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VARIATIONS IN ALLOY COMPOSITION OF ROMAN BROOCHES

Justine Bayley and Sarnia Butcher

Ancient Monuments Inspectorate
Fortress House, 23 Savile Row,
London W1X 2HE, England.

Abstract

Analyses of several hundred Roman brooches, mainly from Richborough and Nornour, both in southern Britain, are considered. The results are displayed as ternary diagrams with zinc, tin and lead (the main alloying elements present) as the three variables. Composition is shown to be correlated with typology and is a function of both date and area of manufacture. The high lead levels found in some British brooch types may be an indication of Britain's importance as a source of lead in the Roman period.

Introduction

This is a progress report on a continuing programme of investigations of Roman copper alloy brooches from British sites. The project is concerned not only with the manufacturing technology and decorative techniques employed but also with the materials of which the objects were made. A considerable amount of work has been done on the applied decoration such as enamel, tinning and gilding but these aspects are not described here; instead, the analyses of the bulk metal of which the brooches were made are presented and discussed. These analyses were carried out with two main aims in view; first to define the alloys in use and then to attempt to relate the choice of alloy to the archaeological data on the brooch - such variables as date and area of manufacture and find location. Brooches were chosen as the objects to be investigated as they are relatively frequent finds and, because of their wide typological variation, can usually be dated fairly closely.

The analyses and their presentation

The majority of the brooches analysed came from Richborough in Kent (350) and Nornour, one of the Scilly Isles to the west of Cornwall (125). Quantitative analyses were carried out by atomic absorption on metal samples drilled from these brooches.

Smaller numbers of brooches from Carvossa (17), Catsgore (36), Chelmsford (5), Gestingthorpe (13) and Wakerley (9) have also been analysed, some by atomic absorption but most by qualitative x-ray fluorescence. The results from these sites are in general agreement with the analyses of similar types from Richborough and Nornour and are therefore not described in detail here. On the basis of these analyses it can be said that composition does not seem to be a function of find spot, although it should be borne in mind that all the sites are in the southern part of England.

The main alloying elements found in addition to copper were zinc, tin and lead. Many objects also contained some silver, arsenic and antimony but all these were usually under 0.1%. Their variation does not seem to be systematic and so, for the present, they have been ignored.

In order to present the analyses in a clear visual form they have been depicted as ternary diagrams with zinc, tin and lead as the three variables. This involves summing the zinc, tin and lead contents of the alloy being analysed and then expressing each element as a proportion of this sum. E.g. an alloy of 70% copper with 5% zinc, 10% tin and 15% lead would have the proportions zinc: 16.7%, tin: 33.3% and lead: 50% and would be plotted at point A on Fig.1. Similarly a pure copper-zinc brass would fall at point B and a leaded bronze with 8% tin and 20% lead at point C.

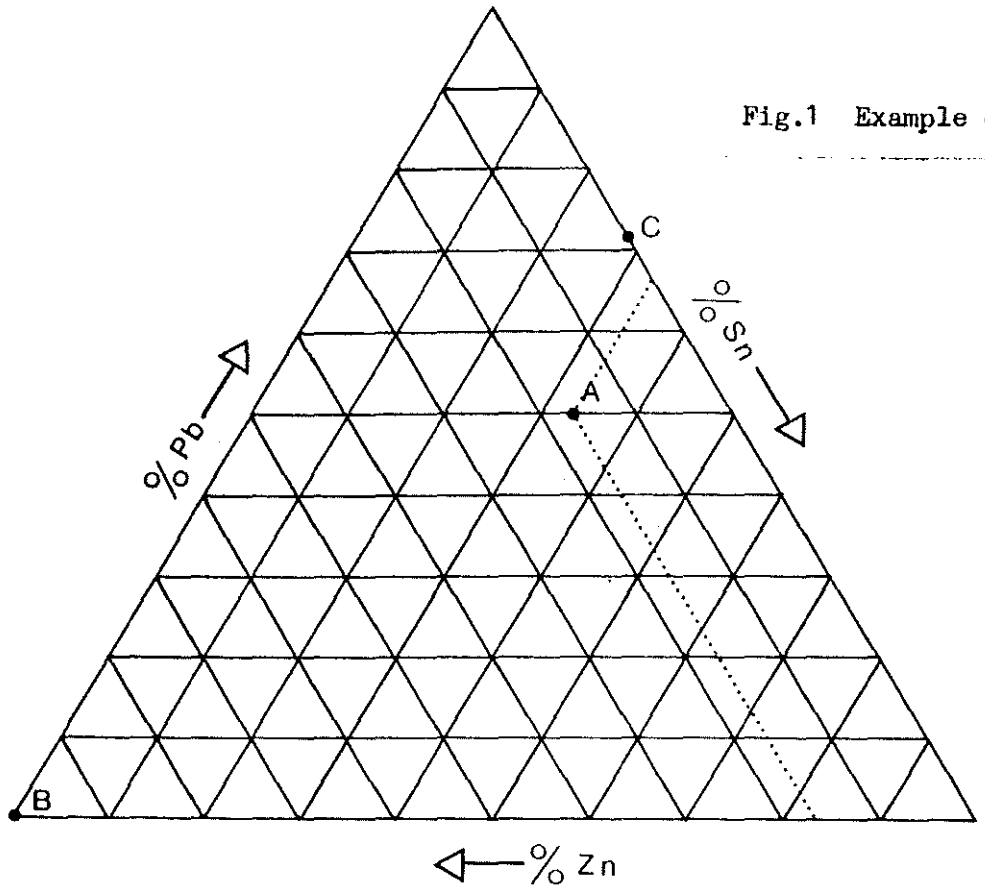

Fig.1 Example of a ternary diagram

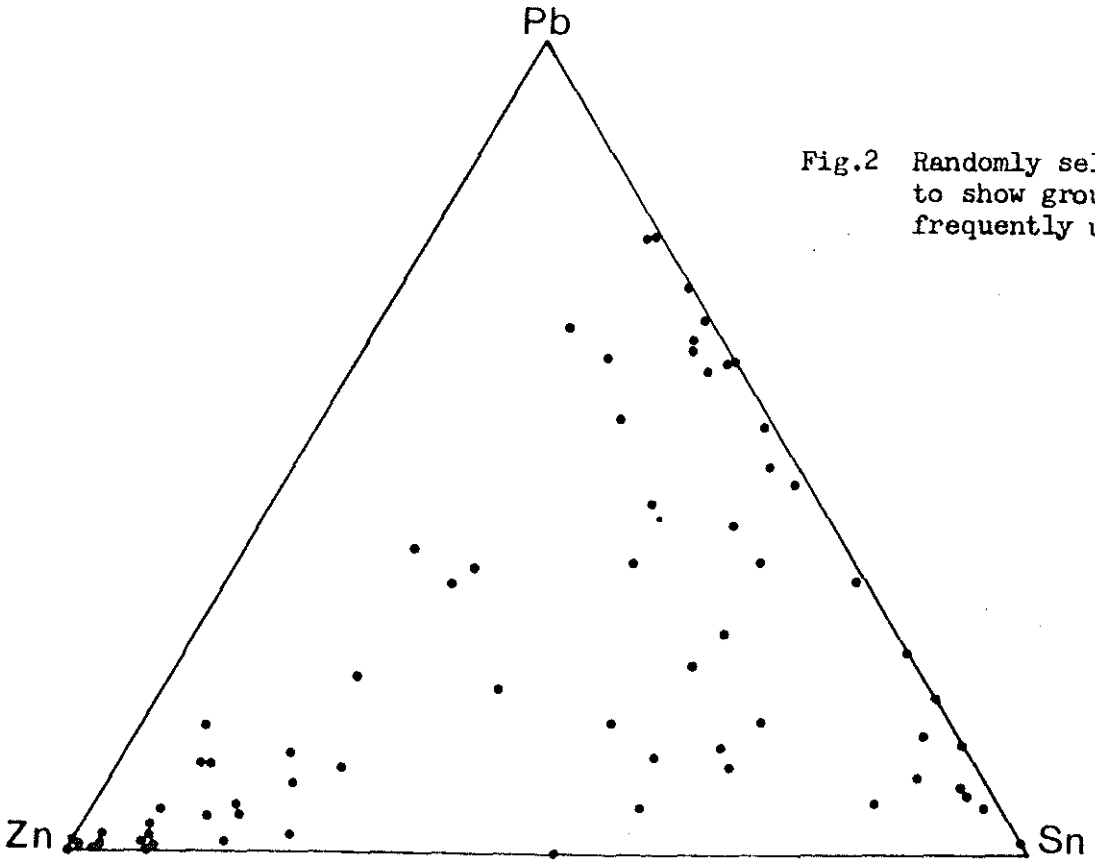

Fig.2 Randomly selected analyses to show groupings of more frequently used alloys

It could be argued that this method of plotting creates false groupings by bringing together alloys of very different compositions in the same area of the graph. E.g. copper with 1% each of zinc, tin and lead falls on the same spot as an alloy with 5% or even 10% of each element. In practice this is not a very real disadvantage as for each broad alloy type the total amount of alloying elements usually falls within a fairly narrow range.

Slight variations in position on the graph are not significant as low levels of all three main alloying elements are usually accidentally present in addition to the deliberate additions. 127 of the 350 brooches from Richborough contain over 10% zinc and therefore could be regarded as brasses; however only 20 of the brooches contain no detectable zinc.

A plot of randomly selected analyses (Fig.2) shows that many alloys were in use but that certain ranges of composition are more frequent than others. There are concentrations near the zinc apex (brasses), near the tin apex (bronzes) and on the tin-lead line from the middle towards the higher lead end (leaded bronzes). The more central points on the ternary diagram belong to those alloys usually described as gunmetals and leaded gunmetals. This overall picture is not clear but selective plotting of analyses of one brooch type or group of types is far more illuminating.

The results and their archaeological interpretation

The varying composition of the main first century types represented probably does have both chronological and geographical significance. Aucissa and Kraftig-Profiliert brooches are datable to the first half of the century and were probably imported from Gaul. All the analysed examples are brasses with extremely low (or zero) lead levels (see Fig.3). Hod Hill brooches were almost certainly made in Gaul but lasted until about AD 70/80. Three-quarters of these are brasses and the remainder mainly bronzes with low amounts of lead (see Fig.4). The non-brass specimens include examples of most of the sub-divisions of this type so, unfortunately, composition cannot be correlated to detailed typology.

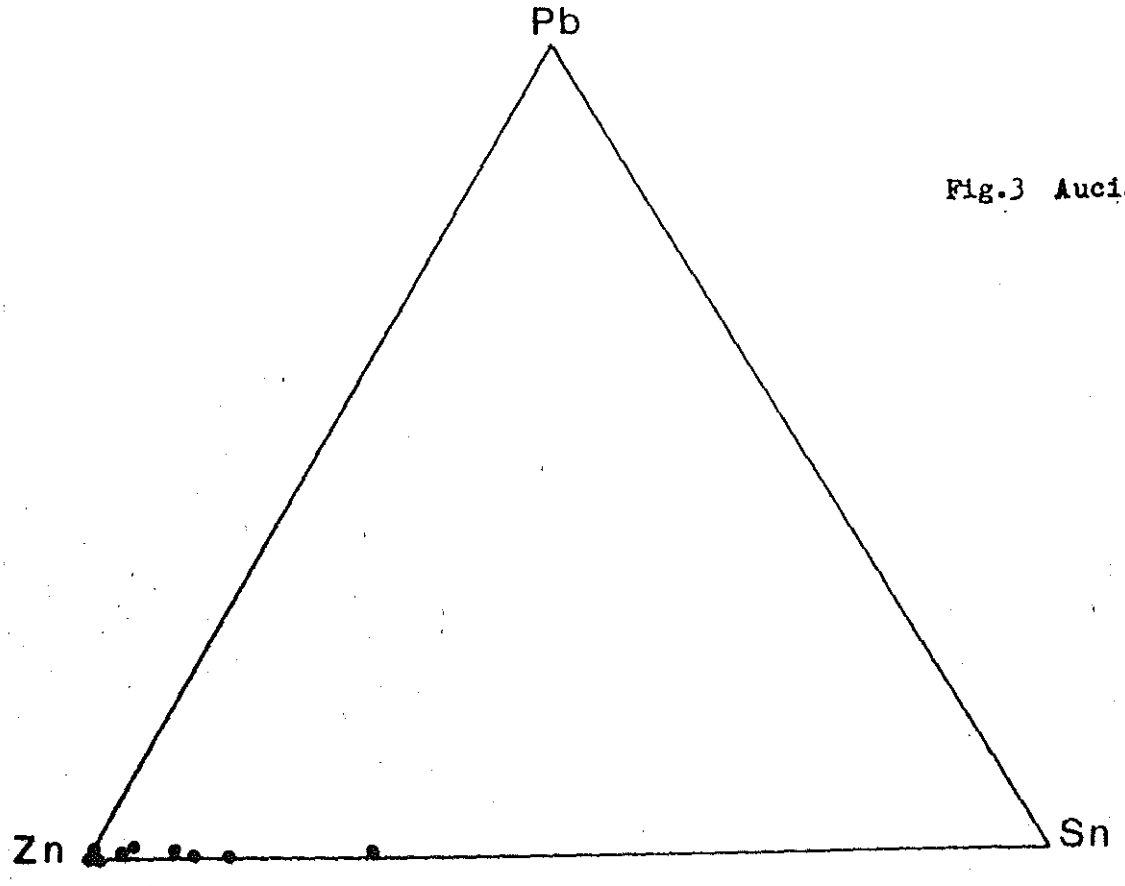

Fig.3 Aucissa brooches

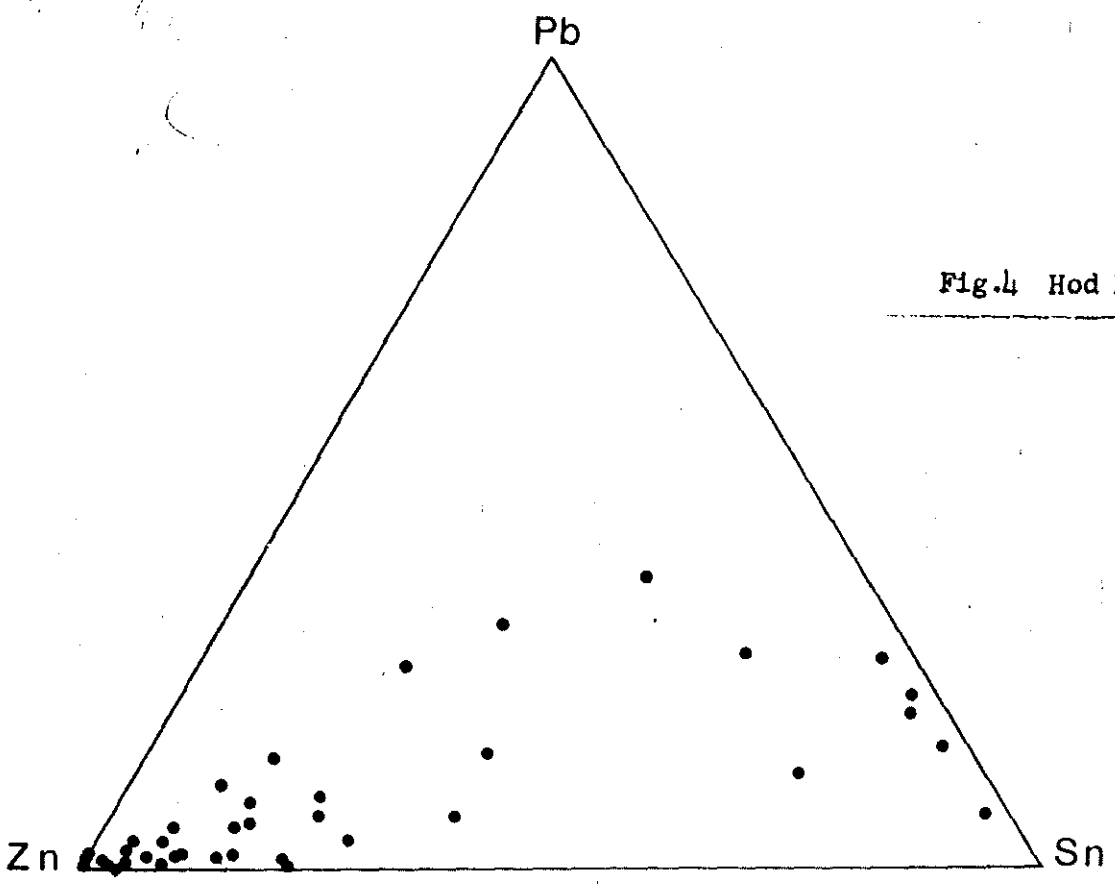

Fig.4 Hod Hill brooches

Colchester 'A' (see Fig.5) and Nauheim derivative brooches were probably made in Britain and their main period is over by AD 70 or earlier. Both types show a similar range of compositions to the Hod Hill brooches but with only just over half the examples being brasses.

Colchester 'B', Polden Hill and Dolphin types (see Fig.6) developed later in the first century and are certainly British products. These groups are of an entirely new alloy type; they are almost without exception high lead bronzes with very low zinc contents. Their high lead content may perhaps reflect the opening up of the British sources of lead, for this province became one of the main suppliers of lead to the western Roman Empire and it is known that Mendip lead was being produced by AD 49.

The large group of bow brooches from Nornour were probably made somewhere in south-west Britain in the late first and early second centuries. Nearly two-thirds of them were enamelled but there seems no significant difference in the composition of the plain brooches as compared with the enamelled ones. On typological grounds also it appears fairly random which brooches were designed to carry enamel and which not. The high lead content (see Fig.7) of all these brooches confirms its use in Britain and provides a clear contrast to the small group of enamelled bow brooches of Continental origin.

The large amounts of lead (up to 25% of the total metal) noted above may be due to the increased amounts of lead available but lead was always a relatively cheap metal so perhaps these alloys represent a 'dilution' or 'debasement' of the available bronze.

From the later second century onwards a different picture emerges. The knee and sheath-footed brooches show a fair proportion of high-lead bronzes (see Fig.8), although they are usually thought to be products of the German frontier zone. Either they were also produced in Britain or the use of high lead bronze had been adopted by the Continental manufacturers, perhaps because of the design of these brooches.

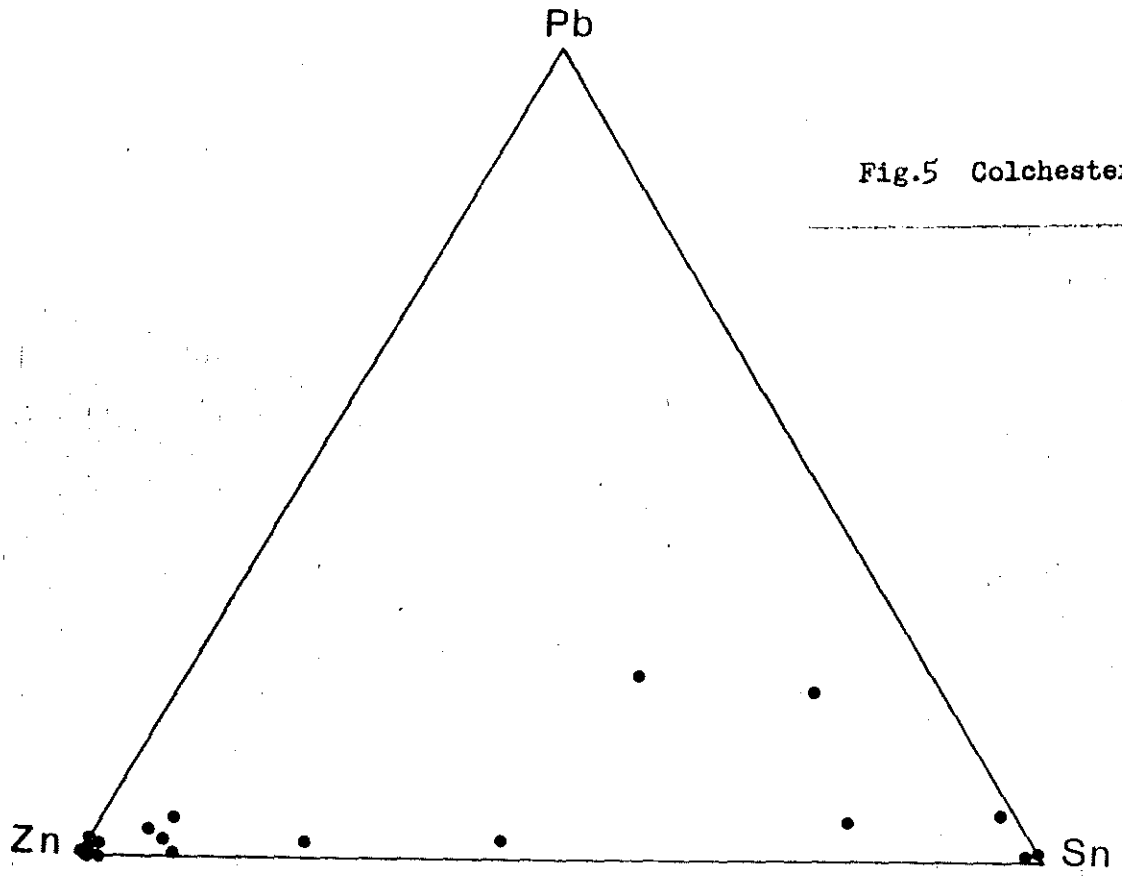

Fig.5 Colchester 'A' brooches

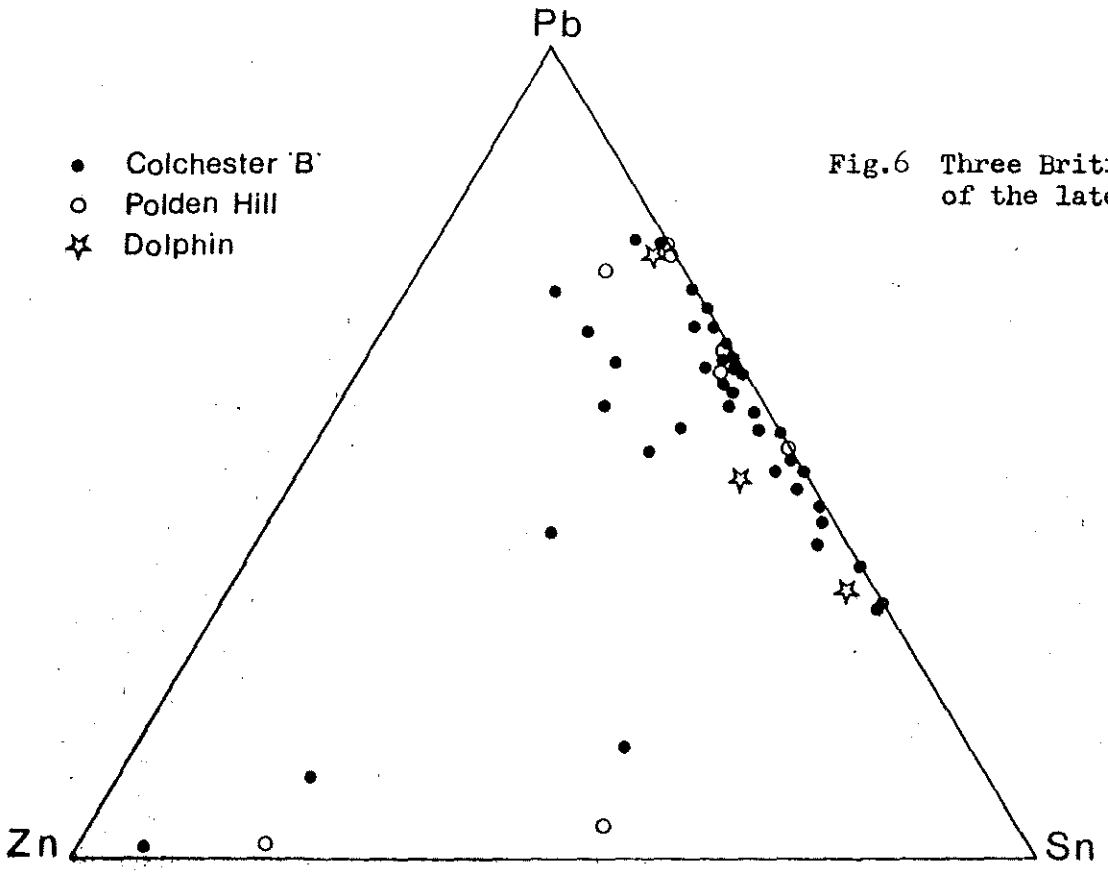

Fig.6 Three British brooch types of the later first century

The plate brooches are compositionally less well defined but may show the same tendency. The first century examples include several brasses but lead is more prominent in both British and Continental types produced in the second century.

The developed cross-bow brooches of the later third and fourth centuries also appear to show the more general use of lead, although it is interesting to see a return to brass for some of the latest and most elaborate examples. The analyses (see Fig.9) show a distinct cluster of leaded bronzes but it should be noted that they contain more zinc than the leaded bronzes of the later first century (Figs. 6 and 7), comparing more closely with the sheath-footed brooches (Fig.8).

It is interesting to see that distinct alloys are still in use right into the fourth century, so it would seem that if scrap metal was reused it was always carefully sorted.

In some cases the alloy chosen for a particular brooch type may have had a technological significance; the design of the brooch may have called for an alloy of particular properties. As an example may be quoted the one-piece brooches where the bow continues on into the spring and then the pin; the metal must obviously be springy enough or the brooch would not function as designed. In other cases the alloy used may have had the colour that fashion demanded or it may just have been all that the craftsman could obtain. The alloys used may also reflect the varying availability of different metals in different areas, perhaps relating to the proximity of mines.

Finally, it should be noted that while a specific alloy type was chosen for a particular brooch type, the actual composition was not so closely controlled.

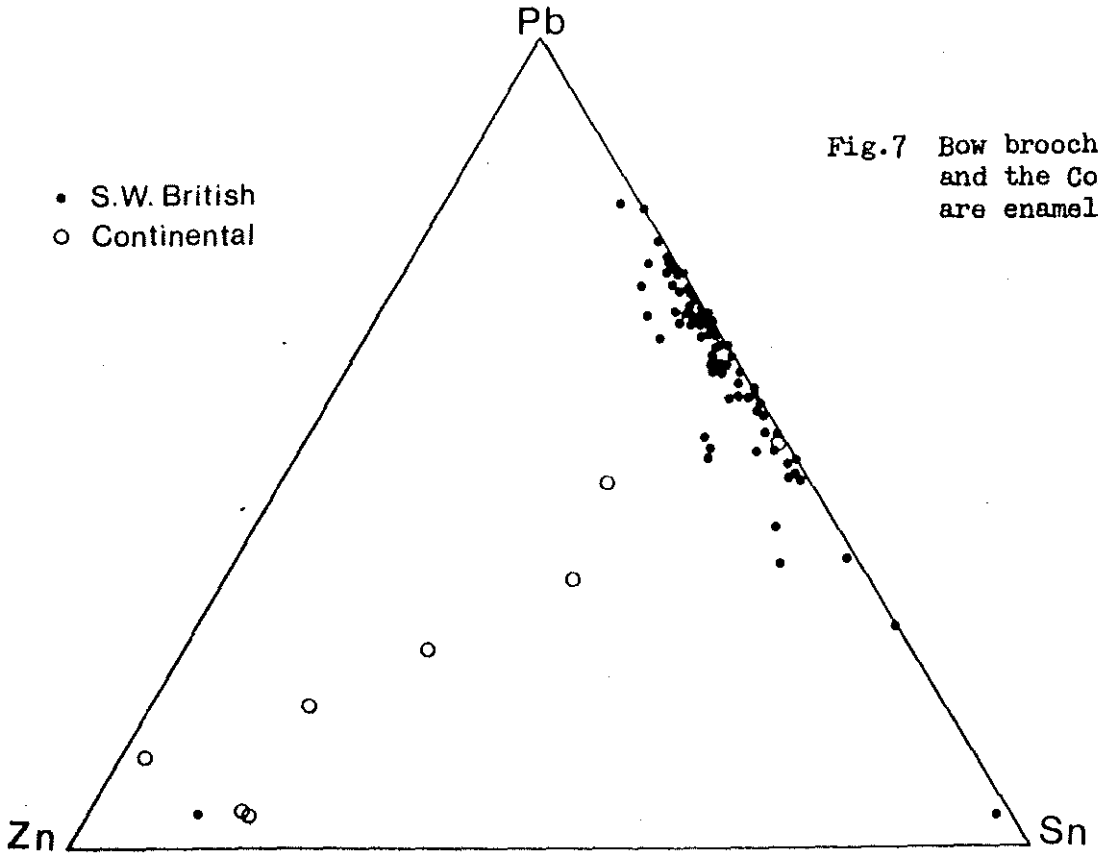

Fig.7 Bow brooches from Nornour and the Continent. Most are enamelled.

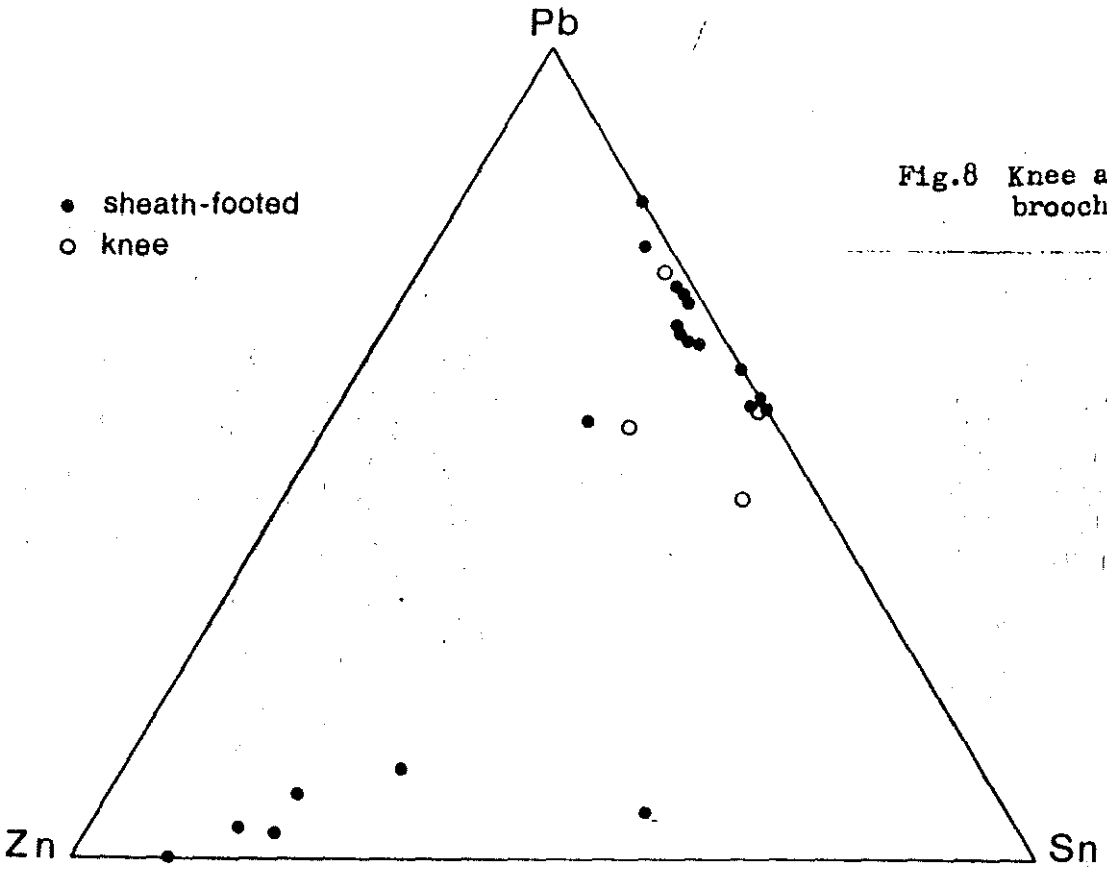

Fig.8 Knee and sheath-footed brooches

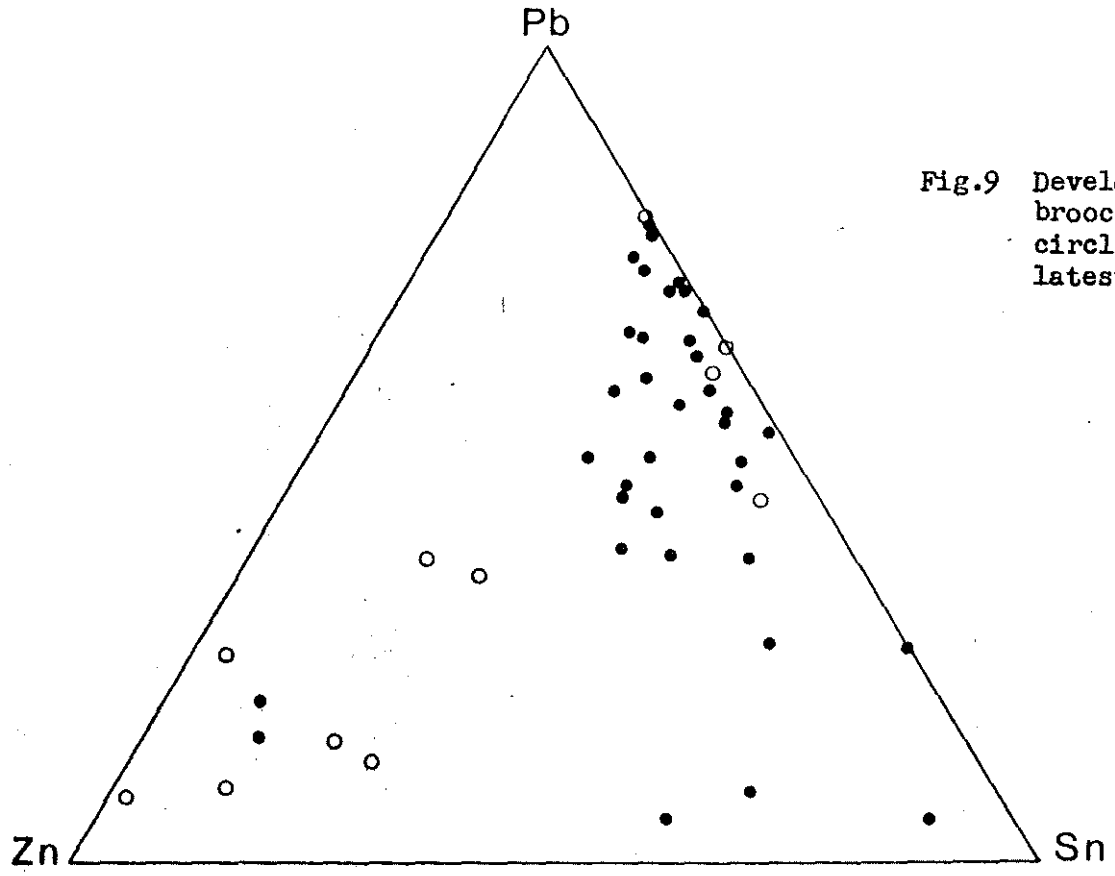

Fig.9 Developed cross-bow brooches. The open circles are the latest types.

Comments and conclusions

Two points that have already been made are worth repeating here. Firstly, brooches of a given type show no greater range of composition when finds from more than one site are compared so a sufficiently large group from a single site can be used to define the compositional range for that type. Secondly, lead appears in quantity for the first time in late first century British-made brooches. It has been suggested above that this may be connected with the exploitation of lead from the mid first century onwards.

The other 'conclusions' that can be drawn from this preliminary survey of results are really the questions that it poses on the relationships between British and Continental brooch makers during the whole period of the Roman occupation of Britain. The following are some of the more basic questions :

Was high-lead bronze in the Roman period a British innovation?

When did its use become widespread in Gaul and the Rhineland?

Common alloys for some brooch types of continental origin have been suggested. Are the examples actually found on the Continent made of the same alloys?

Was brass always prefered to bronze in continental workshops? And if so, why?

It is hoped that this paper will stimulate interest in these questions and that answers will be forthcoming. Sufficient analyses may already have been conducted - if so the authors would be very pleased to hear from those concerned. If, on the other hand, the work is still to be done we hope that it can be done soon so that our hypotheses can be proved either true or false.