhard (1989; 1989a) seems to be based on Manching finds exclusively, which, regardless of their impressive quantity, are of local character. Additionally, there is a need to examine and describe La Tène glass not only as an individual category of finds but also to produce monographs of individual typological groups, like in the case of fibulae.

The lack of archeologically recognised La Tène Culture glass-making/processing workshops is another important issue requiring further study. No conclusive evidence has been presented as to whether glass-making techniques were mastered by La Tène craftsmen or that only half-finished products were imported and then processed. Chemical analyses conducted on late Iron Age glass have not been conclusive enough to answer this question. There is strong evidence, however, that the chemical composition of La Tène glass displays a number of unique features. The research results showed marked differences in the chemical composition in glass items that corresponded to their chronological position. It is to be expected that further studies will provide data related to the quality and origin of raw materials used in glass production. It is necessary, however, to employ several methods of analysis because of the limitations caused by using one method only.

It is also difficult to determine the role that glass working played in La Tène society. N. Venclová (1990, 157) stipulates that glass-working craftsmen could have been foreigners coming from other cultures. Later on their glass-working skills could have been transferred to local artisans. It remains unclear whether they came individually or in specialist groups. Glass ornaments were valuable goods and must have been an important barter commodity. There is no archeologically recognised evidence in favour of centralised glass production (or even processing) functioning in such important centres as *oppida*. This concerns not only the location of glass workshops within the boundaries of those centres, but also in their close vicinity. Therefore, there is no conclusive evidence to make a claim that there is any connection between the hierarchy of production and distribution of glass products in La Tène Culture and the structure of its settlement.

The current research results do not provide enough evidence to the presence of glass-makers in eastern La Tène Culture. The evident concentration of glass finds does not exclude such a possibility, however. Producing concrete proof that there existed a centre with a glass-working workshop, e.g. in western Slovakia or Lower Austria, would certainly be vital to research into the development of technology.

It seems, however, that such evidence would above all be indicative of the existence of organised long-distance contacts, both in terms of half-finished products import and distribution of finished articles. The level of social status of the glass-working profession and the craftsmen engaged in it is an issue related to the above. The limited number of La Tène glass-working centres that probably existed in the area allows us to conclude that this craft was reserved for a relatively small group of specialists. Obviously, without extensive and systematic excavation work it is difficult to determine whether the findings indicate a single workshop located within a settlement of dwellers or a local production and commercial centre. Any remains of glass workshops that did not engage in glass-melting but only specialised in processing of intermediate products are very difficult to identify in the archaeological material examined. In the view above, the fact that a glass-processing workshop was located within the boundaries of an open settlement, e.g. in Lower Austria seems to point to a significant aspect of the local settlement structure rather than to the existence of a newly discovered important centre of La Tène Culture. This aspect might mean the presence of both technologically complex production and trans-regional contacts made by people inhabiting open lowland settlements. As there were not any big sites such as *oppida* in the immediate vicinity, the open settlements could have also performed some administrative functions.

## Bibliography

### **Brand C.**

- 2002 Graphitton und Glas: Studien zur keltischen Keramik- und Armringproduktion vor dem Hintergrund Dürrnberger Siedlungsfunde, [in:] C. Dobiati, S. Sievers, T. Stöllner (eds.), *Dürrnberg und Manching. Wirtschaftsarchäologie im ostkeltischen Raum, Kolloquien zur Vor- und Frühgeschichte* 7, Bonn, 107–116.

### **Braziewicz J., Karwowski M., Jaskóła M.**

- 1996 Zastosowanie rentgenowskiej analizy fluorescencyjnej do określania stężenia pierwiastków w szkłe zabytków celtyckich z Polski, *Archeologia Polski* 41/1–2, 39–63.

### **Březinová G.**

- 2004 Keltské sklo v severnej časti Karpatskej Kotliny. Územie Slovenska, [in:] J. Gancarski (ed.), *Okres lateński i rzymski w Karpatach polskich. Materiały z konferencji*, Krosno, 137–151.

### **Čižmář M.**

- 2003 Laténské sídliště v Bořitově, *Pravěk – Supplementum* 10, Brno.

### **Cofta-Broniewska A.**

- 1977 Celtowie, szkło, Kujawy – sensacja 1976, *Z Otchłani Wieków* 43/1, 12–13.

- 1979 *Grupa kruszańska kultury przeworskiej. Ze studiów nad rozwojem regionalnym społeczeństw Kujaw, Poznań.*

#### **Dorotheum**

- 1999 Dorotheum – Antike Kunst (Auktion am 15. September 1999). 1898. *Kunstauktion im Palas Dorotheum*, Katalog, Wien.

#### **Frána J., Maštalka A.**

- 1984 Neutron activation analysis of some glasses from the stronghold of Závist, *Památky archeologické* 75/2, 458–462.  
 1990 Neutronová aktivační analýza laténských skel z Lovosic, *Archeologické rozhledy* 42/6, 657–660.  
 1994 Analýzy laténských skel z jižních Čech a z oppida Stradonice, *Archeologické rozhledy* 46/4, 584–593.

#### **Frána J., Maštalka A., Venclová N.**

- 1987 Neutron activation analysis of some ancient glasses from Bohemia, *Archeometry* 29/1, 69–89.

#### **Gebhard R.**

- 1989 Der Glasschmuck aus dem Oppidum von Manching, *Die Ausgrabungen in Manching* 11, Stuttgart.  
 1989a Pour une nouvelle typologie des bracelets celtiques en verre, [in:] M Feugère (ed.), *Le verre préromain en Europe occidentale*, Montagnac, 73–83.  
 1997 Oggetti preistorici in pasta vitrea nell'area alpina, [in:] L. Endrizzi, F. Marzatico (eds.), *Ori Delle Alpi*, Trento, 131–133.

#### **Girdwoyń A.**

- 1987 Celtic glass bracelets from excavations in Poland. A technological study, *Archaeologia Polona* 25/26, 199–208.

#### **Grudziński K., Karwowski M., Duch W.**

- 2003 Computational Intelligence Study of the Iron Age Glass Data, *Proceedings of Joint 13<sup>th</sup> International Conference on Artificial Neural Networks and 10<sup>th</sup> International Conference on Neural Information Processing*, Istanbul, 17–20.

#### **Grudziński K., Karwowski M.**

- 2005 The Analysis of the Unlabeled Samples of the Iron Age Glass Data, [in:] M. Kłopotek, S. Wierzchoń, K. Trojanowski (eds.), *Intelligent Information Processing and Web Mining, Advances in Soft Computing* 15, 59–66.

#### **Haevernick Th. E.**

- 1960 *Die Glasarmringe und Ringperlen der Mittel- und Spätlatènezeit auf dem europäischen Festland*, Bonn.

#### **Hahn-Weinheimer P.**

- 1960 Die spektrochemische Untersuchung von Glasarmringen und Ringperlen der Mittel- und Spätlatènezeit, [in:] *Haevernick 1960*, 266–278.

#### **Henderson J.**

- 1989 The scientific analysis of ancient glass and its archaeological interpretation, [in:] J. Henderson (ed.), *Scientific analysis in archaeology and its interpretation*, Oxford, 30–62.

**Iaroslavschi E.**

1997 Tehnica la Daci, *Bibliotheca Musei Napocensis* 15, Cluj-Napoca.

**Jokubonis C., Wobrauschek P., Zamini S., Karwowski M., Trnka G., Stadler P.**

2003 Results of Quantitative Analysis of Celtic Glass Artefacts by Energy Dispersive X-ray Fluorescence Spectrometry, *Spectrochimica Acta Part B*, 627–633.

**Karwowski M.**

1999 Keltische Glasarmringe und Ringperlen vom Oberleiserberg bei Ernstbrunn, Niederösterreich, *Archaeologia Austriaca* 82–83 (1998–99), 209–220.

2004 Latènezeitlicher Glasringschmuck aus Ostösterreich, *Mitteilungen der Prähistorischen Kommission* 55, Wien.

2004a The Probability of the Existence of Glass-working Sites from the Late Iron Age in Lower Austria. A contribution to the question of the significance of the late La Tène open settlements, [in:] H. Friesinger, A. Stuppner (eds.), *Zentrum und Peripherie – Gesellschaftliche Phänomene in der Frühgeschichte*, *Mitteilungen der Prähistorischen Kommission* 57, Wien, 169–176.

2004b Początki osadnictwa kultury lateńskiej na Podkarpaciu w świetle szklanych importów celtyckich, [in:] J. Gancarski, (ed.), *Okres lateński i rzymski w Karpatach polskich. Materiały z konferencji*, Krosno, 153–162.

**Karwowski M., Jokubonis C., Zamini S., Wobrauschek P., Trnka G.**

2005 High-Z Element Concentrations in Glass of La Tène Culture Ornaments, [in:] H. Kars, E. Burke (eds.), *Proceedings of the 33rd International Symposium on Archaeometry – Amsterdam*, Geoarchaeological and Bioarchaeological Studies 3, 207–212.

**Kotigoroshko V. G.**

1989 Ремесленное производство на дакийском городище Malaya Kopania, *Sovietskaya Archeologia* 2/1989, 182–199.

**Schäfer A.**

2003 *Die Kleinfunde der jüngerlatènezeitlichen Siedlung von Berching-Pollanten, Landkreis Neumarkt in der Oberpfalz*, Marburg (Diss. Philipps-Universität Marburg).

**Uenze H. P.**

2000 Die jüngerlatènezeitliche Siedlung von Eggfling, *Bayerische Vorgeschichtsblätter* 65, 1–38.

**Venclová N.**

1980 Nástin chronologie laténských skleněných náramků v Čechách, *Památky archeologické* 71/1, 61–92.

1990 *Prehistoric glass in Bohemia*, Praha.

**Wobrauschek P., Halmetschlager G., Zamini S., Jokubonis C., Trnka G., Karwowski M.**

2000 Energy-Dispersive X-Ray Fluorescence Analysis of Celtic Glasses, [in:] E. Selin Lindgren (ed.), *Special Millennium Issue on Cultural Heritage, X-Ray Spectrometry* 29/1, 25–33.

**Zepezauer M. A.**

- 1993 Mittel- und spätlätènezeitliche Perlen, *Glasperlen der vorrömischen Eisenzeit III (mit Unterlagen von Th. E. Haevernick)*, *Marburger Studien zur Vor- und Frühgeschichte* 15, Marburg.

## Główne zagadnienia dotyczące szkła celtyckiego ze wschodnich obszarów kultury lateńskiej

### Streszczenie

Szklana biżuteria kultury lateńskiej, długo pozostająca niejako na uboczu zainteresowań późnym okresem żelaza, stała się w przeciągu ostatniego ćwierćwiecza przedmiotem bardziej szczegółowych badań. Występujące powszechnie na stanowiskach kultury lateńskiej charakterystyczne ozdoby wykonane ze szkła (ryc. 1–5): bransolety, pierścienie (czyli „pierścieniowate” paciorki) i pierścionki, okazały się nie tylko dobrymi datownikami, ale także istotnym elementem szeroko zakrojonych zmian kulturowych zachodzących w świecie celtyckim w połowie III w. przed Chrystusem. Rezultatem tych zmian było ostateczne ukształtowanie się osadnictwa kultury lateńskiej w rejonie Europy środkowo-wschodniej. Omawiane znaleziska chronologicznie „wypełniają” cały okres środkowolateński (LT C) i wczesną fazę okresu późnolateńskiego (LT D1).

Znakomita większość typów i grup szklanych zabytków kultury lateńskiej występuje dość równomiernie na znacznych obszarach tej kultury. Zaobserwować można jednak kilka cech charakterystycznych wyłącznie dla *Celtyki* wschodniej. Dotyczy to przede wszystkim występowania bardzo ozdobnych bransolet grupy 15 wg systematyki Haevernick (ryc. 6–7) oraz bransolet grupy 6b zdobionych tzw. *Schleifenverzierung* (ryc. 8–9). Ze wschodnimi obszarami kultury lateńskiej wiązać należy także występowanie drobnych szklanych pierścionków (ryc. 10).

Jednym z niewyjaśnionych zagadnień dotyczących omawianych znalezisk szklanych jest kwestia, zarówno lokalizacji hut szklarskich na terenie kultury lateńskiej, jak nawet tego, czy szkło kiedykolwiek na tym obszarze było wytwarzane. Hipotetyczne pracownie szklarskie zazwyczaj lokalizowane są w oparciu o ilościowo duże koncentracje znalezisk szklanych zabytków na ważniejszych *oppidach* jak również na terenie kilku osad o charakterze otwartym (ryc. 11). Unikalnym przykładem rozpoznanej archeologicznie konstrukcji związanej niewątpliwie z przetwarzaniem szkła, a być może nawet jego wytopem, jest pracownia szklarska odkryta na celto-dackim grodzisku w Malaja Kopana w rejonie górnej Cisy na Ukrainie Zakarpackiej (ryc. 12).

Istotną częścią badań nad szkłem archeologicznym – w tym szkłem kultury lateńskiej – są analizy składu chemicznego, stanowiące obecnie właściwie odrębną gałąź studiów. Analizy te, poza informacjami o cha-

rakterze technologicznym, pozwoliły też na obserwacje powiązań stężeń niektórych elementów stwierdzonych w składzie podstawowym badanych szkieł z ich chronologią, a być może także miejscem wytwarzania (ryc. 13–15).

