THE EVIDENCE FOR THE LOCAL PRODUCTION OF IRON AGE GLASS IN BRITAIN

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. Introduction.

This paper summarises some results from an on-going series of archaeological and chemical analyses of Bronze Age and Iron Age glass from Britain and Europe. Some 1500 chemical analyses have been from Britain and Europe. Some 1500 chemical analyses have been assembled for glass of the 1st millenium B.C. from Britain, Ireland, France, Czechoslovakia, Yugoslavia, Hungary, Spain and Portugal. The analytical techniques which have been used are x-ray fluorescence, electron-probe microanalysis, x-ray diffraction and scanning electron microscopy. This short paper will concentrate on some of the archaeological implications from this analytitical research.

The approach adopted here is firstly to define those sites which have produced industrial evidence for the production of glass and/or glass artefacts. Both the archaeological evidence of stratified by-products from the processes of working glass and their specific associations on archaeological sites are considered in assembling this data. Secondly the chemical analysis of industrial materials from these sites are considered. The materials analysed include glass'slag', crucibles with glass adhering, raw unworked glass and mal-formed glass objects and these are related to the chemical analysis of fully formed glass products. The relationship between the archaeological evidence for the glass industry and the scientific analysis of the industry is an important one.

Having studied the industrial evidence it is necessary to define :

1) the compositional features of the glass which may be characteristic of a specific recipe used in the manufacture of glass in prehistoric Europe and

2) the compositional features which are characteristic of specific production zones within prehistoric Europe.

The period to be concentrated on here dates to between c.400 B.C.-c. 1st century A.D. and the specific area is Britain. The changes in the chemical compositions of the glass which occured in this period will be discussed and some attention will be given as to how these compositional differences may reflect differences in the organisations of the glass industry, and specifically evidence for local production. The first area of enquiry to be considered is the general characteristics of Iron Age glass chemical compositions.

. Britisch Iron Age glass compositions.

With very few exceptions the chemical analysis of Iron Age glass in Britain has revealed that it can either be categorised as soda-lime-silica or lead oxide-soda-lime-silica. Within these two categories around the 2nd century B.C. a change from a base glass clarified with antimony oxide (Sb_2O_3) to one clarified with manganese oxide (MnO) took place. This change in composition has been found to have occured in both the base glass used to manufacture opaque glasses and in transparent colourless glasses. In the 2nd century B.C. a tin opacified glass was introduced into the European Iron Age glass repertoire.

. The production of glass at Meare Lake Village. Somerset.

The site of Meare Lake Village was excavated under water-logged conditions. The site itself actually consists of two clusters of mounds, the east and west villages. These mounds are a series of superimposed hearths which lie over a layer of black earth. The site dates to c. 400 B.C. - c. 250 B.C.

Meare has the highest concentration of glass beads from 'a nonfunerial Iron Age site in Britain (c. 300) the vast majority of which are characteristic types to the site (described by Guido (1978))/and are composed of colourless and opaque yellow glass. The main decorative features of thse characteristic beads are a colourless matrix which bears opaque yellow decoration, either in the form of a spiral, a chevron or a trellice. The important feature about the site is that part of the assemblage includes the by-products of glass bead manufacture, including failed moulds and drips of glass from glass-working. The colours of glass which were evidently being worked on the site were transparent colourless, turquoise blue, cobalt blue, opaque red and opaque yellow glass. Though thorough investigation has taken place of the distribution of Iron Age glass, both in the British Isles and on the Continent, no examples of Meare products have been found on the Continent of Europe.

Indeed, not only are the products visually characteristic of the area of south-western England at the time, their chemical characteristics are also very specific, allowing one to form ' core ' analytical groups against which to compare other chemical analyses of Iron Age glass. The chemical analyses of the glass from Meare has been carried out using x-ray fluorescence, x-ray diffraction and electron-probe microanalysis. These techniques provide quantitative analyses for.

1) glass-forming elements such as silica and lead oxide and for the alkalies that have been added to the glass batch, the only one which was used for these glasses was soda.

2) minor elemental contents such as antimony oxide, acting either as an opacifier or a clarifier, and other colorants such as copper oxide and cobalt oxide.

The levels of these element oxides alone are sufficient to chemically characterise the glass which was definitely being worked at meare and possibly actually being melted from primary raw materials there.

. Hengistbury Head, Dorset.

The 2nd-1st century B.C. entrepot of Hengistbury Head, Dorset has, on excavation, produced lumps of raw opaque yellow and transparent purple glass, which are comparable to some from Manching in Bavaria. About 100gms. of raw transparent purple glass has been found at Hengistbury Head compared to about four times this weight at Manching. The site has also produced fragments of armlets of Haevernick's (1960) types 3b and 6b.

Although chemical analysis of the yellow and purple glass incorporated in glass artefacts and found as raw lumps has been carried out, and some chemical similarity between the two has been observed, the analyses by themselves do not prove that glass was being worked on the site. Essential industrial evidence is lacking, and since Hengistbury is a trading site it is difficult to be confident that glass-working took place, since both armlet, beads and raw glass could easily be traded with the site. The presence of a wide range of other high-temperature industries at Hengistbury does however provide some support for the hypothesis that glass-working took place there.

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One of the results of the electron-probe analyses of the Hengistbury glass is to show that three chemically distinct chemical groupings of opaque yellow glass were in use between the 4th century B.C. and he 1st century A.D. in Britain and Europe. The chemical distinctions are based on the levels of manganese, antimony and tin oxides. Relatively high levels of manganese and tin oxides in one group of the 2nd-1st century B.C. opaque yellow glass seems to be characteristic of opaque yellow glass used in European oppida such as Stare Hradisko and Stradonice in Czechoslovakia (currently being analysed). This chemical type of glass is also found at Hengistbury Head. Again, with the chemical analyses of glass from sites such as Hengistbury Head, Stare Hradisko and Stardonice it is possible to build up compositional core groups with which to compare other Iron Age glasses.

. Glass production at Culbin, Moray Firth. Scotland.

Although the dating for the glass-working at Culbin on the Moray Firth in Scotland is insecure, from the collection of artefacts that the site has produced it is possible to infer that opaque yellow and white, transparent colourless, green, blue and colourless glasses were being worked there. The site probably dates to c. 1st century B.C. - c. 1st century A.D.

There is however convincing evidence for the local manufacture of glass if we approach the question from the point of wiew of the chemical analysis of the characteristic bead types found in the area of the Moray Firth. Although opaque yellow glass was being worked at both Meare and in the Culbin area the chemical analysis of opaque yellow glass from both sites is quite distinct. Even when glass beads which are visually identical are derived from both sites they are found to be chemically distinct, and this is therefore good evidence of the use of different raw materials where it is possible to chemically characterise them.

The chemical analysis of the yellow glass used to make beads at Culbin is even relatable to the use of high lead opaque yellow glass used as an enamel for the decoration of massive bronze armlets, such as that from Castle Newe in Banfshire, Scotland. As with Meare it is possible to assemble distribution patterns of chemically characterised glass from the site.

. Conclusions.

To produce a proper assessment of whether local production of glass took place it is essential to study the total glass assemblage including the by-products from the industry such as crucibles bearing glass residues and to chemically analyse them.

It is important to assemble core groups of analyses against which other groupings can be compared and so as to produce the maximum archaeological meaning.

It is possible to provide evidence for distribution of glass by chemically characterising Iron Age glasses. It does not follow that all Iron Age glasses can be chemically characterised.

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