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Some aspects of early medieval copper-alloy technology, as illustrated by a study of the Anglian Cruciform Brooch

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Trinity Term 1990

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A B S T R A C T

This thesis aims to examine the modes of production and the sources of metal supply for Migration period bow brooches, concentrating on a single form, the Anglian cruciform brooch.

The thesis is in two volumes; text and bibliography (volume 1), catalogues, tables, illustrations (volume 2). The text is in six chapters.

Attitudes to artefact studies are briefly discussed in Chapter 1 and the techniques employed in this study are outlined. Chapter 2 places the cruciform brooch forms into a simple hierarchical typology by formal similarity. A relative chronology is gained by contextual evidence, with absolute dates given by associations with other artefact types. Similarities between early English and continental forms are shown to be adequate to suggest importation, during the first half of the fifth century. Frisian and north German brooches have a special place in this system. Parallel stylistic development persisted during the second half of the fifth century but sixth-century English brooches are well distinguished from their continental contemporaries. Simple brooch types are thought to have had a long period of production and use.

By examining methods of casting and assembling cruciform brooches, Chapter 3 establishes the types and ranges of technical variation observable. Some of these technical attributes provide links between England, Frisia, northern Germany and Denmark. English brooch manufacture is diverse throughout the period under study. Norwegian metalworkers developped a very different style and the technical evidence suggests a movement towards standardisation and mass production.

In Chapter 4 we discover the types of alloy used and discuss the likely sources. Initially the alloys used were leaded brasses or bronzes. By the sixth century, copper alloys were commonly very impure. It is suggested that recycling provided a major part of the raw materials for cast copper alloys. Imports of copper alloys from France or the Celtic regions of Britain are relegated to a position of minor importance. The chemical compositions of Norwegian, Frisian, north German and Dutch cruciform brooches demonstrates access to high-tin, high-purity bronzes prevailed throughout the period. Brasses and mixed alloys were also available, probably originating from scrap. With the exception of Frisia, which appears to be more similar to Kent, alloy supplies were similar throughout the Scandinavian and continental cruciform brooch production.

Chapter 5 provides a synthesis for these findings. Plans are given for a project extension into other regions (Chapter 6).

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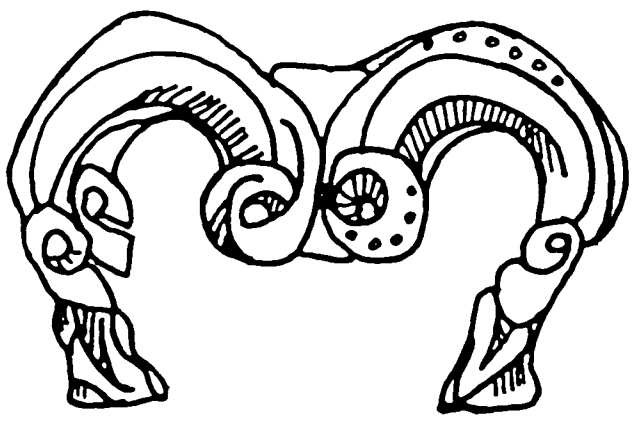
Chapter 1

A. Introduction - Why study Anglian cruciform brooches using scientific methods?



any areas of archaeological enquiry have now seen the application of scientific techniques. Unfortunately, many of these studies have suffered from a lack of appreciation of the nature of the archaeological and scientific records, especially where more than one researcher is involved. The examination of the philosophical distance between 'the sciences' and 'the arts' is material enough for a number of doctoral theses. This study does not attempt to tackle more than a small number of concerns which are of particular importance to 'archaeological science'.

This project sets out some new information from an area which has not been previously examined in any systematic manner - Migration Period copper alloys. Recent archaeological investigations on this material have raised questions concerning inter-regional contact, 'modes of production', source of supply and method of distribution (Reichstein 1975, Leigh 1980, Brown 1986). At the time of writing, these authors had too little scientific data to allow thorough investigation. This project establishes some patterns within chemical and technical data on a small sub-set of the early Anglo-Saxon

corpus. At the same time, it will be important to gain an understanding of the different characters of archaeological and scientific data and how they may be reconciled.

In order to test theoretical hypotheses the limits of the enquiry need careful definition. Within the field of ancient technology, possible methods of research include studying material from an individual site or region, a particular type of site, contrasting types of site or an individual artefact type. In the present study, the last option was selected.

The cruciform brooch was used as an ornamented safety pin, securing women's garments during the fifth century and first half of the sixth century. Burial evidence suggests such brooches were worn at the shoulder (Owen-Crocker, 1986, fig 30) often together with several other types of dress fastening or ornament. The typological requirements for inclusion in this discussion are simple; the brooch must have had three knobs on a rectangular headplate (although the sideknobs are now frequently missing) and a foot whose decoration derives from an 'animal head' design.

The selection of this artefact type was influenced by several practical considerations. The Anglian cruciform brooch form is common, widespread and sufficiently robust for sampling. Non-ferrous metals are well suited to chemical analysis and other technical research since the structure and chemical composition are normally well-preserved. Furthermore, the

typology of the cruciform brooch is sufficiently complex to be informative. Many brooches have burial associations enabling the construction of a relative chronology. The details of manufacture are variable, although all the brooches are cast. Brooches of parallel forms are found on the continent, especially in Scandinavia. All these factors indicated that the cruciform brooch would form an interesting case study.

B. Approaches to Anglo-Saxon artefacts

Attitudes and methodologies within archaeology have changed considerably over the last century. The effects of these changes have been seen to various extents within the Anglo-Saxon study area. There are several useful reviews of theoretical developments, the most up-to-date being Richards (1987, Part 1). The clarity of the latter means that only a brief overview of the most relevant details need be presented here.

a) The earliest approaches

Detailed stylistic analyses of particular artefact types still occupy a prime position in Anglo-Saxon archaeology. Rich grave finds are especially well-studied. There are various reasons for this dominance - some of a practical nature and still tenable and others more purely historical, which are now being superseded .

Until relatively late in the history of archaeological study, there was no evidence for Anglo-Saxon settlements. The period consisted entirely of a set of burial rites. Hence grave goods were the only means of studying the Anglo-Saxons and typological study was seen as the only approach. Now domestic and industrial evidence is beginning to emerge, sometimes associated with cemeteries, at sites such as Mucking, Essex and West Stow, Suffolk (Clarke forth, West 1985). In this respect, the English data still cannot compare in quality to that found abroad.

Archaeologists have often sought to establish continental parallels in order to date English material. However, it is difficult to determine what level of similarity is significant between artefacts or ways of life in two different regions, especially at a time when population movement and social change are likely. Similarly, when continental artefacts are used to date English archaeological contexts, the methods by which these objects were 'imported' are not well-understood. Imported objects are likely to have had unusual value and therefore unusual circulation characteristics. Hence the time lapse between manufacture and deposition is uncertain and the use of continental imports unreliable.

Despite these problems, dating must still rely on archaeological evidence. There are still no scientific techniques which allow the dating of archaeological metals and those dating methods which are available are normally

unsatisfactory for this archaeological period. Neither radiocarbon nor luminescence dating are precise or accurate enough.

Traditionally, the evidence relating to upper levels of the social hierarchy were over-emphasised in order to link the historical record with the archaeological record, i.e. 'culture-history'. In particular, individual events (e.g. battles), people (e.g. kings) or cultural groupings (e.g. 'the Angles') were characterised by evidence from grave-goods (e.g. Kirk 1956, Leeds 1912, 1933, 1945, Evison 1981). This has led to a straining of the evidence (and of credibility). As long ago as 1956, Lethbridge reminded his colleagues that the Anglo-Saxons must have spent most of their time at home rather than waging war, producing food stuffs, making ornaments or burying people (in Harden (ed) 1956).

The result of these uncoordinated approaches to Anglo-Saxon archaeology is that many sites have been studied in depth (providing a multitude of local vignettes) and many artefact types have been exhaustively treated (providing a series of loosely related chronologies) but synthesis is still lacking. There is still no generally agreed chronological framework of artefact sequences as provided for continental and Scandinavian archaeologists (Ament 1977, Bakka 1973).

b) New Archaeology

Those studying Anglo-Saxon archaeology became aware of other dimensions to their data, with the arrival of 'New Archaeology' during the 1960's and 70's. Some specialists adopted methods from the array of techniques borrowed by prehistorians from the biological and social sciences. Of special interest are the statistical approaches discussed by Clarke, Hodder, Orton, Shennan et al, but there are many pitfalls to their use in the Anglo-Saxon period, not least inadequate database size (Clarke 1968, Hodder 1978, Orton 1980, Shennan 1988).

The most important effect of recent attitudes to artefact studies has been to put artefacts in context. Brooches and other items of personal ornament are just one instance of human interaction with the environment. Other artefact types must have been much more important to the average member of the population (e.g. cooking utensils, farming equipment, storage vessels). Personal ornament expresses a need and a capability to use resources on items which were not strictly essential for survival.

Without insights into how or why artefacts were made, research becomes parochial and limited. It is easy to become so deeply involved in minutiae regarding an artefact that we ignore the innumerable number of conceptual steps that lie between the craftworker and ourselves. Aspects we study may have been irrelevant to the people that made the objects. It is salutary to remember that artefacts are only our means of evaluating

social, economic or environmental change and not an end in themselves. Recently, researchers have used more explicit theoretical frameworks to arrive at hypotheses.

The idea that the status of the individual was represented in the manner in which he or she was buried had originated in the 19th century. Many modifications have been made during the late 20th century. Functionalist theory suggests that large numbers of artefacts or rare artefacts reflect higher status. The concept that humans attempt to modify their environment, and that artefacts represent attempts to do this, came with structuralist approaches.

Statistical treatments came into use in the 1970 s and 80 s. However, statistical proof that something exists does not always allow its explanation. Arnold attempted to demonstrate social structure within different regions using wealth scores (Arnold 1980). Wealth scores assume that rich or important people will be buried with expensive or exclusive items. However, the link between social persona and wealth expended in burial is very complex (Richards 1987, part 1). There is no absolute system and regional variation may be considerable. Female graves show a wider range of artefacts and many more artefact combinations than male graves, but this cannot be taken simply to mean that there were more levels of hierarchy amongst women (Pader 1982, Hirst 1985, 96). Status can be ranked by number of functions fulfilled, rather than simply by number of artefacts present e.g. shoulder brooches, brooch-

at-shoulder (Hirst 1985, 97). Pieces of jewellery themselves may be 'subtle personal markers' (Dickinson 1988) but other burial attributes may be equally important, e.g. arrangement of artefacts, position of body and grave structure (Shephard 1979, Pader 1982). Ethnographic parallels were also sought in attempts 'to study the symbolic function of material culture' (Pader 1982, 20-7).

In one detailed working of these themes, Richards established patterning in the form and decorational content of cremation urns (Richards 1987). Statistical analysis of large amounts of quantified data was carried out in classic Clarkeian style. Some of the 'social identities' which Richards identifies confirm features already noted by archaeologists using traditional methods. However, further research is necessary to explain some of his other observations; for example, it is interesting that the burial of brooches in a cremation urn does not correlate positively with female burials (*op cit*, 198). Fortunately, other studies have confirmed that artefacts traditionally considered to be 'female' artefacts are normally found with females (Shephard 1979).

In explaining these social identities, Richards does not claim that age and gender are the only relevant factors. There are many other means through which identity might be assigned - e.g. by method or time of death, occupation, family group, religious affiliation, marital status, paternity/maternity. Certainly, it seems unlikely that the simultaneous death of

both mother and child would merely have the combined social impact of the death of a woman plus the death of a child (*op cit*, 87). Some of these problems may be resolved when the inhumation data is examined in a similar fashion. Although Richards suggests Arnold's 1980 work may suffer from variable precision in dating (*op cit*, 13), the wide date range (c. 250 years) of his own work may also prove to be of some consequence.

Grave-good information is being used to test theories of trade and exchange. Models such as 'down-the-line' and central place trading have been examined, again through wholesale quantification (e.g. Arnold 1980, Huggett 1988). This work will also be affected by the factors discussed above.

It is clear that grave goods and burial ritual may have social, economic and chronological dimensions. It is difficult to give each of them fair treatment in one research project.

The use of simple evolutionary models of typological seriation has caused confusion. The brooch style we are to examine does not undergo evolution as such, merely decorative development (Dickinson 1976, 24). Conceptual bias from our own cultural background is inevitable but, by recognising this, we are able to reduce the worse effects. For instance, it is often impossible to distinguish between a late, 'simplified' style and an early, simple form from which others developed (Leigh 1984, 74).

Computer seriation and cluster analysis of artefacts were tried during the period of New Archaeology (including Anglo-Saxon material e.g. Leigh 1980). In the main, researchers have found computer seriation techniques do not produce typologies which are of use to archaeologists (Adams 1988). In some cases, this can be attributed to problems of the method. Since it is impossible to know what attributes might be significant, all possible attributes must be recorded from the start and a number of different classifying criteria must be tried. This leads to an enormous amount of data and numerous alternative classifications. It is clear that statistical significance is a 'necessary but not a sufficient condition', for many aspects of archaeology (Adams *op cit*, 49). We still have to make intuitive decisions.

In addition, we may be asking the wrong questions if the dataset is not suitable for this type of treatment. Holmqvist indicated that the material from the Helgö casting workshop 'did not lend itself to being arranged in a typological series' (Holmqvist 1972, 158). In the case of the Migration Period, we are attempting to produce chronological divisions of a period of time that is a fleeting moment when compared with time periods studied by other archaeologists. We therefore seek very fine detail for this period, with the subconscious assumption that, since we are dealing with recent human history, the pace of development is fast and this sort of detail is hidden within the data, waiting to be discovered.

c) Science and technology

Science and technology have come to the attention of Anglo-Saxon archaeologists since the 1960's. A flurry of activity using scientific techniques has resulted in a wide-ranging database. Reasons for using these techniques were equally diverse - characterisation of clay sources (Brisbane in Rahtz et al (ed) 1980), identifying types of metals available (Brownsword 1986), method of brooch production (Northover unpubl), amount of debasement in silver coinage (papers in Metcalf (ed) 1987). Provenance studies do not seem to have attracted much attention (but see lead isotope analyses in Northover unpubl and Arrhenius 1971, 1985, on garnets). Some researchers felt confident enough to use chemical composition as a dating method (Avent 1975, using data from Hawkes et al 1966, Kent 1972, Brown and Schweizer 1973).

Each of these projects approached questions which were difficult and probably insoluble using archaeological data alone. Hence the credibility of science in Anglo-Saxon archaeology has not been proved in an independent manner. Science has been tested only in comparison with the reliability of data gained through archaeological approaches. It is apparent that archaeological collections have often been perceived as a resource that will produce well-ordered and easily understood datasets, when adequately sampled and analysed, without the necessity of formulating hypotheses.

Another theme that unites the approaches so far adopted is the relatively 'high-tech' or black box approach. Artefact assemblies are analysed for their trace element contents as well as their major elements. Most of the attributes thus detected in scientific studies are not visible/tangible, so they would not have been appreciated or probably not controlled/controllable in earlier times. The specialist information thus gained is often relegated to the back of site reports, or to microfiche. Hence it is clear that this information is seen as secondary or even irrelevant to the main archaeological argument. However, it is also possible to quantify other variables, which are accessible to the archaeologist - e.g. dimensions of ceramic vessels (Richards 1987) or as in this study, method of casting and assembly. This may lead to greater acceptance of the worth of scientific and technological studies.

Publications of the last 3 decades have been full of '-isms' and many Anglo-Saxonists remained unconvinced. Some of the problems in acceptance probably stem from the deeply entrenched conservatism of some archaeologists, who prefer old typologies and the old methods of investigation. In some cases, new typologies are not accessible to the average archaeologist, since fresh discoveries cannot easily be placed in relation to a computerised database, for comparison and allocation to type.

A move towards synthesis is now apparent. Some of the more intangible concepts are being approached. Scientific and technological examinations of archaeological material are being used not only for studying aspects of technology and economy, but also aspects of social organisation or religion (Richards 1987, 6). Such syntheses may help resolve the differences between the cultural-historian and those who practise more modern methods (Richards 1987, part 4).

The new philosophies have at least demonstrated that the belief systems behind archaeological study must be stated, that the aims for any project must be made explicit and that the methods of operation must be rigorous. Despite this, Anglo-Saxon studies are exceptionally prone to the 'why-not-look-at-the-x-(artefact/people/burial rite)' method of working. With computer databases, it is even easier to assume that if enough data is collected, something will turn up to justify the work.

The scarcity of non-grave good data has meant that many of the hypotheses raised during this period of re-thinking remain untested and apparently untestable. On the other hand, purely typological studies in the tradition of Leeds and Myres can no longer be justified. Typologies will continue to be important in the future, as a prerequisite for any further research. Without a basic classification to provide a simple framework, the first stages of analysis would be very futile. For example, it would foolish to seek to study the technology of

all forms of Anglo-Saxon personal ornament, without first gaining some idea of their sub-divisions by function, material, date and region.

I hope to demonstrate below that traditional methods of forming classifications are adequate, appropriate and essential for many purposes. This may be seen as a reversion to older methodologies or a step forward into a post-modernist pragmatism. I do not wish to suggest that the typology presented here is the only method of ordering the data, or that the divisions of this typology would have had any relevance to the Anglo-Saxons themselves.

C. Directions of research

This research relies on three strands of information which will be seen to be interrelated.

1) Archaeology/typology (Chapter 2)

A new typology of cruciform brooches is required, since there is no recent detailed study that covers the whole of the range of cruciform brooches produced in this country. Amongst those typologies currently in use is that of Åberg (1926), which is useful for its figures and simple to use. The publication by Leeds and Pocock (1971) of a complex classification of 'florid' forms provides too many subdivisions of Åberg's classes IV and V for easy application. These publications were

written at a time when archaeological artefacts were frequently only judged as art objects. Chronologies were based on theories such as brooches with angular designs pre-dated and inspired those with fluid designs. Although truly objective observations are impossible, an effort will be made here to avoid the influence of modern tastes and standards.

Reichstein examined a small selection of English cruciform brooches for the purposes of linking the brooches from this country with those from the continent and hence to a chronology of major Scandinavian groupings of the form based on closed grave finds (Reichstein 1975). It is probable that the observed similarities between English and continental brooches are at a general level (Hines 1984, 244-53). Reichstein was unable to classify a large proportion of the corpus and his typology is difficult to apply, especially to English brooches. The omission of most of the later English forms and several important examples of the early forms means this publication is a further unsatisfactory factor.

The current work aims to satisfy several basic requirements:

i) clear and simple typological definition, based on stylistic grounds only, normally allowing the classification of fragments

ii) full type description (see Adams 1988, 45 for differences between definition and description).

iii) a logical and hierarchical structure

iv) minimal overlap and maximum coverage, so that brooches neither belong to more than one type or to none of the defined types

v) the ability to accomodate future discoveries, with the possibility of some modification

Several purposes lie behind the creation of this typology:

i) to group the data so that brooches do not have to be individually described

ii) form groupings which are of an adequate size for other purposes

iii) to establish which variables are most useful in morphological sub-division and which seem non-diagnostic

iv) to discover factors of chronological and regional significance

The processes behind the exercise of forming these groupings may be evaluated. This provides a demonstration of the manner in which artefactual material is perceived and perhaps an indication of the systems in which the material was produced.

A review of burial associations is essential for understanding which cruciform brooch styles can be said to be contemporary in production or use. Hence a relative chronology can be formed. Many factors affect the reliability of burial associations, not least the quality and quantity of data. Forms may have been in production for a considerable length of time and jewellery may have still been worn when quite antique. Where burial associations are not available, it may be necessary to establish the extent to which a relative chronology may be constructed by traditional art historical means and to discuss how unbiased this type of information may be. The direction of typological development should be evaluated and assumptions tested, such as a linear progression from simple forms to complex ones.

Certain features may be observed to provide links between the fifth-century cruciform brooches of Anglian England and those from the continent, although these similarities are not close enough to prevent one from being able to provenance a brooch (to country, but not county-level) on purely stylistic grounds. It is therefore normally difficult to justify the use of grave-good associations from continental cruciform brooch finds to provide chronological 'pegs' for the English material. Furthermore, few English cruciform brooches were buried in contexts which include chronologically-useful artefact forms. Despite all these problems, typological work remains the only means by which dating can be assigned to artefacts; it must be used with due circumspection.

Establishing the distribution of typological forms across the country will begin with a discussion of modes of production and an examination of the method of transference of ideas and motifs. Without wishing to revert to cultural-historical methods, it is still important to determine comparability between regions to understand the context of the English forms. The symbolic content of cruciform brooch design and use may also be investigated to determine whether elements contain information on social identity or whether they relate to workshop practice. In these ways, a range of information available can be compared with that seen in other artefact forms.

The cruciform brooch typology will also provide a structure for testing theories based on chemical and technical information. Degree of variation within archaeological types could be said to be analogous with standard deviation and mean values in chemical analysis. So it is immensely beneficial to have a personal understanding of the nature of the archaeology behind a typology. Against this advantage may be considered the factor of personal prejudices and preferences which are inherent when constructing a typology, notably, in this case, a desire for typological groupings which are large enough to enable valid statistical treatment of chemical and technical data. However, since this particular prejudice also influences many archaeologists, it may be seen as a necessary evil in a practical world.

2) Technology (Chapter 3)

Chapter 3 demonstrates the potential importance of technological data in understanding Migration period metalworking, using the cruciform brooch data as a case study. Leigh established that there was much of significance in the technical examination of the products of a single, static workshop i.e. the fabrication of the great square headed brooch (Leigh 1980). How much more fundamental must this aspect be in a project with wider geographical and chronological scope, especially one concerning a manufacturing tradition supposedly influenced by social and economic change? Within a Scandinavian database, Arrhenius suggested there may be technical evidence of changes of a much broader nature (Arrhenius 1982).

The division of this thesis into chapters dealing with archaeology/typology and technology separately is one which resulted from the influence of traditional treatments, which deal separately with each type of data[1]. Technology should be seen as just one aspect of archaeological study and the subdivision became increasingly difficult to maintain as research progressed. It is hoped that the features discussed will reveal aspects of continuity and change, control and

[1] It would have been equally viable to discuss the data under sub-headings such as 'chronological development', 'regional development', 'function', 'social identity' and 'social structure'.

variability in the technical organisation, and hence may be informative about the social context in which production occurred.

Within Chapter 3, an attempt is made to avoid the discussion of aspects which are entirely determined by the decorative scheme of a brooch. For instance, cruciform brooch designs with lappets do not necessitate any modification of the technology of casting or finishing. On the other hand where brooches are gilt, a new high-temperature process is being applied to the copper alloys and this is clearly a modification of technology as well as of decorative form.

Metalworking sites of this period have not yet been discovered in England, so research naturally depends on information from abroad and from the artefacts themselves. Much of the existing information was collated and discussed by Brown (1986) and the debate within this thesis will not reiterate his findings there. With tangible scientific data, some of the current theories may be tested. The degree of variability in the production of an artefact type within restricted regions and, conversely, the degree of similarity in production over wide areas should be considered in order to begin to comprehend the traditions of this time. It might be possible to identify whether a 'North Sea Culture Group' had shared metal-working traditions. However, extensive and comprehensive primary research would be necessary to establish that these traditions were not shared by many or all contemporary European cultures

and this cannot be entered upon at this time.

Changes over time can be studied through the use of relative typologies. With lively artistic development evidenced in early Anglo-Saxon jewellery, it is interesting to survey the degree of technical innovation, in this country and abroad. For practical reasons, this research is restricted to cruciform brooches.

3) Chemical composition (Chapter 4)

Discussion of the chemical composition of brooches is a natural extension of themes from other technological research. The results of a chemical analysis programme on a dataset such as this may be used to tackle a number of questions raised by archaeologists and archaeological scientists. In essence, the type of metallurgy shown in a group of artefacts reflects the technological environment of the society that produced it, the availability of resources and, less directly, the status given to artisans and their products. There are a number of important factors which have to be discussed. These include those mentioned above, such as the meaning and reliability of archaeological groupings. Any statistical treatments should also allow for non-uniform frequency and distribution of typological groupings.

Copper and its alloys are suitable for chemical research since there are a large number of variables (i.e. elements) for

consideration. Although there are no extensive chemical datasets in which Migration period copper-alloy artefacts which are related to detailed archaeological information, research projects on other material have shown the potential of interdisciplinary research. In the Bronze Age, Needham et al (1989) have recently demonstrated the possibility of comparing archaeological and chemical information to pinpoint the moment when tin bronze was widely adopted in southern England, more exactly. Changes in metal sources and/or techniques of production are suggested by trace element contents of axes and other cast items.

Chemical research previously carried out on Anglo-Saxon data indicates a much more complicated metallurgical tradition than that of the Bronze Age (e.g. Brownsword 1986, Mortimer et al 1986). Clearly brass alloys were used and bronzes also often had a few percent zinc present. The rarity of industrial evidence for copper alloy working in this period has led to the suggestion that artefact production was on a itinerant, part-time or ad hoc basis, with artefacts and scrap metal (including Roman material) in rapid and haphazard re-circulation. Many authorities believe that supplies for the production of fresh copper alloys were not generally available. A thorough investigation of the chemical information available, and the biases implicit within it, is needed to properly evaluate the skills and resources of the metalworkers of this period.

Using a single type of artefact, the technological processes that may be detected or implied will be summed up and the data evaluated to see what implications can be drawn. Restricting the range of artefact types means that non-uniform technological factors are minimised and the data may be considered to relate more directly to metal supply.

Chemical data from abroad would be a useful aid to determine whether cultures in a 'North Sea Group' had similar resources at this time. With parallel development of decorative themes in Anglian England and the Germanic homelands one might expect a parallel development in metallurgy. Similarly, in the later portion of the period under consideration, cultural links with Scandinavia appear to be strengthened. Unfortunately there are few published analyses from Migration period copper alloys from Scandinavia or northern Europe. A small analysis project was carried out on Norwegian, Danish, German and Dutch cruciform brooches (the size of sample population being restricted by practical constraints) and the results will be examined using chronological and regional divisions. With such a wide-spread data base, it may also be possible to test the interdependence of typological development and metallurgical characteristics.

Brown believes that the metalworkers of this period had an 'empirically derived knowledge of working properties of different alloys' (Brown 1986, 190-1). Even if it proves possible to show that the early Anglo-Saxon metal worker had

this knowledge, it may not have been possible to exert control over composition, in the same manner as in the modern workshop. More importantly, it may not have been necessary. Metallurgical requirements for alloys used for casting small objects are less stringent than for other processes. A number of aspects suggest that surface appearance was a highly important consideration (Mortimer et al 1986, 40). There is a significant degree of similarity in the physical appearance as well as in the casting and working properties throughout much of the range of copper alloys known and used in Anglo-Saxon times. It is therefore of interest to investigate the suitability of the alloys used in making this particular type of artefact and the homogeneity of their production.

The comparison of chemical composition with the archaeological information may provide information to allow investigation of the scale and nature of the systems of artefact production. Brown suggests that the early Anglo-Saxon brooches were made in settled workshops (Brown 1986, 369). By looking in detail at compositions of typologically associated groups of brooches, one can establish firstly whether the data available is amenable to this type of research at all and then whether metal supplies to areas or workshops were chemically distinctive.

Chapter 5 will draw together the data from Chapters 2-4 and provide an overview of the likely modes of production and status of cruciform brooches. There are several concepts which

may be useful in this synthesis, for example, it will be important to discuss whether technological attributes could have had any symbolic content (cf Richards 1987). The production of brooches can be contrasted with that of ceramics and with other artefact types, in terms of material requirements, probable locality of production, volume and frequency of production. It is important in this respect to establish what may be termed a workshop and the degree to which non-typological aspects confirm or refute the strength of association deduced by typological evidence.

The practical and theoretical difficulties encountered in this type of project will be reviewed in Chapter 6 and some proposals for further research on themes raised in the work will be outlined.

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The work will not include discussion on historical, literary or linguistic aspects of these questions, since this author believes that they have been considered to an appropriate degree already, by other authors (e.g. Brown 1986, Ch 5). The majority of texts referring to copper alloy traditions date from the full medieval period and to quite different socio-economic environments (e.g. royal or monastic workshops).

In this thesis, the term 'early medieval' will be used in its archaeological sense, rather than that understood by

historians. In England the immediately post-Roman phase (up until the mid- to late-sixth century) is known as the early or 'pagan' Anglo-Saxon period and on the continent and Scandinavia as Migration Period (see Hines, 1984, 16-20 for discussion of terminology permutations).

D. Parameters and methods in this study

Sampling the corpus

A selection had to be made from the English cruciform brooch corpus, since the form is relatively common and widely spread. To examine every known example would have taken much more time than was available, given the number of procedures which had to be carried out on each brooch. The catalogue lists those brooches which were selected.

Every available cruciform brooch was examined in each of three major collections; the British Museum, Cambridge University Museum, Norwich Castle Museum. Find-spots for brooches at these museums cover regions which have high frequency of cruciform brooch occurrence, i.e. Norfolk, Suffolk, Cambridgeshire and Lincolnshire. Examples were also examined in smaller museum collections, providing examples from regions in which cruciform brooches are infrequent. Brooches known to this author from drawings and photographs alone, bring the total number of cruciform brooches in the corpus to 547.

This study specifically excludes small-long brooches[2] and most hybrid forms. Each of the major typological forms are represented by a number of examples. The list of cruciform brooches known in Norfolk (Appendix 1.4) shows it is extremely likely that many more cruciform brooches are held by private collectors, but these are largely inaccessible. On this evidence, the 'sample' taken in this thesis may not form more than 50% of the entire population so far excavated. This in turn must be a fraction of the original production. Leigh estimates his 80 brooches represent only 1% of the total production of Kentish square headed brooches and we may have excavated an equivalent proportion of the original cruciform brooch production.

The naming of brooches

Individual brooches are distinguished by their provenance and, where known, a grave number and a individual number. Brooch names are typed in bold. The length of a name is thus minimised and depends on the amount known about the circumstances of its burial. Assigning names to individual brooches rather than contexts (Reichstein 1975) or brooch groups (Leigh 1980) avoids unnecessary confusion. For instance, three cruciform brooches from Grave 30, Morning Thorpe, Norfolk are referred to here as **Morning Thorpe G30 (1), (2) and (3)**. Where grave associations are not known, brooches

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[2] Currently the subject of research by Martin Howe, Peter borough Museum

from a known site are numbered arbitrarily e.g. **Mitchell's Hill 1**. If the brooch is a stray find, or only a single cruciform brooch comes from the site, the site name is used by itself e.g. **Northwold**. Where provenance is unknown, this is noted, e.g. **Unknown provenance 1**. As typology is not used in naming brooches, reference to earlier works is facilitated and future changes in groupings may be conveniently carried out without confusion.

Detailed descriptions and measurements

From the beginning, it was apparent that a large amount of detail had to be systematically recorded for each brooch and Appendix 1.1 shows the final form of the proforma sheets used in this project. The descriptive proforma sheet has proved to be a useful back-up to photographs, drawings, sketches and descriptions as it forces the recording of many attributes, which might eventually be overlooked or taken for granted during the course of an extended museum visit.

Variables can be used to select brooches by the computer database system. The INGRES database system (described in Appendix 1.2) allows quick and flexible retrieval of information, by reference to one or more of over 100 archaeological (descriptive and dimensional), technical or chemical

attributes[3]. The number of attributes recorded for an individual brooch depends on the state of preservation, degree of ornamentation, whether the brooch was personally examined or seen in publication only and whether the brooch was chemically analysed.

In descriptions, references to upper and lower, right and left are given as if the brooch is being viewed upright, with the animal head lowermost. Despite evidence which suggests some cruciform brooches may have been worn the other way up, this is the manner in which cruciform brooches are normally displayed and illustrated, so the use of this convention is the least confusing.

Callipers were used to measure the dimensions of parts on each brooch (fig 1.2) to 0.1mm precision. Space does not permit this data to be given in full, but it is available through the database system. Intuition tells us that a sensible amount of dimensional data should be noted in any modern survey, for the sake of completeness and in case of future enquiry. It is also apparent that the 'feel' of an individual brooch which is part of the reason for allocation to production areas or styles is related to the size and proportions of various parts of the brooch as well as to the treatment of decorative elements. Dimensional data is important for discussion of pairs of

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[3] The INGRES database created during this study will be made accessible to researchers on the academic computing network (JANET and BITNET), through a read-only copy.

brooches.

Brooch parts were given names which are as simple as possible, whilst making it as clear as possible which piece is being referred to (Fig 1.1). Most critically, it is important to notice the difference between the catch (the part which 'catches' the pin) and the catchplate (the plate on which the catch is situated). The foot is that area below the catch plate, normally divided from it by a series of ridges or collars and decorated by some form of animal head. Similarly the wire which runs horizontally at the back of the headplate is best referred to briefly as the pin axis. Although this part does in addition serve as a sideknob axis on brooches with separate sideknobs, it is used as a pin axis consistently. Hence this term is the least ambiguous.

Most of the brooches could not be removed from museum property and examination occasionally took place in somewhat primitive situations. This lack of uniformity may have affected the assessment of similarity between pairs or groups of brooches from different museums. Careful photography and detailed note taking were the best methods available to overcome these problems. In future, digitisation of dimensional evidence may be employed.

In addition, the existence in the past of indifferent or destructive conservation techniques will have irrevocably eradicated some information from the surface. The practice of

stripping corrosion products using strong chemicals[4] was widespread in the past. This continued at least into the 1960's in this country and probably later in other areas.

Chemical analysis

The techniques of sampling and chemical analysis are described in Appendix 1.3. These were designed to comply with the following requirements;

1) Small samples and discrete sampling areas, minimising damage

2) Consistent positioning of sampling areas

3) Chemical compositions with known precision, accuracy and detection levels.

Atomic absorption (AA) analysis was available 'on site' at the Research Laboratory and proved to be a satisfactory method of discovering the concentrations of seven major and minor elements. Sample preparation and equipment running time were relatively high and the available equipment is labour-intensive. The use of microprobe facility of the Department of Metallurgy and Material Science was kindly made available by Dr Peter Northover. Sample preparation for this technique is minimal and although the equipment running time is quite considerable, the procedure is automatic, after points for

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[4] Modern conservators are becoming increasingly interested in past techniques of artefact treatment. A note associated with material from Fonaby states '10% Ammonia for 24 hours. Brushing with Genolite on pin. Strong citric acid.' This has had a devasting effect.

analysis have been entered. Copper content was not calculated but five additional trace elements were measured by this method.

Both atomic absorption analysis and microprobe analysis were carried out on samples from 48 brooches (see Appendix 1.3). Comparison of these methods is informative, since one is performed on solid samples and the other on dissolved samples. The results show reasonable comparability between the two methods. In cases where disagreement occurs and the fault may be attributed, problems were detected with both methods. Analysis by atomic absorption has a capacity for operator error and cumulative error (e.g. by dilution). In microprobe work errors may occur when mounting the tiny samples or selecting areas for analysis. The results of chemical analysis are listed in Appendices 4.1 and 4.2.

The lack of scientific research facilities at museums means that the nature of surface treatments are not generally known and these are described as appropriate e.g. 'white metal strips', 'possible/probable gilding', 'copper alloy', 'probable enamel'. A small proportion of the material from the Ashmolean and British Museums was examined using XRF and similar facilities have previously been used on the surfaces of Anglo-Saxon material from Spong Hill, Morning Thorpe and Finglesham (Wardley, 1984; Wilthew 1985a and b).

Where chemical analysis was not carried out on the base metal,

the terms 'copper alloy' and 'white metal' are used, rather than the traditional but inaccurate 'bronze' and 'silver'.

Problem of audience

There is a problem in presenting this study, in deciding the exact 'pitch' of discussion. The data is in places rather detailed and specialised but should be made appreciable to both archaeologist and scientist, without diluting its impact. The solution to this dilemma is to present the data in full detail and periodically to summarise its importance in general terms. This technique may coincidentally allow speedier reading for those less interested in minutiae.

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This survey should provide indications of the areas to which effort could and should be applied to examine the development of metalworking industries in the early Migration Period. As in most theses, every answer raises several further questions, and many of these may be insoluble in view of the nature of the archaeological record. The discussion will attempt to make the most of previous research and to mark clearly where the data is inadequate or has been poorly used. An archaeological study of the cruciform brooch is long overdue and an interdisciplinary study might, in Leigh's optimistic terms 'provide unparalleled insights into the spiritual, artistic, technical and economic forces which governed men's (and

women's)[5] lives in a period for which we have few other reliable documents' (Leigh 1980, 515). In addition, such an approach performs a useful exercise in demonstrating some well-trodden routes to pitfalls in the application of science to archaeological artefacts.

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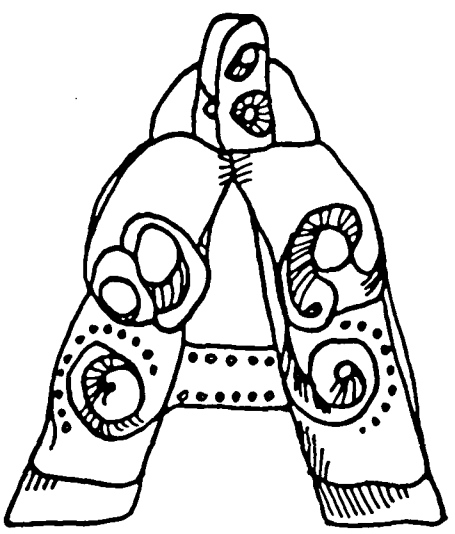
[5] My insertion. Women's graves provide the majority of evidence discussed in this thesis. It is also possible that women may have taken part in many, if not all, of the production processes of metalworking. Several women's graves have been found containing scales, weights and touchstones (Speake 1980, 97), items associated with craftworking although these particular pieces could also have been associated with traders or moneyers. Hence my avoidance of 'craftsman' in favour of neutral terms such as 'producer', 'worker' 'artist' etc.

Chapter 2

Typology and Archaeology

A. Introduction



number of studies have considered the evidence of the Anglo-Saxon cruciform brooch since 1906 when Shetelig produced 'The Cruciform brooches of Norway' (see Hines 1984, 244-53). Some of these have included systems of typological classification on stylistic grounds of which Åberg (1926) remains in general usage. The published classification systems for the Anglo-Saxon cruciform brooch are unsuitable for the purposes of this study, for reasons which will be noted as each work is reviewed. A new typology has been constructed which, it is hoped, will be useful not only within the constraints of this project, but also more generally. As all typologies are based on the same population of brooches, albeit enlarged periodically by newly discovered examples, the new typology is likely to be closely comparable in some respects with other typologies.

My aim is to provide a simple stylistic sub-division of the English cruciform brooch. This will be as independent as possible of the impression formed by the patterns emerging from the chemical and technological data of the brooches. To compare a typological structure with the archaeological and

scientific data satisfactorily, groupings must be formed which are large enough to be statistically significant, whilst remaining archaeologically meaningful. This stipulation means that although membership requirements for a group must be clear and precise, they also have to be reasonably tolerant. Such a classification will allow examination, on similar criteria, of comparative material from Scandinavia and the continent. Hence a scientific exploration of the justifications of claims for common areas of development, trade and exchange or migration of populations may be possible.

It will be necessary also to get an idea of a relative chronology of the types by association and by typological assessment. This gives a framework for the commentary on the chemical and technological attributes of the cruciform brooches. It is not strictly necessary to create a highly precise absolute chronology for the purposes of this project. Other scientific researches on early medieval copper alloys use very broad phases, at least fifty year divisions and generally much wider. In any case, the Anglo-Saxon cruciform brooch has few fixed chronological points over which to place a typology, though Reichstein showed that continental parallels can provide some important clues for the early English brooch forms. Nonetheless, all information relevant to dating will be given.

It is not my intention here to provide a new typology for the brooch form on the continent or Scandinavia, in view of the time restrictions of this project, although naturally comments will be made where relevant. For the same reasons, a substantial proportion of the known population of English cruciform brooches will be examined but not the entire corpus. It is hoped that those examples that have been used are sufficient in scope to be representative.

A review of previous research

Shetelig published the earliest study of the brooch form in 1906 and he selected stylistic features which remain potent for typological divisions. He also described some of the technical features and with these types of information linked a number of examples from quite disparate areas of the known distribution. Evidence of additional data from brooches that have been found subsequently suggests that a number of these distributions are much broader and reflect areas of parallel development.

Shetelig's study takes a narrative form and cannot really be termed a typology. To be usable a typology should at least have named, listed and described forms in detail along with a substantial catalogue of brooches which supports the groupings. Many of Shetelig's descriptions now appear quaintly old-fashioned and the phasing appears to originate from

judgements based on prevailing taste. Brooches are described as displaying 'bad proportions' and being 'carelessly executed' and are considered to be degenerate and therefore late (*op cit*, 64-5).

Åberg (1926) formed his typology by grouping brooches with particular elements concentrating especially on the animal head terminal and knob formation. His typology is simple to apply and is still used widely in this country. However, the chronology is now out of line with current thinking. The volume of finds since the date of publication means that the relative importance of groups and their distributions have changed. Although Åberg Groups I to V provide a good preliminary categorisation, five groups are not adequate for detailed discussion and further descriptive details have to be added to clarify exact brooch types. Evidently the Åberg classification needs to be substantially revised or could be replaced by a completely new structure.

Leeds and Pocock provided a revision or expansion of Åberg's Groups IV and V (Leeds and Pocock 1971). These are the most complicated cruciform brooches and the 1971 work provides numerous sub-divisions especially for the Group V brooches, including 'groups' which consist of one brooch. Within each of the Leeds and Pocock group descriptions, points of similarity are noted for other Group V brooches. This produces a complex network of relationships of varying strengths, linking

individual brooches or complete types. These inter-relationships are not apparent from the group names. Typological division of the florid brooches at a higher level seems to be a sensible step. If this does not take place, it seems that even more sub-types will be found to be necessary in future.

The Leeds and Pocock paper ends with suggested historical reconstructions linking distributions of brooches with the influences of royal dynasties. However the reader may view the uneasy contact between the written history and the archaeology of this period, these historical aspects lie largely beyond the scope of this thesis.

Reichstein (1975) provided a new classification system with a strong Scandinavian and continental emphasis. Reichstein employed and clarified Genrich's classification (Genrich 1954) for the earliest continental examples - *Typen* Dorchester, Witmarsum and Pritzier. This part of the work is pertinent for the rare English examples of these types. However, the method of overall classification for brooches is somewhat unclear (Dickinson 1978). It appears to be at the level of whole composition and not judged by the presence or absence of particular features. This means it is difficult to assign new brooches to Reichstein's types. In a few significant cases however, Reichstein has assigned fragmentary or dubious examples to his *Typen*, which radically changes the

archaeological impact of the type, e.g. the foot from a brooch found at Hoogebeintum, Frisia, given *Typ* Trumpington thus extends the distribution of this type to the continent.

Reichstein's concentration on cataloguing every Scandinavian and continental example resulted in incomplete cover of English examples and specifically excludes the later English examples. His allocation of brooches to types is cautious throughout, and of the brooches which he does consider, many remain unclassified as '*Einzelformen*', '*Sonderformen*' or fragmentary.

Reichstein's top level of grouping is by phases, e.g. '*ältere*', '*späte*' etc. It would have been more satisfactory for general archaeological purposes to first use a high level typological classification to sub-divide the brooches into broad categories before splitting into further types, even if the characteristics of individual brooches within the high-level classifications were rather diverse.

It is frequently difficult to apply Reichstein's typology, notably in the *späte* and *späteste* phases, i.e. those which are most applicable to England. Some of the brooches assigned to *Typen* Islip, Stratford, Midlum and Girton seem remarkably alike and the method of sub-division is unclear. The foot forms especially, seem to vary between brooches allocated to a type, for example, those *Typ* Girton brooches shown in

Reichstein's *Taf* 116, 1, 3 and 5. It would be easier to divide this part of the corpus primarily on the animal head form, since the headplate style does not vary to any great extent.

Some of these simple brooch forms are found over a wide area, and it can be accepted that these brooches have certain very simple developments in common, emerging from a shared original repertoire (Hines 1984, 252). Hence some of Reichstein's types give spurious detail to the distribution patterns.

In her article on the barred zoomorphic comb, Hills criticises Reichstein's typology for overlooking technological aspects, such as the method of sideknob attachment (Hills 1981, 107). This particular technical attribute does seem to be informative, although not easily comprehensible. This detail and others will be examined thoroughly in Chapter 3.

Reichstein's Norwegian and continental chronologies are based on artefact association within closed contexts i.e. graves. Unfortunately many of his types were undated as there were few fixed chronological points or burial associations known, especially from English sites, at the time of Reichstein's research. With the publication of modern excavations at such cemeteries as Bergh Apton, Sewerby, Morning Thorpe and Spong Hill the number of cruciform brooches in well recorded contexts is now more substantial. Hence a relative chronology may be attempted.

Typological similarity has been used in traditional archaeological treatments to prove cultural affinities between regions around the North Sea and to provide chronological links. Previous writers have emphasised links with Frisia, northern Germany, Denmark and Norway. There seems little doubt that some of the earliest English cruciform brooches are Germanic in a true sense, i.e. they were imported from Germanic areas. However, it is a more vexed question to establish exactly what level of typological similarity is 'significant' in subsequent phases of development and what these represent in social or cultural terms. Clearly typological similarities do represent some sort of parallel development of artefacts, from very similar functional and stylistic 'starting points' but the levels of comparability used by archaeologists are often rather low.

It is not my purpose here to re-examine the continental picture in detail so soon after Reichstein's work but recent archaeological finds and technical information may at least allow some new observations. An update of typological parallels will be given here, with careful note of those examples which could have been imported.

The understanding thus gained can be used to begin investigation on several aspects of wider interest.

Modes of production

A major part of this research concerns the nature of the processes that produced these artefacts. 'Where were brooches made, and by whom?', 'what is a workshop?' and 'how can we tell if two artefacts come from the same workshop?' are questions which are currently of interest to Migration period archaeologists. The English scarcity of metalworking evidence contrasts strongly with the Scandinavian pattern, notably with the rich material at Helgö, but also with finds of contemporary date in small farmsteads in Scandinavia (see papers in Lundström (ed) 1988). This is a result of the small number of domestic and industrial sites excavated in England. The combined resources of technical and archaeological information from the brooches themselves will be used to support speculation, where possible, in Chapter 5.

In this chapter, I will indicate which individual brooches may be considered to be distinctive enough to have been produced by the same worker, or group of workers, from the typological evidence. It will be noted that some brooches from different typological groups share distinctive attributes which lead one to suggest that most workshops produced more than one type. Distribution maps may give clues to the location of these workshops. The technical and chemical information of the following chapters may add more weight to these arguments.

Social function

The manner in which an artefact is made reflects the society in which it was made, but the manner in which the artefact was used is also informative. As nearly all Anglian jewellery known to us was buried deliberately, the position of the cruciform brooch in contemporary burial rites must be investigated.

Typological methodology

Visual typologies are the products of personal interpretation and as such liable to bias from preconceptions and current philosophies. Recent attempts to overcome this problem have proposed various theoretical solutions - notably from the viewpoint that a computer will solve everything. However, the application of computer analysis to typological study is not simple and can be misleading (Adams 1988). The necessity of selecting variables for recording and levels of significance for grouping means these new methods are just as likely to be subjective as old-fashioned methods. Hence computers may sort more examples, more efficiently and quicker but use the same old criteria.

One accepted method of resolving the differences between scientific credibility and archaeological practicality is to evolve a typology which is problem-orientated and to make any

assumptions explicit. The requirements and purposes of this particular classification were set out in Chapter 1.

Features which are common to all cruciform brooches (and hence form the class definition) are the headplate with its three knobs, the bow and the animal head terminal. The presence of these features is therefore not informative. There are several other features that occur less frequently, e.g. decoration on knobs and catchplates with lappets. On the principle of comparing like with like, only restricted groupings should be used for computer-based comparisons. In this case, there are huge formal differences between the earliest and latest examples of the English cruciform brooch, especially in their size but also in the amount of detail and decoration. Clearly it would be nonsense to calculate similarity coefficients between all these groups.

In the case of cruciform brooches, once this sort of preliminary selection by eye and instinct has taken place, the groups formed are adequate for the purposes of this work. Further statistical treatments seem unnecessary.

In this work, the first level of the typology will be based on the overall brooch form and size. Further detail is given by more precise definitions, based on several discrete areas of the brooch form - foot, lappets, knobs. These areas will be used to define types polythetically - in other words, the same

brooch parts will not necessarily be used for all type definitions. This is not to pre-suppose that each division or sub-division at any level is equivalent or equidistant (Adams 1988, 44) or that other divisions or sub-divisions would not be relevant in other contexts.

The brooches are split into 5 broad groupings, within which closer definitions are given. Each type and sub-type section will be headed by a definition, followed by a listing of brooches known to belong to the various sub-types and a description of some further characteristics. Fragments of brooches will be assigned to types or sub-types as precisely as possible. The references to brooch illustrations (figures and plates) within this text are given here, but references to other published illustrations will only be found in the catalogue.

B. Typology

Type A) Small brooches with topknobs with circular cross-section. Simple, unexpanded foot forms, plain or very simply decorated.

These brooches all have separate sideknobs. None of the knobs have additional decoration apart from incised lines at the base or on the collars. The topknobs are set symmetrically on the headplate, whether cast with the headplate or added using a spike and a front tab. The reverse of this sort of brooch is often cast quite flat, including the reverse of the bow.

A1) with very small or no headplate, simple or no animal head design at foot, solid bow, triangular or lozenge shaped cross-section

Dorchester G2 (Fig 2.1)
Mildenhall
Spong Hill C2197
Ixworth 1 (Fig 2.2)
Kempston 1
Glentham 1
St John 16

This is a form given a definition such that some considerable variation can be seen amongst it's members. The brooches are ordered above in a suggested typological progression. After the **Dorchester G2**, **Mildenhall** and **Spong Hill C2197** forms, with few obvious animal head features and no headplate, one might place **Ixworth 1** and **Kempston 1** next, at a slightly later stage of development, with rather angular animal head designs and

small, square headplates. **Glentham 1** and **St John 16** can be seen as being of a slightly later stage. They have foot collars, rounded eyes slightly projecting out from the animal head and round noses. Another example comes from Hockwold-cum-Wilton (not examined, see Hines (1984) fig 1.3) which is at a similar stage to **Glentham 1**.

Possibly associated

Nassington 1 appears to have a catch formed by folding over the foot with little animal decoration. There is no true headplate (appearing to be similar in style to **Dorchester**). A further example may be the brooch **Spong Hill C2997**. The foot and part of the bow only are extant, but the style of the animal head is quite simple, related to either A1 or A2 forms. The catch was twisted away from the foot, but was probably rather long.

A2) with widened headplate and two oval nostrils

Barrington A 11 (Fig 2.5)
Colchester 2 (Fig 2.3)
Driffield 1
East Shefford G10 (1)
Little Wilbraham G143
Rudstone 1 and 2 (Fig 2.4)
Spong Hill C1468 (1)
Spong Hill C1468 (2)
Spong Hill C1469
Spong Hill C1216

The pair from Rudstone are amongst the very few well preserved examples of cruciform brooches with polyhedral topknobs in England. This feature is more frequently discovered on German

and Danish brooches. A brooch from Aisne, France is typologically extremely close to the form of the Rudstone pair, with the addition of stamp marks (two concentric semi-circles) on the headplate. This brooch is preserved in the collections of the museum at St Germain-en-Laye.

Colchester 2 has a solid, lozenge-shaped bow cross-section as do the Spong Hill examples. The facetting on the catch plate extends nearly the whole length, up to the bow.

Barrington A 11 is particularly unusual for many reasons and previous discussions have suggested that it was imported. The surface is a dark glossy grey. The edges of the piece are very sharp with delicate and well-formed incised decoration. The particular eye shape here is a raised line running from eye to eye, the eyes projecting outwards from the animal head. This particular form is seen on other brooches (for example, on the Rudstone pair), although nowhere else with such exaggeration and clarity. The unusual separate topknob with a tab is also found on **Little Wilbraham G143** and other brooches discussed below.

Spong Hill C1468 (1), **Spong Hill C1469** and other possible examples from the site form a close grouping. **Spong Hill C1468 (1)** has several similarities to **Barrington A 11**, especially with respect to the square headplate with narrow wings. It also has the same slightly angled catch-plate faceting and

the two sets of rounded indents divided by a single incised line above this and a single foot collar below. The eyes are more rounded but the foot form is otherwise quite similar to **Barrington A 11**. **Barrington A 11** however has its separate topknob and those on the Spong Hill examples are cast with the headplate, leaning forward towards the headplate. **Spong Hill C1469** is again similar to **Spong Hill C1468 (1)** although at a smaller scale and the facetting on the catchplate is not at an angle.

Spong Hill C1216 is smaller again and the remains of an iron pin and coil arrangement here suggests that coils would have been visible from the front and that iron was probably used in the other Spong Hill examples. **Spong Hill C1468 (1), (2)** and **C1469** all have rather rounded bow sides, compared to Barrington 11 which has a tapering bow outline. **Spong Hill C1664** is similar in many ways to the members of this group but has a semicircular cross-section at the topknob and wider wings (and is therefore associated with type B).

Extant catches on all the A2 brooches are rectangular and high.

Associated with A2

A brooch, said to be from East Anglia, illustrated in Åberg (1926) fig 49, is much larger and has considerable amounts of

decoration throughout. **Spong Hill C1034** has a large amorphous topknob but, as far as the slight remains allow interpretation, the rest of the headplate form is the same as **Spong Hill C1468 (1)**. A brooch from the Hattatt collection may have come from Norfolk and shows some typical type A2 features (Hattatt 1987, no 1299, fig 98)[1].

A3) with wide headplate, heart-shaped nostrils

Colchester 3
Frilford
Girton G13 (1) and (2)
Morning Thorpe G346 (Fig 2.7)
Rugby 1
St Johns 17
Spong Hill G26
West Stow Heath 2

The style of **St John 17** can be seen to carry on from the St John example in A1 above. Here the wings have become distinct from the headplate, the bow is wider (although still lozenge shaped in cross-section), the eyes are more exaggerated (possibly continuing the tradition of **Barrington A 11**) and the nostrils are heart shaped. A brooch in the Hattat collection is very similar in form (Hattatt 1985, no 660) and appears to have a complete catch, whose lower edge joins the foot to form a pocket.

Except for the foot form, **Colchester 3** is very close in form to **Colchester 2** (type A2). **Girton G13 (1)** and **(2)** and **Spong**

[1] The Hattatt collection has not been studied in depth and only a selection will be noted in this study. Hattatt has published drawings of several cruciform brooches, mostly unprovenanced (Hattatt 1982, 1985, 1987).

Hill G26 have a polyhedral topknob. Although the eye form on these examples is not the same (they are rounded rather than pointed, in **Barrington A 11** style), the rest of the brooch form is sufficiently similar to the Rudstone pair to suggest a common date (and/or source) of production for these examples with A2 and A3 foot forms. The reverse of the bow on both Girton examples is hollow as is that on the Morning Thorpe brooch.

The Morning Thorpe and **Girton G13** brooches have round eyes and dot stamps at the foot. Both Girton artefacts in this group have extant sideknobs, with slots cut into their base. The Morning Thorpe example was apparently sewn onto a garment, as threads cross over the headplate and bow area. This may suggest re-use after the original catch was broken and the brooch is indeed quite worn.

On **West Stow Heath 2** the topknob is attached using a front tab. Although it has some stamped decoration, the foot form is very simple, with the nostrils and eyes roughly marked on.

An unusual cruciform brooch from Undley has some of the features of this type and should be noted here. The topknob here is larger than normal and the edges of the headplate wings are rounded. However the most surprising attribute is the foot form with a oval nose area and rather protruberant eyes. The whole foot area is thicker and the bow arch higher

than in other brooches of this category. The extensive use of a small ring stamp, in places together with a short line stamp, is also unusual. These features and the slightly larger size suggest a later date for the brooch, but the brooch was a stray find and does not have any typological parallels so this must be a tentative suggestion.

Brooches from Kent, associated with A3

Bifrons G15 (1) and (2) Fig 2.8
Bifrons G23
Milton-next-Sittingbourne 2
Sarre

Bifrons G15 (1) and (2) (Fig 2.8) have nostrils which seem to approach the comma forms of type B3 (described below) but with topknobs with circular cross-section. The nostril forms on **Bifrons G23** may also be embryonic comma shapes. The continental associations are discussed below, in the section on distribution of forms.

Associated brooches, broken or unclear

Brixworth 1
Glen Parva
Howletts 1
Icklingham
Morning Thorpe G362
Spong Hill C1034
Spong Hill C2656 (Fig 2.6)
Spong Hill C3055 (2)
Spong Hill C2918
Trumpington 1
West Stow Heath SFB 6
West Stow Heath 15
Unknown provenance 1

Icklingham has a wide, square headplate and a poorly preserved topknob which seems likely to have a circular cross-section. The nostrils on this brooch are elongated commas or spirals as

found in type B3, especially close to those on **Sleaford 4** and **Sancton 1**. **Howletts G2** from Howletts, Kent, is also poorly preserved and the topknob here was made separately, attached using a front tab. The foot form could be like that of **Glentham 1** and **St John 16** (both type A1). **West Stow SFB 6** has notched lower sides of the wings, round and prominent eyes and an indistinct rounded nose. **Morning Thorpe G362** is very worn and is missing below the rather rounded eyes of the animal head. All the knobs are circular in cross-section and it seems that the brooch would have been of the A2 or A3 type. The foot of **Brixworth 1** is rather indistinct, but could also be either type A2 or A3. **Glen Parva** is quite elaborately decorated, but the form of the animal head is not clear enough to assign the brooch to either type A2 or type A3.

Spong Hill C2656 has nostrils on the animal head which seem to be precursors of the comma form which becomes all-pervasive in later English cruciform brooch types. The headplate is slightly enlarged. The eye forms are rather like those on **Barrington A 11** with additional incised lines crossing over. The brooch is broken at the bow but it appears that, as in other Spong Hill examples of type A2, the headplate again leans forward towards the bow.

Spong Hill C3055 (2) is the foot of a simple cruciform, most similar to several of the A3 forms listed above, but without the rest of the brooch it is difficult to be absolutely

certain that this is not a type B2 brooch.

Although only mangled fragments remain, **Spong Hill C2918** was most probably a type A brooch, since the headplate has the end of the spike for a separate topknob (and, therefore, highly likely to have been circular in cross-section). The solid bow cross-section further strengthens the hypothesis of its association with type A.

Typological affinities for a heavily punch-marked brooch from Abingdon, Oxfordshire will be discussed later in this chapter. Despite it's incomplete condition, **Abingdon G122 (2)** was probably originally a form linked to type A styles.

Finally **Unknown provenance 1** has a circular topknob cast with the headplate, but the foot style is complex and unparallelled anywhere in this country or abroad. The brooch is most probably late and associated with type B or C forms.

B) Expanded headplate. Simple animal head foot forms. Little expansion or elaboration on the foot, no fan at the end of the brooch. No lappets.

Reichstein deals with these brooch types most thoroughly of all the English styles. However, the descriptions provided are sufficiently confusing to make it difficult to assign individuals to Reichstein's types. An alternative suggestion for typological division must be simple and clear. This might be thought to be an easy demand for these brooches, in view of the relative simplicity of the forms. However, the following discussion shows it is not so straightforward.

In general, these brooches appear to be produced in two sizes, either small forms (less than 100mm long, generally less than 90mm long) or larger forms (more than 100mm long, generally more than 110mm long). These groupings appear to be quite discrete, with a neat bimodal distribution (fig 2.58 a-c). However, there are several brooches in forms B2 and B3 with overall lengths which lie around the 100mm value and so this division should be taken cautiously, as a guideline.

The upper parts of type B brooches are generally plain. A few examples have very distinct knob (especially topknob) styles but the great majority of the headplates of the type B brooches have the simple headplates and the knob forms which Åberg noted (Åberg 1926, fig 70, no 1 or 2). Method of sideknob attachment

is a possible area of differentiation from the upper part of the brooch. As will be seen in Chapter 3, division on this basis does not help the typology in all cases, since it frequently appears that it was the perceived impression that was important, rather than the actual method of production. Nevertheless, interesting patterns emerge from the different groupings.

The majority of examples have the same style of faceting, square to the edges, starting from about half way down the catch plate. Lines or decorative punch marks down the bow spine occur in most of the B type brooches with separate sideknobs. For the large type B brooches, there are also parallels with type C brooches, since much of the description of the C type brooches is the same, except the nose area has been expanded into a fan or spatulate shape, in type C brooches.

There are three, very clearly different styles of animal head terminal design, which can be employed to create useful groupings. The differences are most clear in the nostril areas, eyes and foreheads being rather unhelpful for typological purposes except in a few exceptional cases. The nostril forms are i) oval or round, ii) joined ovals or heart shapes and iii) commas, spirals or snail-shell shapes. These animal-head forms continue to be used in brooches with quite complex headplate and catchplate developments in types C and D.

Throughout special attention is given to the small number of Kentish examples. These mostly stand outside the main groupings but are described here in their nearest type, with appropriate notes.

B1) with separate, round or oval nostrils

This is the simplest form and the least common. The small brooches are all very small. The larger brooches also have very simple form, although general parallels can be drawn with type C1 (below).

Small type B1 brooches

Bradwell 1
Faversham 1
Holywell Row G69 (Fig 2.9)
Islip 2
Lackford C50,71
Lakenheath 11
Mucking G878 (1) and (2)
North Owersby
Rothwell 1 and 2
Sleaford G66

Average length: 77.8 ± 6.6 (n=10 of which seven have average length 77.0 ± 1.0, although they are not especially closely linked typologically).

Nine of these brooches have sideknobs cast onto the headplate and most have little or no decoration on them.

The Lackford example has not been examined and it is difficult to determine from the drawing the exact knob style (i.e. whether the sideknobs have circular cross-sections). The sideknobs here

are separate and attached using tabs at the front of the headplate, the eyes are in the **Barrington 11** (type A2) style.

The Mucking[2] examples have very small oval nostrils (possibly worn), angled eyes and square knobs. The brooch foot on **Spong Hill C2195** was probably rather similar. **Faversham** and **Bradwell 2** are examples of brooches with two pin lugs (see notes on this subject in Chapter 3). The topknob on **Islip 2** is attached separately with a tab, as in **Barrington 11**.

Nostril forms on a number of these brooches could be cited as early forms of comma nostrils (e.g. the pair from Rothwell), since a slight line is shown on the foot, above the nostrils themselves. On the large type B1 pair from **Morning Thorpe** (G30 (1) and (2), see below) this line is drawn on the upper edge of the nostril itself.

<u>A brooch from Kent, associated with small type B1 brooches</u>

The brooch from **Faversham**, Kent has a description which fits within that of type B1, but there are so many additional interesting features that a individual note is necessary. The catchplate clearly has diagonal facetting, there are two pin lugs and the animal head has large round eyes, projecting

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[2] Anne Clark, of English Heritage kindly allowed access to the Mucking brooches, and also provided information and drawings, prior to publication

outwards. Reichstein assigns the brooch to *Typ* Midlum although there are clear parallels to brooches such as **Howletts G2** (type B3), also from Kent, which was given Reichstein *Typ* Goutum. Diagonal facetting on the catchplate is unusual in cruciform brooches. This latter feature can also be seen on **Little Wilbraham 2** and **G47** (small type C2 brooches), in a clearer form, such that the reserved area between the facets is triangular.

Larger type B1 brooches

Brooke 5
Little Wilbraham
G73 (2) (Fig 2.10)
Little Wilbraham G143
Morning Thorpe G30 (1) and (2)
St Johns G8
St Johns 12
Unknown provenance 8

Average length: 116.5 ± 5.8 (n= 6)

Most of these brooches have separate sideknobs, but the two examples that do not are otherwise similar to the rest of the grouping. Decoration is minimal. The Morning Thorpe pair have punch marks and **St Johns G38** and the Brooke example have ring and dot marks.

Associated brooches

Loveden Hill C58 (2) has lost its headplate, but the nostrils are small and oval and it seems likely that the brooch belongs to B1.

Brixworth 5 has not been measured, so it is not known how large it is, but the style is clearly type B1.

B2) with oval nostrils joined into a heart shape.

This is a large group and has considerable variety, in view of how simple the form description is. Certain decorative features run across any obvious subdivisions of B2; simple punch marks (dots, semi-circles or rings) and diagonal slashes meeting across the foot area. The difference in sizes is less extreme than in B1 with a number of brooches only just over 100mm long.

Small type B 2 brooches

Alveston Manor G70 (1) and (2)
Ancaster
Baginton 1 and 2
Barrington 4
Barrington A 13 and 14
Bifrons 1
Eriswell G28 (1)
Feltwell
Girton G33 (2)
Haslingfield 3
Hatton
Holme Pierpoint 6
Holywell Row G48 (2) and (3)
Illington C101
Kempston 3
Lakenheath 10
Little Wilbraham G173-4 (1)
Little Wilbraham 3 and 4
Milton-next-Sittingbourne 2
Morning Thorpe G90 (1) and (2)
Morning Thorpe G353 (2) and (3) (Fig 2.12)
Morning Thorpe G318
Mucking G825 (1) and (2)
Sleaford G129
Sleaford G155
Sleaford G205 (1) and (2)
Spong Hill C1168
Spong Hill G57
St John 9
Trumpington 3
Wakerley G1 (1) and (2)
Wakerley G25 (1)
West Garth Gardens G55
West Garth Gardens G61 (2) and (3)
West Stow Heath 3
West Stow Heath 7

Average length: 84.0 $\pm$ 8.2 (n= 28)

Most of these brooches have their sideknobs cast onto the headplate. There are 10 pairs of brooches. **Holywell G48 (2)** and (3) are typologically very similar and were found in the same grave but **Holywell Row G48 (2)** had separate sideknobs whereas those on **Holywell Row G48 (3)** are cast on. This suggests the two methods of sideknob manufacture on this type of brooch were contemporary.

Six brooches have notches in the headplate wings, **Morning** Thorpe **G353 (2)** and **(3), Little Wilbraham G173-4 (1), West Stow Heath 7** and **8** (a larger brooch, below) and **Barrington 4**. Their simple form has associations with Leeds cross pattee derivative small-long forms and **Little Wilbraham G173-4 (1)** is paired with a small-long.

Three brooches have undivided headplates, **Morning Thorpe G90 (1)** and **(2)** and **Ganton Wold 1** (a larger brooch, below). Some features of these headplate shapes could also be parallelled by some of the small-long forms of the period especially Leeds square headed (panelled and plain) small-long types. It is possible that these cruciform brooches were perceived as being similar to small-long brooches.

Barrington 4 has double pin lugs (see notes in Chapter 3). Narrow wings are found on the headplates of **Cranwich, Nassington 1** (both larger brooches, below) and on **Hatton. Feltwell** has the square boss at its bow, associated with D group brooches.

The Barrington A pair and **Sleaford G129** have a slight enlargement of the foot into a fan shape and they could be seen as small versions of the C2 form.

Little Wilbraham 3 and 4, the small Reichstein *Typ* Hjelmhede pair are in rather poor condition. The foot shape in this case may be more accurately described as being without true animal heads.

Possibly associated

Fonaby G28 has strange flat sideknobs and very slight foot details. Cook, writing in 1981, could find no parallels for the foot form but those on the Mucking pair **Mucking G878 (1)** and **(2)** and on the brooch foot from Urn 2195, Spong Hill (type B1) could be quite closely associated. The continental parallels of the sideknob form are discussed below. **Spong Hill C2195** could belong to either type B1 or B2.

Larger type B2 brooches[3]

Bergh Apton G5 (Fig 2.11)
Bergh Apton G6 (1)
Cleatham G30 (4) and (5)
Cranwich
Ganton Wold G1 (1)
Haslingfield 14
Holywell Row G48 (1) and (4)
Kenninghall 1
Little Wilbraham G31 (1) and (2)
Morning Thorpe G90 (3)
Nassington 1
Sewerby G12 (1)
St John 7 and 15
West Garth Gardens G52
West Stow Heath 8

Average length: 112.3 ± 7.9 (n=12, of which six have an average length of 115.8 ± 1.2). Both types of sideknob attachment are used.

Morning Thorpe G90 (3) has indents running across the tops of the knobs and the sideknobs also have an extra collar.

Bergh Apton G6 (1) and **Cranwich** have a loop at the end of the animal head. The eyes are similar to **Barrington 11** (type A2) appearing as raised lines projecting out at the sides. The Cranwich brooch is also notable for having decoration on the catch.

Holywell Row G48 (1) was given Reichstein's *Typ* Corbridge (one of only two examples in Reichsteins typology) and clearly belongs to the themes of type D, the 'florid' types with lappets

[3] Two large type B brooches were recently found at Goldbury Hill, Oxon by a metal-detector operator. One of them has been repaired and has separate nostrils on the animal head (type B1), the other is worn so that it more closely resembles a type B2 brooch. I am grateful to Helena Hamerow for arranging access to these brooches.

and expanded foot styles. This brooch has extra collars on the knobs as in **Girton 2** (type D5a), together with the indent in the foot between the eyes and the forehead as seen in types D1 and D4. This is an example of an simple, early foot style being used at a later stage.

Associated brooches, with round plate or blob as foot terminal, or incompletely preserved.

Little Wilbraham G128
Mitchells Hill 3
Mucking G579
Sleaford G182 (1)
Spong Hill G46
Loveden Hill C58 (1)

Mitchells Hill 3 has the nose area merged into one round plate with a slight notch at the top. In addition it has ring and dot punch marks and diagonal slashes across the nose. All these brooches have sideknobs cast onto the headplate, where extant. **Mucking G579** is a tiny version of the division of B2 which has a round blob at the terminal.

Spong Hill G46 has a straight line across at top of the nostrils but is otherwise a simple small B2 style brooch. **Loveden Hill C58 (1)** has no headplate but the nose is of B2 form.

B3) with comma nostrils

Small type B 3 brooches

Barrington B 1
Barrington 10 (Fig 2.13) and 12
Carlton Scroop 1
East Shefford 2
Fonaby G32
Girton G2 (Fig 2.15)
Howletts G2
Lyminge
Morning Thorpe G97
Sleaford G129
Sleaford G182 (2) (Fig 2.14)
Spong Hill G22 (1) and (2)
Spong Hill C1730
Wakerley G25(2)

Average length = 84.0 ± 8.6 (n=12)

Most of these brooches have their sideknobs cast onto the headplate. There are two pairs of brooches. The Barrington B brooch has a prominent forehead style and an undivided headplate with attached sideknobs.

Carlton Scroop 1 and **Morning Thorpe G97** are quite close forms with similar nostril styles, the end of the comma extending up the side of the foot and they are also very similar in size. The eyes are quite prominent and the wings are expanded at the edges. **Sleaford G182 (2)**, **Fonaby 5** and **Sancton 1** (the latter two being larger brooches, below) have similar nostrils to this pair, except the end of the comma extends further up the catch-plate.

The pair, **Barrington 10** and 12 have neat, bean-shaped nostrils rather similar to those of **Morning Thorpe G97** and Carlton Scroop

1 but they have less prominent eyes and straight wing edges. They also have decorated collars on the knobs.

Notes on B 3 type brooches from Kent

Howletts G2 has large, round eyes, a bow with ridges at the edges and tapering wings. This form has good parallels with continental brooch forms and with the Bifrons Grave 15 pair (associated with type A).

Lyminge has an undivided headplate as in **West Stow Heath 5** but with six ring and dot punches.

Larger type B 3 brooches

Fonaby 5
Haslingfield 5 (Fig 2.15)
Holywell Row 79 (1)
Mitchells Hill 1
Sancton 1
South Willingham
West Stow 5

Average length = 115.1 ± 6.6

These all have separate sideknobs.

Mitchells Hill 1 has a plain catch plate with eyes extending outwards, rather like those of **Barrington 11** (type A2). **South Willingham, Haslingfield 5** and **West Stow 5** have punched decoration and rather rounded nostrils. **West Stow Heath 5** has an undivided headplate. **Holywell Row G79 (1)** has truncated conical knobs. **Mitchells Hill 1** and **Holywell Row G79 (1)** were both

assigned Reichstein *Typ* Holywell Row and parallels can be seen to type D5b and C forms. **Mitchells Hill 1** notably has three collars at the foot as in type D5b but here the nostrils are decorated with spiral incisions. **South Willingham** has Y-stamps on the headplate which shows clearly again connections to the large, more decorated styles of types D and C.

Associated with B forms, unclear or unique forms

Bergh Apton G37
Brooke 1
Fonaby G35
Howletts 2
Howletts G1 (1) and (2)
Lackford C48,2491
Lackford C48,2282 (1) and (2)
Lakenheath 5
Loveden Hill C58 (4)
Milton-next-Sittingbourne 3
Norton-on-Tees
Sleaford G182 (1)
Spong Hill C1176, C1168 (1) and (2), C1664, C1072 and C2087
South Yorkshire

Bergh Apton G37 has a undivided headplate and a semicircular nose with a straight bar across the top. The furrow on the forehead is seen in some of the large type D forms with lappets as are the indents between the eyes and forehead (on one side of this brooch only). **Lakenheath 5** and **South Yorkshire** are incomplete but probably belong to the B group. **Spong Hill C1664** is missing below the foot but has simple semicircular cross-section sideknobs, made separately.

The form of **Fonaby G35** is unclear but the foot form appears to be rather triangular at the end. This may be the upper edges of comma like nostrils. **Milton-next-Sittingbourne 3** is in very poor condition. The Lackford brooches are close in form but all lack

the foot of the brooch, which might enable classification.

Poorly preserved brooches of types A, B or C

Type A or B	Type B or C
Howletts 1	**Cleatham G34 (3)** **Felixstowe 3** **Holme Pierpoint 5** **Holme Pierpoint 7** **Lackford C50,76** **Milton-next-Sittingbourne 1** **Sleaford G129** **Spong Hill C3055 (1)** **Spong Hill C3304** **Unknown provenance 2** **Wakerley G1 (1)**

Milton-next-Sittingbourne 1 is in very poor condition but it appears to have a flat, square plate at the middle of the bow and rather enlarged animal head features.

The fragment from **Spong Hill, Urn 3055** has unusually prominent eyes and hollow casting.

Conclusions on the Kentish forms

Nearly all the type A and B forms found in Kent are associated with other forms at a very general level, without parallels to specific Anglian examples. There are clearly grounds for the construction of a separate regional typology, i.e. treating Kent as an alien entity, much as Frisia and north Germany will be, later in this chapter. It may be thought that, since this would remove many of the continental associations from our English

database, it removes the possibility of tackling some of the most important questions posed by archaeologists. However, if the connections between Anglian and Kentish cruciform brooch styles are not strong, any hypotheses based solely on Kentish associations will also be faulty.

A separate Kentish typology will not be enforced here but these factors will be considered as necessary in the following discussions.

All the following brooch styles, with expanded foot parts are essentially English, without continental or Scandinavian parallels. The brooches are distinguished by being large, with expanded foot parts and wide wings. The type groups may most easily be divided by the lappet forms (or their absence). This approach can be justified by commonsense as it is a very easy criteria to apply. As will be seen in the detailed discussion in type D, several lappet forms are clearly contemporary. Other attributes suggest further contemporaneity between some forms with and without lappets.

C) with expanded foot area, without lappets

The simplest form of these brooches, with straight-sided catchplate area, normally has the sideknob cast seperately. Close parallels for the foot forms can be seen in most of the forms with lappets (type D, following). The members of the following two forms appear to be typologically quite close. The overall lengths seem to be varied and do not cluster around any particular length.

C1) with simple oval nostrils and fan nose

Carlton Scroop 3
Gissing
Grantham
Hunstanton 1
Ixworth 2
Laceby 4
Lakenheath 9 (Fig 2.17)
Mitchell's Hill 3
Morning Thorpe G371
Pakenham
Ruskington G1
Sleaford G13
Sporle 1
Wakerley 28(c)

The core members are very simple but there are some

differences between the foot styles (in the eye area) and the knob styles (some of them have small projections). The style of the replacement ending of **Morning Thorpe G371** is unclear but likely to have been a fan. **Ixworth 2** fits into the description of the type by it's foot form but has much more complicated decoration, with heavy use of triangular punch marks and segmented ridges on the knob, knob collar, bow endings, foot collars and over the eyebrows.

Associated with unusual knob and foot forms

Morning Thorpe G30 (3) has crescent fans instead of knobs and also at the base of the animal head (see forms with lappets and fan-like knobs associated with types D3 and D4).

Associated brooches

Ixworth 3 (Fig 2.21) and **4** have oval nostrils with ornamentation but no fan at the end of the animal head. These are a pair with ring and dot decoration on headplates and catchplates, bar running down between the nostrils, spirals within the nostrils and round loop at the bottom of the foot terminal.

A closely related type was found in south-west France, at Castelnaudry although the animal head terminal is without the loop and there is no use of the ring and dot decoration. This is evidently an English type, as noted in Salin (1952).

Little Wilbraham G73 (1) probably represents a smaller version and has a round boss at the bow.

C2) with nostrils with comma-based shapes and fan nose

Akenham 1 and 2
Baginton 3
Barrington A 13 and 14
Brooke 4
Bury St Edmunds (Fig 2.19)
Haslingfield 12 and 13
Holywell Row G22
Holywell Row G79 (2) (Fig 2.18)
Hunstanton 2
Lakenheath 14
Little Wilbraham G133
Morning Thorpe G370 (Fig 2.20) **and G371**
Sewerby G8
St Johns 9
West Garth Gardens G61 (1)
West Stow Heath 1

Within this group, **Holywell Row G22** and **Bury St Edmunds** have very similar topknobs with fans, ring and dots on headplates, catchplates and foot fans but are not a matching pair since **Bury St Edmunds** has a bar running between the nostrils and a furrow down the forehead.

Five brooches have zoomorphic endings on topknobs **Hunstanton 2, Brooke 4, Morning Thorpe G370,** and **West Stow Heath 1** with the Brooke example being simpler and the West Stow Heath example rather more complicated than the rest. The examples from Sleaford and Hunstanton have sideknobs cast with the headplate wings and the Sleaford example also has a longer foot fan. In **Haslingfield 12** and **13** a Y stamp is used and there is a suggestion of a fan on the topknob, bringing this pair into comparison with those in types D1) and 2).

Associated smaller brooches

Drayton
Haslingfield 6
Little Wilbraham G47, G73 (1), G95 (1) and (2)
Little Wilbraham 2
Sewerby G35
Snape 0327 (1) and (2)
West Stow Heath 9

The nostrils in **Haslingfield 6** and the Little Wilbraham brooches are merged together with the nose fan. The brooches from Snape[4] have a square plate at the foot, clearly resembling those on a type D1 brooch, **Morning Thorpe G131** (see below) which also has extra collars at the knobs, as seen at the topknob of the Snape brooches. **Snape 0327 (1)** has a loop at the end of the foot, a feature which may have originally been present on the Morning Thorpe brooch.

Associated with C forms

Barrington 7
Fonaby 3
Fonaby G35
Girton 4
Morning Thorpe G153
Sleaford G189
Spong Hill C62 and C1168 (3)
Trumpington 2
Undley
West Stow Heath 6

The foot of **West Stow Heath 9** is damaged but the general form is like those of C1 or C2. **Barrington 7** has both heart shaped nostrils and a fan nose. **West Stow Heath 6** has a widened foot form but no fan at the end. **Unknown provenance 1** has a very strange foot form and topknob with circular cross-section. **Undley** was noted under the type A discussion but is probably

[4] I am grateful to William Filmer-Sankey and the Snape Historical Trust for allowing access to drawings and X-rays of the Snape brooches before publication.

closer to a C1 form.

Type D brooches i.e. those with lappets

Foot and headplate forms are frequently found to be of a similar 'standard' pattern in a sizeable proportion of large brooches, both with and without lappets.

Punch marks and other decoration were added after casting and brooches belonging to some of the types with lappets have zoomorphic decoration within the lappets or extensions to topknobs. In most cases, the core of the group can be formed of a number of closely associated brooches and other, more divergent, examples are tied in by those attributes which are sufficiently identical. A list of essential features is given for each group. The order in which the groupings are dealt with in this chapter is not necessarily chronologically significant. The variation in degree of within-group homogenity will be noted.

D1) Large brooches with square lappets and short bow

Frequently square bosses at the crest of the bow, square plates on the knobs, occasionally zoomorphic ending to the topknob, frequently a fan-shaped lower terminal, occasionally with only a slight projection. Most members have their sideknobs cast on

and have simple, usually single lower collars.

Eriswell G33
Haslingfield 2
Islip 1
Kenninghall 3
Lakenheath 2
Morning Thorpe G131 and G133 (Fig 2.25)
Nassington 2 (Fig 2.22) and G28 (3)
Newnham Croft, Cambs 3
Rothwell 3
Sleaford G233 (Fig 2.23)
St Johns 1 (Fig 2.25), 3, 8 and G1
Tuddenham 2
Wakerley G31
Woodstone 11

The Nassington and Haslingfield examples are especially close, sharing the same type of lower terminal, although the Nassington brooches are closer to each other than to the Haslingfield example, which is broken at the headplate and is also much smaller overall. St John G1 has extra collars around the knobs (also seen in **Morning Thorpe G131**) and impressed cast decoration on the headplate and lower fan, but is strongly associated with the core of this group by many other attributes, especially with Tuddenham 2 by virtue of the use of the Y stamp on the headplate and semicircular stamps on the catchplate. St **Johns 3, Lakenheath 2** and **Sleaford G233** are all rather small and in St **Johns 3** and **Lakenheath 2** the nostrils are merged together with the nose fan. **St Johns 1** appears to have a tinned area on the nose fan.

Islip 1 and **Morning Thorpe G131** share an unusual square nose fan. In **Morning Thorpe G133** the square fan on the topknob is extended into lobes and the detail within the nose area is

unusual, having three ridges down it. **Eriswell G33** has lost the animal head terminal, but is similar to the Morning Thorpe examples.

Rothwell 3 is less closely associated with this group. This brooch has small square lappets and uses a double V punch frequently. The nostril style is unusual. Plain lappets and quasi-zoomorphic nostrils are not found in any other cruciform brooches.

Kenninghall 3 is an incomplete example, but has square lappets and fans on it's knobs.

Associated brooches

Great Chesterford **Woodstone 2**
West Stow Heath 12

The other three brooches are small versions of the D1 type. **Woodstone 2** has an oval nose fan. **West Stow Heath 12** has smaller square fans on the knobs and a square boss at the bow, but is missing below the bow.

Conclusions This grouping has a well defined core group with very distinctive features. Elements within these brooches have the look of such uniformity that serial production might be suggested. Most of the other brooches listed above have several

points of similarity with the core members, over and above any general similarities which exist between this group and other type D brooch forms.

D2) Semicircular (occasionally double lobed) lappets, sometimes with a slight extension towards the foot, i.e. D or P shaped in outline. Lappet forms plain in the core members or cast with a few slight decorative, curved lines in other associated brooches. Wide nose parts as in D1, frequently with small projections on knobs, occasionally with other characteristics which also identify these brooches with the brooches in D1. Two brooches have double pin lugs but mostly single lugs are used. The sideknobs are equally likely to be cast on to the headplate or made separately. Dot or semicircular stamps are used frequently.

Barrington 9
Fonaby G23 (2)
Girton G33 (1)
Holywell Row G21 (Fig 2.27), **G99 (1) and (2)** (Fig 2.28)
Laceby G1 (2)
Lakenheath 4 (Fig 2.30), **13 and 15**
Morning Thorpe G160, G208 (Fig 2.26), **G209** (Fig 2.31), **G253 and G397**
Nassington 6, G28 (1) and (2)
Ruskington 5, 7 and G13
Searby
Sewerby G12 (2) and (3)
Sleaford G79
Soham 2
Spong Hill G39 (Fig 2.32)
Woodstone 4 (Fig 2.29) **and 7**

Two pairs (**Nassington G28 (1) and (2) and Holywell G99 (1) and (2)**) are especially close. However there are important differences between **Nassington G28 (1) and (2)** which show although they are close members of the same type, they are not

strictly a pair. A few of the type D2 brooches have simple foot forms or are missing below the lappets. Features found on D2 brooches which are associated with D1 brooches are; the square fans on knobs in **Nassington G28 (2)** and **Soham 2**, zoomorphic endings to topknobs in **Morning Thorpe G208** and **Walsingham** (associated, below) and square boss on the bow in **Nassington G28 (2)**. **Morning Thorpe G208** can be seen as a slightly more simple version of this type. **Ruskington 5** has it's nose fan and nostrils merged together. The pair from Sewerby, **Nassington 6** and **Lakenheath 4** have their knobs flattened and expanded into fan-like projections, the latter two examples being especially close. **Woodstone 4** is an intermediary example between the core members of D2 and this minor variety. The brooches from Fonaby are corroded and badly preserved, but appear to belong to this group.

Associated, brooches broken or with small lappets

Brooke 7
Fonaby 2 and G43 (1)
Ganton Wold G1 (2) and (3)
Lakenheath 15
St Johns 5
Walsingham

Ganton Wold G1 (2) is a small version, unfortunately the lappets are broken but the foot form is familiar, within the D group. **Ganton Wold G1 (3)** has much wider wings and is missing below the catchplate. **St Johns 5** has fans at the knobs and a square boss on the bow but is broken at the foot.

Conclusions This group also has a small number of core members, which possess many similar features. Other brooches approach the themes of the core group, but with more laxity in the execution of lappet styles, knob terminals etc. Several distinctive features link types D1 and D2 together, notably the St Johns style topknob terminal, square fans on knobs and square bosses on the bow. The overall proportions, especially in animal head forms and the specific St Johns style topknob terminal can also be tied in with those seen in type C1 and C2 brooch forms. Here one might suggest a reasonably close association between all these brooch forms, with type D2 lappet forms becoming the more popular style, developped in the brooch types discussed below. Lappet styles of type D3 and D4 follow on (typologically, although not necessarily chronologically) from the diversification shown in brooches associated with type D2 forms.

D3) A diverse group of brooches with lappet forms derived from D2 style, which have cast decoration but yet are not fully zoomorphic

Asgarby 2
Barrington 3
Bergh Apton G6 (2) and (3)
Brooke 2 and 6 (Fig 2.33)
Bulmer 1 and 2 (Fig 2.34)
Fonaby 1
Girton G39 (1) and (2) (Fig 2.35)
Glentham 2
Goodmanham (Fig 2.36)
Holywell Row G16
Kenninghall 5 and 7 (Fig 2.37)
Little Wilbraham G116 (Fig 2.38) **and G173-4 (2)**
Londesborough G7
Mitchell's Hill 4
Morning Thorpe G358 (1) and G396
Sleaford 1
St Johns 10 (Fig 2.41) **and 11**
Woodstone 1 (Fig 2.41) **8 and 9**
Unknown provenance 3

Sideknobs are usually cast onto the headplate. A number have expanded animal head terminal shapes very familiar from brooches of type D1 and D2. Many members of the group have much more individual animal head forms e.g. **Morning Thorpe G358 (1)** where there is an extra bar below the nostrils. A few brooches have fans or slighter projections on the knobs, giving some possible connections to forms in D1 and D2 above.

The pair from Bergh Apton do not have nostrils as such, only two projections at the lower end of the 'animal head' and a fan. **Holywell G16** has square fans at the knobs and a zoomorphic ending to the topknob. This brooch is especially broad and flamboyant and probably had white metal decoration on the knob fans, lappets and nose fan. It also has a square boss at the bow. These features bring the brooch close to type D1. **Kenninghall 5** is unusual for having separate

sideknobs and square notches cut into the wing edges.

Brooke 6 and **Glentham 2** have very similar foot forms, with some attempt at a more complicated zoomorphic style at the lappets. The knob forms are quite different however, as the brooch from Glentham has the unique headplate form with false tabs, apparently belonging to the knobs, cast into the headplate. The rather square sideknob style of **Brooke 6** is also unusual.

Brooke 2 and **Woodstone 1** both have fan-like knobs but are otherwise quite dissimilar, in size and style. The example from Fonaby is a unique form with broad knobs, perhaps showing a simple form of a rare zoomorphic brooch style, known in a few examples, including one from **Morning Thorpe** G 353 (1) (associated with Z). The knobs on the example from Fonaby were originally all cast onto the headplate, although the topknob was reattached using a rivet.

Kenninghall 7 has three plain, semi-circular lobes. **Little Wilbraham G173-4 (2)** has double lobed lappets and only a minimal nose fan. **Morning Thorpe G358 (1)** has a very unusual form at the 'nose' area. The use of a heart-shaped nostril area with a fan at the end is known in few examples, of which **Morning Thorpe G396** is one.

<u>Conclusions</u> Elaboration of lappet styles shown in type D2 is evident in this group, with the addition of inventions,

such as broad fan-like knobs. Zoomorphic elements are occasionally present or indicated using incised lines, not relief, on lappets. The associations with types D1 and D2 are at a more general level (equivalent to those with other type D brooch forms) than those between types D1 and D2 themselves.

D4) These brooches form a very inhomogenous grouping. They all have lappets with unusual shapes, not closely allied with those outlined already. Many of these examples have extensive use of punch marks and a few other features serve to provide sub-groupings. Broad association on this basis is sufficient for the purposes of this project but, with the discovery of further examples, a better division may be proposed in the future.

Asgarby 1 (Fig 2.41)
Barrington A G15, B 1 (Fig 2.41) **and 5**
Haslingfield 4 (Fig 2.39), **7 and 8** (Fig 2.40)
Holywell Row G37 (Fig 2.40)
Kenninghall 2, 10 and 11 (Fig 2.40)
Londesborough G10
Little Wilbraham G81
Rugby 2
Sancton 2 (Fig 2.40) **and 3**
Sewerby G28 (Fig 2.40)
Sleaford G80 (Fig 2.40) **and G158**
Spong Hill G45 (Fig 2.40)
St John's 13 and 14

Again, a few brooches have fans instead of true knobs, **Haslingfield 4** and **7, Kenninghall 10** and **11** and **Little Wilbraham G81. Little Wilbraham G81** is further associated with **Barrington B 1** and **5** as they share a peculiar downward-pointing lappet form. All three have very short catches. The Barrington brooches also have wide, flat knob fans, without losing the knob element entirely. **Barrington 5** has a number of

features comparable with brooch forms in D1, e.g. a square boss on the bow and square knob fans.

Kenninghall 2 has a very unusual lappet form, curving L-shapes with an 'eye' at the corner and lacks a fan at the 'nose end' of the animal head. A large ring and dot stamp is used four times on the brooch. **Sleaford G158** has simple rounded lappets and a fan at the lower end but no nostrils.

Barrington A G15 is most probably associated with the cruciform brooch typology but lacks knobs and proper animal head terminals. The lappets are simple and could be such as are found on square headed or cross-pattée small-long brooches.

Haslingfield 8 has a unique knob style, with extra collars doubling the normal length of the knob. The lappets are small and rounded with pierced holes and the foot although rather long and slim is not far from normal.

<u>Conclusions</u> This is an admittedly inhomogenous group, in which themes seen in type D3 are emphasised, especially the incised zoomorphic elements, within lappets with more unusual profiles.

D5) Lappets with zoomorphic decoration, with expanded, plain foot forms as in D1.

It will be seen that type D4 and D5 brooches only differ in the degree of ornamentation within the lappet and in some cases the allocation of individual examples to either of these types may be argued for. Two individual groups can be seen within the general themes of type D5.

D5a) A small group of brooches have one particular, fully zoomorphic and rather square lappet style (see illustrations) and strong connections to forms D1 and D2 by virtue of such features as fans on knobs, Y punch marks, square boss on bow or St Johns topknobs.

Barton Seagrave
Brixworth 3
Girton 2 (Fig 2.42)
Holme Pierpoint 4
Holywell Row G79 (2)
Lakenheath 7
Londesborough G9 (1) and (2)
St Johns 4
Toddington
Tuddenham 3 (Fig 2.43)

The shape and decoration of the lappets is quite complicated, but similar in all cases (except **Barton Seagrave** which has slightly different features at the lower end as well).

A recent discovery at Brandon, Norfolk also appears to have lappet forms similar to the Londesborough pair, although rather larger and more loosely interpreted. The animal head is closer to the style seen on Girton 2.

D5b) Several brooches have lappets decorated so that two eyes appear within a curved border with simple comma nostrils or slightly more complicated spiral shaped nostrils. Three lower collars and separate sideknobs were always used but the sideknobs are only extant in one case.

Barrington A 1 and 2 (Fig 2.44)
Little Wilbraham G87
Mucking G92 (1) and (2)
Ruskington 3 (Fig 2.44)
Soham G7

Associated:
Lakenheath 3 (Fig 2.44)
Morning Thorpe G91
Spong Hill G22 (3) (Fig 2.44)

The example from Ruskington is in poor condition but the sideknobs are here present on a iron axis. **Morning Thorpe G91** is associated with type D5b, with a foot form as found in D1 and D2.

Lakenheath 3 and **Spong Hill G22 (3)** are also associated with the type, but the lappet design is less clear and the Lakenheath brooch has a zoomorphic topknob.

However, type D5 consists mostly of a large and diverse collection of rather individual brooches, with zoomorphic lappets but plain nostril forms. These are listed below, grouped thematically where possible and with more general observations where there are no close parallels.

General type D5 brooches

Bottesford
Cleatham G30 (1), (2), (3) and G34 (1) and (2)
Coddenham
Eriswell G9 and G22
Felixstowe 1
Flixborough 1
Fonaby 4 (Fig 2.45)
Girton 3 (Fig 2.45)
Greenbank, Darlington (Fig 2.45)
Holme Pierpoint 1 (Fig 2.45), **2 and 3**
Holywell Row G58 (Fig 2.41)
Kenninghall 9
Lakenheath 1, 6 and 16 (Fig 2.41)
Londesborough G9 (3)
Little Wilbraham G79 and G95 (3)
Morning Thorpe G96, G129 (Fig 2.45) **and G393**
Northwold (Fig 2.45)
Ruskington 1 (Fig 2.45)
Sewerby G57 (Fig 2.41)
Sleaford G233 (Fig 2.41)
St Johns 2 (Fig 2.41)
Tuddenham 1 and 4 (Fig 2.41)
Woolsthorpe-by-Belvoir 1

Lakenheath 6, Holme Pierpoint 1 and **2** have in common their extremely broad foot areas and zoomorphic topknob ending. However the Holme Pierpoint pair have neater zoomorphic decoration and the topknobs have in addition a fan on top of the topknobs' zoomorphic ending. In both cases the headplate wings are widened at top and bottom, but in the Lakenheath example, the wings edges are square whereas in the Holme Pierpoint they are curved. **Lakenheath 6** also has a square boss on the bow.

Several brooches, **Holme Pierpoint 3, Little Wilbraham G79** and **G95 (3), Morning Thorpe G96** and **G129** and **Ruskington 1**, have the same bow and animal head forms (simple forms of the forms in D1) and D2) above) and similar lappet forms with a curled portion of the zoomorphic decoration extending down the catchplate. **Holme Pierpoint 3** has a much simplified form of this lappet in which the outline recalls those in type

D2 and D3 brooches. The downward extension is echoed by lappet forms in the fully zoomorphic cruciform brooches. However the lower collars and knob styles differ, **Morning Thorpe G129** having a rather square fan on the topknob, which provides another link to types D1 and D2. Fans on the knobs of **Holme Pierpoint 3** are curved. **Little Wilbraham G79** and **Ruskington 1** have quite small lappets, quite similar to the forms of **Morning Thorpe G96** and **G129**, as there is some extension downwards along the catch plate. **Little Wilbraham G79** has small comma nostrils and **Ruskington 1** has oval nostrils, both brooches have only a small nose fan and a deep furrow down the forehead.

Eriswell G22 and **Northwold** are closely comparable brooches with lappet forms very like some seen on type D6 brooches (see below). **St Johns 2** with fans on it's knobs and Y punch marks has already been noted in D1 to have connections with groups D1 and D2. **Lakenheath 16** has simple heart shaped nose parts but unusual lappets.

The topknob of **Kenninghall 9** was attached by a projection from the headplate and the sideknobs were placed in a notch on the wing edge. The upper edge of the lappets are enclosed with a plain band somewhat as in D5b above. The wide cheeks of this brooch and those on a pair of type D5 brooches from Cleatham Grave 34 are rather like other D5 brooches but the nostrils are quite plain.

Eriswell G9 has a similar lappet style but the rest of the form is very close to **Walsingham** (D2) including the ring and dot stamps on headplate and catchplate and the zoomorphic decoration on the topknob.

Girton 3 has an animal head form rather like those in D1) and D2) above but the lappet forms are unique. Further parallels to D1) and D2) forms are the fans on the knobs and the Y punch mark on the headplate.

Sleaford G233 is quite unexceptional except for the downward pointing biting animals.

Holywell Row G58 has an animal head style as in D1) and D2) but very complicated lappets and an ornate version of the zoomorphic ending to the topknob.

Darlington has a square boss at its bow and very wide animal head area. The elaborate, rather amorphous lappet forms are quite unique.

Similarly, **Lakenheath 1** is not unusual except for the lappets. The bar running down the nose is seen in **Girton 2** D5a) and the bar between two comma nostrils is exactly parallelled in **St Johns 1** in D1). Otherwise this brooch has both different proportions and different details to these brooches (n.b. especially the rather rounded bow and small, rounded headplate wings).

Morning Thorpe G393 is incomplete. It has small, rounded lappets rather like **St Johns 2** but the rest of the form, although unclear, is not very similar.

Tuddenham 4 has a topknob with circular cross-section and a broad tab at the front. The lappets are rather unclear and there is an unexpanded heart-shaped nose, possibly with a loop at the end.

Tuddenham 1 has unusual, curly lappets and the topknob has a fan.

Conclusions These brooch forms are individualistic, linked only by a general theme, that of overt zoomorphic decoration within the lappets and simple, mainline brooch elements elsewhere. One of the two discrete groups which were distinguished, type D5a, was shown to have links with the type D1 and D2 group of brooches, through general design proportions and distinctive features such as Y-stamps, square bosses at the bow and plates at the knobs.

D6) With zoomorphic lappets and nostrils

D6a) A small group has a distinctive zoomorphic decoration type within the nostril areas as well as the lappets (see figures 2.48 and 2.49). The zoomorphic decoration here is used in small, rounded areas. Sideknobs are always separate.

Carlton Scroop 2 (Fig 2.49)
Haslingfield 9 (Fig 2.48)
Holywell Row G99 (3) (Fig 2.49)
Lakenheath 12
Morning Thorpe G80 (Fig 2.49)
Ruskington G11
Sewerby G15
Sleaford G12 (1) (Fig 2.49)

Here **Lakenheath 12** and **Holywell Row G99 (3)** are a very close pair and **Ruskington G11** and **Sleaford G49** are quite similar (especially around the animal head area with widened cheeks, although only **Ruskington G11** has a zoomorphic ending of the topknob). The other two members are more divergent by virtue of the exact shapes of the nostril and lappet decoration. **Carlton Scroop 2** is close to the rest of this group but the style of the lappets on this brooch are more like the eye forms found in D5b. The lappets and nostrils on the brooch from Sewerby are small and simpler than other members of the grouping.

General type D6 brooches

The brooches in the general D6 group are very diverse.

Partney 2
St Johns 6 (Fig 2.47)
West Stow Heath 10 and 11

The zoomorphic decoration forms on these brooches is unparalled within the cruciform brooch corpus. **Partney 2** has a long fan at the animal head terminal. **West Stow Heath 10** and **11** are not well preserved. They appear to have curly zoomorphic lappets and nostrils.

Conclusions This is a small group, with one identifiable sub-set. The remainder are loosely affiliated with one another. Type D6 brooch forms have designs which are echoed in the highly decorated forms of type Z brooches (below) in which knobs, lappets and animal head elements are overtaken by masses of inventive zoomorphic decoration. Some of the lappet and animal head profiles also show some identification with the type Z forms.

Further type D brooches, with unusual lappets, broken or otherwise unclear.

Barrington 8
Fonaby G43 (2) and 8
Lackford C49,429
Lincoln 2 and 3
Little Wilbraham G171 (1)
Snape 0327 (3)
Spong Hill G58
Woolsthorpe-by-Belvoir 2

Lackford C49,429 is missing below the catch plate area, but it

probably had lappets, quite possibly of the D1 or D2 type.

Spong Hill G58 lacks its animal head ending but the lappets appear to be zoomorphic and to have some stamped or incised decoration. **Snape 0327 (3)** must belong to the type D grouping, but the lappets are very small (possibly worn or broken). The elongated animal head form is reminiscent of other type D forms from East Anglia, e.g. **Kenninghall 5** (type D3), **Northwold** and **Little Eriswell G22** (both type D5).

Woolsthorpe-by-Belvoir 2 has very strange lappets with angular decoration running right across the catchplate area. The foot is missing.

The two brooches from Fonaby, must be associated with type D but they are very corroded and battered.

Associated brooches, C or D types (lappet area missing)

Loveden Hill C59 has a large and simplified foot form like brooches in either D or C. **Lackford C49,429** similarly has wide comma shaped nostrils and a nose fan.

Zoomorphic brooches are normally gilded, occasionally with white metal finishes on knob and animal head fans or less frequently with inset garnet or glass. They have zoomorphic style lappets as well and large animal heads with fans. Knobs

are usually entirely zoomorphic with no remnants of true knobs, they are normally very wide and flat divided in two by a fan area, which is sometimes extended further outwards.

Z1) Zoomorphic brooches with complicated, so-called chip-carved decoration at the knobs, lappets and feet of the brooch.

Z1a) Plain headplates, simple wings, zoomorphic knobs with narrow, flat collars. Knob decoration consists of complicated symmetrical designs with two bold eyes near the collar and a flat squared fan at the top.

Kenninghall 4
Lakenheath 8
Mitchell's Hill 2 (Fig 2.51)
Mitchell's Hill 6
Sleaford G50 (Plate 1)
Soham 1
St Ives
West Stow Heath 14

Associated: **Linton Heath 3**
Partney 1
Swaffham G6
(Plate 2)

These brooches form a very coherent grouping, with some features which suggest a workshop character for their production. Two brooches are very nearly an exact pair, **Mitchell's Hill 2** and **Kenninghall 4**. They also have segmented ridges either side of the catchplate and headplate. The bows of these two brooches are in panels and these panels are segmented as well. **West Stow Heath 14** is very similar to these brooches, but has a zoomorphic infill to the bow panels. These three brooches have shovel shaped fans at the end of the animal head and the shapes containing the zoomorphic

decoration are rather more square.

The lappets on these brooches are creeping animals with upturned tails. The lower area of the foot, where the nostrils would be in types C and D, is developed into an extra human mask, with animal additions, and ends in a fan.

Lakenheath 8 has plain bow panels and enamelling in recesses at the bow and catchplate. In all other aspects this brooch is very close to the three previous examples. **Soham 1** has plain lappets, like those in type D1 and a broad crescentic fan at the foot but the knob form here is most like those of **Mitchell's Hill 2. Sleaford G50** has further zoomorphic decoration on the headplate and glass or stones inset in bosses on the knobs, bow and foot. The foot has extra projections at the eyes and a central triangular area.

Swaffham G6 has wider, looser designs generally. The knobs are pierced through with circular holes and the foot has an extra human mask instead of the lower half of the animal head, as in other type Z1a brooches. This brooch has a small zoomorphic panel on the headplate. White metal is applied to the top-knob fan and the animal head fan.

Partney 1 is missing its headplate. There is an extremely complicated design on the animal head, below two simple, staring eyes. The lappet shape is similar to that used in D5a.

Z1b) Brooches which have simplified versions of some of the same features as seen in type Z1a but omit others.

Exning
Laceby G1 (1)
Market Overton 4
Morning Thorpe G16
Ruskington 2 (Fig 2.54)
Sleaford G86 (Fig 2.53)
Sleaford G116 (Fig 2.54)
Sleaford G143 (Fig 2.54)

Associated: **Fonaby 6** (Fig 2.52) and 7
Laceby G1 (3)
Spong Hill G2 (1) and (2)
Spong Hill G57

These brooches have in common a simpler zoomorphic decoration style with more flat and plain areas. Human masks at the end of the foot (the 'nostril' area) are not so apparent as in Z1a, nor are the eyes on the knobs. All but one of the group has a square boss at the bow.

The Sleaford brooches form one closely associated group with **Morning Thorpe G16** and **Ruskington 2** also quite well related to each other. **Laceby G1 (3)** is quite close to the latter pair but also has links to the Sleaford brooches. It has extended knob fans and an extra pair of lappets just above the eyes of the animal head. The decoration styles of these two groups are so individual as to make it likely that the artefacts in them were made by individuals or by copying directly.

Various features link across these small sub-groupings. **Sleaford G116** and **Laceby G1 (3)** both have zoomorphic panels on the headplates, but only **Sleaford G116** has such a panel at the catchplate too. The animal head detail of **Sleaford**

G116 and **Morning Thorpe G16** is similar, ending with a square fan. **Morning Thorpe G16**, **Ruskington 2** and **Sleaford G143** have recessed panels either side of the bow. If individuals or individual workshops produced the brooches in these two groupings they were either in contact with each other or shared very similar artistic influences.

Spong G57 is clearly related to this grouping, but has a little more complexity within the knobs and has applied decoration in the form of circular punches, white metal on all of the fans and gilding elsewhere. The use of such applied decoration calls the piece into comparison with type Z3 brooches (below) but the form is clearly not a part of the range shown in that group. In particular, **Spong Hill G57** has close similarities with **Market Overton 4.**

The pair of brooches from Spong Hill Grave 2 have elements recalling features on brooches of both type Z1a and Z1b brooches. They have an extra human mask on the foot like type Z1a brooches but the knob form is more like those of type Z1b brooches. The pair from Fonaby are most simply allied to type Z1b in style although the knobs are more complex and therefore closer to type Z1a brooches.

Unusual brooch styles, associated with type Z1 forms

Felixstowe 2
Islip 4
Laceby G1 (3)
Morning Thorpe G353
Snape 0421
Sporle 2
Wakerley G74
West Stow Heath 13 and 14
Upton Snodsbury

The Felixstowe, Snape[5], Sporle and Wakerley brooches are extremely similar. They have close associations with other type Z1 brooches, but lappet forms rather like some type D5 and D6 brooches. Pocock states that another brooch from Great Carbrooke, Norfolk is also similar to Sporle 2 (Leeds and Pocock 1971, 30) but the relevant drawing has not been inspected.

Morning Thorpe G353 does not fit into either of the type Z1 categories, but has similarities with the Snape style brooches. The form of the knobs seem to be a complicated version of those found in a few large type D brooches, where the knob is not quite entirely taken up by the zoomorphic decoration. The crouching animal lappets could be parallelled by those on type Z1a brooches. The foot form is unique. An incomplete brooch, **Laceby G1 (3)** appears to be quite similar to this example.

The West Stow brooch has extremely wide and ornate knobs, extending the length of the headplate edges. A triangular stamp is used on the headplate and catchplate but the bow is

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[5] See note 4, above

plain. **Islip 4** also has wide knob collars and an unusual moulding around the headplate. **Upton Snodsbury** has a zoomorphic panel on the headplate but very simple lappet forms, apparently originally much like **Sporle 2**.

The styles of brooch types Z1a and Z1b seem to be interconnected and one can suggest a free flow of ideas between the workshops that produced them or even that they were produced in the same workshop(s).

Brooches linking type D6 and Z brooch styles

Holdenby 1
Haslingfield 1 (Fig 2.50)
Little Wilbraham G105 (1) and (2) (Fig 2.49)

These brooches should be considered here, since the knobs are taken over (or nearly so) by zoomorphic decoration. **Little Wilbraham G105 (1)** and **(2)** are a very unusual pair, where the knobs are purely zoomorphic (slim animals, curved round), echoed at the 'nostrils'. The headplate is wide but with narrow wings, similar to **Haslingfield 1** where the topknob is also completely zoomorphic. The method of sideknob attachment is in line with type Z production (see Chapter 3). **Holdenby 1** is nearer to the type D6 brooch specification, but lappets, foot and topknob are zoomorphic.

Z2) Much simplified zoomorphic decoration

Z2a) Knobs as wide as the headplate and wings combined, or a little wider. Area inside is divided in two by a thin fan rising from the collar. To either side of the fan there are schematic details inside a curved plain border. Little decoration elsewhere, occasionally a few additional lines are found within main elements.

Barrington B G82 (Fig 2.56)
Haslingfield 11
Kenninghall 6
Kenninghall 8
Newnham 1 and 2
Woodstone 3

The lappets are various shapes. The Kenninghall pieces are in different states of preservation but appear to be stylistically quite close. The other four brooches share related 'nostril' area styles, with the top edge running at right angles to the upper part of the animal head but they have different fans. The production techniques are far less accomplished than that on the preceding styles, with no gilding and less detail to the decoration overall.

Z2b) Decoration very smooth and linear, seeming to be a simple form of type Z2a brooch forms. The knobs are wider than the headplate, stepped out at the upper edge. The lappets point downwards.

Colchester 1 Associated: **Churchover**
Ruskington 8 (Fig 2.57)

Colchester 1 and **Ruskington 8** were evidently very similar (the former now lacks its foot below the eyes). **Ruskington 8** has a square element in the 'nostril' area very similar to those in **Newnham** 1 and 2, **Haslingfield 11** and **Barrington B G82** (type Z2a) except without the fan at the end.

Churchover can be compared with these two pieces since the knob forms are very smooth, but here the details are even more sketchy. They must have been lightly incised into the model or the brooch has been heavily worn. The upraised upper 'nostril' elements are again similar to type Z2a brooches.

An intermediary type, associated with type Z1 and Z2 brooch forms

A heavily ornamented piece, **Sleaford G169** (Fig 2.55 and Plate 5) (Leeds and Pocock Vb) must be related to both type Z2 forms described above as it has the same outline to the knob forms but the details are more precise and complicated, as in type Z1 brooches. The 'nostril' area is linked to those discussed in type Z2a again but without any fan ending (as on **Ruskington**

8). Here the square element has a inset garnet. The most impressive feature of this brooch is the heavy gilding throughout.

Z3) Very wide knobs, not divided from the headplate, with wide, incised, segmented collars. Gilded with white metal applied to knobs and sometimes to other areas. Bows are short usually with a decorated boss. Zoomorphic decoration in panels at the headplate and catchplate, and on square lappets.

Baginton 4 (Plate 7)
Bergh Apton G18
Brixworth 2
Brizlincote
Brooke 3
Duston
Holdenby 2
North Luffenham
Longbridge (Plate 6)
Saltburn-on-Sea
Stapleford
Wakerley G42
Willoughby-on-the-Wolds 1 and 2
Woodstone 10 (Plate 3)
Wychnor
Unknown provenance 4 (Plate 4)

Associated: **Market Overton 1-3**
Newnham, Northants

Close affiliations for many of the features seen on the lower half of these brooches can be seen in the square-headed/ cruciform hybrid forms known to Leeds as type C3 (Leeds 1949) and as type Z4 within this typology (see below). Many of the chipcarved elements used in these brooches can be seen to originate in the zoomorphic forms of Z1a and Z1b. Other aspects which recall these types are the short bows with square bosses on them and the animal head 'nostril' areas which expand so drastically. Here there is the additional decorative element of white metal application, often in wide

areas. Rivets are used to fix strips onto the headplate of a few of these brooches, but other means (see Chapter 3) are used on other areas.

The decoration on the sideknobs of **Longbridge** is unusual as it is not symmetrical. This example has unusual openwork on the foot, comparable with **Holdenby 2** (associated type Z4). Hines has outlined similarities between the Holdenby brooch and two other brooches, in forming his Phase 3, hybrid brooch form, Group XXI (Hines 1984 p 165-6) but regards the remainder of the brooches discussed by Leeds under the great square-headed brooch categories C2 and C3 as unique or quite simply more cruciform brooch-like. The outline of **Woodstone 10** can be seen to have links to **Longbridge** but the internal decoration is much closer to the style of brooches associated with type Z1a, e.g. **Partney 1.**

Market Overton 1 and 3 are thematically connected with **Market Overton 2** but have simpler styles of decoration, rather similar to that shown in **Unknown provenance 4.**

The design used on **Unknown provenance 4** is the most simple, consisting of roughly cut circles and triangular or rectangular decoration. There are no other cruciform brooches with this style of ornament and of the brooches illustrated in Leeds' square-headed brooch corpus, few approach this style or standard of decoration, although a Leeds type C3 brooch from Welbourn (no. 29) and **Holdenby** are the closest.

Strong typological connections between the brooches from Baginton, Duston, Wychnor, Brizlincote, Brooke and Bergh Apton have been noted by previous authors (e.g. Leahy 1979). The decorative style of the knobs can be compared to the clearer designs of other zoomorphic brooches (types Z1 and Z2). In the type Z3 brooches, however, the knobs and especially the fans between the outwardly-pointing animal heads become greatly enlarged, a step suggested by two pairs of brooches associated with type Z1b, **Spong Hill G2 (1)** and **(2)** and **Fonaby 6** and **7**. The animal ornamentation is also less detailed and more flowing. In the lappets, 'eyes' may be seen, on the brooches from Duston, Baginton and Wychnor. The lappet style could therefore be linked with the much simpler type D5a brooches. The triangular fields with animal-ornamented projections on the upper edges seen at the foot can be compared with those on some of Leeds type C2 brooches, discussed below, under type Z4. A similar feature is also found within the foot of most of the brooches in Leeds type C3.

The use of white metal is more restricted and peripheral to the decorative scheme of **Woodstone 10** than it is for most type Z3 brooches. **Newnham, Northants** has a closely comparable form to this brooch and both brooches have rather more densely packed and curvilinear decoration than the remainder of the group, suggesting links to type Z1 brooch themes.

Z4) Hybrid forms with square-headed brooch headplate forms, cruciform brooch style lappets and individual foot forms, given Leeds type C2 and C3 (Leeds 1949). For the sake of completeness, these will be given the logical type name of Z4 in this typology. It is difficult to establish where a line between square-headed brooches and cruciform brooches may be drawn, but some examples have features which are clearly too well-linked to cruciform brooch styles to ignore. The headplate forms, although rectangular enough for inclusion in the square-headed brooch catalogue, retain vestiges of cruciform brooch knob forms similar to those seen in type Z1a and Z1b brooches. The forms shown in Leeds (1949) can be most logically sub-divided into two groups, based on the foot style (the element which is closest to cruciform brooch forms).

Z4a) those with a large triangular element within the foot form -three examples were known to Leeds, from Driffield, Staxton and Hornsea (Leeds 1949, nos 131-133) and more indirectly associated, one from Whitehill Point (Leeds 1949, no 137), to which may be added **Sewerby G49** and **Benwell**. The form of **Holdenby 2** must have some association with the designs of these brooches, since this brooch has a square-headed brooch style headplate and a triangular element within the foot. But the foot of this brooch is on the whole closer to **Longbridge** (type Z3).

Z4b) those with a more oval foot outline - Leeds knew of a single brooch from Darlington (Leeds 1949, no 135) to which may now be added **Fonaby G38**.

These brooches have zoomorphic lappets which are basically triangular in outline with the broadest portion at the top of the catchplate area.

Unusual forms, associated with type Z cruciform brooch styles

Two extraordinary brooches are shown in Leeds' corpus, one from Wigston Magna (Leeds 1949, no 136) only known from a drawing and the type brooch for Leeds type C2, from Kenninghall (Leeds 1949, no 130). This last brooch is much more highly ornamented than any of the other brooches in these groupings although associations with **Staxton** are clear, from the decorative style and lozenge-shaped stone settings. The immensely complicated styling and downward pointing animal decoration in the lappets mean that the Kenninghall brooch is sufficiently unusual to make it an unreasonable choice for a type name.

One further incomplete example, from Darlington (Leeds 1949, no 134) has simple lappet forms derived from a semi-circular shape, as seen in D2 and D3 cruciform brooches. The headplate style is however much the same as that on the two Z4b brooches, **Darlington 1** and **Fonaby G38**.

Further excursions into hybrid square-headed/cruciform brooch styles seems unwise as recent studies have investigated the forms and noted their salient features (e.g. Hines 1984).

The forms described in this typology may be summarised as follows:

A) with top knobs with circular cross-section. Small headplates. Separate side knobs. Simple foot forms. Bows often solid.

A1) with very small or no headplate, simple or no animal head design at foot
A2) with broadened headplate, oval or round nostrils
A3) with broadened headplate, heart-shaped nostrils

B) With simple unexpanded foot forms, no lappets, nose fan or zoomorphic decoration, knobs all semi-circular in cross-section

B1) with oval or round nostrils
B2) with heart-shaped nostril area
B3) with comma-shaped nostrils

C) Large brooches, as D) below, except without lappets

C1) with oval nostrils
C2) with comma-shaped nostrils

D) Large, with lappets , expanded foot parts, normally with oval or comma-like nostrils, usually with a fan at the lower end of the animal head, wide headplates, sideknobs often cast onto the headplate, double or single pin loops

D1) square lappets, often with square bosses on the bow, square plates on the knobs
D2) plain, semi-circular lappets, often with bow and headplate details as in D1
D3) lappets related to the semi-circular form but with additional decoration
D4) lappets with more complicated design but not zoomorphic
D5) with zoomorphic designs in the lappets, plain animal head forms; a) and b) two groups with particular lappet designs
D6) with zoomorphic designs in lappets and nostrils; a) one homogenous group

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Z) Zoomorphic brooches, often gilt, sometimes with white metal

Z1 Complicated, chip-carved designs
Z2 Simplified, curvilinear designs
Z3 Simplified decoration, wide knobs, with white metal decoration in various areas
Z4 Hybrid with square-headed forms (Leeds shb type C3)

C. Relative chronology

Having established stylistic groupings of English cruciform brooches, it is now important to structure the evidence in a sequence so that one may estimate the range of production at any one time.

1 Burial association

An attempt will be made here to indicate contemporaneity between cruciform brooch forms. It is important to stress the difference between date of production and date of burial, since the technical and chemical attributes discussed below will normally relate to the situation at the time of production. In most cases, however, only the date of deposition can be estimated. The data used will be from brooches known to be associated in grave finds with comments on degree of wear.

a) Problems of wear analysis

A study examining wear on artefacts is based on the simple principle that the older the artefact at the time of burial, the more wear it is likely to have suffered. Where artefacts of more than one typological grouping are present, it is evidently impossible to judge how much wear a pair of wrist clasps would suffer in normal use, compared to a pair of cruciform brooches, for example.

As ever, the 'heirloom factor' may be significant. It is interesting that most of the earliest forms found in England (type A) are heavily worn and/or mended. Once a brooch became more than just 'rather old-fashioned' and became positively historical to society, it may have been regarded with more respect. Associations with the ethnic homelands may have had an influence. Longevity in use is extremely important in most studies, but in this project some of this stress may be removed since we are primarily interested in the date of production, not of deposition. However, the narrow, longitudinal form of type A1 brooches in particular would have rendered them more likely to be abraded in use from more directions than the wider brooches of types B to Z. Most of the area on the front of the wider brooches would have been protected by the projections formed by the knobs, headplates and lappets.

Evidence for abrasion and rubbing is commonly found in particular areas on cruciform brooches. The highest parts of bows and the most prominent areas of the foot frequently have a high polish and the fine lines that are incised on many surfaces of some brooches are also prone to be lost during wear, especially on the uppermost portions.

Knobs are another obvious general area liable to damage. There are a few examples where the lower edges of the sideknobs were preferentially eroded, especially on the right-hand side (this happens in pairs and in single brooches). This must relate to

the manner in which the brooches were worn. Cruciform brooches are normally pinned at the shoulder, to an overgown or peplos-type gown (Owen-Crocker 1986, 26). If the brooches were worn headplate uppermost, it is understandable that wear would occur on the 'lower' faces of the brooch. However, where full excavation details are known, cruciform brooches have been found placed foot uppermost as well as headplate uppermost and both styles were used at individual sites (e.g. Sewerby, Hirst 1985, 58 and fig 17 and examples at Morning Thorpe). There are too few examples to fully assess whether there is a correlation between brooches with the pattern of wear on this part of the brooch and brooch orientation in burial.

A few brooches retain a crispness which means they can have been worn very little. Extreme wear may be represented by the few brooches known to have been sewn on to the garment after the pin loop or catch were broken, for example the heavily worn, early brooch form (type A3) found at Morning Thorpe, Grave 346. The post-excavation circumstances of artefacts should also be noted, some of which are such as to remove all possibility of observation on wear.

Repair of brooches should not be taken as an unequivocal indicator of extended use unless confirmed by other aspects of the brooch. It is possible that such occurrences and repairs reflect a poor initial casting. The pin lug and catch might be relatively difficult to fashion satisfactorily.

One of a pair of type D2 brooches from Holywell Row, Grave 99 would have needed repair immediately after casting since the wing areas of the headplate were imperfectly filled by the casting alloy and an extra plate was soldered over the defective area. Three brooches from Grave 61, Westgarth Gardens (a pair of type B2 brooches and a single type C2 brooch) all had repairs by the time they were buried. Although on two of the brooches the repairs were non-functional and may have been purely cosmetic, the area of repair on the third brooch was the catch.

The Westgarth Gardens brooches appear to be poorly made (judging from the publication drawings, which may admittedly be misleading) and we may be seeing the products of one of the less gifted craftsworkers of the period. It is therefore important to consider the overall standard of fabrication on an individual repaired brooch, before suggesting that the brooch had an extended period of use. With the expanding data base of well recorded burials, it may soon be possible to detect regional trends, both in standards of production and in amounts of wear detected.

A pair of type B1 brooches from Grave 30, Morning Thorpe, would seem to be an example that might make it necessary to modify even the simplest theory. The brooches appear to have been cast and worn together but one of the pair is noticeably more worn than the other. In this case, the whole enigma is compounded by the presence of a punch-mark linked

type C1 brooch in the same grave, which has suffered very little abrasion. In this case there can be little doubt that all these brooches were made in the same area, at the same time but were subject to different wear patterns.

This single grave group warns us of the possible existence of hidden attributes within the archaeological data collected. Positioning of the brooch on the dress during its lifetime might lead to it being more or less protected from abrasion. However, pairs of brooches were normally worn symmetrically on the body, so this is unlikely to explain the feature observed at Morning Thorpe. It is also plausible to suggest that only one large brooch or one or two small cruciform brooches might be worn for every day purposes.

Conclusions

Overall, abrasion is so common on cruciform brooches that degree of wear may be only really significant in cases of extreme crispness or of attrition. Quantification is difficult and there are many factors which make the information liable to mis-interpretation. However, wear is a factor which cannot be ignored.

b) Within-type development

The type descriptions of cruciform brooches showed a certain amount of variation, within types. Type B3 with its comma

nostrils and occasional slightly projecting elements between the nostrils is especially likely to have typological connections with the large styles, typesC and D.

Grave 48, Holywell Row contained 4 type B2 brooches, one of which is large and broad and is closely linked to type D style brooches. The details on this brooch are in a good, crisp condition whereas the two small brooches in the assemblage are both worn at the bow. The final brooch from the grave is an unusual type B2 form, having conical knobs with additional projections at the top. The decorative lines incised in several areas of the brooch are somewhat erased by abrasion in some parts but in other areas appear quite fresh. At Morning-thorpe a further group of three type B2 brooches (one small pair and one large brooch) were found in Grave 90, all apparently in a similar state of stylistic advancement and all rather battered.

Type B3 with its comma nostrils and occasional slightly projecting elements between the nostrils is especially likely to have typological connections with the large styles, type C and D. However, although two slightly worn small type B3 brooches were found with Spong Hill G22 (1) (associated with D5b), Grave 10, East Shefford produced a small type B3 brooch and a type A2 brooch. It may be significant that the latter burial comes from a peripheral region for this study, the Oxford/Berkshire region. The association with a toilet set emphasises the non-Anglian nature of this burial. In addition,

the Spong Hill pair are more ornate than the East Shefford example and have an execution style very close to that of the associated type D5b brooch. Hence it seems likely that type B3 style animal heads were used over a long period of time.

These grave groups illustrate development within the type B2 and B3 brooch styles. There was some synchronicity in the use of different developmental stages of these styles. Size alone is not a significant chronological indicator. Hence any chronological links founded on these brooch types must be avoided.

c) Associations

One of the three cruciform brooches in Grave 79, Holywell Row (Reichstein 1975, *Taf.* 105) is of type C2 and another is a large type B3. These brooches have approximately the same standards of craftsmanship, and, although their preservation is not first class, it is clear that neither brooch is in a pristine condition. The other cruciform brooch in the assemblage has zoomorphic lappets and is of type D5a. The lower edge of the right hand sideknob is worn smooth, suggesting this brooch also was not in perfect condition when buried. The use of both semi-circular and double semi-circular stamps on the large type B3 and D5a brooches, although individually relatively common stamp marks, does tend to confirm the hypothesis that the brooches in this grave are likely to have been contemporary in manufacture as well as use.

Type D2 brooches have the simplest lappet forms and are a relatively common type. Links with other type D brooches can be made through Holywell Row Grave 99 and Nassington Grave 28. In the Holywell Row example, a pair of little used type D2 brooches were found with a type D6a brooch which was only slightly worn, at the topknob. At Nassington a pair of type D2 brooches and a single type D1 brooch are found together, all somewhat eroded at the bow. The D1 brooch has perhaps the sharpest detail remaining, although the right hand sideknob had been broken and reattached using an iron rivet. Decorative lines incised on one of the D2 brooches were worn off the topknob but are still clear on the sideknobs. The type Z2a brooch pair from Newnham Croft, Cambs were also found with a type D1 brooch. This latter brooch has not been examined but appears to be in good condition, and certainly no more worn than the type Z2a pair.

Possible links may be made between type D3 brooches and large B1 forms by a probable grave group at St John's Cricket Grounds, Cambridge. The finds from Londesborough, Yorkshire Grave 9, suggest a typological progression within the series of brooches with zoomorphic lappets that have been given type D. The type D5a pair from this grave are in a fresher state than the other type D5 brooch which has a looser style of ornamentation.

The finds from Little Wilbraham, Cambridgeshire suffered from very severe conservation treatment and it is now difficult to

establish how abraded the brooches may have been at the time of excavation. In Grave 73 an apparently rather worn brooch in a simple form of type B1 was found with a small brooch associated with the type C1 group which had a repair to the catch. Both brooches are unfortunately heavily pitted as a result of 'conservation' treatments. Grave 95 produced a type D5 brooch which was worn at the bow and on the right hand sideknob, along with a pair of C1 brooches which are also worn at the bow but preserve the decorative lines on the sideknob. Two large type B1 brooches and a brooch associated with type C1 were found together in Grave 30, Morning Thorpe, all in good condition.

Conclusions

This is a rather small database on which to construct a relative chronology of the cruciform brooch and only a sketchy outline can be offered at this point. Ignoring forms linked by type B2 and B3 brooches alone, brooches from several types are clearly contemporary in use; i) D1, D2, D6a and Z2a ii) C2, D5a and large B3 iii) Large B1, C1, D3 and D5. Types B2, B3 and D5 probably had long production spans, demonstrated by the burial association of brooches showing different stages of the type's stylistic development and different amounts of wear. Other styles lack this sort of burial-association evidence but may well have had a long period of manufacture and use.

These facts can be displayed as follows (with no chronological

ordering implied by their sequence):

D1 D2 D6a Z2a

C2 D5a B3L

B1L C1 D3 D5

The fact that two types were in use at the same time does not necessarily imply identical periods of production, nor does it imply that the production of types started and finished at the same time.

2 Typological parallels

It has already been noted that types D1, D2 and D5a are closely linked typologically. Types D1 and D5a may even have been produced in the same workshops (see below). Types A2 and A3 are also likely to be contemporary forms. There appears to be some stylistic cross-fertilisation between types Z3 and Z4. For example, **Holdenby** 2 has a square-headed brooch style headplate (hence placing it in the Z4 category and Hines' Group XXI (Hines 1984, 165)) but a foot form which is entirely in line with brooches from within the type Z3 category. These are particularly distinctive brooch types and this sort of parallel is less clearly seen between other brooch types.

This modifies the diagram above to:

Z3 Z4

B3L C2 D1 D2 D5a D6a Z2a

B1L C1 D3 D5

A2 A3

(with the most likely early types at the bottom)

Although some individual brooches may exhibit particularly strong links to individuals from other types, the remaining types are not well linked overall.

Using the fact that the specific type D5a is probably later than the general type D5 (from the Londesborough Grave 9 finds), but probably did not replace it entirely, some ordering may be implied:

Z3 Z4

B3L C2 D1 D2 D5a D6a Z2a
|
B1 C1 D3 D5

A2 A3

Contemporaneity of styles is one matter, establishing a sequence is quite another. In striving to avoid judgemental descriptions (e.g. 'degenerate', 'parochial', 'misunderstood') and assumptions, such as that the simple necessarily cedes to the complex, it is difficult to say with authority which forms came first, which were inspired by other brooches and which are the last gasp of a production theme. This author does not believe herself suited to this sort of task, by temperament or

training, and will minimise such speculations.

Clearly further sources of information must be added to provide a useable chronology.

Two options present themselves. Cruciform brooch types could be linked via intermediary artefacts. These must have unique or distinct formal characteristics and restricted distributions, and are therefore unlikely to be long-lived. In addition, comparisons with artefacts with very different lifespans (e.g. organic artefacts) should be avoided. Other brooch forms and wrist clasps are obvious candidates. Again the degree of wear on the artefacts is an important consideration.

Alternatively, unique and distinctive features on the cruciform brooches themselves could be used to link individuals. The introduction of further uncertainty by using other artefacts, is inadvisable, at least, until all possible information has been extracted from the cruciforms themselves.

3) Cruciform styles linked by punch marks

Of the wide range of punch marks found on English cruciform brooches, most are so common as to be of little assistance in establishing precise groupings (see Chapter 3). There is an unusual punch mark found on several type C, D and Z brooches

in Cambridgeshire, Suffolk and Lincolnshire and on one brooch from Baginton, Warwickshire. This is the Y-shaped punch mark with internal divisions within the arms / (Plates 15 and 16). It is found on 3 brooches of type D1, 4 type C2 brooches (including one pair), 2 type D5a brooches, 2 other type D5 brooches and one each from brooch types large B3, C1 and Z1a.

Out of this group, the burial circumstances of three brooches from Tuddenham (types D1 and D5) are not known but the presence of this eccentric punch mark is one of several features found on the brooches that makes it likely that they were buried together, during a short period of time or at least were made at the same workshop. The type D1 and D5a brooches from St Johns Cricket Field, Lakenheath and Sleaford are again closely identified morphologically with the Tuddenham brooches via the presence of a square boss at the bow and broad, sub-rectangular fans on the knobs. The type C2 brooches with this punch mark have a few other characteristics which might lead to associations with type D forms, but these are principally rather general aspects such as the form of the foot, with broad comma nostrils and fans. In the type C examples from Haslingfield and Holywell Row there are additional fans on the topknobs. The large B3 brooch from South Willingham is undistinguished from the rest of its grouping.

The topknob of a very individual brooch (type D5b) from Ruskington, Lincolnshire stamped with this punch mark is

completely evolved into a zoomorphic form, with the animal shapes echoed in the forms of the lappets and nostrils on the lower half of the brooch. The remaining brooch form with this punch mark, **Mitchells Hill G1**, is fully zoomorphic and belongs to type Z1a.

This grouping largely confirms the relative chronology of brooch types suggested by brooches found in secure burial associations, with the addition of brooches of types D5b, C1 and Z1a to the phase containing a general grouping of type D brooches. In addition, this would seem to confirm a certain longevity of use for the simple type C1 brooches.

In view of the broad and eclectic grouping of brooches with this particular punch mark, various factors should be considered. First, could a punch mark be used over a long period of time? A punch might be laid aside after the main period of its use and used only infrequently afterwards.

It is not claimed that these punch marks were all made by one particular punch and it would be difficult to justify such a claim with the data available. Because of their method of use, punches are prone to damage and are likely to have been used for a short time only, before being discarded or re-worked and cleaned to renew the pattern. Conversely a punch may have been used only infrequently. The mark produced by a decorative punch can be seen to vary quite drastically over the surface of a single brooch, and is certainly dependent on the skill of

the metalworker and the area to which the decoration was applied. The small size and wide variety of possible angles of incidence of the punch means it would be difficult to establish, even with a high powered microscope, if marks were made by an individual punch. Hence it may only be stated that the punch marks on these brooches are rare and very closely linked to one another.

In this case, since we already have an indication that type C2, D5a and large B3 brooches were contemporary in use (and probably in production) from their association in Grave 79, Holywell Row, it seems reasonable to use the evidence of this punch mark to confirm a similar date (and presumably area) of production for additional brooch styles.

The updated version of the relative chronology therefore looks as follows:

```
Z3 Z4
B3L | C2 D1 D2 | D5a D5b D6a Z1a Z2a
    |          |
B1L C1    D3    D5
A2 A3
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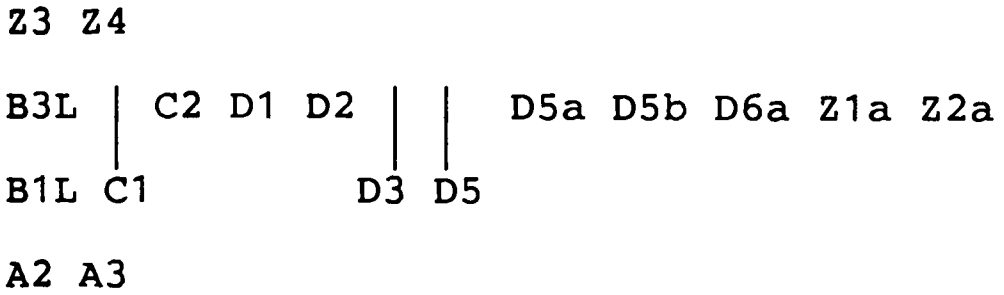
Further links can be made through a small number of other unusual punch marks, such as the double V mark or a single V with a small circle at the top of the angle. These marks are both rather prone to misinterpretation through abrasion or the angle of incidence of the punch. The double V mark appears on

type Z2 brooches and on brooches of types D1, D2, D5, D5b, D6a, C1 and B3 and the V mark with small circle on brooches associated with type D2 (3 examples), C, D3 and D6a. These two punch marks confirm the suggested contemporary nature of the production that was outlined using the Y-punch mark data and elongate the length of production of type D3.

The chronology now looks as follows:



4) Data from other artefacts associated by burial contexts

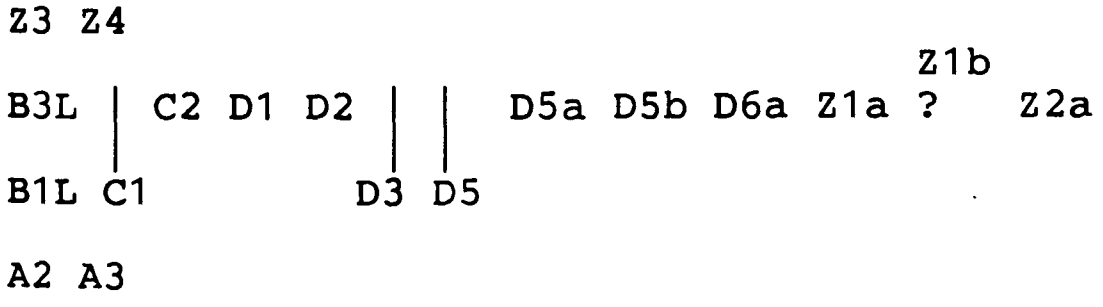
Some thought must be given to several criteria which are necessary for the establishment of synchronicity between two cruciform brooches, when linking involves another artefact type. Firstly the linking artefact form must be both distinctive and rare. If the type used for linking is common, the data produced by an examination of burial associations will tend to be unclear. However, the impression gained of very short floruits for very rare artefact types may be misleading due to the incompleteness of our database. Secondly, each cruciform brooch and linking artefact must have an assessable and similar degree of wear in each context in which they are found together.

a) Wrist clasps

Hines' (1984) typology provides a few examples of rare wrist clasp types found with more than one style of cruciform brooch. There are seven examples known in this country of his style B13b clasps, of which two were found with cruciform brooches. At Morning Thorpe, Norfolk Grave 30, a pair of type B1 brooches and a single unusual type C brooch are all in a good state of preservation, as are a pair of type B13b wrist clasps. In Grave 208 at the same cemetery well preserved B18b clasps were found with a similarly crisp type D2 cruciform brooch. Also buried in Grave 208 were Hines type B8 and B13b clasps which are now in a much poorer condition. Hines type B8 and B13b clasps are likely to be more prone to damage during use, burial and excavation since they were formed out of thin sheet metal. Hines type B18b clasps were cast, therefore much thicker and more resilient. It is difficult to assess a claim for contemporary production dates for these wrist clasp and cruciform brooch styles. Clearly cast wrist-clasps are preferrable since they are more likely to have had a similar lifespan to that of cruciform brooches.

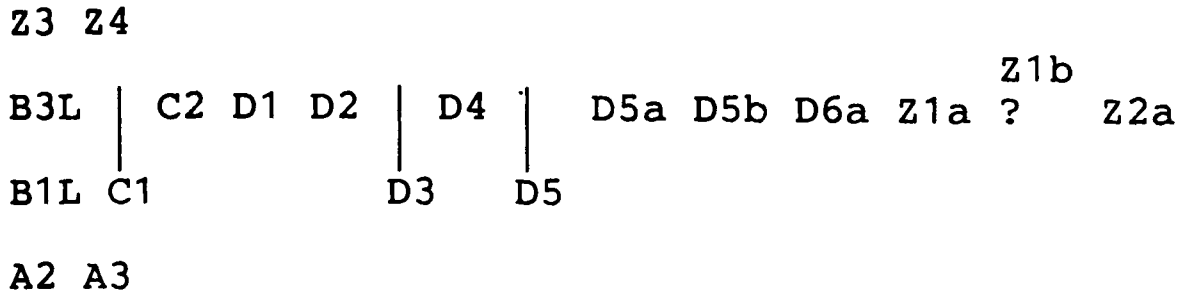
Seven Hines type C3 wrist clasps are known. This type is cast and was used by Reichstein to associate different cruciform brooch styles. The type C2 brooch from Little Wilbraham Grave 133 has suffered extensive cleaning, but was probably quite worn at the time of burial. The wrist clasp was also cleaned,

however, and it is difficult to say how crisp it might have been at the time of burial. The cruciform brooch associated with type D3 from Holywell Row Grave 16 has signs of wear at the bow (the square boss is quite smooth) and at the side-knobs, especially the fan of the right hand one, but the wrist clasp does not look very worn. A further example was found with the type Z1b brooch buried at Morning Thorpe Grave 353 (discussed above). Neither the wrist clasp nor the zoomorphic brooch appear to be much worn, although the type B2 brooches are probably more so. The evidence suggests that the date of production of type Z1b brooches was close to that of the C3 wrist clasps but perhaps later than that of some type D3 cruciform brooches. Given that type D3 brooches are already known to be long-lived means that it cannot be confirmed whether type Z1b belongs to the same phase as the majority of type D forms, or to a phase rather later than this. Some tentative amendments can be made to the relative chronology:



There are thirteen examples of Hines type B14b clasps, of which three were found in association with cruciform brooches, of the forms D4, D5 and Z2a. Fifteen finds of type B17a clasps included

three in association with cruciform brooches, types B2, Z1b and C2. Both of these wrist clasp types were made of sheet metal and the data must therefore be rather less reliable. A position for type D4 can be postulated within the main phase of type D brooches:



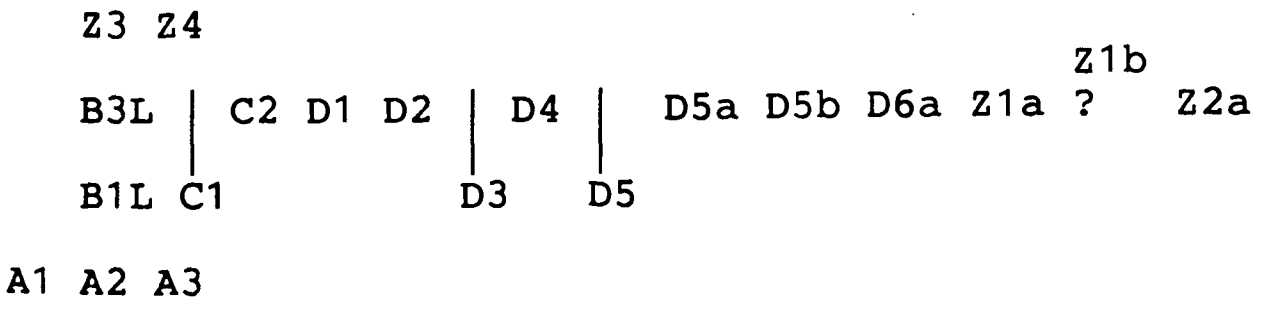
b) Stamped pottery styles

Several early cruciform brooches from Spong Hill were associated in cremation urns. It has been suggested that cremation urns would have been made for the purpose of cremation and at the time of cremation. Hence any urns which are strikingly similar, especially with respect to decoration with stamps, are likely to have been made within a limited timespan. It is the style not the stamps themselves which are necessarily identical. One cruciform brooch **Spong Hill C2197** is most probably of type A1 (Reichstein *Typ* Dorchester). This urn shares stamp type Ia with another urn from the site, urn 1216, in which the tiny cruciform brooch **Spong Hill C1216** (type A2 or A3) was buried, which suggests a similar date of burial for these brooches. Estimation of wear on material which has been cremated is extremely

difficult. The incised lines at the bow of Spong Hill C1216 are certainly worn but those on the sideknobs look reasonably clear.

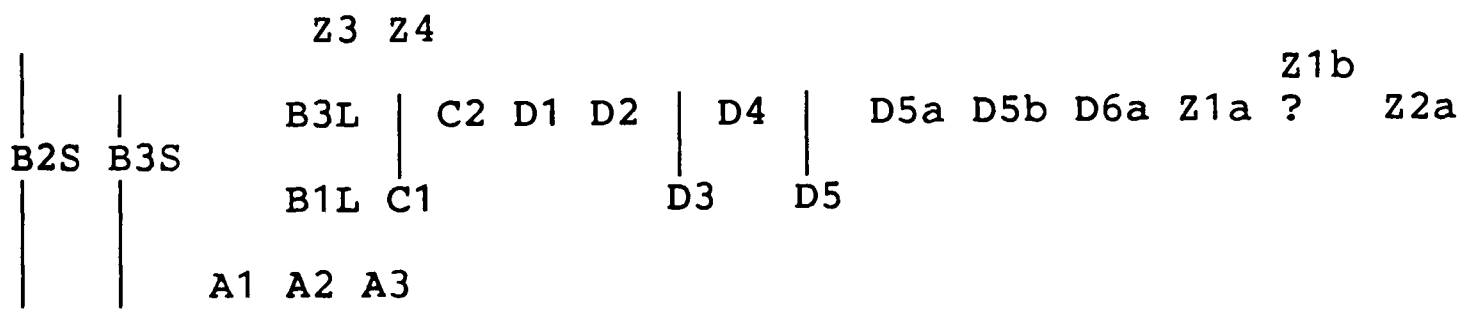
Less clear cut evidence comes from the remains of the headplate and bow of a small brooch, possibly a cruciform of type B (or conceivably a small type C), found in urn 1976 which has stamp type VIIc, as does the pot found with inhumation 26 at this site. This inhumation burial includes a complete type A3 brooch with a polyhedral topknob. This brooch is rather worn at the bow and on the topknob.

Urns 1246, 1689 and 2087 from Spong Hill have further distinctive stamp types but the brooch fragments from urns 1246 and 1689 are so fragmentary as to be unassignable. While the brooch found in the stamp decorated urn 2087 is probably a cruciform of type B, the stamps on this urn are not linked to any of the other urns containing cruciform brooches. So the information from Spong Hill seems to be limited to the fact that some brooches of type A1 were probably buried at a similar date to examples of type A2 and A3. So the relative chronology is amended thus:



c) Buckle type IB *

Find contexts associating type A and B brooches are rare in this country. At East Shefford, Berks, a type A2 and a small type B3 brooch were found together. Indirect association may be made through other artefact types, such as that noted in the previous paragraph at Spong Hill. The finds at Dorchester (type A1) and at Stratford (small type B2) were associated with a late Romano-British buckle Type IB (Hawkes and Dunning 1961). However, none of these brooches appear to be in a very crisp condition. The unusual distribution of these finds (mostly well away from the central areas of cruciform brooch production) may also have some significance. Since small type B2 and B3 brooches are known to be found associated with type D cruciform brooches we can now place these forms into the relative chronology thus:



d) Equal-armed brooches

Hines listed the eight examples of this type known to him (Hines 1984, 253-9). Two are associated with cruciform brooches, **Spong Hill G46** (type B2) and **Holywell Row G16** (associated with type

*See also pp.145-6 and White 1988, Böhme 1986.

D3). Both cruciform brooch forms could belong to more than one phase in the relative typology. Hines places the Spong Hill burial in the early sixth century. However, the simple form and solid bow cross-section of the type B2 cruciform brooch must be noted (for this technical aspect see Chapter 3), seeming to incline towards Hines' alternative suggestion for a late fifth century date of production (Hines 1984, 254). In both burials, the equal-armed brooches do not seem to be in a fresh condition. With a late-fifth century date for the Spong Hill burial, a probable early sixth-century date for the Holywell Row example and heavy wear on the equal-armed brooches, the chronological gap Hines perceived between the Scandinavian examples of equal-armed brooches and the English sequence (Hines 1984, 258) becomes less of a problem.

e) Barred zoomorphic combs and cases

Hills was concerned that the brooches from Spong Hill cremations 1468 and 1469 (both Mortimer type A2) and 1664 (associated with Mortimer small type B) should be allocated within the *späte Typ* Midlum, whereas **Spong Hill C1216** (type A2 or A3) would be more closely affiliated with the earlier, Groß Siemß form (Hills 1981, 107). To Hills, the association of all of these brooches with barred zoomorphic combs or cases indicated a single phase. I believe that all these brooches represent an advanced stage of the continental type Groß Siemß, the wider headplate being similar to some in Frisia (as discussed below,

pp.149ff

under continental parallels). This view is similar to that expressed by Hills (*op cit*, 108).

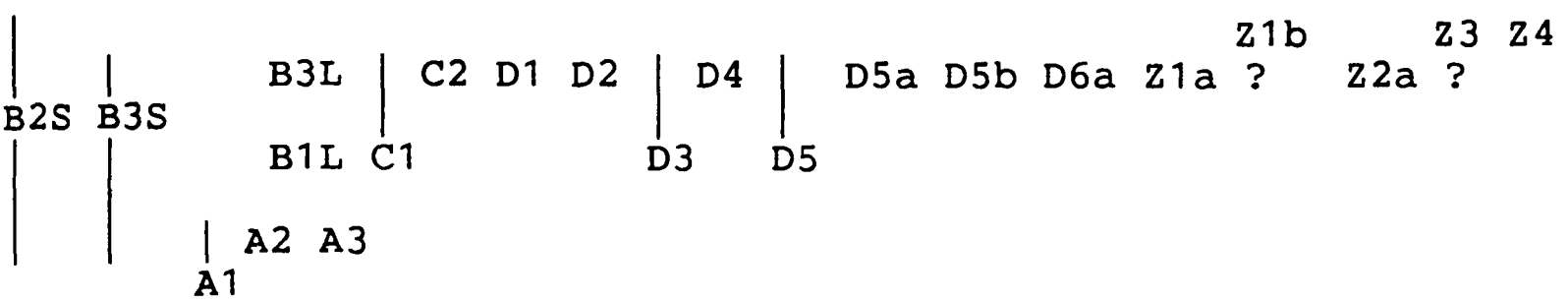
The fact that **Spong Hill C1664** has a topknob with semi-circular cross-section positions it within the English type B. However, the style of the headplates of this and **Spong Hill C1468 (1) and (2) and C1469** leave one in no doubt that these brooches are contemporary. It will be noted below that continental forms with circular cross-sections at the topknob are often typologically quite close to those with topknobs of semi-circular cross-section. The missing foot on **Spong Hill C1664** is a problem, but at least we can use this comb data to confirm a chronological overlap between brooches of type A and type B.

f) C-bracteates

C-bracteates are a rare form of ornament with Scandinavian parallels. Two copper-alloy C-bracteates were found with **Morning Thorpe G80** (type D6a) and a gold example with **Longbridge** (type Z3). Both examples were very worn at the time of burial, but it is difficult to estimate whether thin copper alloy was more or less durable than thin gold. In addition, neither of the cruciform brooches are in a fresh condition and **Longbridge** is an extremely unusual form, whose relationship with the main grouping of type Z3 brooches is unclear. We can suggest that these brooch styles were in use at around the same time.

Summary

Only typological evidence remains to suggest that type Z3 and Z4 are later than type D brooches, since they adopt and develop ideas from type D brooches. Similarly the typological inference that the production of type A1 brooches began earlier than the type A2 and A3 brooches seems unavoidable. Hence the relative typology looks as follows:



Without further stylistic judgements, it seems unrealistic to maintain the sub-divisions within the upper phases of this typology. Production of types C1, D3 and D5 may have started slightly earlier but at least some versions of each of these types may be associated with the other type C and D brooch styles and with some type Z brooches. Similarly, large type B1 brooches are associated with brooches of type C1, which themselves may be found in the main type C and D phase. It is therefore difficult to establish particular periods of use for brooches of sub-types within types C and D. Only stylistic judgements are available to place some type Z brooches slightly later within this general phase.

We may be seeing evidence for long-lived fashions in type C and D cruciform brooch forms and in the artefact forms normally found associated in burial contexts. Certainly type B brooches show very different characteristics. Further blurring of the archaeological record will occur if brooches were held by an individual or family for considerable periods of time. However, stylistic preferences are unlikely to have remained the same for decades (the period suggested below for the production of these brooches). We may conclude that our data is currently insufficient to provide more detail than this.

5 'Horizontal stratigraphy'

Foci of occupation or use often shift over time, within archaeological regions or areas. In the case of cemeteries, artefact typologies can be used to establish such sequences and hence suggest dates for other less well-understood forms in neighbouring burials.

The Morning Thorpe and Spong Hill cemeteries in Norfolk provide an ideal testing ground for theories concerning 'horizontal stratigraphy'. The material evidence is rich and varied, the excavations modern and well published (Green *et al* 1987), Hills 1977 etc). At Morning Thorpe burial rites were mainly inhumation whereas the burials at Spong Hill cemetery include inhumed examples but the cremations are spectacularly abundant.

The results of plotting various artefact types on to the plans of excavation illustrate the possibilities of distinguishing phases of use for different areas within the site (Figures 2.60-2.62).

The 1974-5 excavation at Morning Thorpe revealed around 365 inhumation burials (and nine identified human cremation burials) of a variety of styles and likely dates. Starting with the cruciform-brooch data, three areas of burials are associated with the burial of cruciform brooches, at the furthest northern edge of the site (graves 16, 30, 90, 208, and 209), a band of 12 graves towards the west (graves 80, 91,96, 129, 131, 133, 153, 160, 393, 396, 397) and a more compact group towards the south-east of the site (graves 253, 346, 353, 358, 362, 370 and 371). The extent of the area in which cruciform brooches were found is 40m (east-west) by 25m (north-south). The burials are densely packed in, hence there are several areas which are notably without instances of cruciform-brooch burial.

Two burials with type A cruciform brooches (Graves 346 and 362) are situated within 5m of 3 type D brooches (Graves 358 and 353) and another associated with type Z1 forms (also in Grave 353). Nearby, in Grave 342, a small, burnt fragment of a further zoomorphic cruciform brooch was found. It is possible that burials of both the earliest and the latest phases of use occurred in this one area.

Graves 208 and 209 are close together in the north of the site and both contain cruciform brooches of type D2, but other examples in graves 160, 253 and 397 are some 10-20m distant in the western group. Graves 160 and 209 also share a distinctive annular-brooch style (fig 351, B and C, fig 361, A and C). So this is strong evidence for supposing that different areas of the cemetery were being used simultaneously and that the patterns of use are not straightforward or easily understood. There is a similarly dispersed distribution for type C brooches. Grave 153 contains an elaborately decorated type C cruciform brooch, a further type C example was found in Grave 371, 15m to the south-east and yet another in grave 30 is 15m distant, in the northern group.

Graves 80, 91, 96 and 129, towards the western edge of the cemetery all contain type D brooches with zoomorphic lappets (type D5, D5b and D6a). In addition, **Morning Thorpe G129** (type D5) is linked to the neighbouring **Morning Thorpe G131** (associated with type D1) by the use of a double semi-circular stamp and a small circular stamp, also by the style of the eyes of the animal head. From **Morning Thorpe G131** to **Morning Thorpe G133** (also associated with type D1) the change in catch plate and upper animal head forms is not great. **Morning Thorpe G133** also has flat fan-like projections on the sideknobs, as in **Morning Thorpe G129** and other type D1, D2 and D5 brooches. So the western group of burials containing cruciform brooches could

have originated from the same period of use.

Three great square-headed brooches, linked typologically and placed in the last phase of Hines' typology, in Group XVI (Hines 1984, 151-8) are found in graves 359 and 214 (very close together in the southern portion of the excavation and near to the south-eastern group of cruciform brooches) and in grave 288, 15 metres away, close to the eastern edge of the excavation limits. Three examples of girdle hangers with animal-head endings are found associated with cruciform brooches of small type B2 and type Z1 (associated), type D3 and type D with small-long foot and with type D3, in graves 353, 358 and 396 respectively. These three graves are all in the southern portion of the cemetery. So there seems to be evidence for systematic use of the area and identification of groups of graves whose occupants could have shared the same tastes, or had access to the same metalwork supplies.

This picture is confused by data from other material. Thirty-one pieces of pottery with distinctive stamp marks were found at Morning Thorpe and catalogued by Friedenson and Friedenson in Green *et al* (1987). They remark that only one stamp (VIId) is found on more than one pot at the site, in graves 115 and 40, which are in the western end of the site and in the centre of the site, respectively. Occurrence of the use of other stamps, seen to belong to more general categories (e.g. Ia, Ih, IIIb),

is scattered across the site. Neither the small-long brooches, nor those remaining annular brooches with distinctive styles, produce obvious patterns implying phasing of use across the site, although in both cases, we lack a modern typology with which to assess the information.

A similar case study can be performed at Spong Hill (Figs 2.61 and 2.62). A majority of the data is published in the first four volumes, but a synthesis is still being evolved[6]. The cruciform-brooch evidence is of considerable importance here, although the fragmentary condition of some of the pieces makes the discussion difficult. Hills *et al* (1984, 41) suggest that traditions of inhumation and cremation were partly contemporary although they conclude that inhumation at the Spong Hill cemetery probably only occurred 'as an episode ... in it's middle phases' (*op cit*). This pattern of use is supported by a closer examination of the cruciform brooches with a few amendments.

The very earliest cruciform brooch recovered (and probably one of the earliest burials for the Anglo-Saxon cemetery as a whole) was found in cremation 2197 (a type A1 brooch, close to the style of Dorchester). The cremation cemetery expanded outwards

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[6] I am grateful to Kenneth Penn, Norfolk Archaeology Unit for arranging access to these brooches, giving me drawings and details of the positions of cremations C2997, C2918, C3055 and C3304 before their publication in Spong Hill Vol V and for facilitating sampling for chemical analysis.

to the areas of C1468, C1469, C2656 and C2997 (which have brooches of types A2 and A3). Occasional examples of type A cruciform brooches were seen in other areas, outside the boundary ditch 146; to the west (an example in cremation 1034) where another major cremation grouping has been partially excavated, and to the north-east in a single inhumation grave (number 26). Grave 26 is placed centrally within the sequence of excavated inhumations. The typological closeness of **Spong Hill C1468** and **C1469** to continental examples have been noted and examples of pottery with continental parallels were also found in this central portion of the cremation cemetery. Further burials of this period are implied by the presence of zoomorphic combs, found in the centre and the north of the cremation cemetery (Fig 2.62).

Type B cruciform brooches are found in cremations within the enclosure ditch 146 as well as on its boundaries and amongst the inhumation graves. A small and simple type B2 brooch comes from C2195, which is very close to C2197, the findspot of the earliest cruciform brooch at this site. However grave 46 also yielded a type B2 cruciform brooch of a simple, probably early form. This coffined burial is associated with a ring-ditch system, to the east of the sequence of excavated inhumations.

Hence, the evidence from type A and B brooches show contemporary use of both rituals, except for the very earliest forms.

The preferred area of cremation appears to move outwards and northwards over the period of use. This may be indicated by the cruciform brooch distribution evidence (Fig 2.61) and by ceramic data. Later dates were given for some stamp-linked pottery groups (Fig 2.62) which show a strongly peripheral distribution, away from the centre of the main grouping of cremations. The products of certain ceramic workshops were used in both inhumation and cremation rituals.

Hills *et al* (*op cit*) give two suggestions as to the phasing of the inhumations. Either the earliest inhumations were in the centre of the band of excavated inhumations and later ones were at either end, or two sets of inhumations were established at either end and those in the middle came later.

None of the inhumed brooch forms are identical to those found in cremations. Our relative chronology shows that production periods of type D and type Z cruciform brooch styles are approximately contemporary. The type Z1b brooches from graves 2 and 57, positioned at either end of the excavated inhumations may be slightly later than the type D brooches from graves 39 and 22, but the difference is probably small. So one might conclude that cruciform brooch forms were buried throughout the area of inhumation graves with only a small chronological direction being detectable.

Inhumations at this site are the latest phases of burial datable by cruciform brooch. It is certain that cremation continued afterwards, since two cremations were cut into the top of inhumations. Cremations do not appear to include the burial of very late cruciform brooches. Cruciform brooches could still have been in use at this later period but without being used within burial rites.

Here again the phasing of the site is suggested in part by cruciform brooch data and in part from the ceramic data. A simple model of outward spread has imposed on it the information from the brooches and ceramics. Further work on synthesis of the whole site should provide a fuller understanding and allow a better comparison of information provided by the various artefact types. For the moment, the data neither contradicts nor adds to the information provided by the relative chronology outlined above.

These are only two sites out of many which could have been examined but they suffice to illustrate the fact that a fuller understanding would necessitate a separate, longterm project. The elucidation of phases of cemetery use at these sites is assisted by the use of the relative chronology of cruciform brooches and is of considerable interest as such. However the 'horizontal chronology' of both sites is too complex to give dates to areas and hence to artefacts.

In both these case studies, we can observe examples of the earliest and the latest cruciform brooch styles known in this country buried in close proximity. Hawkes believes such areas, used over extended periods, represent family plots (pers comm). If each area belonged to a family or family group, there is little hope of distinguishing 'horizontal stratigraphy' in cemetery plans.

It can be seen that it is easier to suggest complex series of relationships between areas of the Morning Thorpe cemetery where there is plentiful artefactual remains. The cremated Spong Hill material is not so well preserved and distributions are relatively more difficult to comprehend. The 'horizontal stratigraphy' information does not greatly add to our sum of knowledge as far as the relative chronology of cruciform brooch forms is concerned.

Results of relative chronology

The results discussed are at a minimum level and with luck may be reviewed in the light of new evidence. One important result of this research is the establishment of late phases of use of relatively simple type B brooch forms. Size and amount of decoration may be some indication of later dates within these simple brooch forms, but these cannot be used simplistically.

A wide range of forms with lappets and some zoomorphic brooches were used during a later phase. Stylistic development is also perceivable, by using burial association information, within some of the type D brooch styles. However, in view of burial association and workshop affiliation, it seems likely that most type C and D brooch forms are attributable to within one general phase.

With such a large number of possible element combinations, it seems that personal interpretation and judgements about direction of stylistic development are the only methods of deciding which may be the earlier forms. Since the typology as presented is sufficient for the present purposes, detail may be left to later researchers.

It is hoped that this relative chronology has succeeded in giving a little 'depth' to the cruciform brooch typology. The next step is to tie down this floating sequence into an absolute chronological position and to link it with continental phasing.

D. Absolute chronology

An artefact type may be dated if examples of the type are found in association with other datable objects or, more indirectly, by typological similarity to other artefacts which are themselves dated.

Few English cruciform brooches have associated finds which allow independent dating. The likely dating of **Dorchester** (the simplest and probably the earliest form of type A1 brooch) was thoroughly discussed by Reichstein (1975, 92-94) and more recently by Hawkes (1986, 69-71). The brooch was found in a burial with a late Romano-British buckle (Hawkes and Dunning 1961 Type IB) and the backplate of an early applied brooch. The amount of wear on the brooch and the buckle suggests long use. Using these facts and the proximity of a Saxon, male burial with late Roman military belt fittings, Hawkes concludes that the burial should be dated to after AD 425, at a time when Germanic mercenaries were brought into the area to resist an invasion of their kinsfolk (*op cit*, 70). Bakka (1973) gives brooches of Dorchester style as the indicator of the beginning of the Migration Period (his VWZ *Stufe* 1), at the end of the fourth century and they are found with late Roman artefacts in northern German cremation cemeteries. However, this is a continental brooch form, which has a limited distribution and probably a short period of use in this country. It is important to provide a chronological peg for forms which were commonly found in England and which

provide a basis for the development of later English forms i.e. type B brooches.

In the relative chronology section above, it was noted that a further example of the Type IB buckle style buried with cruciform brooches comes from Stratford-on-Avon, Warwickshire (Reichstein (1975), no 882, fig 90,3 and 5). This pair of cruciform brooches are of the type B2 category and also were not completely fresh at the time of deposition. By association then, type B2, the brooch form found most commonly in England, may have been in use at around the same time as the continental type A brooches. This indicates that the starting point of our relative chronology should be put in absolute terms in the first few decades of the fifth century.

It should be borne in mind that these two graves containing cruciform brooches and late Roman artefacts were discovered in areas outside the normal distribution area for cruciform brooches. This is especially true for the Dorchester find (Stratford-upon-Avon is not very far from areas which have later cruciform brooch forms, e.g. the cemetery at Baginton). These brooches may have been worn by women who had come to this island on quite a different basis to the majority of women who were buried with cruciform brooches. In the main, only styles which may be dated to the first phases of cruciform brooch production are found in these 'Saxon' areas. Böhme believes the unusual English distribution of artefacts dating from the first half of the fifth century relates to the

military nature of the Saxon occupation, illustrated by finds in the Upper Thames and Severn valleys and around the Saxon shore forts (Böhme 1986, 539 and *Abb* 58).

In East Anglia the only well-recorded example of a type A1 brooch occurs in the cremation cemetery at Spong Hill (Spong Hill C2197). The people buried at Spong Hill were equally likely to be cremated or inhumed during most of the period of use. It is difficult to establish whether the cultural background of those who were cremated (including those with cruciform brooches) was different to those who were inhumed.

Other type A1 brooches appear not to have been cremated. Three come from sites within the central distribution area (Ixworth, St Johns, Glentham) and one from Kempston in Bedfordshire, which is slightly removed from the central area. Thus, with one exception, these earliest brooches were probably all inhumed, although they come from very scattered locations across the country.

Grave-good associations are not always straight-forward chronological indicators, as may be illustrated by the association of a cruciform brooch, Spong Hill G26 (type A2) with a gilt and enamelled Romano-British brooch. Mackreth puts the date of manufacture of the Romano-British brooch at no later than 300 AD (Mackreth 1984) and believes the brooch to have been repaired during Anglo-Saxon times. Although the cruciform brooch type is the earliest form to have been

inhumed at this site, there are still at least 150 years between the likely date of manufacture of the two brooches (as the cruciform brooch is worn, the burial could be placed about the middle of the fifth century). There are many examples of the phenomena of similar Romano-British (and earlier) brooches found preserved in Anglo-Saxon burials (White 1988).

The forms of **Colchester 2** and 3 (types A2 and A3) are the next logical development after type A1 (Reichstein's *Typ* Dorchester) brooch forms. **Colchester 3** was found with a coin (a siliqua of Valens 367-78), pierced for suspension. The association of Roman coins with burial, both pierced and in bag collections continues throughout the pagan Anglo-Saxon period (White 1988, 99-110). Piercing is consistently found, although it becomes slightly less frequent in the sixth and seventh centuries. The dangers of circular argument are significant here, since artefact forms such as cruciform brooches will have been used to date the burials in White's work. Hence some of the evidence for early burial based on associations with Roman artefacts may be unreliable.

At the other end of the typological sequence, Reichstein found independent dating for his *Typ* Little Wilbraham, from the associations of **Little Wilbraham G133** (type C2). This was found with two Frankish radiate-headed brooches given the general date 'sixth century' by Reichstein. Hines (1984, 26) refines this dating, using discussions by Koch (1977) to place this type (Kühn 1940, type 21) into Ament's phase AM2, that is

520-560.

Mucking G92 (1) and (2) (type D5b) were associated with a claw beaker dated to the sixth century (Jones et al 1968). More recent discussions do not refine this dating (Evison 1982). Type D6a and Z3 brooches were found with C-bracteates, dated stylistically to the first half of the sixth century (Mackeprang 1952, Hines 1984, 214). As the C-bracteates associated with both **Morning Thorpe G80** and **Longbridge** were very worn, I am inclined to place both brooches late in the period, perhaps around 550. **Longbridge** is a very unusual form of type Z3, whose style of decoration is much less precise and well-organised than those in the main grouping of this type. However, this does not necessarily have to mean that this brooch is very late in the series. This metalworker may have been less skilled or more imaginative than others or simply lived far away from other smiths.

In Bifrons G15, two small type B3 brooches were found with a Frankish buckle. Hawkes places the buckle at around 500 AD and says that this suggests that the cruciform brooches must have been old when buried (Hawkes and Pollard 1981, 323-4), since the comparable Stoveland brooch (Reichstein 1975, *Taf.* 19,7) was found with a pre-475 relief brooch. The late production of this form now appears to be confirmed by Grave 22, Spong Hill where there was a pair of type B3 brooches associated with a type D5b brooch. Admittedly the type B3 brooches appear rather more worn than the type D5b brooch but we may still postulate

the use and production of small type B3 brooches throughout the second half of the fifth century and probably into the sixth.

Further stylistic parallels from Kentish buckles and square-headed brooches may be seen for cruciform brooch types Z3 and Z4. One especially close case is the Hines type XXI square-headed/cruciform brooch hybrid from Kempston (Leeds 1949, 83, no. 141), which Leeds links with **Duston** (type Z3) and other cruciform brooches from the midlands. The style of the headplate is very similar to the design on some buckle plates (e.g. in Grave XX Petersfinger, Wilts, Leeds and Shortt 1953, pl VI) which in turn can be compared to square-headed brooches (e.g. one from Herpes, France (*ibid*, 48)). Leeds and Shortt place these forms in the mid-sixth century[7]. Hence brooch types in the broad, late phase of the relative chronology may have been made in the first half of the sixth century, up until the middle to the century.

This is the extent of independent dating resources for forming an absolute chronology of the English material. These few burial associations indicate broad periods for the use of some cruciform brooch forms but leave the duration of use for each type unclear. If dated brooch forms from abroad can be shown to be sufficiently similar to English forms, further dating evidence may be gained.

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[7] I am indebted to Mrs Hawkes for these references

The evidence of continental and Scandinavian cruciform brooch forms Map 1.3

Reichstein (1975)

Typological parallels between artefacts in various countries were essential to the dating of cruciform brooch types in Reichstein's study (Reichstein 1975). His method involved the definition of brooch types, of which a few occur both in England and other areas. In each country, types were put into an overlapping sequence by the burial associations of type members. The forms were then dated by association with datable artefact forms. Groups of typological forms are then given phases *ältere, ältere/jüngere, jüngere, späte and späteste.* A number of problems in this methodology were noted above and these have specific implications for research on English cruciform brooches.

Norwegian types

Most Norwegian cruciform brooch types are typologically very distant from English forms. Norwegian graves containing cruciform brooches and relief brooches of the early sixth century suffice to give a late date to many of the dominant cruciform-brooch forms such as Reichstein's *Typen* Mundheim, Lima and Skogøya. Some of the more unusual Scandinavian types, such as *Typ* Stoveland and Foldvik-Empingham, are also given späte dates, by association with these Norwegian brooch forms.

There are similarities between English and Scandinavian examples of Reichstein's *Typ* Foldvik-Empingham, but only at a very general level. Certainly, none of the Scandinavian examples of *Typ* Foldvik-Empingham could be mistaken for imports from other areas, since they mostly have pointed edges to their bows. The closest inter-regional parallel known is between a brooch from Humlagården, Sjögestad sn. Vg (Reichstein no 414, *Taf.* 68,8) and the example from Kempston (*op. cit.* no 763, *Taf.* 68,10). The Swedish brooch has an English-style headplate but the slash down the bow is purely Scandinavian. The Kempston example has many more continental affiliations than English ones (especially in the headplate and bow styles) and has no recorded burial context. Hence the typological parallel is not useful for integrating English evidence with Scandinavian.

Typ Stoveland is a far more distinctive brooch form with a widespread distribution. Its associations can be shown to suggest a sixth century date (see below), but the English examples come from Kent and there are no useful connections with the main sequence of English types.

Continental types

Typological associations are known for the finds at Pritzier, Mecklenburg (*op cit*, Tabelle 5) which establish a

chronological overlap between groups of finds with early cruciform brooch forms and those with Nydam brooches. In addition, Reichstein suggests the dates of use for his *Typen* Pritzier, Witmarsum and Groß Siemß are probably not too dissimilar. Hence the earliest cruciform brooches were probably deposited in the late Roman period.

Although Reichstein does not believe that 'horizontal stratigraphy' is appropriate in all cases (Reichstein 1975, 81-82), at Perdöhl he uses this technique to show that *Typen* Perdöhl and Groß Siemß seem to be later forms than *Typen* Pritzier and Witmarsum (as would be suggested by an 'evolutionary' model of typological progression). Hence Reichstein's *Typen* Perdöhl and Groß Siemß are given a jüngere designation. Reichstein suggests also that the simple early style brooches of *Typen* St Johns College and Hjelmhede can be suggested to have a logical position in the typology, between the ältere and the jüngere cruciform brooches, i.e. somewhere between *Stufen* C3/D1 and D2 (*op cit*, 97).

On several counts - expanding animal head features, widening headplates with more obvious divisions between wings and central reserve - the development of continental forms with top-knobs with circular cross-sections have parallels with the progression within the English type A brooches. Since there are relatively few English brooches belonging to this part of Reichstein's typology - and these are rarely linked by burial contexts to the rest of the English typology - this information is of somewhat limited import.

Information relevant to English type B brooches is more

difficult to understand. First of all, there is the difficulty of applying Reichstein's typology to members of the English corpus. If a brooch may belong to any of a number of type forms in a typology, the typology must be less useful.

In his Tabelle 7, Reichstein linked together a large group of English cruciform brooches by grave-good associations. Several of the graves in question are connected by the possession of very common artefact types. Hence these links have dubious reliability.

Brooch types with spatulate feet are thought to show 'a simple parallel development from the same very common feature in an area of common development' (Hines 1984, 252). This means that Reichstein's *Typen* Foldvik-Empingham, Barrington, Bradwell, Ferwerd and Feering are of little assistance in assessing links between England and other areas of cruciform brooch production.

Hence the significance of a number of Reichstein's inter-regional associations is lessened.

Three further continental and English types - Reichstein's types Lyminge, Goutum and Howletts are also suggested to be späte in date (Reichstein 1975, 98). This would seem to be their logical position on stylistic grounds of 'direction of development'. However, these forms have no independent dating information and none of the examples have contexts in which

they are associated with other English or continental forms, by which means they could be linked to the relative chronology. Some of his allocations of English examples to these distinctive types is also questionable (see below).

Typological parallels with continental brooches were found for the English brooches in Tabelle 7. The method of connecting the English and continental typologies to the Scandinavian chronology is of necessity somewhat convoluted and Reichstein combined several pieces of evidence to demonstrate a späte date.

Through a Dutch grave association (at Hoogebeintum, Kerkterp, Gem. Franekeradeel, Reichstein no 747) a brooch of the (very common) *Typ* Midlum is shown to have a similar date of use as the unusual *Typ* Hoogebeintum. By typological similarity, Reichstein linked *Typ* Hoogebeintum with the Swedish form *Typ* Götene and thus by burial association (at Melldala, VG, Reichstein no 402) to späte Norwegian brooch forms.

In fact, the typological connection between Reichstein's *Typen* Götene and Hoogebeintum is not strong. The Swedish form has wide headplate wings with the sideknobs cast on, whereas the Dutch form has a small square headplate with separate sideknobs. The Swedish form has a distinctive animal head form with the features clearly formed, but the animal heads on the *Typ* Hoogebeintum brooches have indistinct features. The only directly comparable feature is the rounded cross-section of

the catchplate area with equally spaced ridges on *Typ* Hoogebeintum brooches and groups of ridges in *Typ* Götene brooches. One of the *Typ* Götene brooches also has incised lines crossing over the eyes, found on one of the *Typ* Hoogebeintum brooches (brooches from Stångebro, St Lars sn., ÖG and Gallin, Kr Hagenow respectively).

Other links Reichstein employed to connect English and Norwegian typological sequences include a Swedish burial (Blomsgården, Skallmeja sn, VG) where *Typ* Bradwell and *Typ* Mundheim brooches are found together, thus dating *Typ* Bradwell to a späte phase. A reliance on the use of brooches with spatulate feet for typological comparisons was noted above to be unwise. The rather doubtful method of horizontal stratigraphy at Hammoor, Urnenfriedhof 4, also associated a *Typ* Midlum brooch with a cemetery area of probable fifth-century use.

Hence Reichstein has used several examples of general parallels between brooch forms to link continental forms with Scandinavian forms. The degree of similarity is not strong and clear-cut contemporaneity cannot be said to be proved. The cruciform brooches of Reichstein's *Stufe* D3 are likely to lie within the second half of the fifth century and the early part of the sixth, but we have no means of pinning this down more exactly, or of providing chronological seriation of types within the phase.

The latest stage of development dealt with by Reichstein concerns his English späteste brooch forms, from *Stufe* D3/E1. There are no continental or Scandinavian parallels. The point at which there were the fewest shared artefact types in Reichstein's Tabelle 7 is used as a boundary between phases of English brooches. The overlap is considerable and Reichstein admits the hypothetical character of this division (*op cit* 1975, 95). Again the description of some of these Typen, notably *Typ* Islip and Feering, makes it difficult to establish the difference between these *späteste* brooches and *späte* brooches belonging to Reichstein's phase *Stufe* D3. For example, *Typ* Islip has a very simple foot form and overall the examples cited are not very different in appearance to *Typ* Stratford. The relative chronology of the English cruciform brooches (above) suggests that several small brooch forms had a long-lived period of production and use. Hence we should not expect to be able to form a clear chronological sub-division of the forms in Reichstein's Tabelle 7.

Clearly there are several problems in using the approaches taken by Reichstein to link the English production with that abroad. It may be beneficial to take a fresh start, tackling the problem from an English point of view and including information from recent finds.

Typological information can be considered at various levels. In the following discussion, data from brooch types will be outlined first, then data from individualistic brooches which do not fit into the general English types and lastly information from individual features on brooches. Even where finds do not have independent dating evidence associated, it is still important to establish the degree of typological similarity between brooches and brooch types in different regions, pending further excavated information.

Type A brooches

The simplest parallels can be shown in the earliest phases of development. The English situation should be compared with the distribution of Reichstein's types on the continent (Maps 2.11 and 2.12). The number of type A brooches has increased through the excavations at Spong Hill. These pieces and the re-examination of older finds have brought a clearer understanding of the similarities between forms in different regions.

The close typological similarity between **Glentham 1** (type A1) and a Danish brooch, from Mejlby, Ålborg allows an independent date (Hines 1984, figs 1.4 and 1.5). The Danish brooch was buried with a Sösdala Style silver brooch (Böhme 1986, 534-5), which confirms the position of type A1 brooches in the first half of the fifth century. A similar silver brooch was found with the Reichstein *Typ* Groß Siemß brooches in Grave D1,

Sejlflod, north Jutland (Nielsen *et al* 1983). This confirms that deposition dates of these continental cruciform brooch styles overlap at the same time as the parallel type A1 and A2/A3 brooches in England, during in the first half of the fifth century.

I do not feel the Glentham brooch is an isolated or inconclusive example (Hines 1984, 253) and should like to add a few comments on its parallels with members of Reichstein's *Typ* Hoogebeintum. This consists of three Dutch and north German brooches with the same type of ridging at the catch-plate and whose headplate and knobs seem to be at the same stage of development (Reichstein 1975, *Taf.* 83, 5-7). The difference here is the scale - the *Typ* Hoogebeintum brooches are around three times the size of the English and Danish examples.

The problem lies in the late dating (Reichstein *Stufe* D3), given by the burial association of the *Typ* Hoogebeintum type brooch with a brooch of Reichstein's *Typ* Midlum (Reichstein no 747). It is possible that the Glentham brooch originally had strong parallels amongst Frisian types (which happen not to have survived amongst the small Dutch corpus), which were later developed into the *Typ* Hoogebeintum style. Alternatively the *Typ* Hoogebeintum type brooch may have been quite old at the time of its burial. The amount of wear observed could be used to suggest lengthy circulation, especially compared with the rather good condition of the *Typ* Midlum brooch from the

same context. In any case, a Frisian connection is suggested for elements seen within **Glentham 1**.

Reichstein's *Typ* Witmarsum brooches have general typological parallels with members of the English type A brooch forms. However, there are a number of clear differences (foot style, topknob styles and the overall size) and there are no English brooches whose form could be mistaken for the true *Typ* Witmarsum form.

The descriptions of Reichstein's *Typ* Groß Siemß and the English types A2 and A3 are also clearly linked and in some cases they are identical. For example, **Colchester 2 and 3** could easily have been made on the continent (see technical evidence in Chapter 3). Amongst the other English type A2 brooches, several of the Spong Hill brooches also look very similar to continental forms (**Spong Hill C1468 (1) and (2), C1469, C2656** and probably **C1216** (fig 2.6; Hills 1977, fig 107; Hills *et al* 1987, fig 92)).

The continental database for these early cruciform brooches continues to grow, but with few independently-dated examples. The unassociated finds from the site at Gudme, Fyn, Denmark include one example each of Reichstein's *Typ* Dorchester and *Typ* Witmarsum (Copenhagen Museum x87, x1370). One of the two very poorly preserved brooches from the settlement at Hoogebeintum, Frisia (Reichstein no 748) may also belong to Reichstein's *Typ* Witmarsum. The other example under the same

Reichstein catalogue number is the piece assigned to Reichstein's *Typ* Trumpington, whose headplate (not illustrated by Reichstein) is small and square. This may also belong to *Typ* Witmarsum or to *Typ* Groß Siemß[8]. Several fragmentary parts of *Typ* Witmarsum or *Typ* Groß Siemß brooches have been found at Schmalstede, Kr Rendsberg, Schleswig-Holstein[9] of which those from cremations x32 and x77 are most probably similar to *Typ* Witmarsum forms.

Further examples of the Groß Siemß type are arriving thick and fast. The excavations at Hjemsted, Skærbæk, Hvidinge in southern Jutland produced a further example of the normal *Typ* Groß Siemß (Ethelberg 1986, 112) and another possible fragmentary example (*op cit*, 143). A pair with a square area raised at the crest of the bow were found at Sejlflod, North Jutland (Nielsen et al 1983, figs 9 and 10). New examples of *Typ* Groß Siemß brooches from Schmalstede (from cremation 272 and probably also 132, 250, 255 and 280) begin to fill in an apparent gap in the distribution map. The brooch from cremation 272 also has rather scroll-like nostrils and that from 250 has a furrow down the bow as in the Spong Hill examples.

A Frisian form belonging to the *Typ* Groß Siemß style comes

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[8] Dr Egge Knol, Archeologisch Instituut, Vrije Universiteit brought this piece to my attention.

[9] Access to these brooches was kindly provided by J Reichstein, in advance of their publication by Ms Bode of Kiel University.

from recent discoveries at Bornwird (Fig2.64)[10]. This has many similarities to the quoted type A2 examples from Spong Hill, notably the style of the animal head, the facets on the catchplate and the gently curving bow with lines running down it. The examples from Bornwird and Spong Hill have headplates which are slightly wider than those on German and Danish *Typ* Groß Siemß brooches and this width is similar to that of another Dutch example, from an unknown findspot (Reichstein 1975, *Taf* 82,3).

There seems to be less stylistic division between continental brooches with topknobs with circular cross-section and those with semi-circular cross-sections than in the English corpus. On the continent, brooches whose forms lie between Reichstein's *Typ* Groß Siemß styles and his general type, *Typ* Midlum (or within *Typ* Midlum) often have circular cross-sections to their topknobs. At the stage of development somewhere between these two forms (with circular topknobs), one may quote two brooches from Ribe (Copenhagen Museum DK1335 and 213), at least one of which has scroll-like nostrils, rather like those on Reichstein's *Typ* Stoveland brooches and a very similar piece from Dankirke, both in the south of Jutland (Ethelberg 1986, fig 52). These three brooches have rather wider headplates.

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[10] Access to this information from Gilles Jan de Lange, Biologisch-Archeologisch Instituut, Groningen, in advance of his publication.

Few brooches with secure positions within major English typological groupings exhibit this tendency. Spong Hill C1664 (associated with type B, by virtue of its topknob cross-section) has, in general, a very similar form to the type A2 brooches at the site. However, this example is only fragmentary and cannot be allocated to a more precise type. Barrington A 11 (type A2) is an exaggerated form which Reichstein places in the heterogeneous *Typ* Midlum category, by virtue of its expanded headplate. This is another good candidate for imported status. The closest parallel for this brooch is Frisian, from Midlum, Gem. Franekeradeel (Reichstein 1975, *Taf.* 84,7).

The form of the brooch from Aisne, northern France can be easily compared with examples from type A2 forms. One must suppose an extraordinary form of trade, exchange or other transference process (e.g. exogamy, J. Werner 1970) for this and the type C brooch from Castelnaudry.

It is clear that the typologies of all type A forms are strongly linked to continental forms. Type A brooches still have their closest parallels abroad most densely clustered in Schleswig-Holstein. This region is the area which most closely resembles that which Bede describes as being the homeland of the Angles (viz. between the Jutes and the Saxons). Recent discoveries on the continent appear to extend the early cruciform brooch distribution somewhat further north and west than previously known, especially for the type A2/Groß Siemß

forms. The early cruciform brooch finds from Fyn, Denmark coincide with the extent of Anglian ceramic finds which Genrich displayed (Genrich 1954). English examples have been clearly shown to lie within a restricted range of the total repertoire of styles known on the continent. The eighteenth- and nineteenth-century practice of removing soil from terpen has resulted in an appalling recovery rate of Migration period artefacts in Frisia, so we must allow for an underestimation of the importance of Frisian parallels.

Type B brooches

English type B forms are primarily those grouped within Reichstein's *Typen* Stoveland, Midlum, Achlum, Krefeld-Gellep and Stratford but with many additional examples, which Reichstein did not discuss or described as *Einzelformen.* There is a relatively high concentration of continental examples of these Reichstein types in Frisia, with other examples in Schleswig-Holstein and Denmark. Numerous further examples can now be added to those known to Reichstein, notably various fragments from the sites at Hjemsted, Gudme and Bejsebakken in Denmark, two from Schmalstede (cremations 148 and 155), another brooch from Bornwird in Frisia (Fig 2.65) and various fragments in private collections in Holland[11]. Allocation to Reichstein's types is rather difficult for many of these

[11] Stray finds from Fran, Wijnald and Dongjum, the collection of J. Zylstra of Leeuwarden. E Kramer, Fries Museum, Leeuwarden brought these items to my attention.

pieces, although fragments from Gudme could be assigned to his *Typ* Midlum (x337 and x387) and to *Typ* Krefeld-Gellep (x819). These allow the distribution of Reichstein's *Stufe* D3 brooch types to be more firmly extended over most of Denmark.

Most English brooches of Reichstein's *Stufe* D3 forms with close similarities with continental and Danish brooches have been dealt with under the heading of type A brooches, in view of their topknob style. If we turn the question on its head, it is possible to select the continental brooches which would look least obvious amongst a collection of English type B brooches; Reichstein's *Typ* Achlum examples (Reichstein 1975 *Taf.* 88, 2-6) and some of his *Typ* Krefeld-Gellep (*op cit Taf.* 89, 7 and 9). These still stand out as 'unEnglish', to the attuned eye. A brooch from cremation 148, Schmalstede comes nearest to an English form - type B2. Although the animal head decoration is now very abraded, this example could be compared to several English brooches, e.g. **Holywell Row G48(2).**

It is not easy to find any other very close English parallels for continental brooch forms, although the general similarity of developmental state and themes of decoration can be in no doubt. Hence import seems unlikely for most English type B brooches. Information from type B style brooches will be discussed further in the sections below, on individual brooches and individual brooch elements.

Kentish brooch types

In the section on typological definition, Kentish brooches were highlighted as being unusual examples of type A and B brooch styles. With new finds, the stylistic range of their continental cousins is now becoming more diverse but 'Jutland, adjacent parts of South Scandinavia, or Frisia' remain likely sources of inspiration for the Kentish brooches (Hawkes 1969, 190). In the angled bow edges of a brooch from Howletts (Reichstein 1975, *Taf.* 118,7) and the form of the pair from Grave 15, Bifrons (Fig 2.8) we see Scandinavian connections, to Jutland and further afield. In the brooches from Grave 2, Howletts and in **Faversham**, the connection to Frisia is clearly stated (illustrated by Reichstein's *Taf.* 117). 'Normal' English cruciform brooch styles are rarely found (the fragmentary **Stowting** is an exception). The Kentish brooches thus show some of the closest associations with continental forms, whilst being separated from development in the rest of Britain. These parallels will be noted as the discussion proceeds but, since the Kentish brooches are too individualistic to be clustered or assigned to the main English typology, the typological connections are not central to the central discussion of this project.

Continental links for individual brooches

Unusual occurrences must be described in order to investigate any substantial patterns, over and above the general themes

which link English type A and B brooches with continental and Scandinavian forms. A number of individual brooches have interesting typological parallels with brooch forms from the continent or Scandinavia. Some parallels were suggested in Reichstein's work and these discussions need to be reappraised.

1 Northern Germany and Frisia Although the flat sideknobs of the Lincolnshire brooch **Fonaby G28** (small type B1) are without an English parallel, they are somewhat similar to those of a rare north German brooch form with spatulate feet, three examples of which were known to Reichstein and given the *Typ* Perdöhl (Reichstein *Taf.* 83, 1-3) and *Stufe* D2. The Fonaby brooch also has a solid bow cross-section which may be suggestive of an early rather than late date of production and of continental links (see Chapter 3). The *Typ* Perdöhl brooches have not been examined and it is not known whether the bow sections on them were solid or not. However the topknob of **Fonaby G28** has the semi-circular cross-section normal within the English corpus and the animal head form was noted above to be very close to those on a pair of brooches from Mucking, Essex and a piece from Spong Hill. An idea with a continental source may be suggested, but not continental execution.

Two brooches from Sleaford, Lincolnshire were selected by Reichstein for association with his continental *Typ* Goutum (possibly belonging to his *Stufe* D3). These are **Sleaford G182 (1)** (associated with type B2) and **Sleaford G182 (2)** (small type B3), but they are considerably different in many essential ways

from the central members of his Typ. The Sleaford brooches have separate sideknobs, the eyes are much less round and prominent, the nostrils on **Sleaford G182 (2)** are long commas rather than small round ones (**Sleaford 182 (1)** has a rounded end to the foot, without decoration), the faceted area is rectangular rather than triangular and there are no ridges at the edges of the bow. Within the broad range of English brooches, the Sleaford brooches can be quite easily placed within the more normal range of English type B brooches and hence cannot be used for purposes of comparison with continental brooches.

From Kent, the large type B1 brooch **Howletts G2** was also assigned to Reichstein's *Typ* Goutum and the continental stylistic parallels here are obvious (see e.g. Reichstein 1975, *Taf* 117, 3 and 4). **Faversham** (type B1) has the same bulging eyes and diagonally faceted catchplate. A technological aspect, the possession of two pinlugs, can be shown to further link **Faversham** and **Howletts G2** (see Chapter 3). The same feature can be used to suggest a more general link between these brooches and the Anglian type B1 brooch **Bradwell 1**, also with **Barrington 4** (small type B2) and **Barrington A 11** (type A2) and with examples from Schmalstede, Schleswig-Holstein and three from Holland including one from the type site, Goutum. **Bifrons G23** (type A3) also has bulging eyes at the animal head, like *Typ* Goutum brooches. Although it has only a single pin loop, the headplate is small and square, with lines running down the sides of the headplate, recalling features seen on continental brooches.

2 Scandinavia Typological similarity was shown by Reichstein between a small number of brooches from Norway, Sweden, Germany and Kent in outlining the six examples of his *späte Typ* Stoveland. This has an individual animal head style with eyebrows or ears extending up the foot plate (see Reichstein 1975 *Taf.* 19,7 for the type brooch). **Milton-next-Sittingbourne 3** (associated with type B) should be considered in context with this type. Although the exact style of nostrils on the animal head of this brooch is not clear and appears to be rounded or heart-shaped, the rest of the form fits the *Typ* description very closely. A further example from this site, **Milton-next-Sitting-bourne 2**, has similar foot style but has a full-round topknob and is therefore associated with English type A brooches.

Although the foot form of the brooch from Veremoen, Lista pgd, Norway (Reichstein no 90, *Taf.* 19, 2) could be said to be inspired by the styles of the *Typ* Stoveland brooches, this brooch is much larger and has knob forms which are clearly in the tradition of other Norwegian styles such as Reichstein's *Typen* Røssøy, Lunde and Eine. Removing this brooch from consideration leaves one example of the *Typ* in Norway, Sweden and Germany, with a pair at Bifrons and the Milton-next-Sittingbourne examples in England.

The pair **Bifrons G15 (1)** and **(2)** are associated with type A, through their topknob cross-section, but the rest of their form is closer to type B brooches. These brooches also have unusual wing forms, with inwardly curving upper and lower edges. This

style of wing is seen in few English brooches, although there are a number with curves over a smaller proportion of the wing width (on some brooches these are merely notches, however). A Danish brooch of unknown provenance, Reichstein number 514 (Reichstein 1975, *Taf.* 84,2), also has these indents and is quite similar to some English type B brooch forms in other respects, e.g. that of **Baginton 1** and **2** (type B2), except the Danish brooch has the sideknobs cast with the headplate. Other features of English brooches with this type of headplate are not very similar to the Bifrons brooches however, and this feature may have arrived through other routes, e.g. from small-long brooches.

Reichstein's *Typ* Stoveland remains an interesting form, with its examples in Kent, Germany and Scandinavia, but close associations with other English examples are not easy to find. It is difficult to suggest on typological grounds which country was the origin for this brooch style.

Lyminge (type B3) has extensive ring and dot decoration, with no wings marked and rather straight bow and foot sides. It has very rounded eyes with small upright portions, seeming to form commas, The foot form has extremely close resemblance to that on a brooch from Mage, Norway, causing Reichstein to give a *späte Typ* to these two brooches alone. Schetelig noted that the Måge brooch may well be an import from England and this statement remains true as far as typological and technological evidence can prove.

Reichstein's Norwegian *Typ* Byrkje has associated examples in Kent and Holland, but these do not appear to be very closely associated, for reasons which are readily apparent when inspecting the figures (Reichstein *Taf.* 37, 2 and 6, *Taf.* 38, 4 and *Taf.* 72,4). Major differences can be observed in the headplate, knobs, catchplate and animal head styles. The Dutch and Kentish example do bear comparison with each other and with a brooch from Denmark (unknown provenance, Reichstein no 515, Copenhagen 7472). The Danish brooch has similar bow and animal head form to that seen on the brooches from Kent and Holland and a long catch as seen on the Dutch example (the Gilton brooch has not been inspected). However, the Danish brooch has a simple topknob form and diagonal faceting on the catchplate.

An interesting continental parallel can be suggested for a brooch with an unusual, small-long hybrid form, from Abingdon, Oxon (**Abingdon G122 (2)**). The topknob here is conical and the foot form curls upwards (with a long catch). The Abingdon form is much broader than the other brooches of Reichstein's continental type Ferwerd with which he associated this brooch (Reichstein 1975, 46). A recent find from Gudme, Fyn, Denmark (Gudme x77, Copenhagen) lacks a topknob and the foot ending and has ring and dot decoration throughout, rather than just at the headplate and foot. However, when complete, the rest of the form may well have been very similar to the Abingdon example.

The unusual brooches from Oxbøl, Vester-Horne h., Ribe Amt,

Denmark and Faversham, Kent which make up Reichstein's *Typ* Oxbøl are not true cruciform brooches nor are they particularly well associated with other bow brooch styles of this period. This is an intriguing example, since the typological similarity is so very strong. The style may be related to that seen on other Scandinavian bow brooches with rectangular headplates, e.g. one from Brunnhem, VG, Sweden (Reichstein *Taf.* 72,4).

Hence we have a small, diverse group of Kentish brooches, with strong links to the continent, with Holland, Schleswig-Holstein and Denmark. Other areas of England have less precise affinities.

Distribution of individual elements

Reichstein (1975) uses similarity between complete brooches but Shetelig (1906) and Åberg (1923) had provided evidence for a number of similarities between English brooches and those from areas of Scandinavia and the continent, using individual elements from brooches.

The discussion below centres on various aspects of type B brooches. Hines concluded that most individual elements were much more widely distributed than the early researchers realised. Nonetheless, 'specific forms of particular parts of cruciform brooches' were noted to 'define a consistent Anglo-Scandinavian area covering Jutland, South Sweden, Norway, Anglian England and to a certain extent Kent and Frisia' (Hines

1984, 247). These elements include sideknobs cast onto the headplate, lappets, scroll-shaped nostrils and trefoil-formed noses.

A few more examples can be added to those in Hines' survey, from recent finds and from Dutch collections. In the discussion below, these are shown to enlarge on his theme that there are very broad areas of parallel development.

The site at Schmalstede yielded urns with two examples of cruciform brooches with sideknobs cast onto the headplate (Urn nos 148 and 155). This is well south of the limit of distribution for this feature in Jutland, noted by Hines. A brooch from a site in the east of Denmark, at Neble, near Slagelse, Sjaeland, (Copenhagen Museum 4970/83) also has its sideknobs cast onto the headplate and a simple foot form.

A total of six brooches from Holland are also known to have sideknobs cast onto the headplate (from Ferwerd, Burmania, Gem. Ferwerderadeel, (FM 101bis-1776), Goutum, Teeghiem, Gem. Leeuwarden (FM 16c-6), Wirdum, Terp Tjaard, Gem. Leeuwarden (FM 17b-20), Hallum, Terp bei Tsigera Zather, Gem. Ferwerderadeel (FM 26d-2), Hoogebeintum, Kerkterp, Gem. Ferwerderadeel (FM 28-699) and Midlum, Terp Middlestein, Gem. Franekeradeel (FM 126-34)), further extending the area in which this 'late' feature is seen. Further discussion of this technical attribute will be reserved for Chapter 3 where an understanding of the factors behind the use of the attribute will be attempted.

Schmalstede also provided an example of an animal-head foot with comma-like nostrils (Urn 272), on a brooch of Reichstein's Groß Siemß style. This is a feature that Shetelig thought Anglo-Danish and Hines showed to have Norwegian parallels as well (Hines 1984, 248). Three more examples can be seen on brooches from Holland (from Ferwerd, Goutum and Wirdum, as noted in the paragraph above).

These Dutch brooches are also some of the 13 examples known in Holland where the wings of the headplate slope back at an angle from the rest of the headplate. Hines mentions that this characteristic occurs at Borgstedt, Kr. Eckernforde, Schleswig-Holstein. These further examples show that Shetelig's theory that this is an exclusively Anglo-Danish feature is thoroughly disproved (see Chapter 3 for distribution of this feature).

Another feature Schetelig thought was Anglo-Danish is the heart-shaped nose, but Hines showed it was known in Schleswig-Holstein and Norway. A further eight Dutch brooches are known with nostrils of this shape or shapes closely approaching it.

A broad plate below the bow is thought to have been ancestral to proper lappets. Brooches from the Lindholm Høje and Sejlflod excavations and from Ørnefenner, Thise, Børglum, Hj show that there is probably little significant difference in the dating of the first Norwegian, Danish and English examples with true lappets (Hines 1984, 246-8). Another Danish example was found at

Bejsebakken, Hasseris s., Hornum h., Ålborg in 1982 (Copenhagen no C30731). This is perhaps even earlier than the brooch from Ørnefenner since it has a topknob with circular cross-section as well as a simple form like Reichstein's *Typ* Groß Siemß (i.e. in line with the state of development seen in English type A2 brooches).

The Bejsebakken site has produced at least five other cruciform brooches with lappets. One poorly preserved example (amongst several labelled no. 4685/82) may represent a slightly later state of development than the one cited above. All the knobs on this brooch are cast onto the headplate and have semi-circular cross-sections. Other brooches with lappets from this site are probably rather later, with feet with rather more complicated animal-head terminals (e.g. C30766, C30772, C30978 and another brooch under the general list no 4685/82). On these brooches, the division between eyes and eyebrows give an exaggerated profile, although the design appears to be a number of steps away from brooches of Reichstein's *Typ* Krefeld-Gellep or from English type B brooches.

Further evidence of the distribution of the 'ancestral' version of lappets should be noted on two rather similar brooches from Borgstedt, Kr Eckernforde, Schleswig-Holstein (KS4024 p A) and Midlum, Hooge Terp, Gem. Franekaredeel, Holland (FM 69a-45), whose rounded projecting plates could easily have served as forerunners of the simplest English forms, as seen on type D2 brooches. Further examples of such lappets are also to be found

on other Dutch brooches (e.g. from Dorkwerd (Reichstein 1975 no. 738) and Hallum (Reichstein 1975 no. 741)).

Typ Trumpington is one of Reichstein's brooch forms with which he links England with Norway and Holland. This form does not have any examples with grave-good associations to give it a chronological position and the Dutch example was shown to belong to another grouping. The similarity between the English and Norwegian examples lies chiefly in two features, the channel running down the bow and the incised lines crossing over the nose. These attributes do not seem to be adequate reason for forming a separate Typ, since neither are unique occurrences in their respective countries. The English example fits fairly easily into English type C brooch typology and its relationships with other brooches will be discussed further by including features with a technological basis in Chapter 3.

The links between Kent and Denmark can be further enlarged by a fragment of another brooch with ring and dot stamp marks from Gudme, Fyn (Copenhagen x146) which may originally have been similar to the Lyminge, Nebstrup and N Møllegard examples (Hines 1984, 6). Ring and dot stamp marks are quite common amongst Danish, Norwegian and Swedish brooches, however (see chapter 3), and the site at Gudme has produced a number of other examples with this decoration (e.g. x77, with ring and dot decoration throughout).

The brooch from Sejlflod, Fleskum, Alborg, Denmark which Hines

illustrates (*op cit*, fig 1.2) as a parallel for Milton-next-Sittingbourne 1, may have as sequels brooches from Gunderup, Borglum and Store Stensingmark, Dronninglund in Hjorring Amt, Denmark. These also have decorated flat areas at the rise of the bow (see Chapter 3, section 9).

The tendency emerging from the study of individual features on recently-discovered brooches is to broaden even further the areas in which they are found. Patterns originating from evidence from individual elements is in line with those indicated by complete brooch forms.

Conclusions

Typological similarity and/or disparity cannot be used simplistically, merely to support theories of population movement or similarity in racial or cultural background. We must note that we cannot determine whether the degrees of similarity or disparity between datasets we observe today were perceived or considered important by the people of the time - but the fact that they are observable today remains valid and important. We may make a judgement as to when we see the material buried in England as being no longer strongly related to the German material in a general way and started being distinctively English.

There can be no doubt of the continental flavour of the English

type A brooches. Indeed, it should be noted that many type A brooches are not just typologically similar to continental examples, but they are identical and most likely are imports. Hence we can align the beginning of our relative English chronology with other production areas, using the date from the Dorchester brooch as an absolute chronological dating 'peg'. Phasing of brooch types within this early phase appear comparable on both sides of the channel.

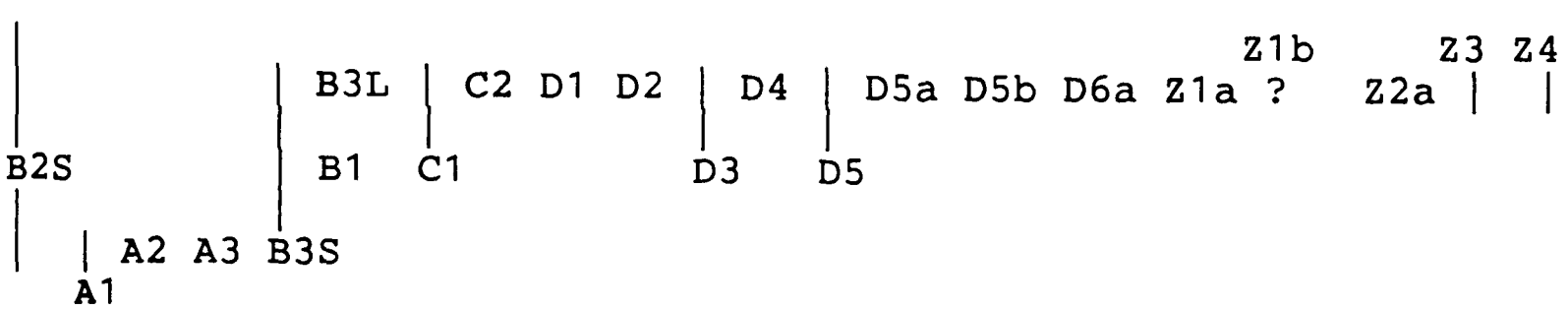
It is significant that a large proportion of the English brooches which were drawn into the discussion of continental parallels are amongst the few which have topknobs with circular cross-sections, when the rest of the form would lead us to expect semi-circular cross-sections. This feature was noted to be a continental trait. Other technical aspects will be discussed in Chapter 3.

The geographic distribution of cruciform brooch forms will be shown to be significant (below). English type A brooches have an unusual distribution and the Kentish brooches are especially notable for the strength of their typological similarity with the continent. A small number of brooches from more 'Anglian' regions were also brought into consideration. The evidence from Spong Hill emphasises the strength of the links between Norfolk and Frisia.

After the earliest period of cruciform brooch production, it is always a simple matter to distinguish English brooches from

continental ones. From this time, English cruciform brooches are highly important in defining the 'Anglian province of culture' (Vierck 1966) as distinct from the Saxon areas of the Thames Valley and the Jutish areas such as Kent. Reasonably good, general typological parallels for Anglian brooches are to be found in Frisia, northern Germany and Denmark.

The final version of the English chronology reads thus:



with the lowest line dating to the early fifth century, the penultimate to the late fifth century and first half of the sixth century and the last to around the middle of the sixth century. Some brooch forms were probably produced over a longer period than we can prove as yet - notably type B1.

Another source of cultural influence for Anglian England has been proposed at various times - the areas to the north of the Anglian homeland (i.e. most of Denmark, Norway and Sweden (Shetelig 1906; Åberg 1953; Leeds 1949; Hines 1984)). Few of the English cruciform brooches bear any strong relationship to material from these areas (Reichstein's *Typ* Stoveland brooches may be an exception) but other artefacts have

more forceful implications (i.e. wrist clasps, square-headed brooches, bracteates, Hines 1984). Hines found sufficient evidence, on the basis of the adoption of wrist clasps, to support a migration from western Norway to Norfolk and/or Humberside dating to the last quarter of the fifth century (*op cit*, 272). It remains difficult to identify other credible examples of Norwegian character for artefacts belonging to these English areas, but amongst the square-headed brooches, scutiform pendants and bracteates of the sixth century Hines believes further influence can be seen, this time between southern Scandinavia and Anglian England (*op cit*, 277).

The ability to distinguish significant, **singular** links has been considerably decreased by our increasing knowledge base. The history of this aspect of Anglo-Saxon artefact study, over the last few decades, is an object lesson on the problems attendant on simple models of cultural-historical links. It is hoped that research into technical aspects will provide some additional sources of information, either to confirm the picture of overall 'commonality', to emphasise particular links or to provide a little local variation[12].

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[12] The current study has been restricted to those examples relevant to the English brooches. The recent finds from the sites at Schmalstede, Gudme and Bejsebakken would repay much more extensive surveys, as they illustrate many more contacts, including some to Sweden - e.g. from Gudme, a piece which must clearly be associated with Reichstein's Swedish *Typ* Götene (x1477).

E. Distribution of English brooch types

(Maps 2.1-2.12)

Distribution patterns have always formed a central part of archaeological analysis. Localisation of artefact styles may be sought to show shifting emphasis in use/production areas. The distribution maps for types of English cruciform brooches should be considered in the light of the number of relevant sites (Map 1.1) and the number of brooches found at each site (Map 1.2). The non-uniform distribution of cruciform brooch find spots over the landscape should be emphasised. Small symbols on Maps 2.1-2.10 represent the finding of one or two brooches of the type in question at a site, a larger symbol being used for sites where three or more separate designs of a type were found (i.e. pairs count as one).

Although it is possible to subdivide the area in which brooches were found at several levels, for the present purpose, a simple grouping is as follows; three major groupings 1) the large Cambridgeshire/north Suffolk/south Norfolk/north-west Essex group (including Morning Thorpe and sites in the vicinity), referred to below by the initials CSNE; 2) a western/Midlands group, extending from Stratford to Peterborough; 3) a south Lincolnshire grouping around Sleaford; and 6 smaller groups of sites with slighter concentrations of brooches 4) Kent; 5) Berkshire and Oxfordshire; 6) eastern and southern coasts of Essex; 7) southern Humberside; 8) northern Humberside; 9) Cleveland and County

Durham. Few sites lie outside these groupings.

Summary of distribution of English types

Map 2.1 Findspots for type A brooches are widespread, including areas well removed from the main concentrations e.g. in Berkshire, Oxfordshire, Kent, north Humberside and northern France. Many examples have also been found within the main areas of site concentration; the notable exception is Lincolnshire, with only a single find from Glentham.

Maps 2.2 and 2.3 The common type B brooches are better represented in Lincolnshire and the western/Midlands areas. There is a heavy concentration in the CSNE area and a scattering of brooches across the western/Midland group of sites (but only one small type B3 brooch). Larger type B1 and B2 brooches seem to be slightly more restricted to the CSNE area than small examples, but this reflects the overall scarcity of large type B brooches. Type B brooches are represented in Kent by small examples of each form, including the relatively rare type B3 style. A single type B3 brooch was found at East Shefford, Berks, two in Kent and a further five examples from Lincolnshire and south Humberside. Hence this form may have an unusually high density of distribution in the periphery of the normal distribution area. This observation will be affected by the small database size.

Map 2.4 Type C1 and C2 brooches and those associated with the

forms are mainly found in the CSNE group of sites and in Lincolnshire. A brooch associated with type C was found in southern France. A tendency for sites in the west of the CSNE group of sites to have type C2 brooches (large and small) rather than type C1, and vice versa in the east of the group of sites may be discerned.

Maps 2.5-2.8 There are many type D brooches within the cruciform brooch dataset and their overall distribution not surprisingly echoes the main areas of concentration of sites shown on Maps 1.1 and 1.2. There are some more detailed facts to be mentioned. With the exception of type D1 brooches, type D brooch styles are uncommon in the western/Midlands area. Type D1 brooches with their square lappets are a distinctive style and have a well-defined distribution in CSNE and the western/Midland group of sites. Type D2 brooches, those with lappets of the simplest designs (P- or D-shaped in profile), have a larger northern distribution, with only two examples in the western/Midlands area. Neither of these forms are common north of the Humber, where types D3, D4 and D5 brooch styles may have been preferred. Type D3 and D4 brooches, which continue and elaborate on the type D2 lappet theme, again are concentrated in the CSNE area and are significantly absent from the western/Midland group of sites.

Types D5a and D5b are also distinctive brooch styles but examples have roughly the same rather broad distribution as type D5 brooches generally. The lack of type D5 finds amongst

assemblages from the north and east of the CSNE group of sites may be significant. Type D6 brooches (with zoomorphic decoration on the lappets and at the foot) are restricted to CSNE and Lincolnshire, with one example at Sewerby.

Maps 2.9-2.10 Type Z brooches forms are distributed in areas which are essentially exclusive and complementary. Types Z1a, Z1b and Z2a are found in the CSNE area and occasionally in Lincolnshire. Type Z3 brooches are found in the western half of the western/Midlands area, although there are two examples in the eastern side of the CSNE area. Type Z4 brooches are found in the north of the distribution, in Humberside, Cleveland and County Durham.

Comments

When using distributions of artefact types to establish centres of production, one would like ideally to see clear-cut patterns, with individual types being found in restricted areas with few outliers. The information summarised above is not so readily intelligible, since most of the typological groupings were used over wide areas.

The relative homogeneity of typological forms should be considered. Several types within the new typology were created out of necessity, without a feeling that the brooches could have come from the same worker or workshop, although they were clearly inspired by the same ideas. This applies in particular

to type B brooches where considerable variation in size and proportion is acceptable within the general formula, and also to some type D brooch styles.

Degree of homogeneity of form is sometimes echoed in the degree of scatter in distribution. Homogeneous types such as C1, C2, D1 and some of the sub-types within type Z (e.g. types Z1a, Z3 and Z4a) have rather more closely restricted areas of distribution compared with those of heterogeneous forms e.g. types D3, D4 and D5. However, the typologically well-defined types D5a and D5b do not appear to be geographically restricted. So we can see that both general themes and specific styles were widespread and that some specific styles can be shown to have particular areas of concentration. This data will be considered in more depth in Chapter 5, with the additional benefits of insights gained from the technological data.

Regional frequency of cruciform brooch usage

It can be seen that the burial of cruciform brooches is not a common occurrence in Kent, Oxfordshire and Berkshire. The exceptions are brooches of types A and B. Several authors have assigned the occurrences of early cruciform brooches in these areas, to the existence of Germanic mercenary units in the early fifth century (Hawkes 1986, Böhme 1986). The disappearance of the cruciform brooch type from these areas relates to the 'Saxon' rather than 'Anglian' nature of the

subsequent occupation. Artefact forms such as saucer brooches become common. The recent discoveries at Goldbury Hill, Oxon may lead to some moderation of this view, since these large type B1 brooch forms probably date to late in the fifth century, and could be as late as sixth century[13].

A broad range of types are found in the western/Midlands area, but at a lesser density overall than in the central areas of distribution. Types D3, D4, D5 and D6 are virtually absent in this area. Type D1 and Z3 brooch styles (and type Z brooches generally) are unusual for having patterns of distribution which differ significantly from the norm. Some of the impetus for developing these particular brooch styles could have come from the western/Midlands area. The fact that none of the cruciform brooch styles have particularly strong associations with Essex suggests that this area was peripheral to the development of the brooch type.

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[13] See note 5, above

F. Cultural evidence from burial ritual

The use of artefacts in burial rituals gives us cultural information but there are many problems in interpretation of the data. This is primarily because of a lack of an overall survey of Anglo-Saxon burial rites, in which to place observations based on sub-sets of the data. There is also a wide range of attitudes as to the type of information which may be extracted from the data.

In previous studies, regional and chronological variation in costume has been studied for various purposes, mostly for cultural or historical reasons of identifying hierarchy (e.g. wealth scores), ethnic groupings (e.g. Angles or Saxons) and social changes (e.g. those brought about by Christianisation). Each of these uses has problematic aspects. The stresses of these socially-based interpretations to a large extent run counter to technically-based directions of interest stimulated by an examination of the evidence for workshops and modes of production, which will be explored later (Chapters 3 and 5).

The most intractable (probably insoluble) aspect is the nature of the correlation between daily costume and costume in burial. This matter has been much agonised over, with respect to datasets from all archaeological periods. The discussion below will order data relevent to the cruciform brooch as used in burial and detailed theoretical speculation will not be entered into here. The limited dataset studied here will restrict the

number of approaches applicable.

It seems likely that data extracted from information relating to one sub-division of one artefact type (i.e. the cruciform-style bow brooch) will be prone to bias. We do not know how the items found associated with cruciform brooches fit into general patterns, i.e. compared with other brooch forms, or with other artefact forms. The function, i.e. the fact that an object was seen primarily as a brooch or as a peplos-fixing item, rather than as a cruciform brooch specifically, may be relevant.

Cruciform brooches, along with other bow-brooch types at this time, are dress fastenings associated with females. Within the early Anglo-Saxon record, female costume has greater scope for expression of social information, since there are normally more artefacts and more types of artefact found associated with women than with men.

From well-recorded graves, we can see that English cruciform brooches were used in several different assemblages. Several publications differentiate between brooches at the shoulder and at the breast (e.g. Hirst 1985) i.e. in terms of the brooches function, rather than their appearance. Matching pairs of brooches are common, thought to have been positioned at either shoulder, on a 'peplos'-style gown (Owen-Crocker 1986, 28ff). This type of arrangement was very common in northern Europe at this time and during subsequent centuries, including the Viking Period. Pairs of brooches at the shoulders were also found

together with a third, non-matching, often larger brooch at the neck. The third brooch may have been placed in a non-functional central position (*ibid*, fig 30) or on a further cloak-like over garment (*ibid*, 49). Very rarely three brooches were used none of which were paired. The use of more than three brooches by a single woman is unusual but five have been found used together at Cleatham, South Humberside[14]. Cruciform brooches are also found used singly, centrally at the neck (in these cases, other brooch types are frequently present at the shoulders) or on a shoulder (where another brooch may be used at the other shoulder).

Vierck notes the prevalence of the one-large-and-two-small-brooches combination in female burials in several areas around the North Sea, with examples including cruciform brooches (Vierck 1978, 245). This tradition may represent a broadly-based ethnic dimension within the dataset. It may be contrasted with areas of mainland Europe where women normally used a single brooch, placed at the neck and where imported brooch pairs are used singly (*ibid*, 289). Interpretations of correlations observed between general burial practises in this country and abroad are difficult. There are many instances of grave goods and burial rituals having clear regional characteristics, not least those defined by cruciform brooch (*ibid*, 290).

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[14] There are no details of the remainder of the burial circumstances, as yet.

Grave good associations and wealth scores

Within this general picture, further information may be gained by testing hypotheses linked to social status. The manner of an individual's burial has a relationship with the position accorded to her, both as an individual and as a member of the society. This 'social identity' may have been gained as a result of age, wealth, occupation, social grouping (family ties etc) or a mixture of several factors. Modern researchers have sought to identify social identities from within the dataset set, without necessarily assigning causes behind these identities (Pader 1982, Richards 1987).

The expenditure at the time of burial may be broken down into separate units (including those which are invisible in the archaeological record, e.g. extensive mourning, gift-making) or considered as a whole. For example, the size of a cruciform brooch may be taken as a single, simple indicator of material wealth. A large and gilded type Z brooch must have required more metal and greater technical skills than a simple type B form, so one may assume that richer or more important individuals would merit these brooches. Such simple correlations may be supported by evidence from various burials. In Grave 49, Sewerby, a young woman wearing a type Z4 cruciform brooch was accompanied by a wide range of artefacts, including an imported copper-alloy cauldron, a wooden box and possibly food offerings (Hirst 1985). Furthermore, the

sprawled body of an older woman, was found over the first burial. The attitude of the body in this second burial (Grave 41) has been considered to be evidence of murder or sacrifice. The artefactual material associated with Grave 41 is poor (buckle, knife, beads, annular brooches) and does not include any items that she might not have been wearing in everyday life. Possible implications are that the rank of the first woman was sufficient to merit the inclusion of human sacrifice in her burial rite (Vierck 1978, 274) or that the death of the older woman was punishment for being involved in the death of the young woman (through witchcraft etc (Hirst 1985, 43)).

Whatever interpretation is preferred we can see that, in Grave 49, Sewerby, a woman with an ornate 'expensive' style of type Z brooch was indeed buried in an highly distinctive manner. Other type Z brooches were also used as part of numerically- and materially-rich grave good sets (e.g. **Morning Thorpe G353 (1)**) or with unusual artefact types (**Longbridge** with a gold bracteate). However the relationship between type Z brooches and other indicators of material wealth is not an exclusive relationship. Other grave assemblages provide evidence that type Z brooches were not always associated with large numbers of other artefacts. For example, **Fonaby G38** (type Z4) had a very poor gravegood assembly. Furthermore, type D brooch forms are also often discovered in relatively rich grave-good assemblies (e.g. **Little Wilbraham G40, Londesborough G9**). Similarly, the logical corollary is not always true; simple forms are not necessarily found in impoverished circumstances.

Pairs of type B brooches are often found as part of larger assemblies and **Glen Parva** (associated with type A) had a rich and varied assembly.

It remains probable that rare and expensive brooches were used by members of wealthier social groupings but that several other factors must be taken into account as well. Any social identities hidden within the burial rites which include cruciform brooches must be discovered using many variables.

Following Richards' theory that social identity may be discovered by tabulating grave good associations and thus identifying the artefacts consistently found together, one might hope to characterise a 'message' associated with the cruciform brooch or particular cruciform brooch types, even if the meaning of the message is obscured.

At the simplest level, this may be done with comparative ease and conviction. A tabulation can be made for cruciform brooch types found buried with 12 other grave good types (Table 2.1):

Type	n+	Av. no. /grave*	Artefact type											
			1	2	3	4	5	6	7	8	9	10	11	12
A1	2	3	1					1			1			
A2	3	3.3				1	1		2			2		1
A3	4	4	2	1		2		2	2	1	1			
B1S	3	4.3	2		1	1	1	2		1				
B1L	5	3	3	1	1	1	2	3	2			1		1
B2S	14	4.6	7	8	4	7	6	3	7	4	5	3	2	3
B2L	6	4.2	4	5	1	2	2	2	4	1		2		1
B3S	4	3	2		1	1		2	2			1		
B3L	2	4.5		1			1	1	2			1	1	
C1	3	4.7	2	1	3	1	2		1	1	1			1
C2	8	4.2	5	6	2	4	2	1	3	1	2	1	2	
D1	6	4	5	4	6	2	3		1	2				
D2	18	4.5	15	9	11	7	7	6	6	4	3	4	2	
D3	7	5.6	4	7	3	3	3	3	2	2		2	2	1
D4	8	3.9	8	3	4	3	1	2	1		1		1	1
D5	10	3.4	7	5	7	2	2	2		1	2	1	2	1
D5a	4	4.5	3	3	2	1	1	1			2		4	
D5b	5	4.6	3	2	2	2	1	3	1		2	1	1	
D6a	5	5.4	5	3	3	4	3	1	1	1	3			
Z1a	2	4	1				1	2			1			1
Z1b	7	6	3	6	4	6	3	3	1	2	3	2	3	3
Z2a	1	4	1	1				1						
Z3	3	1.3			1		1			1				1
Z4	2	5	1	2		2	1	1		1			1	
			84	68	57	52	44	42	38	23	27	21	21	15

Total number of graves 132

Artefact coding:

1 Beads
2 Wrist clasp
3 Annular brooch
4 Iron knife
5 CA pieces
6 Small-long
7 Cruciform brooch
8 Iron pieces
9 Buckle or belt set
10 Ceramic
11 Girdle hanger
12 More than 50 beads

Table 2.1

More than 25 other classes of grave goods were found at lower frequencies (I have selected only the most common). More than one instance of a brooch type (e.g. brooch pairs, pairs of girdle hangers) are recorded only once for each grave.

This database is clearly incomplete. We have relatively few pieces of information concerning the structure of graves (coffins, stone linings etc), the positioning of the body, the

*Average number of artefact types per grave

+ n = number of graves with grave-good associations recorded

positioning of the limbs, the positioning of the grave goods within the grave and the direction of grave cut. Only a small number of sites have good-quality examinations of the skeletal evidence, and these include sites such as Morningthorpe, where the soil conditions conspired to remove all bones from the record, in many cases. These factors were therefore not included in the table. Furthermore, there are a number of factors which make this data unsuitable for statistical testing of hypotheses on social identity. These are:

a) Database size, there are only 132 graves for which 566 associations are known. Only three sub-types have 10 or more examples recorded, therefore the data will be statistically unreliable. It also seems unwise to sub-divide further (e.g. by region or by age of buried individual)

b) Uncertainty in recording - in some early excavations, it is difficult to tell how complete the details are.

c) Cremations - few cremations with cruciform brooches have their grave-good associations well recorded and those which do demonstrate how difficult it is to interpret the evidence. So cremations are not included in the dataset, hence causing some bias.

d) Range in date - type Z brooches are late forms, so their correlations with particular styles of burials may merely reflect a chronological change in ritual

e) Range in location of burial - Pader (1982, 181-183) shows there is a large degree of variability between sites, even those which are close geographically.

For the moment, it is still a useful exercise to characterise the types of artefact which are most likely to be associated with cruciform brooches. It may be possible to suggest particular unusual correlations of grave-good types with cruciform brooch sub-types.

It can be seen that beads are the most commonly found artefacts buried with cruciform brooches. More than half the sample had beads and 15 burials had more than 50 beads recorded. Wrist clasps, annular brooches and iron knives were also very popular. This sort of association pattern is familiar from other studies (Pader 1982, Fig 8.3; Hirst 1985, fig XIV).

There may be some indication that the association of grave-good types is not uniform amongst the typological sub-divisions of cruciform brooches. Table 2.1 illustrates the archaeologically-observed fact that small type B2 brooches were often used to accompany other types of cruciform brooches and are not often found with annular brooches.

The small database size is problematic and information from the overall groupings may be prepared (table 2.2):

Type	Artefact type											
	1	2	3	4	5	6	7	8	9	10	11	12
A	3	1		3	1	3	4	2	1	2		1
B	18	15	8	12	12	13	17	5	6	8	3	5
C	7	7	5	5	4	1	4	3	2	1	2	1
D	50	36	38	24	21	18	12	13	10	8	12	3
Z	6	9	5	8	6	7	1	4	4	2	4	5
Total	84	68	56	52	44	42	38	27	23	21	21	15

Artefact coding as above.

Table 2.2

Hence it becomes evident that the small type B2 brooch data conforms to a general pattern - i.e. most type B brooch styles are well correlated with other cruciform or small-long brooches and rather poorly correlated with annular brooches. This simply indicates that small type B brooches are often found in pairs, for example, in place of annular brooches.

Similarly, although type D3 brooches are normally found in graves with examples of more than 5 other grave good types, they are not the grave-good types which might have been expected, from the overall counts (as tabulated in Table 2.1, above). The number of associations with beads especially, is lower than might be expected (although type D brooches are normally strongly associated with beads, overall (Table 2.2)). Hence there may be some differential patterning of grave good associations with particular type D sub-types.

Relatively few type Z brooches have come from well-recorded excavations. Amongst these, type Z1b brooches are frequently found with wrist clasps and iron knives and infrequently with

other cruciform brooches. It is also interesting that three out of 7 type Z1b brooch burials included more than 50 beads. Similarly the correlation between type Z1b (and type D5a) and girdle hangers may be significant.

In all these cases, the number of samples is too small to be certain. By further combining data from type B, C, D and Z brooches and 5 artefact types (table 2.3), one can achieve a contingency table in which the contents of each cell is five or more (the minimum for statistical testing).

Cb type	Artefact type					
	Beads	Wrist C	An br	Knife	Bow br	Total
B	23	15	8	12	30	88
C	8	7	5	5	5	30
D	53	36	38	24	30	181
Z	11	9	5	8	8	41
	95	67	56	49	73	340

Table 2.3

A Chi-squared test shows that there is a significant difference between the associations of grave-good types, but only at a very low (80%) level. This difference may be attributable to unusual frequencies of annular brooches and bow brooches found in association with cruciform brooches of types B and D, which was discerned empirically above.

Conclusions

We have outlined the normal range of grave goods found with cruciform brooches and shown that there is some differentiation

in the associations between cruciform brooch types and grave-good types. For the various reasons outlined above, it is not sensible to attempt to further refine regional identities or to deduce 'social identities' on the basis of these figures.

In the future, we must continue to use personal judgement combined with rigorous recording and display in a comprehensible form. This will be based on datasets from individual sites until such time as several more fully-recorded cemeteries are available. Such discussions have been shown to have great interpretative value (Pader 1982, Hirst 1985), although they may be prone to error. Specifically, if it can be shown that sites were supplied by individual metalworkers, the particular styles of these artists may be mis-interpreted as having social or cultural connotations rather than mechanical sources.

Chapter conclusions

In essence, the research directions followed above are no different to traditional treatments, although the application may have been a little more rigorous. This type of research could have been carried out 10, 20 or 100 years ago. We have at least laid the foundations for more radical departures from the methodological norms.

Members of the English cruciform brooch corpus have been placed in a typology which is robust and easy to apply. The stylistic connections between Anglian England and the continent have been

summarised. These confirm strong links for a small number of brooches during the early part of the fifth century and emphasise the ever-widening parallels which are the result of increasing database size. Localised typological characteristics emerge in the latter part of the fifth century, but there are still some general parallels with continental forms. Some small forms (type B), developed during this time, continue in use at least until the mid-sixth century. Much greater variety of forms is found in the later phases and these are uniquely English. Some depth of chronology can be seen, but the majority of late cruciform brooch forms can only be dated to a general date range 500-550. Some brooches from the later forms exhibit features which suggest they may have been produced by workshops.

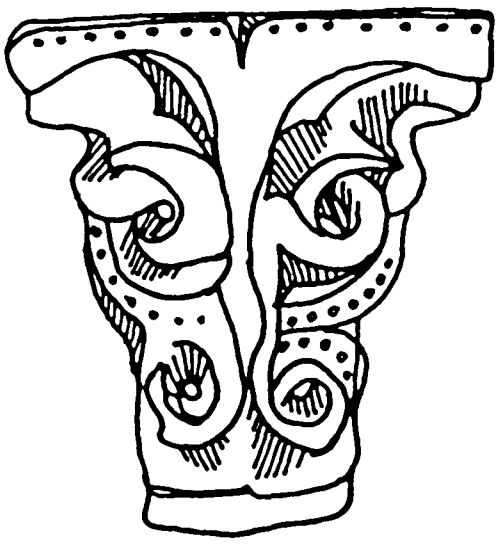
The cruciform brooch typology shows Kentish developments to be foreign to those in Anglian England and closer to those abroad. Early cruciform brooches from both Anglian and Kentish sites are linked with brooch styles in Frisia and northern Germany, however. Any sixth-century cultural connection between Norway and England is not illustrated in the cruciform brooch data.

Cruciform brooches are part of a larger dataset, consisting of many other types of personal ornaments which, together or separately, may have had cultural dimensions. The status of cruciform brooches is shown to be variable, with smaller brooches sometimes taking on a different role.

Chapter 3

Technology

A. Introduction



There have been, essentially, two different attitudes to the lack of evidence for early Anglo-Saxon non-ferrous metal industries. In the past, most researchers examined only evidence from artefacts (i.e. 'metalwork' rather than 'metal-working' Brown 1986,1). Although Avent (1975) noted sources of constructional information for Kentish disc brooches, he did not use them as a primary consideration for discussion or classification. Technological aspects have taken a greater role in other studies. For example, Dickinson (1976, 1982) and Leigh (1980) investigated the manner in which the method of production might have affected the observed decorational variation. Arrhenius outlined technical properties which might act as discriminants amongst traditions of jewellery making (Arrhenius 1982).

The alternative approach is to use data from continental and Scandinavian metalworking sites, and from British sites dating to the centuries before or after the period in question (collated in Brown 1986, discussed in Lundström (ed) 1981 and 1988). Within Britain, contemporary Celtic production methods are an area of great potential for research, since industrial evidence is relatively abundant (Craddock 1989). However, this

potential is so far untapped; for example, Kilbride-Jones (1980) thought that the methods of production for penannular brooches were simple and therefore uninformative.

In this project, the information used is that which may be gained from the artefacts themselves.

The most difficult requirement of this type of research is to balance the archaeological and technical information. An artist will put much care and consideration into those aspects of an artefact which others will notice first, i.e. its outward form or style. Technical aspects, such as the method of production, the type of alloy and its properties, are often secondary attributes to the purchaser, although not necessarily to the originator. The owner may be unaware of technical aspects at the time of acquisition or perceive them only sub-consciously as elements of the artefact's appeal, e.g. its weight or lightness, its delicacy or strength.

Our examination of technical factors will follow a number of themes:

1) One must establish where variation is detectable. Technical attributes and variable states must be precisely defined and capable of being observed objectively. Avent (1975), Dickinson (1976) and Leigh (1980) provide some pointers for sources of technical information from Dark Age brooches. However, their data came from material from different cultural groupings and

regions. A number of methods of understanding the technical variation have been proposed in these works and others will be brought forward below.

2) Is there evidence of technical innovation or conservatism? What forces lay behind any changes?

Changes in manufacturing variables could be caused by practical factors, such as the availability of raw materials or by other factors, such as changes in typological demands. New skills or fresh supplies of resources may have enabled the production of new artefact styles. Alternatively, the requirements of new designs or new functions may have induced an expansion in the range of skills available. A change from the use of single brooches to paired saucer brooches at the shoulder occurred at the same time as the change from cast applique to fully cast techniques (Dickinson 1988). Is the evidence of distinctive sixth-century typological ingenuity parallelled by dramatic changes in technical attributes? The availability of chemical data (see Chapter 4) may allow the additional factor of alloy supply to be added to the equation and the economics of production may then be more fully discussed.

There are many possible forces behind technical continuity. To develop new production traditions, the investment required may be considerable and yet may be unrewarded. Hence production methods may not have changed with the decorative style if it

was possible to continue manufacture in an established manner. Similarly, alloy compositions need not have changed if the technical demands of artefact fashions were no more severe than previously. In our synthesis we must discuss the evidence for continuity, for example, determining whether the number of methods of production in use at any one time is minimised and whether manufacture is homogeneous and unadventurous. Regional aspects are also significant; use of particular production techniques may cut across typological and geographical boundaries, with some styles continuing throughout and others having short-lived or localised applications.

3) Levels of technological homogeneity must be established as well as a direction of development. Without direct metal-working evidence (excavated furnaces, smithing hearths, etc.) the data must be at one remove, coming from the artefacts themselves. The range of attribute states must be determined and factors which might have caused variation (for this particular artefact type) can be suggested.

The technology of the cruciform brooch dataset is homogeneous at one level as the brooches are all cast, nearly all made from copper alloys and fitted with a separate pin. At other levels, more variety may be seen. It is important to establish the normal pattern of production within a particular area or type, as well as to note unusual practices. Research into diversity in production may give a lead into understanding the modes of production, i.e. large or small scale,

workshops or individuals, itinerant or permanent, part-time or full-time?

4) The typological evidence presented in Chapter 2 suggested that English cruciform brooch styles became largely independent from continental influence by the late fifth century. After the earliest phases of use, very few distinctive brooch forms or individual typological features were noted to have distributions in more than one region. The broadening distribution of these typological occurrences (through increasing database size) suggests that any such connections were at a general level. Technical data from English and continental material can be used to confirm or enlarge on this and may help to establish more exactly when the stylistic divergence became apparent. Especial interest may be paid to the similarity between English type A and B brooches and continental forms.

Very few strong typological parallels were seen between England and Scandinavia. By establishing regional characteristics for each area of production, one can comment on Hines' Scandinavian migration hypothesis (Hines 1984, Chapter 2). Do cruciform brooches dated to the late fifth-/ early sixth-century have any similar manufacturing attributes, in England and Norway, in terms of methods and variability?

Before assessing variation in cruciform brooch technology and comparing technical practices in England and other cruciform

brooch producing areas, an outline of our state of knowledge on the relevant English copper alloy technology should be attempted. This chapter is concerned with the physical actions after the manufacture or selection of the casting metal. The chemical considerations of metal resources and their production are discussed in Chapter 4. Brown's recent thesis (Brown 1986) is a useful reference work for data relating to these two chapters as little of any substance has come to light since the time of his research.

It should be noted initially that the processes relevant to the manufacture of a cruciform brooch only involve a small proportion of all the techniques known to metalworkers of the Anglo-Saxon period (for a full list, see Brown 1986, 152-187). The Anglo-Saxon metalworking repertoire in turn will represent only a proportion of the craft practices known amongst Germanic people in north-west Europe. These are thought to demonstrate a restricted range when compared with Roman skills (Arrhenius 1982,1). The methods demonstrated on cruciform brooches seem very simple compared to those used on composite brooches (Avent 1975).

The skills relevant to cruciform brooches are mould-making, casting, cleaning and assembling, marking with a punch, turning small circular designs and applying surface decoration. The majority of the decorative elements on cruciform brooches were cast, not added subsequently, hence a discussion of this process is a necessity.

B. Mould and casting technology

Some important technical variation comes from moulding and casting processes. The question whether two-piece moulds or lost-wax methods were used is central to understanding the manufacture of cast brooches of this period. There are arguments for and against the use of both methods, when the data from the Anglian cruciform brooch is considered in detail.

Piece moulds

An unsuccessful casting, representing the foot of a small-long brooch was recently found at Winterton, South Humberside, showing 'flashing' - metal flowing along the cracks between the mould halves[1]. This is thought to represent the product of a casting using piece-mould technology, where the mould halves had slipped. The small-long brooch form had a similar period of use and area of production to the cruciform brooch. There is also stylistic cross-fertilisation between the two forms. There are a number of pieces of evidence that exist for the contemporary use of piece moulds on Swedish, Danish and continental sites (Brown 1986, 173-186) and during the Viking age (e.g. Brinch Madsen 1984). Two fitting fragments of a piece mould for a square-headed brooch mould were found at Mucking, Essex (Jones 1975). Hence it is likely that this

[1] Access to this piece was facilitated by Kevin Leahy, Scunthorpe Museum and Art Gallery.

technique was used for cruciform brooches too.

In the piece mould method, a model, probably made either of wood or another hard substance such as bone (or even an already-completed brooch), would be pressed into a damp clay surface. Evidence from Helgö, Sweden indicates that soot was used to dust the model (Lamm 1973). Alternatively the model could be laid face up on an impermeable surface and the mould built up in layers of increasingly coarse clay slurry (see appendix 3.1). The edges of the front half of the mould would be dusted and/or allowed to dry slightly so that the mould halves would not stick. Holes would be cut to allow registration. Clay forming the other half of the mould would be then added.

A space would be made for pouring in the metal (the 'ingate'). Evidence from Helgö, Sweden shows a conical ingate form, with the top surface at an angle. This style of ingate system would allow venting through the metal and be more gentle to the inside of the mould. The brooches at Helgö were cast from the foot. The evidence of the Winterton small-long brooch and Partney 2 suggests that casting from either end may have been used for cruciform brooches. On the brooch from Partney chemical 'cleaning' has stripped away corrosion and revealed bands of preferentially etched metal (fig 3.8). These may relate to a rather low temperature in the melt and/or in the mould. This would cause the metal to chill quickly and unevenly with areas of inherently weak structure (i.e. more

liable to corrosion and then to chemical stripping). Pouring from the foot end of the brooch could also explain the unusual feature at the end of a recently discovered brooch from Goldbury Hill, Oxon[2]. Insufficient metal remained to cast both of the brooches and the end of the animal head on one of them was completed with metal from a second melt.

In modern castings, holes are pierced through the mould allowing free flow of air and surplus metal ('runners' and 'risers'). These are only seen on the largest moulds at Helgö, so venting through the metal was adequate.

The two halves would then be separated and the model removed. It would be easiest to construct the catch and pin attachment at this point by cutting straight slots into the back half of the mould. After drying and any necessary cleaning, further clay would be used to 'lute' the pieces together, ready for casting.

Brinch Madsen (1982) describes the processes involved during the assembly of the mould and pouring the metal. He notes that metal would run into the cracks between the front and back portions of the mould, forming flashing if drying had been uneven or if the mould halves had slipped relative to one another. Basic finishing would be completed by removal of this flashing and the ingate. The surface could be cleaned using

[2] See note 5 in Chapter 2.

abrasives, such as sand. The catch would then be hammered over, the pin lug drilled through and the pin coil (and side-knob axis assembly if appropriate) attached. Punched decoration could be added at this late stage.

If the moulds were carefully cracked open the mould halves might be cleaned, reassembled and re-used to cast another brooch. The fact that piece moulds are always found broken on archaeological sites (e.g. at Helgö) cannot be said to signify that such moulds were always broken to release the casting (Brown 1986, 180). If the moulds were used either once or re-used repeatedly until accidentally broken, all excavated mould pieces are likely to be broken. Positive evidence for the reuse of moulds is rare however. Certainly mould halves with multiple layers of luting have not been noted at Helgö. The re-use of moulds would allow the manufacture of sets of identical artefacts which do not exist during this period. Other evidence for re-use of moulds will be considered below.

Lost-wax casting

The alternative method of production is the lost-wax method, still used today for bronze casting of artwork. In this method, all the cast detail to be on the final brooch is formed on a wax model. A wax sprue cap and wax strips to form runners and risers would be added to the model. The whole assembly is enveloped in clay and allowed to dry.

The mould is then baked so the wax runs out. The brooch is cast and finished in much the same way as the products of piece moulds. However, unlike piece moulds, the mould must always be broken to get at the brooch so there is no chance of re-using the mould.

Leigh (1980, 150f) confirmed the metallurgical impossibility of the so-called lost-lead process which Vierck (1976) employed to explain the occasional discovery of lead brooches/models at this time (most famously at Dinas Powys, Glamorgan, Wales (Alcock 1963)) and also at Geneva, Switzerland (Bonnet and Martin 1982). It would be extremely difficult to remove all traces of lead from the mould (Northover pers comm). Leigh notes that lead brooches have occasionally been found to be used practically, and are buried in the normal position on the body. Alternatively, or additionally, they may have been test pieces for moulds.

There are no mould fragments for the early medieval period which require the use of the lost-wax method but many of the features seen on cruciform brooches would be easier to produce in wax than on a durable model, notably the thin, curved areas of the bow and complicated decoration. Wood, a durable modelling medium suggested for this period, would not have a close enough grain to be able to take fine detail. In addition, the examination of several hundred cruciform brooches has failed to detect any examples of wood-grain impressions, even on the back of brooches. Denser materials

such as bone or ivory are not normally available in sufficient volume to make a brooch model in one piece, so models would have to be constructed out of many parts. The extreme angles (approaching 90 degrees) seen at the junction of bow and catchplate or headplate would be difficult to achieve using such media. In addition, modelling a new brooch from wood or bone for every casting would be very time-consuming.

Practical experience confirms the suitability of wax (Taylor '1978 and Appendix 3.1). The fragility of the modelling medium is more than compensated for by the possibility of re-use of wax and easy alteration of wax models.

Early cruciform brooches with continental forms (e.g. **Dorchester** (type A1), Fig 2.1) have catches which are not just bent or hammered over, but actually form a pocket. Brooches with this type of catch could not be cast using piece moulds, only by lost-wax methods. The date (and provenance) of these brooches are sufficiently distant from the majority of the corpus that one may want to set aside this piece of information and study Anglian cruciform brooches on their own merits.

The front half of the wax model may have been invested first, giving greater stability, so that details (e.g. catch and pin lug) could then be added at the back. If this was the normal method of manufacture, it is possible that the two halves would not dry at the same rate. This would lead to cracking

between the front and back of the mould and hence could explain flashing on the artefact when cast, as seen in the piece from Winterton. Type A1 brooches, however, are formed 'in the round' (see e.g. the lozenge-shaped cross-sections) and are likely to have been invested in one episode.

If the front half of the mould was invested first, wax from areas such as the back of the bow could be hollowed out to the required thickness. This could explain smoothing marks sometimes seen at the back of bows (as distinct from filing marks on flat, accessible areas around pin attachments), which might lead one to suspect that modelling took place in a soft medium. It is possible that some of these marks may have been made on the damp clay of a piece mould, although <u>visually</u> they seem to be the products of a process concerning a positive, not a negative artefact i.e. they took place on a model or a brooch, not a mould. Since both brooch and model would have been in the positive, it is difficult to assert definitively that 'smoothing marks' may not have been features formed subsequent to the metal casting.

Combination methods (Fig 3.09)

Processes involving wax models seem the most natural way of producing various details observed on artefact forms of the period. However, metalworking sites of the period have only produced evidence for piece moulds so far. Researchers working on individual artefact types have put forward cases supporting the option of combined methods (Brinch Madsen 1984, 91; Dickinson 1976, 1982; Leigh 1980; Northover unpubl). These methods have been proposed to explain variation seen between pairs and within series of brooches.

In combination methods, the front half of a permanent model was pressed into a clay surface, as in normal piece moulding. The permanent model therefore serves as a 'pattern' in this process.

1 Secondary wax models

In the case of methods using secondary wax models, the 'pattern' may have nearly all of the decoration to be found on the final brooch or may have been a 'blank' (Leigh 1980). Several near-identical secondary wax models could be taken from the impression in the clay. Cleaning and decoration on these wax models would introduce variation.

Leigh suggested that square-headed brooches could have been made by forming separate, flat wax pieces for the headplate,

bow and footplate. These would be decorated, then joined by warming the wax and pressing the pieces together. Hence areas at the top and bottom of the bow were left plain, to avoid damaging the decoration (Leigh 1980, 169ff). The positioning of decoration close to the bow on many type Z brooches shows this does not provide a full explanation in the case of cruciform brooches (Plates 3, 6 and 7). Some decoration could have been left until after assemblage of the individual wax pieces.

The mould would then be invested around the wax form, as in lost-wax casting. Again, the front half of the mould is likely to have been formed first so that the catch and pin lug(s) could be added at the back.

2 Thin-casting

Examples of thin-casting methods can be seen amongst Reichstein's *Typ* Mundheim brooches (Fig 2.66). These are cast with very thin metal walls, less than 2mm thick in many cases. The morphology of the reverse of the casting follows precisely the morphology at the front. The catch was occasionally attached using rather elaborate structures (Fig 2.67). It would be difficult to achieve this sort of detail on secondary wax models and laborious to do so when using piece mould technology. A separate explanation can be made.

This effect could be achieved by forming a negative

impression in a clay surface using a permanent model (with full decorative detail), running a thin layer of molten wax inside the impression, adding wax pieces for pin attachments and then forming the second half of the mould on top of this thin skin. When the wax was run out, the remaining casting space would be very narrow.

Using a permanent model to impress the front half of the mould allows repetition. Norwegian brooch forms, e.g. Reichstein *Typ* Mundheim are much more repetitive than contemporary English forms.

Some Norwegian brooch forms have very pointed eyes, and occasionally nostrils, on the animal head (e.g. Reichstein 1975, *Taf.* 35,5; 63,5; 63,7). These could have been made by pushing a conical implement into the surface of the impression whilst the clay was still damp. Eyes on these exaggerated elements are normally cast solid at the topmost end, suggesting a plug of wax remained at the end, during formation of the second half of the mould.

There has been no evidence, to date, for the use of cloth as reinforcement for thin wax models in the manufacture of cruciform brooches (Arrhenius 1973, 102-3; Brinch Madsen 1984). Neither has there been any evidence of the use of chapelets (metal spacers between the mould halves), even where the surface of the brooch has subsequently been chemically 'cleaned'.

Positive and negative modelling

There is little evidence for decorational elements being formed on a negative model. The majority of features observed on cruciform brooches are suitable to be formed in a positive model. A small number of characteristics may be quoted as being more easily formed in the mould or on some other sort of negative model. The relevant characteristics are free-standing ridges or sharply-angled ridges which cross each other or curve in such a way that postive modelling seems very unlikely (Axboe 1982; Haseloff 1981; Brown 1986, 207ff).

The most likely examples of modelling in the mould are found on type Z brooches e.g. **Longbridge** (plate 6) and **Sleaford G50**. Most of the decoration on the latter example can feasibly be suggested to have been completed in the positive, but the decoration on the headplate panel can only be explained if detail was added by cutting into the mould surface.

In the brooch styles which seem to have used both techniques, the use of secondary wax models is likely. Most of the decoration would have been formed on a permanent model. An impression would be made in a clay surface and details would be exaggerated or completed on the still damp mould surface. This seems to be a sensible solution to the formation of such elements as square or circular bosses and settings on the bow or elsewhere (using a suitably flat- or hollow-ended tool). Then wax would be poured into the amended impression, pin

attachments added at the back and the second mould half added.

Hence one may conceive of a small amount of detail being added in the mould. This seems to have happened, especially in the later brooch forms but it may be only a matter of degree. On other artefact forms, negative carving seems to have been far more common. Later square-headed brooches are often made in a flat 'engraved' style (Brown 1986, 211). Whether this represents a decline in production techniques (*op cit*, 361) is a matter of personal interpretation.

Casting techniques for cruciform brooches

Which of these casting techniques were used for cruciform brooches? It is likely that a single technique was not used at all times and in all cases. Since cruciform brooches encompass a wider range of sizes and styles and a longer period of production than Leigh's Kentish square-headed brooches, one may expect some technical variation and development.

Some of the argument rests on the nature of the model and the information from series of brooches (Brown 1986, 179). Other information comes from a variety of sources, including castings that are slightly imperfect, as well as those which are well-formed.

Catches

It has been suggested that the curled-over catch represents an undercut in the mould. Evidence from Helgö suggests that contemporary Swedish moulds were made by dividing the mould into several pieces, not just a two-piece mould (Lamm 1980, 107). This would allow undercuts. However, the metalworking industry at Helgö may have been rather more advanced than that in Britain, and may have employed different techniques (Dickinson 1982, 21).

If the catch was cast straight and later hammered over, the problem of undercuts is overcome. This was probably the method used on a cruciform brooch at Spong Hill (Manser Jones 1977). Unfortunately, the Spong Hill material is not the ideal choice for study. Since cremation is the predominant burial rite at the site, temperatures may have been sufficient to alter metallographic structures.

Catches are frequently replaced. Some of the replaced catches may signify the results of problems or complete failure in the initial casting. However, frequent breakage along the length of the catch could also represent structural weakening due to working into shape after casting. The pin lug, which would not have been hammered, is less frequently replaced. This suggests the pattern of replacement cannot be explained simply by the vulnerability in use of such projecting parts of the brooch but may be related to the method of manufacture.

Hence the style of the catch is not a method of distinguishing between casting techniques, without recourse to further metallurgical sectioning.

Cast decoration

1 Repeated motifs

Some decorative motifs are duplicated on many occasions, for example, the St John's style terminal at the topknob (fig 2.25) with a distribution chiefly in East Anglia. Where the style of the knob terminal is very similar in several brooches, this detail may have been added separately, at a late point in the mould-making sequence. For example, in combination methods, an impression made by a plain brooch model could have been embellished by impressing a small, separate model shaped in this motif style. In Chapter 2, other typological features were seen to link brooch types which include members with these knob types (types D1, D2 and D5a), for example the use of a square boss at the bow and square fans on knobs. It is these features that suggest a common workshop environment for these brooches. In such a situation, a durable, permanent model could have been used on several brooches.

In view of the simplicity of the design it is also possible that the design could be copied accurately, by hand.

Furthermore, there is a wide distribution of several more complicated versions of this knob style. Not only were versions of this motif used repeatedly in workshops in East Anglia but the idea was elaborated upon and copied more loosely both in this area and over a wider area.

The use of separate models to form individual parts could be confirmed by evidence from sideknobs. On the reverse of some brooches in which the sideknobs are cast with the headplate, they project slightly back from the headplate (fig 3.20, **Holme Pierpoint 4** (type D5a); fig 3.4). This feature is unlikely to have been created by cleaning after casting. If the models for the sideknobs could have been made in wax, in lost-wax or the secondary model method, or in durable materials, within production using piece mould techniques, these features would still be comprehensible.

However, non-functional detail on the reverse of the casting of some Norwegian brooch forms (e.g. appearing to emulate sideknob axes, amongst brooches where the sideknobs were cast with the headplate (Appendix 3.3)) is most probably the result of using completed brooches as models.

There is only slight evidence for the use of separate models to form particular motifs on cruciform brooches.

2 Pairs

A major objection to the use of piece moulds in the case of cruciform brooches (and other contemporary brooch forms) is the lack of duplicate brooches. Duplication (and even mass production) is an advantage of the piece mould technique. It seems unlikely that a large database should fail to pick up a few examples of true duplicates if they existed.

In the present work, the term 'identical' is used carefully. 'Dark Age objects were not precision made' (Dickinson 1982, 22). Given the likelihood of mould shrinkage, of deterioration in the model, of slight miscasting and of cleaning, it would be extremely difficult to produce several brooches which were identical in all aspects, even if the same mould or the same model was used. 'Identical' in this case is taken to mean similar to the extent that only a very detailed examination can show any differences and these differences may be attributable to the effects of cleaning, wear or corrosion.

In a number of brooch pairs, differences are initially only apparent in the punched decoration, which was added after casting. Dimensions are very closely similar ($\pm$ 2 mm). However, as a result of various post-depositional effects (from differential preservation and corrosion), dimensional information alone may be misleading if used uncritically. Comparison can only be made by the use of very high quality drawings (copied onto transparencies) and accurate

measurement. Fortunately, through the excellence of some of the published data (e.g. Spong Hill, Morning Thorpe, Sewerby) and the unpublished drawings from Mucking, we can perform this type of analysis (Transparencies 1-5).

Not surprisingly, castings which most closely approximate to true similarity occur most frequently in simple forms e.g. **Little Wilbraham** 3 and **4**, **Morning Thorpe 90 (1)** and **(2)**, **Mucking G825 (1)** and **(2)** - all small type B2, **Rothwell 1** and 2 - a pair of small type B1 brooches. Simple forms give less scope for observing variation.

However, **Morning Thorpe G353 (2)** and **(3)** (fig 2.12) were intended to be a pair of small type B2 brooches and yet one can see that the animal head forms were never the same in profile or face on, even before wear (Transp. 1, Green *et al* 1987, fig 415). The same feature is to be seen on the pair of small type B2 brooches from Grave 90, Morning Thorpe (Transp. 2, Green *et al* 1987, fig 323, especially the angle of the upper part of the 'nose' element on the animal head). A close inspection of **Mucking G878 (1)** and **(2)** (Transp. 3) shows the proportions of the animal head differ and the angles of all three knobs cannot be made to match up at the same time. A type B3 pair from Spong Hill, Grave 22 (Transp. 4, Hills *et al* 1984, fig 78,4 and 6) seem to show some differences in detail, e.g. at the collar of the topknob and on the foot.

Hence these brooches, which initially appear similar, are

different in detail. The observed variation must have been a result of casting. These features are not explicable by such post-manufacturing effects as distortion during use and/or burial, which would be capable of changing the distance from headplate to catchplate, but have little effect on proportions within the individual elements of the brooch[3]. There is the possibility of human error during drawing, although the detailed measurements taken from these brooches appear to confirm the precision of recording. Since these brooch forms are simple, the possibility of observation of variation is correspondingly small. Hence the occurrence of any detectable variation should be seen as significant.

Similar features can be seen on more complicated brooch forms. **Bergh Apton G6 (2)** and **(3)** (type D2) are a close pair but the style and size of the lappets, especially on the left hand side, are different. Type D5 brooch pair **Holme Pierpoint 1** and **2** have different patterns of punch marks, but the former is also smaller and the proportions of the cast details on the lappets are different. The two type Z1a brooches, **Mitchell's Hill 6** and **Kenninghall 4** have nearly identical, very intricate decoration on the topknob and foot. The differences between these two brooches are subtle, including some best described in terms of slightly rounded lines rather than straight lines. Again, these do not seem to be features that could have been

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[3] This factor has been suggested as an additional complication in the discussion of discrepancies between the angle and distance between foot and headplates which led Leigh to develop his theory of separate parts at the wax model stage.

created by cleaning the brooch after casting.

In all these cases, the differences relate to the proportions of sections of the decoration and the style of their execution. If secondary wax models were used, they could have been made with outlines only on some areas, leaving scope for the introduction of such variation in the finishing stages.

The most noticeable difference between **Girton G39 (1)** and **(2)** (type D3, fig 2.35) is the solid bow in the former and the hollow one in the latter. If a piece mould was reused and had broken at the bow after the first casting, then the second brooch would have a solid bow. The pair **Howletts G1 (1)** and **(2)** (associated with type B) show a similar pattern of bow detail.

Identical 'mistakes' can be seen on brooch pairs, for example **Mitchell's Hill 6** and **Kenninghall 4** (type Z1a) with identical lopsided eyes on the animal head, **Newnham 1** and **2** (type Z2a) with identical unequal wings and **Holywell Row G99 (1)** and **(2)** (type D2, fig 2.28) with identical kinks in the catchplate, below the lappet. The pair of small type B1 brooches from Morning Thorpe G30 show similar, although very slight, misalignment of the topknob with respect to the divisions of the headplate and also similar unequal heights of the upper wing edges (Transp. 5, Green *et al* 1987, fig 305).

The general pattern for pairs of cruciform brooches is that

they are normally very closely related but that, in most cases, small discrepancies may be detected. In each of these cases, the observed pattern could be a result of finishing wax models which originated from a shared pattern. It is possible that attention to fine detail was not considered necessary, so that a few 'mistakes' from the permanent model were retained in the secondary models.

One should note that, although certain techniques form the most reasonable and logical explanation, this does not necessarily mean that these techniques were always used. One further curious feature was noticed on a number of cruciform brooch pairs. When both brooches are to hand it is noticeable that the design and attention to detail on type Z1b brooch **Spong Hill G2(2)** is less clear than its pair. Other examples can be suggested, for example **Spong Hill G22, (1) and (2), Morning Thorpe G30 (1) and (2)**. This may represent use of a shared mould, and that the second brooch from the mould was of an inferior quality.

Early brooches

The fact that secondary wax models provide a sensible solution to the variation observed in pairs of brooches does not necessarily mean that wax modelling was used for single brooches. For most single brooches, the manufacture of both a 'pattern' in a durable modelling medium and a wax model for final detail seems unnecessary. All detail could be carried

out on a wax model, with pin attachment details completed on the reverse after the front had been invested.

It was noted above that the earliest cruciform brooches must have been made using lost-wax type methods. It may be significant that some early examples of type B brooch 'pairs' were also made individually. **Alveston Manor G70 (1) and (2)** are not a pair although they are both very similar expressions of the small type B2 style. It is possible, however, that the Alveston pair were never intended to look like a pair.

The extremely well-worn state of both **Rothwell 1** and 2 and **Rudstone 1** and 2 (Reichstein *Taf.* 87, 1-4) makes further analysis of these early pairs difficult. It is interesting to note, however, that the slashes across the forehead of the animal head of **Rothwell 1** cross in the opposite manner to **Rothwell 2** and the style of the collar on the animal head of **Rudstone 1** is different to that on **Rudstone 2.** The detailed measurements in each of these two pairs are very closely similar (with the exception of a slightly longer catchplate on one of the Rudstone pair).

Hence secondary model techniques could have been used for brooch pairs of these types as well. We cannot prove that the use of simple lost-wax techniques extended to type B brooch pairs.

Comparative work

The only comparable piece of detailed research comes from Dickinson's study of saucer brooches in the Upper Thames Valley (Dickinson 1976, 1982). She found nine different degrees of variation between pairs of brooches. Only a few pairs of saucer brooches were similar enough to have originated from the same model, without some intermediary processing (designated Class 1 variation). At the other end of the scale, Dickinson's Class 9 variation (same 'design-idea', different execution) must relate to the use of two separate models. Production of brooch pairs exhibiting variation in Classes 2-8 may also have been made using this technique.

The greatest amount of variation was observed on the larger, later and more complicated forms (Groups 10-18). However, the discussions on saucer brooches have some of the same problems as those for cruciform brooches; it is easier to see differences in complicated designs because there is more scope for variation (Dickinson 1982, 32). Alternatively, or concurrently, it may have been considered less important to produce exact replication in the later period.

The variation seen on saucer brooches from Dickinson's Groups 10-18 was explained by workshop practice, using a non-durable secondary modelling medium (Dickinson 1976, 46-49, 1982, 36). This would allow flexibility in reproduction of detail whilst a common template would ensure consistency of size. Since

brooches from Groups 1-9 and 10-18 have some chronological overlap and share some sources of inspiration, Dickinson concludes that the patterns of variation seen in both early and late brooch groups are most easily explained by workshop production.

Hence Dickinson's conclusions on the subject of casting techniques for paired brooches seem to be similar to those from cruciform brooches.

Conclusions

Information on the method of casting brooches has been shown to be complex. Several contradictory hypotheses may be supported by selecting particular subsets from the data. Several production methods may have been in use at one time, depending on the requirements of the end product.

Various details suggest the use of secondary wax models for the production of pairs of cruciform brooches, possibly using primary 'patterns' with outlines only for the decoration of the more complicated styles. In this method, the primary 'pattern' could have been solid at the back, as most of the finishing could be done on the secondary wax models. Hence the primary model could have been fashioned out of bone or wood, thus explaining the apparent lack of models in the archaeological record of this period. In view of the variety of brooch types on which small but significant variation is

observed, this technique may have been used in most periods of production.

In the earliest phase of cruciform brooch manufacture, the existence of a simpler technology, closer to true lost-wax techniques is indicated, possibly at the same time as the use of secondary wax models for the production of brooch pairs. For the remainder of the output, the lack of duplicates and several aspects of decoration on cruciform brooch forms seen in England also suggest the use of a soft modelling medium.

Further technological detail

Having discussed the likely methods of casting English brooches it is also now necessary to establish where other forms of technical variation can or should be observed. The primary requirement must be that the features discussed are essentially technical and do not relate simply to demands placed on manufacture due to decorative fashions. Hence most information will come from the back of the brooch. Some idea of the range of information may be seen from Figs 3.1 - 3.7 .

Several technological features are present on all (complete) cruciform brooches and have qualities that are simple to record and analyse. The normal pattern for each feature, as well as unusual patterns will be shown and the position of the English brooch forms within wider datasets outlined. Since there are few precedents to follow, my interpretation will be

influenced by the themes raised in Chapter 2.

Although brooch technology did not change drastically during the time under investigation, it is hoped that some technical details will be found that have consistent associations with groupings of brooches, such that chronological and regional trends may be determined. This sort of research is prone to bias caused by several types of assumption.

Clearly, 'early' manufacturing features are those which occur consistently in the earliest brooches found in England, i.e. continental types, belonging to type A and some type B brooch forms. However, the longevity in production of type B brooches must be considered. Similarly, 'late' manufacturing features are those which are seen consistently on the latest English forms, large brooches, especially those with lappets (type D) and those with zoomorphic decoration (type Z). Features found on early brooch styles may also be found on the later brooch styles, since the same style may have been adequate for all typological divisions. Alternatively, aspects of late typological development may have introduced different requirements, which happen to be served using apparently 'early' techniques.

Some technical characteristics which are potentially significant are discussed below with respect to the contemporary Scandinavian and continental evidence. Similar technological traits do not necessarily imply similar cultural background or

the transfer of cultural groups, individual craftworkers or artefacts. Cultures from very different environments may solve a technical problem in similar ways. However, the coincidence of both technological and typological similarity may be thought to be more significant.

Since the Kentish typology was found to be rather separate from the Anglian data, information from Kentish brooches will not be included in the general discussions below, unless otherwise stated. The non-English datasets used are sometimes rather small. In the discussions below, German and Danish databases are sometimes combined as are the Norwegian and Swedish. Regional studies of this type have not previously been attempted in any of these areas, but would undoubtedly repay a serious study of their own. For the purposes of comparison, I have taken Reichstein's general typological and chronological conclusions for the Scandinavian and continental corpus at face value. Recent discoveries will be included where relevant.

In the previous chapter, it was suggested that the status of bow brooches was related to their context. By discovering the attention given to technological detail, it may be shown how the standard and direction of technical development may have enabled or hindered such symbolic expression.

The following features will be considered:

1) Bow cross-section

2) Catch length and profile

3) Sideknob style

4) Pin axis and coil

5) Pin lugs

6) Wing profile

7) Weight

8) Unusual features

9) Decoration forms

C. Other technical features

1) Bow cross-section (Tables 3.1a-c, figures 3.1 - 3.6, 3.10)

A hollow at the back of the bow would allow slightly more fabric to be bunched up behind the pin, but making taller pin lugs and catches or a deeper bow, moving catch and pin lug further apart or using a curved pin would give similar advantage (fig 3.10). None of these alternative refinements appear to occur in the cruciform brooch dataset. There would, however, be a saving in metal and weight carried, especially for the larger forms. Since hollows are frequently found in other areas of brooches when they are noted to exist at the back of the bow, they can be used as an indicator of a general tendency towards reducing the thickness of casting.

Manufacture of models for casting would be easier if bows were cast solid, as the models would be more robust. Manufacture of durable models with deep concavities in the reverse would be very difficult. It was shown above that the combination method could be used to make brooches with deep hollows.

The sequence of bow cross-section styles has been quantified in Tables 3.1a-c for each of the production areas, sub-divided chronologically according to Reichstein's phasing in the non-English cases. The information recorded was binary (presence/absence) and had no further quantitative measure. This means that somewhat arbitrary decisions had to be made in border-line cases.

Pattern of use

Early cruciform brooch styles, such as Reichstein's *Typen* Witmarsum, Pritzier and Dorchester on the continent, have solid, triangular or diamond-shaped cross-sections at the bow. This is part of a general pattern, in which the majority of the continental cruciform brooch forms examined have solid bow cross-sections. This echoes the pattern in other brooch forms of this period (and that which immediately preceded it) which also have solid bow cross-sections, e.g. cross-bow and Nydam-style brooches.

Only a minority of continental cruciform brooches have concavities at the bow (26 out of 89 German, Danish and Dutch brooches examined). These are mostly of forms which were given types belonging to *Stufe* D3 by Reichstein or those which could reasonably be typologically associated with these types. The early brooch styles in Norway and Sweden are also normally formed with solid bows, with only two exceptions. These exceptions are brooches of Tveitane-Hunn style, shown in Reichstein's *Tabelle* 3 (Reichstein 1975) as possibly belonging either to the *ältere* or *jüngere* groupings.

In later Norwegian and Swedish brooch styles, the bow area is again more normally concave at the back and often extremely concave in those examples where the brooch is thin-cast. However, it can be seen that, whereas the bows of Norwegian brooches given Reichstein's phase *Stufe* D2 are mostly concave,

the changeover to this style does not occur in the southern European distribution area (i.e. Germany, Denmark and Holland) except in types belonging to Reichstein's later phase, *Stufe* D3. When the change occurs in these areas, it is by no means as complete as it is in Norway and Sweden.

The situation in English technology is by no means as clear as that abroad (Table 3.1c). All type A1 and A2 brooches have solid bow cross-sections (this is one of the classificatory features of type A1) and all C1 brooches have concave backs. Each of the other typological divisions contain examples of both bow styles, although there is a tendency towards the use of concavity at the bow in large B types and in types C and D, with around 70% of brooches in types C and D having this style.

Considering the evidence in detail, three of the type A3 brooches are solid at the bow and three are concave. On the available dating, the production/use of these brooches was shown to be likely to overlap that of type A2 brooches (i.e. Reichstein's Groß Siemß type), so an English use of a concave bow may be seen to be emerging in the phase known to Reichstein as *Stufe* D2, as it does in Norway and Sweden. It is interesting that some type A3 brooches with continental attributes, such as a polyhedral topknob (**Girton G13 (1)**) and others with simple forms (e.g. **Girton G7** and **Morning Thorpe G346**), have hollow bows.

The majority of type B brooches have concave backs to the bow. Only one sub-division, small type B1 brooches, have a tendency towards the use of solid bows. Type B1 brooches with solid bow cross-sections include some which are typologically very close to type A brooches, for example **Bradwell 1** but not **Faversham**, whose continental associations were given in Chapter 2. The sample of small type B2 brooches has nearly the same number of solid bows as concave ones. Type B2 brooches with solid bows include both plain and decorated forms, amongst them brooches from Kent **(Bifrons 1)** and from CSNE sites. The rather unusual type B forms from Mucking all have solid bows as does **Fonaby G28**, which was typologically linked to **Mucking G878 (1) and (2)** and to continental forms, in Chapter 2. Only one small type B3 brooch examined had a solid bow cross-section. This is **Barrington B 1**, whose form is unique amongst the English corpus, with rather better connections to items from Reichstein's continental type Krefeld-Gellep than some of the other English examples.

Neither in England nor on the continent, did the concave bow style achieve the dominance seen in those Norwegian brooch styles allocated *Stufe* D3 by Reichstein (i.e. 97% of all recorded brooches). The manufacturers of type D brooches retained the solid bow cross-section option, in all areas of production. Those examples of the East Anglian brooch styles type D1 and D5a, thought to be possible workshop groupings generally have concave cross-sections. Although this conforms to the general type D practice, it is interesting that type

D5a brooches thought to have been made in the midlands (e.g. **Brixworth 3, Barton Seagrave**) had solid bow cross-sections, whereas **Holme Pierpoint 4**, thought to have been imported to the area of its discovery from Cambridgeshire, has a concave cross-section.

In the 'florid' English styles of type Z, the solid bow is again more prevalent, seen in 21 out of 39 examples. Any consideration of weight- or metal-saving did not seem to be important in these late styles. It is likely that the increased weight of metal in the headplate and footplate meant a more substantial bow was necessary.

Conclusions

After a common beginning with solid bow cross-sections, concavity at the back of the bow is adopted by the Norwegian and Swedish makers of cruciform brooches more or less completely, as part of the overall tendency towards thinner, lighter brooches. In England, Denmark, northern Germany and Holland, the change is not as complete, with around 60-70% of all late (i.e. Reichstein's *Stufe* D3 or later) brooches having concave backs to their bows. The change in Denmark, Germany and Holland may be slightly later than in England, Sweden and Norway. In England there is a distinct return to solid bows in type Z brooches, marking a tendency towards massive castings in the latest and most ornate forms.

The evidence from type A2 brooches is similar to that from their continental contemporaries. The brooch styles of English brooch forms thought to have been used during the first half of the fifth century (i.e. small versions of types B1 and B2) also often have solid bows. However, throughout the production of English brooches, both alternatives are employed and it is not appropriate to attribute import status, on the stength of this characteristic alone.

2i) Catch length (Table 3.2, figures 3.11 - 3.18)

Catches, pin lugs and sideknobs are areas which are particularly prone to damage or loss as evidenced by the number of repairs and replacements. Data is therefore slightly less abundant. Reichstein noted that the length of catch varies with the phasing of Norwegian brooches (Reichstein 1975, 70 and *Tabelle* 4). The earliest brooches have long catches while the latest brooches have mostly shortened catches. His *jüngere* brooches have mostly long catches but some are shortened. More precise measurements on a sample of the population show a complex picture, with different traditions prevailing in various areas and periods of production (table 3.2).

Instinctively one would expect larger brooches to have larger catches, hence the ratio (catch length):(overall length) should be calculated. The fact that this proportion does not remain constant but, for example, significantly decreases for the

largest English brooches (types D and Z) suggests catch length itself is also important. Table 3.2 shows the mean and standard deviation of the data from brooches in each of Reichstein's phases. The ratio (catch length):(foot length) could have been used, since the ratio (foot length):(overall length) varies. Preliminary calculation using both these factors suggested that the overall length was adequate to give a good visual impression. Graphical representation shows the situation clearly (figures 3.11-3.18). The small number of German and Danish brooch styles to which Reichstein assigned a type or a phase means that comparisons between databases must be carried out with caution.

Comparing figures 3.11 and 3.12, we can see that, in the earliest continental and Scandinavian brooch forms, catches are normally long - running along 40-55% of the length of the brooch. The restricted range of the (catch length):(overall length) ratio values is of interest, since the actual catch lengths are very varied. Clearly the proportion was carefully controlled during production.

Seven *Typ* Witmarsum brooches (including one each from Holland and Norway) have values with particularly small ranges (catch length 49 $\pm$ 5, ratio 0.48 $\pm$ 0.03). This is not merely because these brooches are typologically very distinctive. Several other later brooch types are also well defined stylistically (e.g. *Typ* Mundheim), but the length and ratio values for these types have greater variety.

The position of English brooches can be seen on the upper plot of figure 3.13, where datapoints from English brooches are plotted at the same scale as those for continental and Scandinavian brooches (figures 3.11 and 3.12). Only two English type A brooches measured have values anywhere near to this area of the diagram - **Dorchester, Kempston 1**. These are both type A1 brooches. These two brooches were amongst the earliest in England and they have catches which run the entire length of the brooch foot.

The continental and Scandinavian brooch forms assigned to Reichstein's phase D2 have a broad range of catch dimension values, with considerable overlap with those from the earliest brooches. On the whole, most of the non-English values for this phase seem to belong to the higher end of the spectrum. Two large groups - Reichstein *Typ* Lunde and *Typ* Røssøy brooches - tend to have long catches and high catch/overall length values. It is noticeable that about half of the values for English type A brooches lie outside the normal range of English brooches. This illustrates a tendency towards longer rather than shorter catches amongst these brooches, but one which seems minor in comparison with data from abroad.

60% of the later Norwegian and Swedish brooches have much smaller catches (less than 30mm), extending along less than 30% of the overall length. Despite this tendency towards short catch lengths in this later period, more extreme values were still known. The Norwegian sample reveals a number of brooches outside

this distribution, in which the use of long catches persists, notably nine out of fourteen *Typ* Skogøya brooches. These, and a number of other late brooches, have values lying well away from the axis of distribution of data points belonging to late Norwegian brooches.

German, Dutch and Danish brooches assigned to *Stufe* D3 are not common, but it is clear from the figures available that catch lengths were diminishing here also. *Stufe* D3 Dutch samples seem to have the lowest values - although not as low as English examples.

In conclusion, one may say that catch dimensions on the earliest brooch forms show a tendency towards uniformity, in spite their widespread geographic distributions. In the later phases much more variety is seen. Non-English production systems retained the option of a long catch, although the modal length was considerably smaller.

Compared to the continental and Scandinavian situation, English brooches have a very restricted range of size and ratio values. Data points for all English brooches, except the two examples already noted, lie within the relatively small area which is defined by catch length < 30mm and ratio < 30% of length.

By producing plots at a larger scale, some further detail can be observed amongst the English data (figures 3.14-3.18). These plots show a strong positive correlation between catch length

and catch/overall length ratio, in comparison with data from non-English brooches. In other words, there was great degree of consistency within Anglian England, respecting what was deemed to be the appropriate catch length and (catch length):(overall length) ratio.

The majority of type B brooches have ratios between 0.15 and 0.25. Large brooches naturally have longer catches. There is a great deal of within-type scatter but the large type B brooches seem to have a more restricted range of length and ratio values than the small brooches.

Some examples are found with rather higher (catch length): (overall length) ratios, but figures 3.22-3.27 show that English large type B brooches seem to be part of a trend towards low (catch length):(overall length) values (i.e. < 0.20). A total of nine type C, D and Z brooches have extreme values, with ratios below 0.10. Type Z brooches have the shortest average length of catch and ratio. At this point we might be approaching the practical limits required by technology, since these brooches are around 100mm long and a catch cannot practically be made less than 10mm long. Catches were not being increased in size at a point when brooches were getting very large. Evidently not even type Z brooches were so heavy nor their wear so excessive as to demand a very substantial catch. Logically then, the long length of catch found on early brooches was probably not functionally determined.

Apart from these general conclusions, it is difficult to observe any outstanding trends within brooch types from the plots. The catch length was probably one of the least controlled aspects on a brooch. Since few people would see the catch and it may have been added to the mould at a late stage, selection of the size and ratio could have been a rather haphazard decision. Other proportions of the brooch appear to have been much more consciously designed.

To test the hypothesis that decorative design elements were more carefully controlled than functional ones, the ratios of catch length:overall length, bow length:width and catch plate length: width were determined for 124 type D brooches. The mean and standard deviations of these distributions were calculated:

Ratio	Mean	S.d.	S.d/mean
Catch l./overall l.	0.162	0.042	0.25
Bow length/width	1.465	0.292	0.20
Catchplate "	1.078	0.226	0.20

By dividing the standard deviation by the mean, it can be seen that, when one takes into account the effects of the relative scales, the amount of variability in the catch dimension is not much greater than that in the bow or catchplate dimensions. A F-test gives a figure of 1.56, which demonstrates a difference at the 90% level but not at the 97.5% level. Hence, from a purely statistical point of view, it cannot be proved that the dimensions of bows or catchplates were any more (or any less) carefully controlled than those of catches.

Evidently such a broadly-based test may disguise a great deal of variation. To test whether brooches within individual sub-types have more restricted dimensional ranges, a similar test was carried out on nine type D1 brooches and twenty-seven brooches associated with type D2.

Type D1

Ratios	Mean	S.d.	S.d./mean
Catch l./overall l.	0.125	0.046	0.37
Bow length/width	1.460	0.146	0.10
Catchplate "	0.904	0.247	0.27

Type D2

Ratios	Mean	S.d.	S.d./mean
Catch l./overall l.	0.169	0.036	0.21
Bow length/width	1.470	0.230	0.16
Catchplate "	1.141	0.130	0.11

This demonstrates that the catch dimensions of type D1 brooches were much more variable than the bow dimensions (significant at the 99% level). Hence the front aspect was more carefully controlled than elements at the reverse of the brooch form. The statistics from the type D2 brooches were inconclusive, which may reflect a wider typological variety within the sample population. However, comparing the information from type D1 and D2 brooches demonstrates that catch dimensions of type D2 brooches were significantly more controlled than those of type D1 (at the 97.5% confidence level). So, even a sub-type of type D brooches which are typologically diverse, may have a small set of possible values for the catch ratio.

Through these tests, it seems that catch lengths were as well controlled as a number of typologically-determined features which one would have thought would have been of more immediate concern. One should not underestimate the care with which these brooches were made.

Conclusion

It is clear that catches were designed in proportion to the overall size of brooch. Different sizes of catch and different ratios of catch to overall length can be seen during various periods of production. In each of the production areas, later brooches have smaller catches. English brooches display far greater homogeneity than the Scandinavian and continental examples.

What were the factors behind decreasing the length of the catch? The outward typology of brooches would be little changed by a change in catch length. Catches formed on a wax model during the lost-wax process (i.e. those on a few type A brooches) would not be worked after casting. However, most cruciform brooches are likely to have had their catches cast straight. If the process of working catches into shape after casting was somewhat hazardous, leading to length-wise weakness in the catch, shortening the catch would minimise this risk. Since it seems that a very short length of catch , worked well enough for practical purposes, long catches may be seen as an 'heirloom feature'. A combination of rationalisation in production and reducing risk

of manufacture failure may be inferred as explanation for this direction of development.

2ii) Catch profile

The catch profile was another factor noted to vary within the English database. This is essentially decorative, but related to technical developments. Angled upper and lower edges is the most commonly observed style (figs 2.8, 2.10, 2.13 etc). Upright, more or less rectangular styles are also found frequently, longer on early brooch styles (type A) and short on type Z brooches (e.g. figs 2.15, 2.47, 2.56).

Single or multiple steps at the lower edge of the catch are also quite common (e.g. fig 2.4, 2.15, 2.20). These may have been produced during a late stage of manufacture, whilst the casting was being cleaned. In some cases, a 'step' may be elongated as a ridge, sometimes right down to the end of the foot. This feature is related to the long catches discussed above and is also found on square-headed brooches (Leigh 1980, 239). Leigh attributed it to a 'skeumorph' of long, applied catch styles. On cruciform brooches, both pin lugs and catches are found on such ridges or spines, some of which extend into the bow area. So it seems quite likely that this feature resulted from the method of making the mould cavities for the catch and pin lug (by cutting into the still-damp mould, before finally luting the two halves together, see above).

Examples of these features were found in each of the other regions of cruciform brooch production. Insufficient dimensional

data was recorded to firmly establish the significance of these features.

3) Sideknobs

i) Sideknob attachment (table 3.3, figures 3.19-3.21)

General design

The method of assembling the pin and sideknob combination was best explained by Drescher (1955). The earliest forms of continental and Scandinavian cruciform brooch have their sideknobs threaded onto a length of wire. This wire runs through the pin lug at the back of the headplate and also forms the axis for coils of the pin (figure 3.19). It seems likely that the wire was fashioned to fit the holes tightly. The knobs could then be forced on after the coil and pin assembly had been positioned. This is confirmed by fragments of copper alloy which can be seen within iron corrosion from the pin of a cross-section of a pin and knob assembly from Spong Hill[4]. The fragments have been prised off from the inside of the knob, during the passage of the axis through the hole (plate 8).

[4] These samples are probably those taken for J Manser's dissertation, retained by the Norfolk Archaeology Unit. Their re-examination was facilitated by Dr P Northover, Dept of Metallurgy, Oxford University

Casting sideknobs in one piece with the headplate[5] becomes a common procedure in later brooch styles from all areas of production. In this case, the pin coil would have been wound around a small length of wire for its axis. It was noted above that completed cruciform brooches could have been used as models for some brooches, which would explain the projection of sideknobs from the headplate (Fig 3.20).

The proportion of brooches with each type of side-knob attachment varies within later brooch types, with few types employing one method exclusively. Either method was seen as equally applicable, for the production of most brooch types. The small type B2 pair Holywell Row G48 (2) and (3) have separate sideknobs in one case and sideknobs cast with the headplate in the other. There are several examples of type C brooches which are extremely similar in all typological respects except for the method of side-knob attachment.

Continental and Scandinavian data

Sideknobs cast with the headplate are infrequent on continental brooches, but are not entirely absent, occurring on a few of the brooches assigned to the latest of Reichstein's forms e.g. *Typen* Midlum and Krefeld-Gellep in *Stufe* D3. Production from Germany, Denmark and Holland may

[5] The technique of casting knobs with the headplate should not be confused with the metallurgical term 'casting on' i.e. casting extra elements onto a form which had been previously cast, for example adding rims onto buckets.

have begun to employ sideknobs cast with the headplate on brooch styles from Reichstein's phase *Stufe* D2 (e.g. a single example allocated to Reichstein's *Typ* Groß Siemß by this author (Schmalstede Urn 132)). This type of sideknob is also found on 50% of Norwegian *Stufe* D2 brooch styles, where the metalworkers began to cast brooches with hollows at the back. They are even more frequent on the latest of Reichstein's Norwegian forms (i.e. *Stufe* D3), occurring in about 85% of the total number of brooches examined.

In Norway, there appears to be a continuous correlation between provenance and method of sideknob attachment, since most of Reichstein's *Stufe* D2 and D3 examples with separate sideknobs are found in the north. However, this is a direct product of the dominance of *Typen* Røssøy and Skogøya style brooches in the north of Norway, during their respective periods of production. About 90% of *Typ* Røssøy brooches (Reichstein *Stufe* D2) have separate sideknobs, compared to 50% of *Typ* Lunde and 10% of *Typ* Eine (contemporary south Norwegian styles). By Reichstein's *Stufe* D3, 50% of the dominant northern type, *Typ* Skogøya still were made with separate sideknobs compared to a mere 10% in the dominant southern form, *Typ* Mundheim. Hence, manufacture in the north of Norway appears to retain earlier styles of production, whilst the south of the country moves towards newer methods. In this comparison, one must rely on Reichstein's chronology to some extent, since time does not permit re-evaluation of the

Scandinavian brooches[6].

Such differences between regions are linked to other technical aspects. The *Typ* Skogøya style is quite robust and hence attachment of separate knobs to the headplate is feasible. The thin-casting style of the south-western *Typ* Mundheim brooches (and of a large number of other closely associated brooch styles e.g. *Typ* Lima) means sideknobs cast with the headplate are normally most practical for this type. Comparisons of the ratios of weight to overall length suggests that *Typ* Mundheim brooches are proportionally lighter than *Typ* Skogøya brooches [7].

It is difficult to establish whether this spatial distribution of the occurrence of the separate sideknob relates to place of manufacture or to the place of burial of the brooch. Two examples of the northern, *Stufe* D2 *Typ* Røssøy brooch style which do have sideknobs cast with the headplate were from Nord-Trondelag and Hordaland (Reichstein nos 288 and 230), i.e. areas which are south of the central distribution area for this type. One could suggest that they were manufactured as well as deposited in this region. Since manufacture occurred far from the normal production/use region of this type, the metalworker may not have been conversant with the

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[6] This discussion represents an update on the observations on this feature made by Sjøvold (1962, 159).

[7] Unfortunately only a small database was available for this purpose. Six *Typ* Mundheim brooches and three Typ Skogøya gave weight to length ratios of 0.40 ± 0.06 and 0.65 ± 0.06

normal method of production for this type and may have worked in the local manner.

However, only one out of four examples within the *Typ* Mundheim corpus observed to have separate sideknobs, was found north of the normal distribution area of the type (Reichstein no 276, from Hen, Grytten pgd, Møre og Romsdal). The other examples come from Rogaland and Hordaland and all four brooches have unusual typological styles. Discovery of this brooch type in the north of Norway does not imply manufacture in the north; it is possible that even brooch forms with one clearly preferred style of production were occasionally manufactured using a more unusual style. These unusual examples may have been amongst those imported from the south.

Since 85% of the brooches from late Norwegian types (as defined by Reichstein), have their sideknobs cast with the headplate, exceptions are of interest. *Typ* Volstad is another north Norwegian type, with only two examples. One of these has separate sideknobs and the other does not. Of a further six unclassified (by Reichstein) northern brooches that are likely to have late dates (by burial associations with brooches belonging to Reichstein *Typen* or by typological similarities), only two brooches have separate sideknobs. Manufacture in the north did not use separate sideknobs exclusively.

The other Scandinavian *Stufe* D3 examples with separate sideknobs are brooches of Reichstein's *Typ* Stoveland, an unusual

form that provides close parallels to the continent and England. It is the animal head form which provides the typological connection to *Typ* Stoveland, for the large example from Veremoen, Lista pgd, Vest Agder (Reichstein no 90, *Taf.* 19,2) but this brooch has its sideknobs cast with the headplate. This brooch has similarities to many late Norwegian brooches. On the whole, I feel that this brooch is not typologically close to other members of Reichstein's *Typ* Stoveland and may be omitted for the purposes of discussion here.

The Scandinavian examples that are typologically nearest to the other members of the *Typ* (the other brooch from Veremoen, one from Stoveland, Holme pgd, Vest Agder, Norway and one from Stentorp, Västergötland, Sweden) are also technically similar, with separate sideknobs and small size. This small grouping is rather isolated from the main sequence of Scandinavian types, but its probable late date and southerly distribution are of interest, as an example of the separate sideknob tradition continuing in use.

Conclusions

In the south of the country, the makers of Norwegian cruciform brooches adopted the idea of casting the sideknobs onto the headplate, to the virtual exclusion of the use of separate sideknobs. This was probably necessitated by the use of a complex technology that aimed to make the casting as thin as

possible. Manufacturers supplying the north of Norway also cast the sideknobs onto the headplate, but the thicker castings of the northern styles meant the use of separate knobs could also be continued.

Despite a scarcity of information from contemporary material in northern Germany, Holland and Denmark, it seems likely that casting sideknobs with the headplate was adopted on the continent as well, at this time.

The English pattern

The situation with respect to the English brooches is just as complicated. It is difficult to tell if there is any chronological or typological significance to the patterns observed. Many types do not have a overwhelmingly dominant method of attachment (see table 3.3). The longevity in production of some brooch forms complicates explanation. It may be noted that most of small type B brooch forms (66%) have sideknobs cast with the headplate whereas 70% of the larger type B brooches have separate sideknobs. The large number (23) of small type B2 brooches with sideknobs cast with the headplate has a significant influence on these figures. Although it seems safe to say that a brooch with sideknobs cast with the headplate is unlikely to have been made very early in the sequence, in cases where a brooch has separate sideknobs, this fact has little interpretative consequence on its own. In England, either technique seems to have been

considered possible in most forms.

Absolute size of the headplate (i.e. the total span to be covered by the sideknob axis) does not seem to be a material factor here. Types C2 and D2 are examples of brooch types in which both methods were used. Average widths across the headplate (including wings) were calculated.[8] The headplates are narrower on brooches with sideknobs cast with the headplate than those on brooches with separately cast sideknobs although the ranges overlap. This suggests that the strength of the metal used for the sideknob/pin and coil axis (and the distance over which it had to stretch) were not limiting considerations. The size and robustness of brooches do not seem to influence the style of sideknob manufacture significantly.

The largest English brooches of all, of type Z style, are mostly made with the sideknobs cast with the headplate or, where separate, with rather unusual methods of attachment. All central members of the type Z1b and Z2b brooch forms have their sideknobs cast with the headplate.

The makers of some type D brooch styles, especially those types with very distinctive designs, do seem to have had more definite preferences. For example, all examined members of the distinctive types D1 and D5a have their knobs cast with the headplate. Hence these closely allied types share another

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[8] The following statistics were used;
Average headplate width (mm), ± standard deviation, number of samples.

Type	Sideknob style			
	Sideknobs cast separately		Sideknobs cast with headplate	
C2	42.8 ± 10.5	n=10	37.2 ± 8.2	n=6
D2	44.4 ± 5.8	n=10	40.8 ± 6.3	n=12

attribute. The more typologically diverse contemporary groupings, types D2 and D5, have less clear preferences, as might be expected.

One factor which may have influenced the adoption of the 'cast-with' sideknob technique was the increasing complicated designs on the sideknobs, together with a more flattened profile. This means it was more difficult to pierce such knobs to take a sideknob axis. More simply, casting sideknobs with the headplate eliminated one step in the process of production - although this option was not always adopted in the instances which one would expect. The change to sideknobs cast with the headplate would have necessitated a change in pin attachment style (see section 3.5).

Some type Z brooches use loops at the back of the knob and headplate to attach sideknobs (Fig 3.21). An iron pin runs through one or two loops on the reverse of the sideknobs and then through the pin lug. The full list of examples is **Baginton 4, Brixworth 2, Duston and Wychnor** (all type Z3), possibly **Kenninghall 4** and **Lakenheath 8,** certainly **Little Wilbraham G105 (1) and (2), Mitchell's Hill 6, Morning Thorpe G353(1), Wakerley G74** and **Spong Hill G2** (all associated with type Z1) and **Kenninghall 10 and 11** (type D4). This list shows the feature was widely understood and not just a local idiosyncrasy. The practice relates to the difficulty in attaching separate sideknobs onto very wide headplates.

These loops are part of an unusual repertoire of manufacturing techniques used on type Z brooches, many of which are not seen on other brooch types. These involve a number of assembling operations, such as using iron rivets to attach sideknobs and white metal strips. Type Z (especially type Z3) brooch styles are therefore rather labour-intensive, when compared with the contemporary type D brooches. The complications of these methods of attachment seem to have left the brooches rather weak, as many examples show multiple fractures and repairs.

There appears to be little evidence for regional preferences of particular methods of sideknob attachment. Taking datasets from type B and type D brooches, as test cases, demonstrates little geographic patterning.

Summary

Both methods of attachment continued in use on most brooch forms from all areas of production. Although late brooch forms in this country and in Norway tend towards the use of side-knobs cast with the headplate, the Norwegian production is most strikingly in favour of this method, as a result of the thin-casting method. Members of some late, closely-defined typological groupings in Anglian England share an unusual type of sideknob attachment.

ii) Sideknob cross-section

a) English brooches

The majority of English brooches have knobs with semicircular cross-sections, whether they are cast with the headplate or not. Those with circular cross-section sideknobs are either early brooches, belonging to type A, or unusual examples, belonging to type B. Circular sideknobs are never found cast with the headplate on English cruciform brooches.

The simplest and most 'normal' English cruciform brooch with separate knobs of circular cross-section is **Holywell Row G48(3)**. The rest of the form, however, fits in perfectly within the small type B2 description. The high frequency of small type B brooches with sideknobs missing may mean many more examples may have had sideknobs with circular cross-sections originally. Alternatively, it may be that **Holywell Row G48(3)** was repaired and the original sideknobs had been semi-circular in cross-section. Examples of mis-matched sideknobs confirm that knobs could be replaced.

b) Scandinavian and continental practices

In other areas of cruciform brooch production, there are many more examples of early brooch types, which invariably have separate sideknobs with circular cross-section. When the idea of casting sideknobs with the headplate was introduced to

Norway, on brooch styles from within Reichstein's *Stufe* D2 styles, circular cross-section sideknobs continue in use, both cast with headplates and made separately. Both styles of knob cross-section continue in brooches from Reichstein's Norwegian *Stufe* D3, although semi-circular cross-section sideknobs cast with the headplate were preferred in all areas (and within each type for which there are enough examples for a preference to become clear). There is thus quite a variety of techniques which were considered appropriate during the latest phases of Norwegian cruciform brooch production, some of which were very different to those seen in England and on the continent, but the preferred techniques appear to be similar to the English ones.

In Germany, Denmark and Holland, relatively few examples are known to be safely dated to the latest period of production. Circular cross-section sideknobs are only found cast with the headplate in one example, an unprovenanced brooch from the National Museum in Copenhagen (Reichstein 1975 *Taf.* 144,10). The headplate of this brooch is very similar to many examples of Norwegian *Typ* Lunde. Pointed edges of the bow, although rare in *Stufe* D2 brooch styles, can be seen on *Typ* Eine brooches (e.g. one from Maela Nordre, Gjerpen pgd., Te, Reichstein 1975 *Taf.* 13,4). So this particular Danish example could well be imported.

German and Danish production in the later period appears to have preferred semi-circular cross-section sideknobs, cast

with the headplate. A small number of Danish brooches were found to have rather flattened sideknobs, as seen on late English brooches. The Danish examples are probably also late in date, as their decoration includes zoomorphic and applied surface decorations[9]. There are no examples of separate sideknobs with semi-circular cross-section in these areas.

Summary

During the earliest phases of production, there was a single style of sideknob in use. This is the circular cross-section sideknob, cast separately and attached using an pin. This style of cross-section was more or less completely discontinued in England, whose sideknob styles become quite uniform, with the exception of type Z brooches. Norwegian production continued to use a variety of types of manufacture. Data from late German, Danish and Dutch brooches are too small in number to be certain of their relationship to the English corpus, but sideknobs were frequently cast with the headplate, with a semi-circular cross-section.

Fig 3.22 summarises the information from this section. It can be seen that Norway and England each had a distinctive method of production, shared another method and shared the most common method with the continent and Denmark.

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[9] See Section 3.9, Decoration, below, for full details of these brooches.

4) Pin axis and coil assembly (table 3.4, fig 3.19)

Similar quantification of the type of metal used for constructing the pin axis and coil assembly shows some regional patterns of association. English brooches rarely employ copper alloy, with two exceptions associated with type A brooch forms (**Colchester** 3 and **Kempston** 1). Both copper alloy and iron are used in continental and Scandinavian brooches, sometimes in combination (table 3.4). Iron wire was also used on square-headed brooches and saucer brooches. There is no evidence to suggest which, if any, of these occurrences reflect repair or replacement of the pin axis and coil assembly.

The earliest Scandinavian examples (brooch types from Reichstein *Stufe* C3/D1) use a variety of metal types and of metal type combinations. At least three out of the nine early examples inspected used copper alloy for both pin and sideknob axis. In the south of Norway during Reichstein *Stufe* D2, iron appears to be the preferred metal, with ten of the eleven *Typ* Lunde brooches using iron only. In *Stufe* D3 similarly, *Typ* Mundheim brooches mostly use iron for the pin, with only two out of seventeen examples using copper alloys in either

position. However, the pattern of use seems to be more variable in the north and west of the country, with four *Typ* Røssøy (*Stufe* D2) brooches using copper alone but three other contemporary examples using iron. In the latest period, iron begins to dominate in the north of Norway as well, with only one example examined using copper.

The pattern of metal types used is different again, in Germany and Denmark, with iron and copper being used together on 19 early German brooches and one Danish brooch (there are very few *Stufe* C3/D1 Danish examples in the dataset). In later phases, when sideknobs are more frequently cast with the head-plate, iron becomes more popular for the pin. Copper was apparently never used for the sideknob axis. Very little evidence is extant for Dutch brooches, but three brooches of probable late date used iron for their pins.

Hence we can see quite different techniques prevailed in different areas of cruciform brooch production. Regional preferences are perceivable in Norway, where the south of the country converted to the use of iron wire more quickly and more thoroughly than the north. The use of both iron and copper or copper-alloy wires was more common in Germany, at least until the latest phases of production. In Anglian England, copper wire was very infrequently used and only amongst early brooches or in replacement.

Discussion

An increasing preference for iron wire for the manufacture of these parts may have occurred due to a number of factors. These are concerned with access to supplies and suitability for practical or aesthetic purposes.

a) Supplies and skills

Iron[10] suitable for the manufacture of wire was available to the artisans of the continent and Scandinavia during the earliest phases of the Migration period[11] but copper alloys were nonetheless preferred in the case of cruciform brooch manufacture at this time. The switch to ferrous wire may reflect problems in finding suitable supplies.

Ferrous wires from this period have not yet been analysed. Saxon pins were made of a variety of copper alloys (Caple 1986, Mortimer 1988). Even if copper-alloy supplies came under some stress in the very latest periods of cruciform-brooch production (see Chapter 4), it still seems likely that there

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[10] The term 'iron' has been used here in a non-technical manner, to mean any type of ferrous alloy. The metals available may have included mild steel as well as cruder ferrous metals.

[11] Even though iron wire was not used on early Norwegian cruciform brooches, it was available. It was used on other artefacts some of which were associated with cruciform brooches e.g. a ring brooch at Fosse, Alversund pgd (Reichstein *Taf.* 5) and an equal-armed brooch from Tveitane, Brunlanes pgd (Reichstein *Taf.* 4).

would be some copper-alloy supplies suitable for use in pins, if required.

Hines (1984, Chapter 2) mentions that both silver and 'bronze' (i.e. copper/copper alloy) were used in England for his wire-based Class A wrist-clasp forms, until at least the mid-sixth century. Interestingly, this is at a time of decline in production of this wrist clasp form in Scandinavia, although the use of particular metals may have as much to do with fashion as with availability of resources.

The manufacture of iron and copper wire are similar. Both may be made by hammering or by drawing, although pure copper is easier to form than either copper alloy or iron.

b) Practical suitability

Not all wire is equally suitable for making coils and the copper alloys used for making single pins may have been inappropriate for coils or springs. Pure copper is probably the best for this purpose. Few of the copper-alloys analysed in the cast brooches of this project are low in alloying elements, although other metals available to the metalsmiths may have been.

It is possible that wire was drawn in the Anglo-Saxon period. A wire-drawing plate was discovered amongst the material from the metalsmiths grave at Tattershall Thorpe (Brown 1986, 55-

57). Other examples are known in Viking Age contexts. One Norwegian cruciform brooch, of Reichstein's *Typ* Kvassheim (Reichstein 1975, *Taf.* 7,4, no 221) has a single line, forming a seam running down the copper-alloy pin. These pieces of evidence may be taken to suggest that the technique of wire-drawing was understood at this time. However, the same feature may have been a result of rolling thin strips of metal (Oddy and Swaddling, 1985). The uneven diameter of wire used in the manufacture of toilet sets and Hines Class A wrist clasps indicates that other methods (i.e. casting as thin ingots and hammering) are likely to have been used in other cases (Hines, pers comm).

c) Aesthetic suitability

The scarcity of copper wire in the manufacture of most English brooches and amongst late brooch styles from other areas may be explained by other, less easily comprehensible, factors (e.g. fashion/taste).

The use of copper/copper alloy wires may have originally been considered essential in early bow brooches since the small headplates would expose the coils of the spring assembly and the silver-white colour of iron would be evident (as would any unsightly corrosion). With the increasing size of headplates, the colour of the pin would become irrelevant.

So it is possible that the dominance of iron, rather than

copper or copper alloy, for the manufacture of wire fittings on cruciform brooches was determined by a lack of suitable materials and by practicality rather than by a lack of skill.

5) Pin lugs (Table 3.5, Figs 3.23-3.24, Map 3.1)

A single pin lug is the most common style found in all areas of cruciform brooch production. The shape does not vary much from a standard rounded form, except occasionally where the lug has been replaced (e.g. **Barrington A 6**, fig 3.7). In England however, two parallel pin lugs are found quite frequently (see figs 3.2 and 3.5). Large square-headed brooches also normally have this style of pin lug (Leigh 1980, 243). Around 17% of the total cruciform brooch population surveyed had this feature, on a variety of brooch styles, from type B brooches to type Z brooches (see table 3.5). Only the production of brooches from types D1, Z1b and Z2b (and possibly D5a) was dominated by this type of pin attachment.

It is interesting that the large type B2 brooch **Holywell Row G48(1)**, which has typological connections to type D brooch forms, has only a single pin lug. Hence the manufacture of type B brooches may not have followed the pattern of other brooches in the same workshop.

The distribution of the earliest of these occurences (map 3.1) shows that three out of eight type B brooches with two

pin lugs were found in Kent (**Faversham, Howletts G2, Lyminge**). Further examples are known from Germany and Holland, from urns 132, 148 and 155 at the excavation of Schmalstede, Kr Rendsburg, Schleswig-Holstein and from Holland at Goutum, Teeghiem, Gem. Leeuwarden (Fries Museum FM 16c-6), Hallum, Terp bei Tsigera Zathe, Gem Ferwerderadeel (FM 26d-2) and Hoogebeintum, Kerkterp, Gem. Ferwerderadeel (FM 28-699).

The Frisian brooches were given Reichstein *Typen* Goutum and Midlum (with one unassigned brooch). The brooch from Goutum is especially close to that from Howletts and the example from Hoogebeintum is one of the closest parallels to English type B brooches. One of the brooches from Schmalstede (from urn 132) probably belongs to Reichstein's *Typ* Groß Siemß but the other two have expanded headplates and are more in line with members of Reichstein's *Typ* Midlum. Ignoring for the moment, the possible early brooch (from urn 132, Schmalstede), the typology of most continental brooches with two pin lugs are not dissimilar to those of the English type B brooches with two pin lugs.

Further technological similarity with 'continental' or 'early' features can be drawn for other elements on some of the English type B examples, e.g. solid bow cross-sections (seen on **Bradwell 1, Barrington 4, Bergh Apton G37** and **Lyminge**) and sideknobs cast with the headplate (an unusual feature amongst continental brooches, but one seen on all the English type B examples with two pin lugs).

Little remains in the way of pin fragments on these simple brooches with two pin lugs but traces on some of the later English brooches (mainly type Z brooches) indicate that such pairs of lugs supported a short axis used as a pivot for a hinged pin. This seems to indicate a style of pin attachment which was one posssible consequence of the adoption of the technique of casting sideknobs with the headplate. For practical purposes, a pivoted pin would hold the pin within the catch as firmly as a coiled arrangement, since an extra turn could be taken round the axis to provide a sprung element (Fig 3.23).

The type B brooches which show this feature are not otherwise closely identified with late English brooch styles, in form or decoration. It seems unlikely that these type B brooches were made in the same workshop as large brooches (of type D or Z). This unusual attribute in simple type B brooch forms provides another parallel between cruciform brooch production in England, Frisia and Schleswig-Holstein.

A certain amount of confusion may have occurred during the period in which sideknobs began to be cast with the headplate. At Spong Hill, an unstratified fragmentary example (no. 1553[12]) seems to have sideknobs cast in one with the headplate but additional loops at the edge of the headplate (Fig 3.24). This suggests that the pin axis was being stabilised in a way that

[12] See note 8, in Chapter 2.

would have appeared similar to that seen on brooches with separate sideknobs.

The position of the pin lug(s) on cruciform brooches is nearly always central on the headplate. However, Leigh notes that the pin lug(s) on square-headed brooches are placed below the centre of the headplate (Leigh 1980, 243). This may have been used to bring the centre of gravity nearer to the 'visual centre' of the brooch, since square-headed brooches have a greater proportion of their mass below the bow than most cruciform brooches.

6) Slope of headplate wings (table 3.6, figure 3.60)

Shetelig thought angled headplate wings were an Anglo-Danish characteristic, with one Norwegian example (Shetelig (1906) 101, 113). He thought the technique was to make the connection of the sideknobs and their axis easier. As many examples have sideknobs cast in one with their headplates, this factor cannot have been consistently important, even if it was important for some brooches, at some points of time. Hines noted a German example (from Borgstedt, Kr Eckernförde; Hines 1984 246).

This feature is indeed prevalent throughout all types of the English corpus. There are a total of 190 examples of almost every major grouping, from type A2 through to Z4 and in most

areas of the distribution, including most of the examined examples from Kent (table 3.6). However, further examples also exist elsewhere. Although the degree of slope of the wings is slight in many cases, this feature was observed to exist to a noticeable degree on at least four Norwegian brooches (in addition to the Måge, Ullensvang, Ho brooch discussed in Shetelig 1906, 113) and four Swedish brooches. These are either *Einzelformen* or belong to brooch forms given *Stufe* D3 phasing by Reichstein, chiefly of his *Typen* Mundheim and Skogøya but also on two brooches, one each from Reichstein's *Typen* Lyminge and Stoveland. A further thirteen brooches from Holland and two from Germany were observed to have this feature, in addition to eighteen Danish brooches. With the exception of two Danish brooches, from Mammem, Middelsom h., Viborg a. (Reichstein *Typ* Lunde) and the type brooch from Hjelmhede, Sevel s., Ginding h., RA, all these brooches appear to be late in the sequence of manufacture, given their Reichstein types - Krefeld-Gellep, Achlum, Hoogebeintum, Stoveland and Midlum.

Conclusions

This appears to be a feature with a much wider distribution than previously appreciated. It is very difficult to quantify amount of deflection accurately, in view of the different widths of headplate and wing. In practice, binary data (presence or absence) were recorded on the proforma. It does not seem sensible to use this data in any detail.

7) Thickness and weight

Thickness of casting was determined in several positions on each brooch (Fig 1.2). However, the small range of variation detectable (c. 1-3mm) means that experimental errors are likely to be large. This makes these dimensions unsuitable for quantification. A combination of weight and length may be a better indicator for thickness of casting.

Weights were recorded for a proportion of the cruciform brooches examined. This information can be used in discussions on various aspects of cast brooch production but there are many pitfalls to the utilisation of this data. Many brooches are broken or heavily corroded so their extant weight has an uncertain relationship with their original weight[13]. Others are missing their sideknobs and pins. The alloy composition will also make a difference, if significant lead is present. Hence the recorded weight can only give an estimate of the original weight[14]. Weights are tabulated with brooch type in table 3.7 , for complete and near-complete examples.

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[13] This problem is most extreme in the case of Norwegian brooches where sampling for chemical analysis proved that many brooches are now corroded right through, with no metal remaining

[14] Weights were recorded to the nearest gramme, which seems to be an appropriate level of accuracy, given the problems of survival.

English pattern

a) Amount of alloy used per brooch

It has been noted above that, although the earliest cruciform brooches have solid bow cross-sections and are solid elsewhere, they are also slim without any significant expansion of the headplate, catchplate or foot. Extant type A1 brooches weigh around 10g, but all known English examples lack their sideknobs. Type A2 and A3 brooches are longer and broader and six type A2 brooches weigh 27g ± 11. Later brooches (types B, C and D) are wider and longer but the reverse of the castings are more frequently hollow at various positions. Small type B brooches generally weigh around 20-30g, larger versions may weigh up to 80g. Type C and D brooches normally weigh between 60 and 80g. Type Z brooches are often very thick and solid castings. Only a few brooches of these types have been weighed and their weights are normally in excess of 80g and sometimes more than 100g.

Up to ten times more metal weight was expended to make the latest brooch styles than in the earliest brooch forms. Hence we have evidence for an 'order of magnitude' increase in availability of copper-alloy metals - or in willingness to expend copper alloy on this brooch form. This is quite apart from the expense of surface decoration in the case of type Z brooches.

This evidence may be compared with the chemical data (Chapter 4). The latest types display a lack of compositional control. The increase in individual brooch weight and the volume of overall output was not marked by better access to fresh metal resources.

b) Amount of alloy expended per grave

When the number of items in individual graves is taken into account, the significance of this expenditure factor is magnified. In many cases, individual or paired cruciform brooches are found together with other copper-alloy artefacts (wrist clasps, buckles, girdle hangers, annular brooches etc). In the corpus, 47 grave groups were recorded which had more than one cruciform brooch present, of which 17 have a pair of brooches and at least one other cruciform brooch present. For example, at Cleatham, S Humbs, the five cruciform brooches in Grave 30 weighed at least 280g in total. The three brooches in Grave 34 weighed at least 240g and probably originally nearer 260g (both these grave groups include brooches which have lost their sideknobs; a few percent weight loss is likely to due to corrosion). Other grave groups such as Holywell Row G48, G79 and G99 have not been weighed but must have total weights within this sort of range.

c) Functionality and function

Personal experience suggests that wearing a single cruciform brooch weighing around 70g is quite practical (when pinned high at the shoulder, on a sturdy garment) but the addition of a further one or two brooches would make it much less so. Wearing about 200g of metal (e.g. two small and one large cruciform brooch), which were also bulky and valuable, could not have been an everyday occurrence. The display of such large amounts of metal must have been quite a social statement.

It has been noted above (p. 186-7) that cruciform brooches may have fulfilled one of a number of functions within the costume of the time. Brooch pairs were used at the shoulders, whereas single brooches were used centrally in a more simply decorative function (Hirst 1985, 46-8). However, the degree of wear observed amongst large brooches varies in a similar fashion to that on small brooches, i.e. from 'nearly new' to severely abraded. It is therefore unlikely that even the largest brooches were used very infrequently or were made for burial alone. Instead, different combinations of artefacts may have been used on different occasions, thus causing some wear to occur on each item within a large personal collection.

d) Volume of crucibles

The volume of metal contained in the crucible must have been equal to the volume of the brooch plus extra metal for runners and risers. If the metalworker was very skilled, the amount 'wasted' would be small, but modern day practice is to melt much more than needed for the object, to allow for mould cracking and spillage. One might suggest that small brooches might be cast using a volume of molten metal at least twice the final volume of the brooch, but large brooches would need proportionately less, perhaps only half as much again as the final volume of the brooch. Using the figures above, each type A brooch would need a crucible capable of holding 20-30g molten metal and each type Z brooch would need a crucible capable of taking 120-150g molten metal.

Small brooch pairs are the most common type of pairs to be found but larger brooch pairs are also to be found (10 type C, D and Z brooch pairs have been recorded from the English database). If members of type D pairs were cast at the same time (i.e. using two moulds), the total volume of molten metal would be around 250 or 300g. Coincidently, ingots known from this period may also have weighed up to 270g, if pure copper (Brown 1986, 172).

There are no early Anglo-Saxon crucibles known to us at this time. There is considerably variety amongst the size and style of crucibles dating from the late Anglo-Saxon period but some

of them would have been suitable for containing this sort of quantity of metal (see Brown 1986, fig 4). In chapter 4, the chemical compositions of pairs of brooches may be used to establish whether crucibles with this considerable volume would have been used, or whether pairs (or larger sets) of brooches were likely to have been cast in more than one operation.

Conclusions

The existence of large amounts of copper alloy in the later phases of English cruciform brooch manufacture cannot be doubted. There may be social implications behind the technique of the late brooch styles. Certainly, the thickness of casting shows that metal saving was not an important consideration. Questions regarding the source of these supplies must be left to subsequent discussions but one might suggest that the mechanism that brought metal and metalsmith together was efficient.

Comparison with Norway and Holland

The English pattern of weight is to be contrasted with the Norwegian situation, where large, high-relief but comparatively light brooches were made during the latest phases

of production table 3.7a[15] . The method of producing this effect was discussed earlier. Here too, the emphasis is on ostentatious display, but without unnecessary expenditure of materials. Thin-cast brooches would have been more wearable. The evidence of pre-depositional damage patterns does not suggest fragility, since Norwegian brooches do not seem to have been dented in use.

The early brooches tend to weigh between 10 and 40g. Weights for later brooch styles range up to 130g but most southern brooches weigh 50-80g. It should also be noted that, although the frequency of discovery is much lower, the sixth-century north Norwegian burials are dominated by rather heavy brooches of Reichstein's Skogøya form (Reichstein 1975, *Abb* 8). Difficulties in metal supply are not indicated. If south Norwegian metalsmiths took the route of thin-casting, those in the north evidently did not feel the need. Reasons behind these patterns will be discussed later (Chapter 5).

Amongst the few complete Dutch examples, most are small and therefore light. A few larger brooches remain. These may be late and are rather massive e.g. Westerwijtwerd, Oosterambt, Gem Middelstum (Reichstein no. 753, *Taf.* 72,1) weighing 92g and Hoogebeintum, Kerkterp, Gem. Ferwerderadeel (Reichstein *Typ* Hoogebeintum, no. 747, *Taf.* 83,5) weighing 84g. These

[15] Unfortunately the state of preservation of many Norwegian brooches is extremely poor and the practise of chemical stripping is especially annoying.

examples are very solid and both have solid bows. The database is too small to be certain, but resources seem to have been quite adequate for the production of large brooches in the later phases of Frisian cruciform production. Danish and German brooches were not weighed in this survey.

8) Unusual technical features (Table 3.8 and Appendix 3.2)

The discussion above set out the normal pattern of production for cruciform brooches. There are a number of technical features which occur on cruciform brooches only infrequently. The observed frequency and distribution of occurrence is summarised in table 3.8 and the brooches listed in Appendix 3.2.

i) Ridge between knob and knob collar (fig 3.26)

If turning was employed during the manufacture of models for knobs then this feature could be inadvertantly produced. The low frequency of observation seems to indicate that it was normally possible to achieve a smooth surface. This effect must be differentiated from the deliberate creation of an extra collar for decorative effect (**Holywell Row Grave 48, Morningthorpe G358**). The Scandinavian and continental examples appear to be widespread and datable to *Stufe* D2 and D3, but the English examples are all brooches of either type A or B.

ii) Slots cut into the base of the sideknob (fig 3.28)

A line may be worn into the base of a separate sideknob due to movement. However, amongst brooches from several areas, it is noticeable that a slot was deliberately cut into the base of the knobs, so as to secure the position better. English examples have been observed on brooches belonging to a variety of types and distributed throughout the major concentrations of findspots, including Kent. This feature is less common in Norway, but it is found in Nordland, Rogaland, Vest Agder and Aust Agder, on brooches belonging to types of Reichstein's *Stufe* D2 and D3. The three examples from Denmark and Germany are typologically the closest to English forms, belonging to *Stufe* D2 or D3.

On a brooch from Grytten pgd, MR, Norway, two slots are cut, only one of which could have had practical use at any one time.

iii) Knobs with tabs (figs 2.5, 2.41 (Tuddenham 4), Map 3.2)

A small number of brooches have knobs which are cast separately and their position on the brooch stabilised with small flat tabs, which rest in front of the headplate. Top-knobs of this style were placed on a spike emerging from the top of the headplate. This is a design which is naturally rather unstable. Sideknobs are better suited to using this

technique, since the pin axis secures them. Many more examples may have existed originally, having now lost their knobs. The interest in this style of knob must have been quite strong, as the production of **Glentham 2** (type C1) attests. On this example, the knobs are cast with the headplate but the headplate is fashioned so the sideknobs appear to have been made separately, with tabs.

English brooches with this feature are generally of types A or B. A number of examples have other features which link the brooch styles with continental styles. For example, **Lackford 50,71** and **Barrington A 11** have simple but distinctive foot forms, which are similar to those found on Dutch and German members of Reichstein's continental *Typ* Midlum.

Few examples of this feature are known outside England. The links made through the feature between the pair from Skogen, Hedrum, Vestfold, Norway (Reichstein no 26, *Taf.* 116,6 and 7), a pair from Borgstedt, Schleswig-Holstein (Reichstein no 540-541) and **Barrington A 11** (type A3, fig 2.5) are especially significant (see discussion, below). The variation at the feet is less important when compared with the overall similarity, in terms of proportions (these brooches are within 5mm of being the same length), as well as knob and bow styles. The topknob of an additional example from Urn 250 Schmalstede, is also of this style, although the sideknobs do not appear to be so.

Several more examples can now be cited from Gudme, Denmark which extends the distribution to most areas of cruciform brooch production[16]. The broad distribution means it is difficult to suggest a single origin for this feature. Northern Germany is feasible, or possibly Frisia to judge from a close parallel for **Barrington A 11** found at Midlum (Reichstein no 749, *Taf.* 84,7).

Type B brooches with this knob style also tend to be simple forms but there can be no doubt that this technique was fully absorbed within the English range of designs (e.g. **Islip 2**, a distinctively English-style brooch). Most other English brooches with this knob style are less closely associated with these continental examples. Large and probably late English brooch forms use this topknob occasionally, which would seem to demonstrate yet another example of longevity of unusual technical features.

iv) Loop at the end of the animal head (Fig 3.27)

A loop at the end of the animal head could be used to suspend a metal tab, such as those on **Cleatham G34** and **Trumpington 2**. Other brooches with loops have now lost these endings, if they ever possessed them. No continental or Scandinavian examples have been observed but the pair from Skogen (mentioned under iii) above) seem to have a projection, which could conceivably

[16] Collections of the National Museum, Copenhagen

have been of this type.

v) Pin lug attached to lower edge of topknob collar (figs 2.2, 2.6, 2.8, 3.1)

This does not seem to have served any practical purpose, but occurs quite frequently in Norway and occasionally in Sweden, Denmark, Germany and England. In order that the pin lug can be attached, the topknob collar must be circular in cross-section, and the headplate should be quite small. This means the use of the feature is impossible, if knobs are cast with semi-circular cross-sections. Hence only English brooches of type A are capable of being included in the grouping and the feature disappears altogether in areas such as England where the semi-circular cross-section knob form becomes ubiquitous. A very broad range of brooch types have this feature in Norway, mainly within Reichstein's *Stufen* D2 and D3 but in Sweden, Denmark and Germany this feature is seen on *Stufe* C3/D1 brooches only.

This feature could have been produced by chance, or as a deliberate method of stabilising the topknob, in a wax model. The finished brooch would probably not require extra strength at this position. Catches and pin lugs may have been cut into the back half of the mould at a late stage of mould making. Elongation of the slot relating to the pin lug could easily be effected at this point of manufacture.

Conclusions

A ridge between knob and collar and attached pin lug and topknob are both infrequent and accidental features. Their distribution over a wide area shows similar methods of production.

The remaining features in this grouping were used as a deliberate policy, where the more common methods of manufacture were perfectly satisfactory. It is interesting to see that where these unusual features are to be found both in England and in other areas, the English dataset includes both early brooches (type A) and brooches from Kent.

Further unusual technical connections may be noted between Scandinavian and continental brooches. These are shown in table 3.8a and listed in appendix 3.3. They serve to show further links between these areas. The technical variation within the Norwegian corpus seems to have considerable potential for this type of study.

9) Decoration after casting (Figs 3.30-3.33, Maps 3.3- 3.5, Plates 1-7, 11-18)

In chapter 2, styles of applied decoration on cruciform brooches were mentioned but not fully discussed. In this project, the technology behind the decoration styles is as

important as their typology, so a fuller treatment was deliberately reserved for this chapter. I believe it is essential to understand the processes that formed the decoration, so that the methods of investigation chosen will be appropriate. From a technical basis, one can assess the likelihood of identifying workshops through punchmark data. It may also be possible to show how widely understood some decorational methods were and if certain skills were practised in particular workshops.

Punch mark styles (tables 3.9 -3.12, maps 3.3 - 3.5 , figure 3.30, plates 11-18)

Punch marks are commonly used to decorate the front side of cruciform brooches in England, as they are on other types of jewellery of the period. They are also found less frequently on cruciform brooches from other areas of production. Tools for making punch mark decoration could be quite small and easily transportable (fig 3.30). The idea of a particular punch mark style could also be conveyed in a artist's mind or on an artefact. It is therefore of interest to see how styles of punch marks are distributed throughout the area of cruciform brooch production.

The method of making the punch marks has been discussed by Leigh (1980, 258). The reversed image of the mark to be made is cut into the end of a blank, using filing and polishing, finishing by hardening (by heating until cherry-red and then

quenching). The punch is then used by being hammered into the surface of the metal, keeping the tool at right angles to the object (Fig 3.30).

Using enlarged photos, Leigh attempted to characterise the production of a Kentish workshop by the styles of tool use and by a set of punch marks. He outlined the characteristics of six punches and attributed differences in the style of use to their use by individual metalworkers. The use of particular tools cut across chronological and series boundaries, as would be expected in a single workshop (Leigh 1980, 278). Impressions were taken from a small selection of cruciform brooches and photographed using an optical microscope (Plates 14 and 16)[17].

The problems Leigh noted in the pursuit of this type of characterisation work were i) variation of angle and depth of strike, ii) degree of sharpness/effects of resharpening, iii) abrasion, corrosion and other alteration after punching, iv) visual or photographic effects. These effects are severe enough within a group of brooches which are clearly the products of a single workshop and production

[17] The best method for studying punch marks in a workshop milieu is by examination of impressions by scanning electron microscope. This method was succesfully used by Benner Larsen to identify the stages of construction of the Gunderstrup cauldron (Larsen 1989). Migration period bow brooches might be suitable for this type of research if the scope of the project was not too wide-ranging and there was a good chance of a particular tool being used on several brooches. The cruciform brooch dataset as a whole is too heterogeneous.

period, such as the sixth century great square-headed brooches of Kent. With a large and varied artefact group such as the Anglian cruciform brooch, it seems optimistic to expect to identify individual tools or workers[18].

The current project places the punch marks into groups without, in the main, trying to identify individual tools. Figure 3.30 shows idealised versions of punch marks seen on cruciform brooches, those in the top three rows being frequently found. The lower row of marks shows a few highly distinctive styles of punch marks, found on some late English cruciform brooches which seem to be of use in identifying particularly closely-associated brooches. Most of the punch marks seen on English cruciform brooches are less than 3mm across and many are less than 1mm across. The precision with which the punches were applied to brooches varies but in some cases punch marks are aligned very exactly.

In tables 3.9 and 3.10, data from 417 English brooches was used to provide information. The set of common marks includes those for which tools are not easy to manufacture and maintain. The maintenance of a tool would be an important factor, since the use of punches involves heavy wear. Larsen (1989, 404 and fig 30) suggests that damaged tools may have continued in use by being transformed progressively into

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[18] The factors Leigh outlines may cause an overestimate of the number of types of punches used on an individual brooch, e.g. if a circular (or ring and dot) punch is used obliquely in one area of a brooch and perpendicularly in another.

simpler forms (in his example, from a circle within a triangle, to a circle and finally to a semi-circle). Working on a large object, such as a cauldron, gives ample opportunity to detect such features, whereas individual cruciform brooches have quite a small surface area.

The forms most frequently seen on English brooches are single points (dots), semi-circles, double semi-circles, circle, double V-shapes, ring-and-dot and notching along ridges. The high frequency of complex tool marks in a variety of sizes and proportions and the existence of several complex punch marks on contemporary brooch types demonstrates that metalworkers were able to produce detailed and delicate tips for their tools. However the punch marks on cruciform brooches are by no means the most complicated of this period and, on the whole, they are smaller and simpler than those on square-headed brooches. The frequent occurrence of brooches with more than one punch mark type shows us that metalworkers would have a selection of punches available for use at any one time.

Patterning

The tables and maps show that none of the popular styles of punch mark have restricted distributions, geographically or typologically. The frequency of punch marks within county boundaries is roughly proportional to the frequency of brooches within the counties, i.e. highest in East Anglia and Lincolnshire. Kent, with few cruciform brooches, still

provides brooches with single points, semi-circles and ring-and-dot punch marks, i.e. the commonest types of mark. Although absolute frequencies are very low, there are indications that certain punch marks were preferred in some regions. The double semi-circle and ring and dot appear popular in Norfolk and Suffolk, the single ring appears most frequently in Northamptonshire, Lincolnshire and Cambridgeshire brooches often have semi-circles and triangles but V-shaped punchmarks are only common in Lincolnshire.

Typological associations

Although there are few examples of punch-marked type A brooches recorded in this data base, they include brooches with six common punch marks. These are mainly found on type A3 brooches, only very infrequently on type A2 brooches and not at all on type A1 brooches. Punch marks are only found occasionally on type B1 and B2 brooches, but, with type B3 brooches, an average of one style of punch mark per brooch is bettered. Amongst the larger cruciform brooches, the range of punch marks produced increased considerably and an average of one style of punch mark per brooch is observed throughout most of the remainder of the typology (even in the gilt, zoomorphic type Z brooches). Several special affinities can be seen between various brooch types and common punch types, e.g type B3 and the semi-circular stamp, type D5 with circular punches, but unfortunately, not between single brooch types and unusual punch styles.

These rather indistinct patterns are frustrating, suggesting that there was widespread and long term use of most styles of punch mark. It is likely that our database is as yet insufficient to show further detail. Additional confusion may be caused if brooches were cast in one locality and finished in another. Such late stages of finishing may have included punch marks as well enamelling (Danks 1977). It is also likely that one metalworker could have produced and marked several types of cruciform brooch, and/or other artefact types, within a short period of time.

Punch marks may have been the property and therefore the symbol of particular workshops or cultural groupings. Various factors, discussed in Chapter 5, make it unlikely that punch marks used on brooches had a very precise connection with the social identity of the owner (cf Richards 1987).

Large ring-and-dot designs (fig 3.31)

Small ring-and-dot designs are unusual. Those recorded in tables 3.9 and 3.10 as ring-and-dot are more than 3mm across. It seems unlikely that these designs could have been made by a single blow of a punch, since the area was too large. If a punch was used one would expect correspondingly raised areas at the back of the brooch (or file marks where such raised areas had been cleaned off). Neither of these features have been observed so far.

Close examination shows that the annular depression has curved marks at the bottom (e.g. on **Lakenheath 14** (type C2); fig 3.31).

The whole brooch could have been placed in a clamp and a tool shaped to take out a curved gouge (known technically as a scriber). Alternatively, the punches themselves could be made by turning. The turning processes could leave raised curves on the punch, which would be transferred on the brooch.

Although wood-turning is known from the seventh century, (e.g. at Sutton Hoo), metal turning is not known during the early Anglo-Saxon period (Brown, pers comm). The most likely solution is that these ring and dot decorations were formed on the model. Whether the model was of wax or a permanent medium such as wood or bone, it would be relatively easy to form such patterns.

Such rings could be filled with enamel. Several examples seem to have white material in their rings, (e.g. **Ixworth 3** and **4** (type C)), but unfortunately it was not possible to take a sample. Ring-and-dot decoration method was also popular in Scandinavia, although no examples have so far been observed to bear infilled material which resembles enamel.

Decoration on the catch

It seems rather perverse to put decoration on the catch, where it was concealed from everyone except the wearer. On the other

hand, the small scale of some punch marks suggests that cruciform brooches were made to be examined at close range, at some point in time, unless the metalworkers produced detail which was never appreciated by anyone but themselves. If artefacts were made to be passed around and/or gloated over in the hand then decoration on the reverse is more understandable, as is attention to casting detail at the reverse of the casting.

Some interesting details have been discovered on the reverse of examples of other Anglo-Saxon brooch types, e.g. an animal at the back of square-headed brooch from Wakerley, Northants, scratched runes on the reverse of another square-headed brooch from Flixborough, south Humberside (Hines pers comm) and zoomorphic additions to a catch on the back of a silver square-headed brooch from Bifrons Grave 63 (Hawkes and Pollard 1981, fig 8). A late cruciform brooch from West Heslerton, North Yorks, has four scratched runic letters (the reverse is illustrated in Powlesland, 1987 and the brooch is perhaps related to type Z3) but, on the whole, decoration on the reverse of cruciform brooches remains unusual.

Seven English cruciform brooches have sets of incised lines on the catches; **Cleatham G30 (3)** (type D5), **Cranwich** (large type B2), the pair **Little Wilbraham G105 (1)** and **(2)** (type D6, fig 2.46), **Newnham, Northants** (associated with type Z3), **Spong Hill C2195** (small type B1 or B2), **Wakerley 9** (associated with type Z1) and **Woodstone 6** (type C1, fig 3.3). **Carlton Scroop**

2 (large type B1) has crossed incised lines, apparently scratched on late in the manufacturing process. The styles of brooches carrying catch decoration are very varied and do not seem to have any typological associations, although they could all be late in the production sequence.

Another minute detail

A very unusual detail can be used to link the typologically early Colchester 2 (type A2) with brooches from Germany and Denmark. This is a small zig-zag line, apparently scratched onto the brooch after casting, usually placed within the facets of the catchplate (Fig 3.34). Reichstein *Typen* Dorchester and Groß Siemß cruciform brooches from Bordesholm and Borgestedt, Schleswig-Holstein and from Denmark are known to have this form of decoration (see e.g. brooches KS 10323, KS 3903 b, KS 4024 B, KS4024p A, KS 4025b, KS 4025b15 from Schloss Gottorf collection and Copenhagen C6394) as well as Nydam type brooches from the same region (see e.g. KS 4021p, KS 4026a1, KS 4026a3 from Schloss Gottorf collection and Gudme x1143, at Copenhagen). In the case of Colchester 2, the method of execution of the design as well as the style and position of this decoration appear to be so identical to that observed in Germany and Denmark, it seems very likely that the Colchester brooch was imported.

Two other decoration forms are seen so frequently on cruciform brooches that detailed investigation of their pattern of use

seems likely to be unproductive. These decoration types are listed below.

Straight, incised lines (fig 3.32)

In all English cruciform brooch types, even the simplest, the bow is frequently marked, above and below, with a straight line. Further lines are often found on the catchplate, singly or in groups. These appear to be formed by a single impact from a straight-edged tool, but it is difficult to say whether this was done on the completed object or on a model. As the lines on the bow do not differ significantly in form, from the incised lines around knobs and collars, which would have been very difficult to complete on a cast metal object without a high failure rate, it seems likely all incised lines were completed on the model.

This agrees with the smoothness with which these fine decorations are carried out. They are free from 'feathering', which would be seen if the line was made up of individual blows from a small chisel-edged implement and from other irregularities that might be expected, if decoration was carried out on the metal itself (see e.g. Scull 1986).

Notches (fig 3.33)

Matching pairs of notches are frequently found above and below the bow and on the catchplate, above the facetted area. These

are normally rounded but occasionally square edged. In both cases it would have been possible to complete these effects either on the model or on the finished brooch.

Comparison with continental and Scandinavian cruciform brooches

Comparing the pattern relating to English cruciform brooches with that abroad (table 3.11), one can see that there are some clear differences, with further internal patterning visible in Norway, where there are sufficient examples (table 3.12 and 3.13). Punched decoration is not as frequently found in Scandinavian brooches as in English brooches and the range is less extensive.

Ring and dot designs are especially numerous in Norway, Sweden and Denmark, notably in the south of Norway and in Sweden. Regional differences can be demonstrated, for example, in Nordland ring and dot designs were not recorded on cruciform brooches. Notching was often used down raised ridges on north Norwegian brooches from both Reichstein's *Stufe* D2 and *Stufe* D3, i.e. *Typen* Skogøya and Rossoy, as well as on a scatter of other brooch styles from further south. Other punch designs are only infrequently found, although, not surprisingly, single points were probably among the first to be introduced. The use of punch tools is only evident in later phases, Reichstein's *Stufe* D2 and D3. There are possibly small concentrations of punch mark usage in Rogaland and Nordland.

The pattern of use in Denmark appears to be quite similar to that in Norway. In Germany, few brooches have punch marks and with so few late examples from the area or Dutch examples with punch marks, it is difficult to discern patterns in these areas.

Comparison with other artefact types

Punches are a simple way of providing decoration and texture to a metal surface and were used in other areas at this time. It is interesting to see how fashion in this respect varied on other artefact types.

With few detailed databases on contemporary material, direct comparisons are difficult. However, there is considerable overlap between the range of punch marks commonly used on English cruciform brooches and those used on the English great square-headed brooch (e.g. Leigh 1980, figs 70-73). These forms are also used on contemporary silver foil brooches from Sejflod, Jutland (Larsen 1989, 402-7). These punch mark styles are so common that their distribution merely marks the extent of the northern Germanic culture in a very general manner (punch marks on Frankish or southern German artefacts have not been studied in this respect, as far as I can discover).

Points of particular similarity with square-headed brooches include a single example of a brooch from Bifrons with what seems to be the segmented Y-stamp (Leigh 1980, fig 70, Bi 4).

There are many other complicated stamps used on great square-headed brooches, which are not known on cruciform brooches, especially those with multiple internal elements (e.g. Leigh 1980, fig 70 and Green *et al* 1987, fig 389).

Summary

Early brooch forms were not normally decorated after casting. Punch marks were used frequently in late English brooch forms. The number of punch mark types and the number of individual punch marks per brooch varies, the highest frequencies being those observed on type D brooches.

The use of individual punch marks was not restricted to particular typological groupings. The skills necessary to form the punches were available throughout the Anglian area. The most common forms were also used on Scandinavian and continental cruciform brooches and on other artefact forms. Complicated forms are found comparatively rarely on cruciform brooches and use of these forms may have been restricted to a small area or a small number of workshops.

Discussion

The frequency of usage of punch mark forms is not the same throughout all areas of cruciform brooch production. This may be for a number of reasons. Chemical analysis suggests that all metals used to cast cruciform brooches were suitable for

punch marking (Chapter 4). Workers in one area may have lacked the metal or knowledge appropriate to the manufacture of certain types of punches. Certainly punches are not normally used on the late southern Norwegian forms (i.e. *Typ* Mundheim), where, because of the thinness of the casting, the punch might have pierced the artefact. However, this problem could have been simply overcome, by placing a resilient material behind the area to be decorated. The move towards forms without punched decoration must have been a deliberate policy. The visual impact of the high-relief cast design may have been considered adequate or, if late Norwegian brooch production may have been dedicated to increased output, the time consumed in punch-marking artefacts would not be economically justified.

Leigh (1980) states that large sixth century brooches had non-functional attributes, acting as amulets with religious concepts implied by the Style I ornament. It might be possible that punch marks on cruciform brooches had a religious significance. The tiny dimensions of punch marks provide a parallel with complicated animal ornament, since careful examination would be necessary to understand the implications of the decoration in either case. Style I ornament is found occasionally on small areas of type D brooches and in greater amounts on type Z brooches. If punch marks have a symbolic import, this may have been transferred to cast ornament in later brooches, since type Z brooches have fewer punch marks than type D brooches on average. With gilding, white metal and

zoomorphic ornament covering most of the front surface, there was little room or need for punch marks. However, late square-headed brooches have gilding, silvering and rich embellishments of punch marks (Hines pers comm).

Hence the range of punch marks used on English cruciform brooches seems to cover only a small part of the total set known and used in Migration Period manufacture. They demonstrate an attention to detail that was considered suitable for many jewellery types but the information from cruciform brooches seems to have the potential to display relatively small amounts of information, when compared with other forms.

Surface layers

White metal treatments and gilding are found infrequently amongst English cruciform brooches, except in type Z brooch forms, when such surface treatments become normal (see tables 3.9 and 3.10). Techniques by which white metal and gold surfaces could have been applied to copper alloys have been well discussed (e.g. Oddy 1980, Tylecote 1985a). These techniques are further proof of the expertise and ingenuity of the artisans in high temperature methods. However, it will be seen that Anglian metalsmiths did not always use sophisticated methods of applying surface layers.

a) Gilding

Mercury gilding (also known as fire gilding) was the normal method of operation at this time. This was probably achieved by spreading a gold-mercury amalgam over the surface and heating to around 357 °C to drive off the mercury (Roth 1986, *Taf.* 25). The alternative method which Oddy suggests (*op cit*, 131), in which mercury is spread over the surface and gold leaf is rubbed on, would be impossible for pieces with such complicated surface morphology. It has been noticed previously that, on some areas of disc brooches, the gilding appeared to have flowed out past the intended areas, which suggests the use of rather a liquid amalgam (Avent 1975, 14).

Which of the known sources of mercury were used is not clear but trade is certainly indicated. Material originating from the Spanish ores seems quite likely, although it may have passed through several hands before arriving in this country. Although the extractive industry in Spain may have been in decline (Brown pers comm), there are few other credible sources for the metal. Mercury was used for gilding in Roman times and metallic mercury was apparently found at Hedeby (Tylecote 1976, 101[19]).

Sources of gold are more numerous, including several in the west of the British Isles. Continental gold coins may have

[19] This observation has not been confirmed.

been used as the primary source at this time. Access to both gold and silver was always much better in the south-east of England during the period of study, with Kent occupying a controlling role. The use of gold on type Z brooches may demonstrate a phase of improved availability for gold, during the late sixth-century (Arnold 1980, 91).

Gilding techniques included some styles of manufacture which produced thick layers of gold (e.g. **Sleaford G169, plate 5**). This demonstrates the ability to spend a long time over gilding, as well as good access to gold and mercury. Other examples are much less thickly coated.

The composition of surfaces does not appear to have been a factor which was controlled, during the production of cruciform brooches with surface coatings (see Chapter 4).

b) White metal surfaces

White metal surfaces on Anglo-Saxon artefacts may have been applied by silvering (which may also be achieved by mercury processes) or by tinning, achieved by rubbing a tin stick over the brooch at a an elevated temperature (232 °C) or possibly by cementation (i.e. heating a tin compound on top of the metal surface). The results of testing early Anglo-Saxon pieces, from sites in Norfolk, Suffolk, Oxfordshire and Kent suggests that tinning was used very infrequently, except on disc brooches (Brownsword *et al* 1986; Mortimer *et al* 1986; Mortimer

1988; Oddy 1983; Wardley 1984; Wilthew 1985a and b)[20].

Silver peaks are unmistakable on spectra produced by simple, non-destructive X-ray fluorescence analyses. The evidence for tinning is more complicated. Where the composition of the underlying metal has been determined in a completely non-destructive analysis (i.e. without removing corrosion products), it is extremely difficult to prove that there was a deliberate tinned (or tin-lead/lead-tin, see Wilthew 1985b) surface. If the underlying metal is a tin bronze, tin peaks will be present in the spectra, without any component from an applied surface layer necessarily being present. Corrosion will mean that any comparison of white metal on brooches with untreated surfaces by surface analysis will be inaccurate and prone to misinterpretation.

The tinning observed on these artefacts is unlikely to be 'apparent tinning' (Tylecote 1985a). 'Apparent tinning' may be caused due to corrosion processes, in which other metals were preferentially leached from the surface. The casting phenomenon known as inverse segregation or tin-sweat, could also be relevant. In this case, tin-enriched solutions would be the last to crystallize in a casting and would be squeezed to the surface. The real nature of the tinned surface can only be checked using destructive methods, i.e. taking a section across the surface of the brooch.

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[20] Thanks are due to Duncan Hook for arranging access to the British Museum brooches for XRF analysis.

In the case of cruciform brooches, only limited areas have silvery colour. Unpredictable effects such as those of corrosion and casting processes are unlikely to have occurred so consistently and so the white metal portions of cruciform brooches must have been deliberately treated.

White-metal areas tend to be at the edges of brooches which are also gilded, e.g. fans on knobs, lappet edges, fans at the end of the animal head or on prominent areas such as the rise of the bow (see plates 1-7). This may be due to the fact that these areas of a brooch were more accessible than areas in the centre.

So far, there is no clear evidence for tinning on cruciform brooches. A technique for applying white-metal coatings that is not temperature dependent is to rivet on silver strips, using ferrous, copper-alloy or white-metal coated rivets. This technique is seen in type Z3 cruciform brooches only and tends to be applied to central areas of brooches, often around the headplate area.

Riveted strips were not used merely because other methods of applying white metal surfaces were impractical on the base metal of these particular brooches; other areas of the same brooches have white metal decoration which must have been applied by other methods (since no rivets are visible). Hence it is not appropriate to suggest that the composition of type Z3 brooches meant that normal methods of applying white metal coatings would not work.

Gold foils were often used in Anglo-Saxon jewellery, as backings for garnet inlays and as decorative elements in their own right. The manufacture of foil probably involved processes which are still used today, i.e. hammering plates of metal between layers of leather. Although silver is not as soft as gold, the purity of silver pieces used on Hoxne (Hughes and Tite 1977) would be suitable for this sort of foil-making process.

It is noticeable, especially amongst the type Z3 category, that some white metal areas appear as distinct sheets or foils (e.g. Baginton 4, plate 7), not as smooth, bonded surfaces (e.g. Longbridge, plate 6). These foils are now often lifting off the copper alloy surface, due to post-depositional effects (of burial, excavation and storage). Silver foils were probably attached using 'soft', i.e. lead-tin solders (no mercury was detected). Hence, it is possible that some white-metal surfaces which have a smooth, bonded appearance are the remains of solder, rather than the original white metal layers. The consistent appearance of the foil method of white metal surface application on type Z3 brooches echoes the close typological links between members of this brooch style.

Scandinavian and continental parallels

In Scandinavia and on the continent, gilding and white metal surfaces are extremely rare, throughout all periods of cruciform brooch manufacture. Furthermore, surface treatment

frequently appears on brooches which stand out as extraordinary amongst their compatriots. Gilding occurs on a few silver cruciform brooches (Gunderup, Vreilser s, Børglum h, Copenhagen Mus C7431; Unknown provenance, Denmark, Copenhagen Mus, no accession number, probably Reichstein's no 520; Danmarksby, Stockholm Mus, find no A141 F184). Other contemporary brooch forms, such as silver-sheet brooches, are also gilt.

A white metal strip was applied to an unusual brooch found recently at Midlum, Gem Franekeradeel, Friesland (De Vrije Fries LXVIII 1988, 180). The curious stylistic links with a Danish cruciform brooch from Strandelhjørn, Bevtoft s., Nørre Rangstrup h., Haderslev a (Reichstein no 448 Taf *125*. 12) were noted.

The brooch from Gunderup is very unusual in having inlaid white metal strips and rectangular applied gold foils. The closest technical links I have seen for the applied foils, are those on **Hoxne** which also has inlaid white metal strips. On the English brooch, the white-metal strips have been tested and shown to be silver. The gilded foils are backed onto a copper alloy tray, which may also be the technique used in the Gunderup brooch (chemical data and metallurgical sections were not available for the Danish example).

The use of foils in copper-alloy trays is a trait of Style II ornament (Speake 1980; Brown pers comm). The decoration at the

lappets and on the gold foils of the Gunderup brooch is clearly zoomorphic and therefore highly unusual within the Danish database. A mid-sixth century date is probable.

A brooch from Store Stensingmark, Understed s., Dronninglund d. (Copenhagen Museum C26076, Reichstein *Taf.* 120,6) also has inlaid white-metal decoration - ring-and-dot designs and a decorated plate riveted to the headplate. In this case, the white metal was available in strips. It was cut to approximately the right size and curled around inside incisions on the copper alloy surface.

These two Danish pieces, found at sites only 30km distant, are clearly similar in their overall proportions, unusual knob styles, flattened bow arches and white metal rivets. They also both have applied decoration which includes strongly zoomorphic motifs. A single workshop origin may be suggested for these brooches.

Conclusions

Amongst English brooches, the techniques of surface coating are distinctive within particular typological groupings. High temperature processes involving mercury gilding were well-controlled but white metal surfaces were often obtained using simple mechanical methods.

In England and Denmark, cruciform brooches with surface

coatings and inlays were made in the sixth century. Continental and Scandinavian craftsworkers did not use gilding on copper alloys, but did apply gold and white metal pieces to copper-alloy brooches using mechanical means. An interest in contrasting metal colours is evident in most areas, excluding Norway (for this brooch type).

Glass and garnet inlays

Seven type Z cruciform brooches in the survey were decorated with small inlaid elements. Some of these inlays are now in very poor condition. Probable glass inlays include **Morning-thorpe G353 (1)** and **Sleaford G50** (plate 1). The inlaid areas on **Lakenheath 8** may also be glass, now decayed to a red paste, which somewhat resembles enamel. Garnet survives post-depositional effects much better. Example of garnet inlay may be seen on **Brixworth 2** and **Brizlincote** (type Z3), on the foot of the type Z1 or Z2 brooch **Sleaford G169** (plate 5) and on the type Z4 square-headed/cruciform hybrid **Kenninghall 12.**

The use of inlay on cruciform brooches was much less frequent than that of gilding and white metal treatments. However, this decorative technique was practised within workshops producing most forms of type Z brooches. On simpler brooches, circular and rectangular knobs are often found on bows and on other areas of brooches, thus providing an alternative to true inlays.

Order of technical processes

Performing both tinning and gilding on a single object may be problematical. Oddy proposed that tinning should be carried out first. The object would be kept at an elevated temperature for several days (to allow diffusion of tin to occur) and then gilded (Oddy 1980). In the case of type Z3 cruciform brooches, attachment using white metal strips rather than chemical methods decreased the amount of control necessary.

Garnets and glass inlays would be placed in position last of all, to avoid damage by heating. Enamels were not often used, but if large ring-and-dot decorations (described above) were filled with enamel, this could have been carried out soon after casting, since brooches with this decoration are not gilded or coated with white metal.

The evidence of decoration techniques

1. Punch marks on English brooches are very widely spread geographically and typologically, with only slight indications of regional preferences. The level of association is too general to use the data for the identification of specific workshops, without extensive microscopic examination.

2. Most metalworkers or workshops possessed more than one punch. Some used the punches on more than one artefact type.

3. Punched decoration was less frequent in non-English areas of cruciform brooch production, as were gilding and white metal treatments. Applied decoration is a late feature in each area.

4. Patterns of association between decoration styles and types/regions seem to be more clearly defined in Norway than in England.

5. The function of punch marks is unlikely to be symbolic or ritual but they do add texture to plain areas, amongst increasingly large brooches.

6. Mercury gilding was practised in an efficient manner. Other metal coatings were not always obtained using high-temperature techniques. Surface treatments of this kind are infrequent, but more common in England than abroad.

D. Understanding technological variation in English brooch styles

It is difficult to comprehend the cumulative effect of such large amounts of data, when the evidence is presented piecemeal. Most techniques of construction were used widely, on many brooch types and sizes. On the other hand, it is clear that some technological aspects were used so rarely that they may be informative on the basis of a single attribute alone. These exceptions were found amongst early brooch styles, likely to have connections with continental brooch forms or within late brooch styles, with zoomorphic decoration.

This sort of technical evidence can be used as further data to confirm theories based on typological evidence. For example, the mid-fifth century cultural parallels based on the observed typological similarities between England, north Germany and Holland, are strengthened by technical data concerning the pin lug and sideknob. The typological 'distance' between late fifth- and early sixth-century Norwegian and English brooches are echoed in the strikingly divergent casting methods. Catch length and sideknob attachment data show parallel styles of development in the early period and the emergence of a distinctive English style in the late fifth century. Kentish cruciform brooches are shown to have several unusual manufacturing features. A summary of this type of information is given in table 3.14.

A more detailed consideration of the potential of

technological information from early brooch types follows.

Early cruciform brooch types

Type A brooches are the English examples which are most like continental brooches, typologically. When comparing their technical attributes with those of contemporary cruciform brooches abroad, there are a number of points of disparity. Three out of six English type A3 brooches have hollow bows, whereas all the early continental brooches have solid bows. Catches on Anglian types A1 and A2 are long, but generally not as long as on the continental parallels. The English brooches are all rather smaller than the continental examples.

One or two unusual features were observed amongst English type A brooches which provide particularly strong links to themes pursued within continental production (e.g. the occasional use of copper-alloy wire or of catches running the entire length of the brooch foot).

Type B brooches also show a fair degree of similarity with their continental contemporaries (i.e. brooches from Reichstein's *Stufe* D3). At this time, both regions were conversant with methods that produced a casting that was flat or concave at the back, in contrast to the earlier methods which produced convexity at the back and allowed undercuts. Catches are normally rather shorter than amongst brooches from the earlier period and punch marks became popular. The use of

two pin lugs is also a significant, if rare occurrence.

There are, however, some important regional differences. The Anglian sideknob style changes completely; semi-circular cross-sections are the norm and circular topknob cross-sections are only seen where the topknob was cast in a separate operation. In other regions, the earlier methods were still retained, for example, late German and Danish brooches are occasionally seen with circular topknobs cast with the headplate. To take a further example, continental workers were completely converted to the method of casting sideknobs with the headplate. They did not arrive at the method of casting sideknobs with the headplate by the half-way measure of continuing to pierce sideknobs, as did the English workers.

Both regions showed a measure of stylistic conservatism, but it seems that the continental production style shows greater appreciation of the possibilities raised by technical innovation. Kentish brooches may have more direct parallels with continental practices, since many Kentish brooches with type B style animal heads also have circular cross-section (type A style) topknobs (Chapter 2).

On the whole, fifth-century changes in Anglian brooch production seem to have run in parallel with those in continental brooch production. The production used for Kentish brooch styles may have been even closer.

Technical differences between regions that were observed in the cruciform brooch database are interesting, but they are details. When viewed from a wider perspective (e.g. if the Scandinavian data is included), they were probably not of consequence in restricting practical or decorative themes. Particular similarities between individual brooches may be used to exemplify this.

Similarity of some English, continental and Scandinavian brooches using technical and typological data.

A number of examples were chosen, with a view to investigating the links between two particular brooches (**Trumpington 2** and **Barrington A 11**) and other members of their Reichstein *Typen* and with other English brooches in general. It was suggested above (Chapter 2) that the Trumpington example is not particularly close to the Norwegian pair from Skogen, but belongs to the English type C grouping. **Barrington A 11** has been assigned continental parallels from its typology.

These two English brooches were amongst those discussed in section 3.8 above. In this section, a series of unusual technical features were shown to be of interest in linking a small number of English brooches with others from abroad (e.g. knobs with tabs, loop at the animal head). Further English examples with these characteristics were chosen for the purposes of comparison.

The following typological and technical attributes were used: style of topknobs - with/without tabs, circular cross-sections, indents and decorative lines; style of catchplate - with/without lappets; style of headplate, square or expanded; style of bow - with/without lines and/or with a central furrow, curving sides, solid cross-section or not; style of eyes on animal head - pointed or otherwise; style of nostrils on animal head - oval or rounded; loop at the end of the animal head; crossed lines over animal head nostrils; decoration on catch.

The theoretical maximum value for similarity is 15. Very few of the correlations are above half this value so any value of 8 or over is highlighted, below.

Similarity coefficients

	1	2	3	4	5	6	7	8	9	10	11
2	**10**										
3	5	6									
4	7	8	5								
5	5	4	2	7							
6	7	7	6	**8**	7						
7	6	6	5	7	7	**9**					
8	6	6	3	7	**8**	7	**9**				
9	5	3	6	3	3	4	3	2			
10	3	3	6	5	4	6	4	3	7		
11	6	6	8	6	3	7	6	4	6	6	
12	5	5	6	7	2	**9**	6	4	6	**9**	**8**

Coding for brooches

1 Midlum, Hoge Terp, Gem Franekeradeel R749; *Typ* Midlum
2 Borgstedt, Schleswig-Holstein R540; *Typ* Borgstedt (Fig A.1)
3 Skogen, Hedrum pgd, Vf, Norway R26 (pair); *Typ* Trumpington
4 Barrington A 11, Cambs (type A2) R768; Reichstein *Typ* Midlum
5 Spong Hill C1468 (1), Norfolk (type A2)
6 Spong Hill C2656, Norfolk (associated with type A2 or A3)
7 Colchester 2, Essex (type A2)
8 Colchester 3, Essex (type A3)
9 Trumpington 2, Cambs (assoc. with type C) R802; *Typ* Trumpington
10 Bergh Apton G6 (1), Norfolk (type B2)
11 Cranwich, Norfolk (type B2)
12 Cleatham G34(3), S Humbs (type B2)

The last four English brooches all have loops at the end of the animal head.

The tabulation illustrates complex relationships between brooches and similarity between brooches from different areas. It can be seen that the Skogen pair are not particularly well linked with **Trumpington 2**, nor are the other English brooches with loops at the end of the foot, except **Cranwich**. **Cranwich** is rather an unusual brooch within the English corpus but one glance is sufficient to realise that it does not look like an Scandinavian import. The high correlation with the Skogen pair is fortuitous.

The Barrington, Spong Hill and Colchester brooches form a linked group as do the Bergh Apton, Cranwich and Cleatham brooches. A connection between these two groups may be made through **Cleatham G34(3)** and **Spong Hill C2656**.

This table confirms that a good correlation exists between the Midlum and Borgstedt brooches. Hence a separate type for the Borgstedt brooches seems to be unnecessary (Reichstein 1975, 46).

In forming Reichstein's *Typ* Trumpington, a technical feature seems to have been selected as being of overwhelming importance - i.e. the presence of a loop at the end of the animal head was the major reason for type membership for the Norwegian and

English examples of this particular group (Reichstein 1975). However, this fresh measure of similarity shows it is much more sensible to associate together a) the Borgstedt brooch tabulated above, b) one very similar example from Borgstedt (Reichstein no 541, KS 4024p), c) the Skogen pair d) **Barrington A 11** and e) the brooch from Midlum. The source for these brooches is likely to be in northern Germany or Frisia, judging by the frequency in distribution of parallels for each of the idiosyncratic features noted (i.e. knobs with tabs, rounded 'embryo' lappets, furrows down the bow). The Trumpington brooch itself clearly fits in well within the English corpus.

These cruciform brooches, found in a number of regions, have many typological and technical attributes in common. The groupings detected represent typological groupings, not workshop groupings. This example confirms how difficult it is to select variables which are both meaningful and easy to observe objectively. Further tests of this nature will not be entered into here.

Type Z brooch features

Some type Z brooch groups had clearly distinguishable, unusual methods of construction, notably the attachment of silver strips using rivets in type Z3 brooches and the use of hinged pins on type Z4 brooches. Other brooch groups show exclusive use of certain technical practices (e.g. sideknobs cast with the headplate on type Z1b and Z2b brooches) or definite preferences

(e.g. two pin lugs, on many type Z brooch forms). These techniques were known amongst other brooch forms (e.g. type D brooches) but were not normally used exclusively or preferentially in these types.

There is a small amount of typological and technical evidence for suggesting that the continent and Denmark also saw further development along the lines of that shown in England (see especially notes on surface applications in section 3.9 above).

Other brooch forms

Apart from these forms, brooch groupings gained by typological means do not possess particular clusters of technical attributes. The difficulties of interpretation may be illustrated by studying combinations of technical data. Table 3.15 displays the technical variation observed within the cruciform brooch dataset, based on five variables which are present on all complete examples and which may be expressed in binary form (presence/absence) - bow cross-section, sideknob attachment and cross-section, pin lug and angle of headplate wings. The status of each of these attributes is contained in the combination coding.

Each brooch design is counted separately i.e. pairs are counted only once. A count is only made where the brooch is complete enough to assess the evidence for each of the attributes encoded. Seventeen combinations were found to be used, including

three combinations which were used on one brooch form each. This is much less than the theoretical maximum ($2^5 = 32$) since some possible combinations are never used (e.g. sideknobs with circular cross-sections, cast with the headplate).

1) Correlations of production types

It is interesting to see that two combinations used in type A3 (numbers 3 and 4) were adopted in a small number of other brooch types - types B2 and small B1. Furthermore, some of the examples of these combinations are Kentish (e.g. **Bifrons 1**), have other unusual typological features (e.g. **Illington** with knobs with tabs) or may possibly have replacement sideknobs (e.g. **Holywell Row G48 (3)**). It is possible to find reasons to state that the other brooches made using technical combinations 3 and 4 also lie outside the main themes of typological development, e.g. **Cleatham G30 (4) and (5)** has a rather simple nose style, (as seen on **Barrington A 11**) and a knob with a circular cross-section cast with the headplate. So these brooches with unusual technical attribute combinations confirm patterning already detected in the study of individual typological and technical attributes.

These are rare exceptions from the general pattern of combinations used. Since sideknobs with circular cross-sections are not used on most cruciform brooches, combinations 1 through to 4 drop out of circulation. Amongst type B, C, D and Z brooches, ten technical combinations are frequently used. The

most popular combinations overall are numbers 8, 9 and 10. These have hollow bow cross-sections, single pin lugs and sideknobs with semi-circular cross-sections in common but with different methods of attaching the sideknobs and different angle of wing to headplate. Although three rare combinations were only used by three particular brooch types and combination 14 was used by type D brooches only, none of the brooch types used one combination[21] exclusively.

Preferences for individual brooch types may be discerned. For example, small type B2 brooches are frequently found with combination 6. Types C1 and D6a use combination 13 relatively frequently. Type Z brooches may employ a slightly smaller number of combinations (often those with two pin lugs). It seems that brooches of types D1 and D5a reveal identical ranges of combinations in manufacture (numbers 5, 8, 10, 12 and 14). In these examples, the number of samples is too small to be sure of the significance, but these factors may be borne in mind for the purposes of discussion in Chapter 5.

A search for regional production preferences was not very revealing. Two unusual combinations, numbers 11 and 14 on table 3.15, can be shown to have distributions which are almost mutually exclusive (Map 3.6). This is not simply a reflection

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[21] Table 3.11 includes examples which are 'associated with' types as well as central members of types, including a small number noted above to have strong correlations with particular methods of construction. This may reduce the ability to detect some correlations, but is necessary to provide enough examples for balanced discussion.

of the type of brooch on which these combinations were used. Combination 11 is mostly used in type Z brooches, but the exceptions to this rule (three brooches of types B and D) are not those examples which lie outside the main geographical grouping of the combination. Combination 14 is used on various type D brooches, showing a spread in the west of the CSNE group of sites and in the midlands.

This evidence gives an indication that some methods of brooch manufacture were associated with metalworking traditions in particular areas. However, most technical attribute combinations have widespread use.

This tabulation shows that there was a great deal of continuity and of variety in English production styles, after the earliest phase of cruciform brooch use. Manufacture was not systemised. Further variety was introduced within the production of later brooches styles but the newer styles were used for both large and small brooches and throughout the Anglian area.

The technical combinations used here employed the variables which are the simplest to quantify, in a binary fashion. Other attributes, and attribute combinations may be relevant. These may be tested, during further research.

Norwegian comparison

The English dataset can be compared with a small amount of

Norwegian information. The attribute combinations in table 3.16 are based on a different range of technical variables to those used in table 3.15, since a different set of technical variables are available for discussion. The dataset is rather small and of necessity biassed towards the late brooch forms (since there are many more extant late brooches than early brooches). Fourteen different attribute combinations were used, of which only two could be said to be commonly used. These popular combinations are similar in having the sideknobs cast with the headplate, a hollow bow cross-section, single pin lug and iron pin. They differ in sideknob cross-section, most having semi-circular sideknobs but quite a few having the distinctively Norwegian-style circular cross-section.

Combinations seen on the dominant early northern type (*Typ* Røssøy, from Reichstein's phase D2) are generally not retained in later production, with one exception (CSSFH) which then becomes dominant. Production of *Typen* Lunde and Eine, early southern types, employed a wider range of combination types which were also used later. Overall, the differences between early and late styles of production in Norway are much more extreme than those observed in Anglian England. The speed and completeness of the conversion to thin-casting is significant.

Continental and Danish information

Table 3.17 shows that seven technical combinations were used on the mainland. Of these, two 'early' methods with separate

sideknobs and circular cross-sections dominate (they differ only in the type of metal used for the pin), since the majority of the database is early in date. Separate sideknobs are rarely found on brooches with bows with concavities at the back. Where sideknobs were cast with the headplate, the bow may be solid or hollow, but otherwise the only departure from a standard formula (i.e. CSSFS or CSSFH) is seen in brooches with two pin lugs.

Hence it can be seen that cruciform brooch production on the mainland became more or less uniform in the later phases of production.

2) Measures of heterogeneity - richness and evenness

It is difficult to describe the amount of patterning seen in these studies. The technological data may be said to show diversity, variation, variability or heterogenity. Even assuming that our database represents an unbiased sample of the whole, these terms can only be interpreted relative to the amount of data collected and to the amount of variation possible.

Recent discussions relating to quantifying diversity in archaeological data emphasise that it is important to provide indices for both 'richness' and 'evenness' (Bobrowsky and Ball 1989). These may be combined in a single value, 'heterogenity', at the risk of 'masking the different properties of richness and evenness' (*ibid*, 7). One or other of these concepts is frequently ignored, in archaeological discussions.

Various methods of calculating richness were proposed by Bobrowsky and Ball (*ibid*, 5). In this case, richness is the number of ways in which the values for each technical attribute can be combined (referred to here as combinations). In this project, with statistically small populations, a simple ratio,

$$\text{Richness} = \frac{\text{number of combinations observed}}{\text{number of brooches}}$$

can be used.

Evenness can be expressed as the standard deviation, i.e. the sum of the deviations of the observed frequencies from the expected value (Hayslett 1968, 30). In this case, the expected value can be taken as the average number of examples per class, in each brooch type. However, the standard deviation will be dependant on the number of examples and classes present, so the results from classes of different sizes would not be strictly comparable. Multiplication by the richness index gives a correction to these values. Bobrowsky and Ball note that 'evenness remains an awkward property to measure' (*op cit*, 7).

Small datasets are likely to give unreliable results, so classes with less than ten samples are not used for evenness calculations. The 'raw data' counts (frequency of each combination) could be seen as equivalent to Whittaker's abundance values mentioned by Bobrowsky and Ball (*op cit*, 7). These give a visual impression of the quantified data.

The results of analysis of richness and evenness in technology amongst types of English cruciform brooch, using the binary technological data employed in table 3.15, are displayed in table 3.18. The amount of information available is clearly influential, so an arbitrary limit was imposed; data were only used where n, the number of samples, was at least twice N, the number of classes, and where n was also more than 10.

It can be seen that the classes which are selected as being 'rich' (i.e. use a relatively large number of combinations) are those with small n values. Similarly it is difficult to tell whether the evenness value is statistically meaningful, except where many brooches were available for inspection. .

The best solution to this problem is to combine the results of several types together. Table 3.19 shows that such an operation minimises the differences between 'richness' values for each brooch type*. Common brooch types (e.g. type D) appear to be the least rich. This probably represents the fact that the number of brooches examined has achieved a critical value, beyond which it is very unlikely that further combinations will be discovered. On the other hand, the production of type A brooches seems to be quite rich, despite the fact that we believe that the small dataset available to us represents most, if not all, of the technical combinations likely to be found on a type A brooch (from continental parallels).

*not all brooches from Table 3.18 are represented in Table 3.19

Cumulative frequency plots

The discussion above revealed some of the difficulties of quantifying technical diversity. If our richness index is taken to its logical conclusion, the more examples examined, the higher the possible number of combinations. However, none of the brooch types shows anywhere near the theoretical maximum variety in production. Since we suspect (although we cannot be sure) that much less than the theoretical maximum number of combinations were ever used in production, the maximum number of combinations detectable, in reality, will be lower than the theoretical value.

Where a large number of combinations were used but the production is dominated by a small number of the possible combinations (e.g. small type B2 and B3 brooches), one would expect the likelihood of finding more examples of different combinations to remain quite high during all phases of sampling. Where there is a large number of combinations but no dominant combination (e.g. type C2) the probability of finding a new combination is high at the beginning of the sampling programme but becomes low and then very small quite quickly.

However, it is unlikely that small datasets such as those used in table 3.15 will be representative, hence our state of knowledge is likely to be poor, and the degree of statistical certainty correspondingly low.

The difficulties lie not just with sample size. The graphs in Fig. 3.35 represent the proportion of the total number of combinations, known at various stages in the sampling process[22]. Although the sample sizes are very different (ranging from 22 to 104), it is still clear that each of the major typological groupings show a similar 'growth of information' curve. Each group of brooches uses a relatively large number of combinations frequently. For example, in order to discover 60% of the technical combinations, 80-90% of the sample must have been taken. From the shallow angle of the lines above this point, it follows that it is highly probable that one third of the combinations used in the production of any brooch type are so infrequently used that they will not be discovered until the final 10-20% of the sample has been taken.

Cluster analysis

The methods above were based on the status of five binary attributes. This is probably the largest number of attributes which can be examined in this way, without computer aid. Further attributes may, however, be of significance. These include catch size, a continuous variable which was added to the dataset for

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[22] These figures are calculated theoretically. For example, 9 out of 23 (39%) type A brooches were produced using combination 1, another 9 (39%) using combination 2, 4 (17%) using combination 3 and 1 (4%) using combination 4. Since there are four combinations present, each combination represents 25% of the total number of combinations present. Hence four points are plotted, at 25%, 50%, 75% and 100% on the horizontal axis (cumulative number of combinations discovered) and 39%, 78%, 95% and 100% on the vertical axis (proportion of sample).

statistical treatment.

Analysis was attempted using the 'Cluster' routine from the CLUSTAN package (Wishart 1987), on a mainframe computer[23]. This method has been used widely for archaeological purposes and defines clusters of cases (i.e. brooches, in this case), based on their similarity in multi-dimensional space i.e. 'evenness' between examples. The results of cluster analysis on this data reproduced evidence of broadly the same themes as the simpler methods. However, the output is much less easy to understand and did not add any further information about the technology. This technique was therefore abandoned.

[23] The VAX cluster, at the Oxford University Computer Centre.

Summary

The statistical treatments used above were useful for showing some technical patterns. Many of the difficulties in understanding diversity in cruciform brooch production lie with the heterogeneous nature of the data. Popular attribute combinations can be picked out, but each sample set normally contains several brooches which employed unusual attribute combinations.

The dataset size is also a critical factor in discussions of preference within and between classes of brooch. Similar problems would be encountered when examining the data for significance of geographical patterning. Until the size of the dataset has been increased for all types of brooch, possibly to two or three times the present size, further speculation will be reserved for study by more statistically-minded researchers.

Despite these problems, some significant points may be made. Amongst the English corpus, there is evidence of conservatism in manufacturing techniques (after the earliest phases of use/ production). Some fifth-century methods of manufacture were capable of being adapted to sixth-century stylistic demands. When new techniques were introduced, they were added to the original methods and did not entirely supplant them. These changes represent adjustments for size, rather than radically different approaches to production. Any 'mental template' for the type did not produce uniformity in the method of production.

This may be contrasted with the Scandinavian and continental situations, where the ranges of production styles used were always more restricted.

The English production in a general context

This chapter has revealed the potential of technical research. Our general conclusions include the fact that each production area underwent changes in manufacture. Casting techniques were similar in the earliest phases throughout all areas of production. Methods involving extensive hand finishing of models, i.e. more closely allied to lost-wax casting technology, may have been used at this time. Regional characteristics can be seen in the methods of assembly, e.g. in the use of copper or copper alloy in pins and sideknob axes of brooches made on the continent and in Scandinavia. There are a small number of technical features which have surprisingly restricted distributions or periods of use.

In the later phases of production, Scandinavian casting technology appears to diverge sharply from styles prevalent in England and the continent. In both England and Norway, techniques of piece-moulding and/or combination methods were developed to a high art. Manufacturers in both areas were striving towards ostentation. However, late Norwegian styles rely on extreme three-dimensional relief whereas zoomorphic English styles employ complicated 'chip-carving' and surface applications on brooches which are much flatter although not

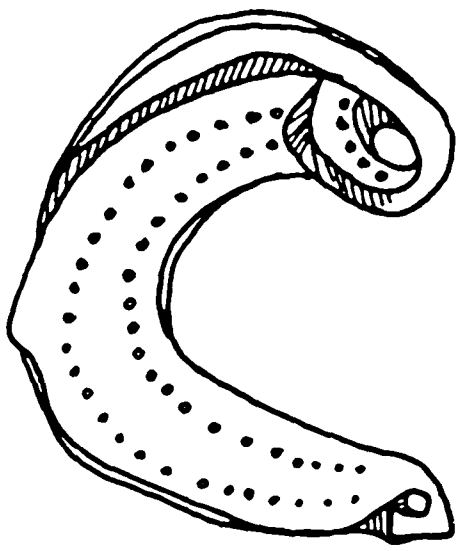
strictly two-dimensional. The Norwegian metalworkers seemed to have placed more emphasis on control and on technical development whereas the English brooches show rather more basic standards of casting and a dramatic stylistic floruit.

In Chapter 5 (Synthesis), I will discuss the manner in which the patterns revealed through technical analysis reflect socio-economic influences.

Chapter 4

A. Introduction

Chemical composition of cruciform brooches



hemical analysis gives an insight into some basic factors behind the existence of an archaeological artefact. The composition of an artefact represents availability of resources, both those which are directly represented in the artefact (metals in this case) and those which are implied (fuel, human time and energy and technical skill). In the case of personal ornament, use of metal represents a wish or a need to 'spend' resources in a non-functional manner. Furthermore, in societies where burial rites include the deposition of jewellery, the use of metal represents a wish or need to 'spend' resources in a non-returnable way. Compositional variability represents the degree of system control available, but also the degree of control that was required or seen to be applicable for particular purposes. Hence chemical data may give further information on the socio-economic position of cruciform brooches and of the processes that produced them.

Supply

The source of the metal used during the Anglo-Saxon period has been frequently discussed (Oddy 1983, Leigh *et al* 1984, Brown

1986, 250-72)[1]. One possible strategy is to use only fresh supplies, either imported or local. These could be transported in the form of ores, partially refined material, finished alloys or artefacts. The late Roman metal economy has not been thoroughly examined; whether there is any similarity between it and the Anglo-Saxon situation is unclear. After the Middle Bronze Age, imported metal was normally a factor in the British metal economy (Northover pers comm). Supplies from the continent are possible and could have come by several routes (Hodges 1989, fig 5). The lack of published analyses for continental artefacts of this period means it is difficult to assess similarity and whether some of the English supply of this period may have originated from imported alloys or ores.

There are also useful sources of non-ferrous metal ores in the west of Britain (Tylecote 1986), although none in the Anglian region. With the exception of lead ores, British non-ferrous sources are thought to have been of little economic significance in Roman times (Brown 1986, 250). In view of the fragmentary social and economic systems of post-Roman Britain, one may suggest that British metal sources may have become either more or less important to the production systems of Anglian England. If trade with the continent became difficult and infrequent, British sources may have been used. However, since transport over land would have been far more time-

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[1] I am grateful to Dr Northover for useful discussions relating to this chapter. All errors and inaccuracies remain my own.

consuming (i.e. 'expensive') than sea transport, importing material from across the Channel may still have been cheaper.

Some authorities seek to demonstrate that Cornish tin sources were in constant use during the Dark Ages and continued to export to the European mainland (Penhallurick 1986, 237-43). Workings at other non-ferrous ore sources may also have been in operation at this time. Unfortunately, evidence for mining operations is notoriously difficult to date and easily eradicated by later workings.

The other alternative source is re-use of scrap.

> 'With little evidence for primary production of the raw metals until quite late in our period, the jewellers ... must have secured supplies for themselves' (Brown 1986, 333).

Even societies in the most metal-rich regions recycle their own miscasts and worn-out or old-fashioned metal artefacts. However, if a society continues to produce artefacts which are buried or otherwise disposed of, and to increase the number and size of such artefacts, clearly supplies must be relatively easily available. Was there enough copper-alloy scrap available to support a large-scale output? The theory of abundant Roman scrap must therefore be examined carefully.

Attempts to discover the original ore source of Migration Period copper-based artefacts are likely to be futile (see notes on trace elements below). However, we may attempt to characterise the English output and discuss its relationship

with the input to the metal use system. Chemical analysis may help to establish which of the supply options seems most appropriate, by use of regional and chronological information.

Cultural characteristics

Chemical compositional patterns may add to our understanding of the typological and technical parallels with other areas of cruciform brooch production which were investigated in the preceeding chapters. Information about artefact style and the method of manufacture was shown to support other evidence of cultural identity. The earliest phases of cruciform brooch use were supported by brooches produced in a truly Germanic style but later production became more regionalised. However, we can only guess which level of stylistic or technical similarity was significant.

The chemical evidence is even more complicated. Two cultures producing artefacts with similar stylistic and technological characteristics need not necessarily use similar alloys, nor do different styles and technology necessarily require different alloys.

The time period concerned is rather short to expect metallurgical developments with distinct regional characteristics to occur. For such developments to be visible, metalworkers must have control over composition and/or access to a constant supply of resources. Evidence of the need for and ability to

control metal content (i.e. alloy design) in early medieval copper-alloy technology must be reviewed.

Depending on the nature of the evidence revealed in the analysis programme, various questions may be tackled. If Scandinavian and English copper-alloy technologies were different from each other in the late-fifth/early-sixth centuries, the metals used may also have been different. If cultural similarities persisted between the Anglian 'homelands' and England, then metallurgical practise and alloy supply may be shown to have been similar as well. The style of Kentish brooch production is closer stylistically and technically to the continental brooch production - can we suggest that these brooches were made in Frisia? Some chemical information will be presented and some possible methods of understanding the data.

Workshops

This leads to the question of characterisation of regional or local production styles. Some late English cruciform brooches seem to be produced in identifiable workshops. Other sub-types can be localised to particular areas. We can try to establish the nature of metal supplies to individual areas and workshops by examining the pattern of alloys used. The products of a workshop will show less compositional variation than those of a region in general, if smiths had control over their alloys or if there was a consistent supply to the workshop. The

ability to perform this type of characterisation depends on the overall variation observed.

Chronologically-related variation in the metals used may be due to to changes in the metal availability. However, if there was a change in the organisation of metalworking (e.g. from small-scale or part-time operation to more highly systematised or high-status production), this may also have caused a change in the manner of operation. The sixth-century English data may be compared to the contemporary Norwegian data, where product standardisation and more sophisticated modes of manufacture may have allowed an increase in output.

B. A review of comparable analytical programmes

Before discussing the contribution to be made by metal analyses in this thesis, previous studies must be appraised. In 1962, Tylecote wrote 'there is an almost complete absence of analytical information regarding Dark Age material'. Since any analysis would therefore have represented a great step forward, it is possible to say that the situation is now much improved. However, the results of research projects have not been as beneficial as they might have been, since the archaeo-logical questions to be answered were often not clearly stated before analysis and there is a lack of consistency in the approaches to the material.

The modern study of Anglo-Saxon copper alloys by chemical

analysis was begun in earnest by Oddy, who produced a review of comparative material available to him when discussing the seventh-century artefacts from the Sutton Hoo ship burial (Oddy 1983). He found very little published data that was relevant but what there was raised a number of interesting topics for discussion.

Oddy made a tentative suggestion of a negative correlation between tin and zinc in the composition of a small group of Anglo-Saxon copper alloy artefacts. In other words, the alloys were either bronze-like or brass-like. The variable compositions of a small group of Anglo-Saxon artefacts led him to suggest that Roman material was being reused and that fresh brass in the form of imported artefacts was also used, providing a higher zinc content in some cases. Subsequent work has shown that only a small proportion of early Anglo-Saxon artefacts are made of brass. The nature of the correlation between tin and zinc in copper alloys has become apparent, with a continuum of alloy types running between the two extremes. A major concern of this project is to see whether the entire range of alloy types was used throughout the early Anglo-Saxon period, without regional or chronological differentiation. This may help us determine the nature of metal supply and consumption systems at this time.

Since 1983 a number of analytical projects concerning English material have produced more chemical data relating to copper-alloy artefact production of the period. The purposes and

coverage of these projects have been various. Chemical data have sometimes been presented with little consideration of the archaeological factors that inevitably must have introduced bias. Direct comparison with the results of these investigations must be carried out with caution.

Method of analysis

It is not always possible to compare directly the results of analyses carried out in different laboratories, although co-operation between laboratories involved in archaeological science is improving and various inter-laboratory comparisons have been carried out on copper alloys[2]. Sampling and analysis techniques vary considerably. For instance, surface analysis by X-ray fluorescence (XRF) is invaluable for checking that the methods of applying gilding and white metal surfaces are those that are commonly thought to be practised at this time. But the nondestructive testing of copper alloys by XRF merely indicates that certain elements are present (with most of the signal coming from layers of corrosion), without necessarily gaining a clear idea which were originally the dominant elements. Surveys of this type (Wilthew 1985a and b, and Wardley 1984) merely confirm the alloys are mostly bronzes, with zinc and lead present, probably at percent levels.

Surface preparation by abrasion may improve the accuracy of

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[2] See, for example, various papers in Hall and Metcalf (ed) 1972

XRF analysis but may not completely remove the chemical effects of corrosion, although the 'sample' may look very clean and shiny. Leigh *et al* (1984) discuss corrosion processes for silver which lead to confusing effects during the analysis of square headed brooches. The surface analysis of silver is especially misleading when alloyed with elements other than pure copper (cf Mortimer 1986). This problem of surface preparation means that XRF analyses must be compared with other methods with care.

In extreme cases, lead segregation during casting means that the consistency of heavily-leaded copper alloy artefacts is not uniform (Hughes *et al* 1982). Tin and zinc are also found to have anti-phase segregation - *i.e.* areas high in tin will be low in zinc and vice versa. However, the scale of these segregations is probably sufficiently small that the techniques used in this study will give reasonably accurate results. Analytical methods may also have dissimilar levels of detection, accuracy and precision.

Method of manufacture

In many circumstances, the method of manufacture is a highly significant factor for alloy selection. Different chemical and physical properties are required for different types of object. Cast objects are often heavily leaded whereas items to be hammered and worked are normally low in lead or lead-free. Brass and bronze are both suitable for casting purposes, but

even after the discovery of brass, bronze has been commonly used in many cultures.

Alloys for artefacts that were to have subsequent treatments which involved high temperature episodes, such as gilding, tinning and silvering, may have been selected specially. The unpublished results of analyses on cast saucer brooches from the Upper Thames Valley (Northover unpubl) show all the alloys used have very low levels of lead. This may relate to the mercury gilding that was to be carried out. Theophilus states that gilding and enamelling are best carried out in the absence of lead. However, work on Roman and Anglo-Saxon material suggests that the type of metal on which surface treatments were applied was not strictly controlled (Oddy *et al* 1986).

Cultural background of manufacture

At Sutton Hoo, patterning was evident within the chemical composition dataset (Oddy *et al* 1983, 950, 953). The princely burials of Sutton Hoo are unusual within England as they contained many high status artefacts, several of which were imported, for example, the 'Coptic' bowls, made of leaded brass and the Celtic hanging bowls in bronze. Clearly, artefacts from two very different traditions of manufacture are being buried in the same mound. In addition, the date of burial is later than the chief area of interest of this project (probably around 625 AD) although some of the

artefacts may have been produced considerably earlier.

Bronzes appear to have been the metals used by Celtic metalsmiths, with brass occuring only infrequently and then probably as scrap (Campbell forth). Some brass was being used in French and Italian jewellery during this time and probably in other areas of mainland Europe (Mortimer, unpubl[3]; Riederer 1975). Certainly the Byzantine world was well versed in the production of brass vessels and smaller artefacts (Richards 1980; Mortimer, forth,b). Any differences between metals used by the Anglian and the Saxon cultures may be less dramatic but clearly the cultural background of production is significant.

Period of manufacture

Some of the chemical studies on early Anglo-Saxon material provide no archaeological or technical information. Without this, we cannot know the precision of the dating or classification. It is difficult to establish how the objects used in such chemical datasets fit into the overall archaeological picture.

Anglo-Saxon brooches from the Avon valley are of various forms; the dates of production and technical requirements will also be variable (Brownsword 1986). Most of the brooches are those known as small-long brooches (although the authors refer to them as cruciform brooches), others are cruciform, square-

[3] Material from the Ashmolean

headed, disc and saucer brooch forms. They are probably all cast, some of them are also gilt. Unfortunately, although they are probably all of the same general period as the cruciform brooches of this project (fifth and sixth century), there is no phasing for the dataset, so it is difficult to see if there is any pattern related to a chronological sequence within this database.

Caple's (1986) thesis on early medieval pins is the work which has the greater similarity of approach to that of the current project on cruciform brooches. The technical requirements of metal for production of pins are dissimilar to those for cruciform brooches. The metals used had to be strong and ductile - most pins were worked after casting and many were 'drawn'. Caple demonstrated that there was a time-related change in preferred alloys[4]. Pins were made of bronze and brass, and occasionally of gunmetals and copper during the Roman period. Early Anglo-Saxon material is not well represented. Lead contents were maintained at low levels throughout the Anglo-Saxon period. There was little analytical differentiation between styles of pin, except where there were also changes in the method of manufacture[5].

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[4] See also Caple and Warren 1982

[5] The equipment used for Caple's work had poor detection limits for tin. This means it is difficult to estimate the purity of brasses and coppers.

Northover's analytical work on saucer brooches was carried out in parallel with Tania Dickinson's study of the decorative styles (Northover unpubl). Although there were only a small number of analyses, they concluded by suggesting there was some evidence of correlation between alloy type and period of production.

The lack of analysed material from the middle Saxon period in part reflects the nature of the archaeological evidence of the period. The arrival of Christianity and changes in dress fashions combine to reduce the number of copper alloys available for analysis. A few relevant analyses were done by Caple (1986). These suggest that the movement towards the increased use of brass began during this period. There was contemporary Northumbrian production of silver coins alloyed with brass (Metcalf 1987). However, the XRF analysis of material from Repton, shows that 9 out of 19 copper alloys dated to the eighth and ninth centuries were made of bronze, with low levels of zinc (Mortimer unpubl[6]).

Regional supply characteristics

Caple's data came from material from sites from a wide area of distribution. There is no evidence of any regional patterning of alloy type. Brownsword's analysis of material from the Avon Valley and Northover's from the Upper Thames Valley

[6] To be published in the Repton excavation volume (Biddle, work in progress).

(Brownsword *et al* 1986, Northover unpubl) may add important data to the consideration of regional metal supplies, if the analytical methods prove comparable[7].

In the XRF projects on material from Watchfield and Lechlade (Mortimer *et al* 1986, Mortimer 1988), the analysis was limited to copper alloys supplied to two individual communities. The Lechlade material produced some patterning when sub-divided according to the type of artefact. These XRF data are not suitable for direct comparison with the current database but may be used to support other evidence.

Hence the available chemical database relating to Anglo-Saxon non-ferrous metalwork is rather fragmented. It is not a simple matter to compare results from different projects. Broadly-based analytical programmes are necessary before general conclusions may be made[8] but the chemical analysis of the cruciform brooches may still provide information on a number of aspects.

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[7] The results of comparable analyses carried out by Dr Brownsword on brooches from the Ashmolean Museum's collection are awaited at this time. AA results on this material are given in this work.

[8] Nigel Blades PhD student at Royal Holloway and Bedford Colleges is working on a wide-ranging project on post-Roman copper alloys. It is hoped that his research will cover this area.

Directions of research using current database

The primary questions that should be investigated in studying the results of analysis of this material, and any other large database, are pattern seeking. These are:

1) Which alloys were in use?
2) Which trace elements are present?
3) Are there regional differences in copper alloy usage?
4) Are there chemical differences between artefact types or sub-types? And hence
5) Are there detectable changes in copper alloy useage over the period of production?

The answers to these enquiries will be sources of information for more specific questions. For example:

1) Economy Can one identify the source of the 'raw resources' of the metal economy of the period and if so, what part did scrap metal play? Did the access to supplies change? Can the middle/late Saxon movement towards brass alloys, seen in Capel's work on pins, be detected in the compositions of late cruciform brooches? From these considerations, could chemical analysis be used in attempts to provenance or date fragmentary material or do archaeological and technical attributes have more potential?

2) Parallels What alloys were available in other areas? Where

did other metalsmiths get their supplies from? Did they have similar attitudes to alloying? How does alloy supply and use in England compare with that in the continent and Scandinavia? Are the socio-cultural relationships which were explored through the archaeology of fashion, reflected in contemporary approaches to metallurgy?

3) Modes of production How does the observed variation in archaeological and technical attributes compare with variation in the chemical attributes? Are groups of brooches which have little typological variance from a set of closely definable attributes made with a particular type of metal? Are pairs of brooches cast from the same melt? Can patterns of alloy use be employed to investigate the existence of workshops and the modes of production? Is there evidence for control of alloy composition for this particular artefact type, i.e. did the metalworkers appreciate the chemical and physical properties of the metals they used and could they control them?

Any attempt to investigate these questions must note the methodological and practical problems outlined above.

The first step in this research will be to establish if there are significant patterns in the chemical data for English cruciform brooches. A large amount of the available information can be gained from the alloying elements.

C. The alloying elements - copper, tin, zinc and lead

Pure copper may be used to make objects, but it has commonly been mixed with other elements. Three elements are found with copper in cruciform brooches which alter the metallurgical properties and cause changes in colour, weight and texture. These are zinc, tin and lead.

There are various reasons why elements are present in the alloys used for cruciform brooches. It is likely that some were selected for practical reasons but inclusion may often have been quite accidental. For the purposes of this discussion, it is important to understand what forms of non-ferrous metals were known at this time and where they came from.

The methods by which tin, zinc and lead were extracted and hence brought into circulation in antiquity have been examined in detail in various publications (e.g. Tylecote *et al* 1977, Tylecote and Boydell 1978). We can initially note here that copper, lead and tin were all known in distinct, pure forms at this time.

Metallic copper has been exploited and traded for thousands of years. There are a variety of copper ore types known to the modern day geologist, but those exploited in early technologies were normally oxides or sulphides. Many additional elements are normally present in small amounts, as impurities. Copper deposits with significant proportions of lead, tin and zinc are also known.

Copper ores can be reduced in the solid state at temperatures as low as 800 °C. The presence of charcoal in a forced draught produces carbon monoxide which would allow the reduction of copper oxides. These processes would also allow the reduction of other elements. Hence copper ingots are likely to have many impurities present, including tin, zinc or lead at percent levels.

Copper ore bodies are known in the west and north of Britain, in Wales, Cornwall, Yorkshire, Scotland and Ireland. Larger ore bodies exist in Europe, for example the Harz mountains of Germany where other metals can also be found.

Lead deposits have a similar distribution within Britain, with the addition of a few areas closer to the Anglian region, such as the Mendips and the Peak District. Ores used in antiquity included galena (lead sulphide) and cerussite (lead carbonate). The techniques of production could be quite primitive. Galena could be roasted to an oxide at the top of the furnace or even a bonfire and then reduced to lead by

contact with unroasted sulphides.

Lead is a soft, grey-white metal and can be easily worked. Large quantities of the metal were extracted and used during the Roman period. A great deal of economic interest has been taken in lead ores since silver is a frequent 'impurity', often at large enough concentrations to be recovered economically. There are a number of simple recovery processes which are highly efficient, producing high-purity lead as well as silver.

The tin deposits of Devon and Cornwall were important ore sources in antiquity for Britain and for other countries. A temperature of least 1000 °C would have been necessary to smelt cassiterite (a tin oxide) as well as some careful tending of the furnace. Tin is a silver white metal and is very soft and malleable. Pure tin was used as a metal in its own right but it was much more widely used in the form of bronze. Ingots of tin and lead were traded in Roman times and subsequently, as were various combinations of copper, tin and lead.

Zinc was the last of the four alloying elements to be exploited deliberately. Brasses (copper-zinc alloys) were the only form in which zinc was used. Zinc was not produced as a metal in Europe until the sixteenth century AD. Brass manufacture was probably introduced into this country by the Romans. Sources of zinc ores are again restricted to the west

and north of the British Isles and are often associated with lead ores, in varying proportions.

The late stage at which zinc exploitation began was due to the unusual requirements of its extraction. At high temperatures, zinc oxides are lost to the atmosphere as gases, rather than forming a solid metal. Hence zinc-containing alloys had to be made by cementation techniques. These involve heating zinc ores (e.g. zinc carbonate (smithsonite)) in an enclosed crucible together with charcoal and copper ores or copper metal granules. Zinc is absorbed into the copper and brasses with up to 28% zinc have been produced experimentally by this method (Werner 1970). The resultant alloy is normally quite pure.

Crucibles have been discovered in first- or second-century Romano-British contexts with large amounts of zinc within their walls (Bayley 1984). These crucibles are thought to have been used for making brass, although any zinc-containing ore or metal is capable of giving off considerable amounts of zinc on heating.

So various forms of metals and alloys were known and theoretically available to British metalsmiths. A variety of compositions have been found in copper-alloy ingots from late Saxon and Anglo-Scandinavian metalworking sites (Brown 1986, 383-471). It is also possible that raw or partly-refined ores and copper alloy artefacts were traded to be used as raw

material.

At each heating episode, some elements may be added or removed from the alloy. As in extraction, whether elements are lost or gained at these occasions depends on the nature of the element and the environment in which the heating took place.

Cruciform brooch compositions

Which types of alloy were used for casting at this time? Chemical analysis of some English cruciform brooches has revealed a wide range of compositions, with some natural sub-divisions, but other areas of confusion. For the purposes of this project, it is logical to produce a simple alloy typology in the same way as a formal typology was provided in Chapter 2, so that individual examples need not be discussed. With numerical data it is possible to produce average compositions in the same way as a list of descriptive attributes were provided for the archaeological groups.

Various authors have given definitions of early copper alloy types (e.g. Bayley and Butcher 1981). However, although careful note has been taken of their reasons for sub-division, such criteria should not be applied uncritically to material from all periods. For example, in periods where metal types are more distinctive, the limits for impurities in a 'bronze' would be more stringent. Definitions of some copper-alloy types are suggested here which are appropriate for the logical

discussion of Anglo-Saxon material.

The data set could be placed in a large computer file and multivariate statistics, such as clustering, immediately applied. This would be unwise in this case for a number of reasons. Additional scientific gloss might be gained but the ease which groupings can be made using simple descriptive data suggests more statistically advanced techniques would be wasteful and quite possibly misleading at this point. There is a strong correlation between zinc and tin, which has unwanted effects on most clustering techniques. Simple graphical representation seems to be the best way to begin investigation and to describe the data.

The traditional method of displaying alloying elements in copper alloys is the triangular plot (e.g. Bayley and Butcher 1981). This method has a number of difficulties attached to its use. As there are four elements concerned in alloying at this time, two elements are often combined for any one triangular plot. Copper and lead are often chosen for this purpose, hence reducing the amount of information available. Alternatively plots can be used where only zinc, tin and lead are displayed, but there is a mathematical problem. A point representing a copper alloy with 2% zinc, 2% tin and 2% lead will be plotted at the same point as one with 6% of each element, i.e. it is the ratios that are being plotted. To use this method, one must assume that all of the alloys have the same level of alloying, which appears to be far from the case

in this work. Oddy (1983) used the somewhat inelegant method of three different plots to display all the information from each section of the Sutton Hoo data. Lastly, there is the problem of making the diagrams understandable to all readers. Triangular plots are still unfamiliar to many archaeologists and those who are aware of them may yet be unaware of their shortcomings. For these reasons simple xy plots will be used.

The overall pattern of element concentrations can be seen from the graphs in Figures 4.1 and 4.4. On a zinc vs tin plot, the data points from analysis form a continuum. There are some indications of natural groupings within this continuum (Figs 4.2 and 4.3). A logical first step in outlining an alloy typology is to remove samples with chemical compositions which belong to discrete groupings. Decisions on group definitions will be made on a practical basis. The definitions will be appropriate to this particular project and may not be applicable elsewhere.

In the alloy typology below, distribution histograms for alloying elements are given for each alloy type defined (if sufficient samples exist) and their average contents noted where appropriate (Figures 4.5-4.8 and Table 4.1). The standard deviation figures are useful as a mathematical expression of the cohesion of the samples belonging to a grouping[9].

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[9] Lead has low levels of concentration and little variation (see Figures 4.1). It also has no significant overall correlation with zinc or tin. Lead is an element in which comparison between

Bronzes

It is necessary to provide clear limits for inclusion in each alloy type, even though the tin vs zinc plots make it obvious that such divisions will be for practical purposes rather than having any absolute nature. In this case, we are trying to place a line between a group of well clustered bronzes with at least 6% tin and low levels of zinc present and a rather more scattered group of bronzes with lower concentrations of tin and larger amounts of zinc present.

In a bronze, more than 5% tin begins to make a noticeable impact on the characteristics of the metal, so an arbitrary limit of <5% tin was taken for bronzes in this typology. Since most alloys in this dataset also have zinc present, the permissable levels of zinc in a true bronze must be defined. In this case, visual judgement was used to place lines on the zinc% vs tin% plot (Fig 4.3a and 4.3b), in a manner which satisfactorily subdivided the compositional data. These lines are approximately perpendicular to the continuum.

The resulting division forms a compositional grouping whose zinc, tin and lead contents have approximately normal

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the two analytical methods appeared to be less than satisfactory. Agreement between analytical and standard values is also poor (Appendix 1.3). Lead will be considered within the text, where relevant but not used for primary definitions within the alloy typology.

distributions (fig 4.5), suggesting that the groupings make statistical 'sense'.

Around 50% of English cruciform brooches (162 examples) are made from alloys thus defined as bronze. The elemental distribution graphs (Figure 4.5) and average composition figures given in Table 4.1 disguise some further variation within the data (see below). The distribution of lead contents is normal for these brooches but the range is quite broad, running up to 16%. 5 bronze brooches have very high levels of lead (>12%). The tin contents of these lead-rich samples are near to the average values within the data set.

Brasses and tin brasses

At the other end of the spectra, there are a number of alloys with high levels of zinc present. Only three of these examples are known to have less than 1% tin present. These can be termed true **brasses**. For simplicity of typology, a lower limit of 4% zinc will be given. In practice, the zinc content of brasses ranges from just under 12% to around 21%. These alloys also have low levels of lead.

29 samples, around 9 percent of the total number of alloys analysed, have significant levels of tin present (i.e. more than 1% tin) in addition to zinc above 11%. These are termed **tin brasses** (Figure 4.8). There is a natural division between these alloys and the more tin-rich 'gunmetals' (see below)

given by another line perpendicular to the continuum. Only one of these samples contained more than 5% lead.

Zinc bronzes

In between bronzes and brasses lies a large number of alloys with both zinc and tin present. For the majority of these compositions, the zinc/tin ratio is greater than that for true bronzes but tin still dominates (i.e. tin >4% and zinc/tin <1.55). An upper limit is given by an apparent division between these tin-rich alloys and more zinc-rich alloys (gunmetals, see below).

91 alloys (about 28% of the total) fit into these limits, and are given the name zinc bronzes. The divisions between bronzes and zinc bronzes is not well marked, likewise that between zinc bronzes and gunmetals. These divisions are for convenience of discussion only and may well be changed if further data points are added to the dataset. Tin and zinc contents of zinc bronzes thus defined appear to be have statistically normal distributions (Fig 4.6). Three zinc bronzes have more than 10% lead present.

Gunmetals

The remainder of the continuum consists of a scatter of data points representing alloys that have more than 4% of zinc and more than 1% tin present, but where zinc dominates. The 36

samples which belong to this area are here termed 'gunmetals', as are modern copper alloys with high tin and zinc contents. The distribution of tin content appears to be normal (Table 4.7) and only one gunmetal has more than 10% lead but the zinc content is rather varied.

Coppers

Finally, there are only two samples in the dataset with very low levels of alloying components (i.e. <4% tin or <4% zinc). These are called 'coppers' in this alloy typology. Other alloys can be seen to represent the lower ends of the bronze or tin bronze distributions, with very low levels of tin compared to the average bronze and are included in their respective categories. It is likely that the two 'coppers' are outliers of the bronze and zinc bronze composition groups.

In discussions concerning material from earlier metallurgical periods, lower limits might be set for a definition of pure 'copper'.

Sub-division of the alloy typology

The intention behind the alloy typology was to produce cohesive, natural groupings. Hence, it is generally difficult to see any patterns within the alloy types. It is noticeable however that although zinc and tin are always negatively

correlated, there are a number of pure bronzes with high tin contents, which are outliers from the normal zinc/tin correlation line (Fig 4.2). 27 alloys have more than 11% tin and less than 1% zinc present and can be called **high tin/low zinc bronzes**. Other subdivisions of the alloy typology are not easily perceivable on the basis of the zinc/tin ratio.

Physical and chemical differences between alloys used

Would each of these alloys have been distinctive to the metalsmith? If so, would some alloys have properties which were so beneficial for the purposes of making brooches that it would have been worth attempting to control the composition?

At this time, the differences between alloys would have been detected only through the working properties and the physical appearance of the metals. For example, the presence of zinc, tin or lead will reduce the liquidus temperature of an alloy. Hence the metal could be poured at a lower temperature. Both zinc and tin can act as de-oxidants. Zinc in brasses can cause a strong smell when handled and white zinc vapour when heated, which would be further distinctive characteristics.

A range of colours would have been noted in these alloys and must have been an important method of distinguishing between them. A range of modern copper-alloy standards give a

practical idea of the differences[10]. Relatively small amounts of these metals can affect the colour of the finished alloy, lead making it grey, tin and zinc making it more golden. High concentrations of tin make copper alloys silvery. Copper with low levels of alloying elements remains quite orange. As lead does not readily dissolve in copper, bronze or brass, a heavily-leaded alloy might appear rather grey. Most of the alloys seen here would have been gold-yellow originally.

There is little evidence for hot-working of cruciform brooches after casting. Most of the alloys used would have been 'hot-short' and hence not capable of being hot-worked (Northover pers comm). The catch and pin lug would have been formed by cold-working, possibly using some annealing (heating to soften the metal). In wear, the brooches were not subject to any great stress. The presence of tin and zinc might be seen to improve the wear resistance of the metal. Small amounts of lead will improve resistance to fracture.

This implies that the physical and chemical requirements for casting would not have been great, although variation may have been noted during preparation and casting. If the range of alloys used in this database represents anything like the total supply known in early Anglo-Saxon times, it would not have been necessary to take special precautions to select

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[10] In this case a series of bronze and brass metal standards were available at the laboratory, supplied by British Non-ferrous Metals Co.

metals appropriate to this purpose. Any of these alloys would have been quite suitable for this type of work.

The wide range of alloys used and the continuous nature of the zinc/tin distribution do not suggest much control was exerted over the composition during the casting of cruciform brooches. However this does not prove that Anglo-Saxon metalsmiths took little notice in general of the composition of the alloys they used. Some indications of control have been noted, for material that was to be worked (e.g. pins and sheet metal, Mortimer 1988). Control of lead, in the case of brooches which were to be gilded, is commented upon, below

In summary, a tin bronze composition with small amounts of zinc is likely to represent the majority of the cast artefact output by the English metalworking systems of the fifth- and sixth-centuries. High-zinc copper alloys form a minor component, but mixed alloys are more common. Now that we have this basic outline of the compositions used within this dataset, we may begin to discuss the likely sources of raw materials and the methods of their distribution.

Non-ferrous metal sources

During the late Anglo-Saxon and Anglo-Scandinavian period, the composition of non-ferrous ingots is known to have been variable (e.g. White 1982). In the preceding discussion, the chemical pattern of output for cruciform brooches was also

shown to be variable. However, this does not necessarily imply a one-to-one relationship between input and output i.e. inhomogeneity amongst the types of alloy produced does not necessarily indicate a mixed-alloy input. In this particular case, the metallurgical requirements for succesful production were minimal. An efficient, 'maximising' manufacturing system would have utilised any available sources. Hence the use of several individually-coherent sources is quite plausible. These could be:

1) Fresh metal supplies from British sources

2) Fresh metal supplies from abroad

3) Scrap from Roman sites or Roman artefacts still in circulation

1) Imports

Celtic bronzes analyses (Oddy 1983; Campbell forth) show that even high tin bronzes may have traces of zinc present (up to 2%). Depending on extraction and furnace technology, sources from the Welsh borders could have been used to produce copper or bronzes with 1-2% zinc (Northover 1982, 231). It is feasible that the source for the bronzes could have been metal of this type.

The lesser components within the alloy spectrum, the zinc bronzes, gunmetals and brasses, could have been made by combining this low-zinc bronze with various amounts of zinc-

containing metals. The copper-alloy technologists of the early Anglo-Saxon and Celtic worlds had little cognizance of the manufacture of high-zinc copper alloys. The metallurgists of Frankish kingdoms may have had an early knowledge of good quality brass-making or maintained production techniques from Roman times. Certainly by the sixth and seventh centuries, French metalworkers had precise control over each alloy type available to them[11].

It is not known how much zinc might be lost on re-melting copper-zinc alloys. In most heating episodes, crucibles would have been covered (by a lid, cover or simply a layer of charcoal) to reduce the possibility of oxidisation. This would also have reduced the risk of zinc loss from brasses, so that a high zinc content may be preserved in the final alloy.

Hence, some or all of the input to Anglian metal supplies could have come from British and French sources, if mixing took place. Evidence for such supplies must be assessed.

If trade from an external source is significant, one may assume that areas closest to the source will have better access than those further away. Regional patterns of alloy use should therefore logically reveal more pure bronzes in the north and west of the Anglo-Saxon regions and more good

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[11] Buckles from the Ashmolean Museum were cast in bronze with brass attachments. It is hoped that further analysis on French material will be performed in the near future (see Chapter 6).

quality brasses in the south and east. Trading over long distances, as demonstrated in the Coptic metalwork at Sutton Hoo, is likely to be less important, as imported artefacts are infrequently found in fifth-and early sixth-century graves. Unfortunately, since cruciform brooches are not often found in the north, west or south-east of England, the relevant portions of the current database is likely to be rather small.

Any such regional patterning is unlikely to be very clearly visible. If sea-trading was important, areas such as East Anglia and Lincolnshire may have been less 'distant' from such sources than appears from a simple calculation of physical distance. Hence supplies may have arrived from several directions. Mixing of sources may always have occurred and taken place soon after metal arrived in this country. Attitudes to mixing metal resources may have differed over the country. If there was a change in the method of distribution or in the sources of metal then regional patterns will be confused.

2) Indigeneous sources

Many authors have stressed the possibility of recycling Roman metals, discovered in the ruins of towns and villas. The stone walls of Roman buildings would have presented ideal markers, where these themselves were not robbed out. The material available would therefore be in the form of completed artefacts, perhaps as coins, domestic implements or personal ornament.

There is very little archaeological evidence with which to assess this possibility (see Chapter 2). Simply because there are few metal collections or hoards in particular parts of our archaeological record, does not mean this method of metal distribution did not exist at that time. An efficient recycling system would leave little trace. In non-metalliferous areas such as the south and east of England one must expect a careful use of those supplies which were available (see Chapter 5, for further discussion).

How do Anglo-Saxon copper alloys compare with Roman compositions? There is no published discussion or wide-ranging analysis programme for the Romano-British copper-alloy industry in general. Bronze, leaded bronze, brass and mixed alloys were all produced in Roman Britain. We know that zinc-containing alloys included a minor proportion of bronzes with small and erratic amounts of zinc - i.e. less than 4% zinc, thought to be unintentional additions through scrap (Craddock 1978). These are not dissimilar to the bronzes and zinc bronzes used in Anglo-Saxon brooches.

There were also very high-zinc, low-tin brasses i.e. 21-28% zinc and less than 3% tin. These could have been the occasional additions to the melt that caused high-zinc values. It is known that zinc levels in coins decrease during the third and fourth centuries and the production of mixed copper alloys increased (Bayley 1984). However the use of brass in decorative metalwork appears to have been continued.

Hence the copper alloys used by Roman metalworkers would also have been suitable candidates for recycling in early Anglo-Saxon times. However, we do not know the overall balance of alloy types in either period nor can we know whether particular Roman artefact or alloy types were selected for recycling, until more metalworking evidence is available. It is certain that some types of metalwork are unlikely candidates for recycling, for example, heavily-leaded alloys were used in third- and fourth-century bow brooches (Bayley and Butcher 1981).

The early Anglo-Saxons could have recycled Roman material. Again, regional and chronological patterning may be informative. If recycled Roman metal was a significant source, one might expect to observe little regional differentiation for Anglian copper alloys. All the regions under consideration had similar access to Roman material. Furthermore, if there was extensive recycling, decreasing proportions of pure alloys may be observed. Corrosion, deliberate deposition in burials and intense exploitation of known sources would make supplies more scarce. Metalworkers may have been obliged to lower their standards, making many more mixed alloys. By examining the sequence of alloy usage in the fifth and sixth centuries one may determine whether these effects can be seen.

A regional and chronological sub-division of the chemical data may therefore give us information on the sources of the metal used in early Anglo-Saxon metalwork. The hypotheses which will

be tested using sub-division of the chemical data, by geographical and typological criteria are;

a) there are regional differences in alloy usage

b) there are chronological differences in alloy usage.

D. Characterisation by trace elements?

The other range of elements detected by the chemical analysis of copper artefacts are impurities i.e. present at low levels. The copper ore bodies used in antiquity were normally composed of either oxides or sulphides, in which copper is found along with many other elements. These other elements may be at very low levels (i.e. parts per million), which are not detected by the types of analysis performed within this project or at higher levels (i.e. fractions of a percentage), several of which may be detected using either microprobe or AA analysis. Since ore bodies may have distinctive trace element contents, it has been postulated that it is possible to provenance archaeological metal artefacts by their trace element contents (e.g. Pernicka 1986). Unfortunately, a number of insoluble problems have been discovered. A short summary is presented here as there are other recent accounts (e.g. Caple 1986, 312-333; Craddock 1978, 94; Craddock 1988), and experimental work (e.g. by Tylecote and associates) has merely confirmed the extremely complex nature of the problem.

Although few ore bodies have been extensively investigated,

variation within the ore body is thought to be significant, even where there is only a restricted area of outcrop accessible. On the other hand, two ore bodies from different regions may have indistinguishable impurity patterns, due to similar geological histories[12]. When a research project involves a large data base, few ore sources and an archaeological period in which large-scale trade or movement of peoples is not thought to be prevalent, these factors become less problematic. However, there is archaeological and literary evidence for both trade and recycling of metals during the Anglo-Saxon period.

Experiments have suggested that few 'impurities' were consistently retained in the copper (perhaps nickel, silver and gold). Most of the others were partially or completely removed during smelting or remained only as slag inclusions (Tylecote 1986, 22). Which elements were retained within the metal, and which were removed by high-temperature operations, depends on the original ore type and the environment within the furnace. Variation in the furnace technology could produce a range of compositions from the same raw materials. Antimony and arsenic are very likely to be prone to the effects of such variation (Northover pers comm).

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[12] Lead isotope research allows a further method of characterising the geological history of an ore body. Large samples and many samples are needed for this type of research to be carried out successfully.

If the atmosphere is sufficiently reducing, other elements such as tin and antimony from the copper ore will also be reduced. Trace elements with similar chemical and metallurgical characteristics to copper (or those that are more inert) are likely to remain largely unchanged in the copper, throughout the processing (e.g. nickel, cobalt, silver, bismuth and gold). It is also important to notice the degree of solubility in copper for each element. Hence the ratio of elements found in the final alloy has a complex relationship to that of the original ore. The products of one particular area may be similar, if the ore was treated consistently throughout a production period.

The deliberate addition of brass, tin and lead to Anglo-Saxon copper alloys means that zinc, tin and lead cannot normally be considered as trace elements. Each of these alloying components acts as an additional source of impurities and the physical process of alloying itself will bring in further impurities (from crucibles etc). Recycling of scrap copper alloys is likely to be of particular concern, during this particular period of study.

The combination of all these effects is to muddy any characteristic 'signatures' from ore bodies. It is difficult to assess whether artefacts with similar trace element composition could have had the same original ore source. In examining the trace element composition of this material, one can perhaps hope to characterise groups within the alloy

stock, and only exceptionally to suggest the provenance of the original copper ore source. With this in mind, the trace elements are discussed below.

Trace element content of English cruciform brooches

The majority of the microprobe results show negligible levels of gold, bismuth and cobalt. Arsenic, antimony, silver, nickel and iron occur more frequently at detectable levels and the latter three elements may also be detected by AA analysis. The overall concentrations of these elements are shown in Figure 4.9. 46 samples were analysed by both methods and comparability is discussed, in Appendix 1.3.

Silver

Microprobe and AA results are closely comparable. Six English samples contain high levels of silver, around or above 0.8%. These are (in decreasing order of concentration): **Little Wilbraham G73 (2)** (large type B1), **Spong Hill C2656** (associated with type A2 or A3), **Milton-next-Sittingbourne 2** (small type B2), **Fonaby 2** (associated with type D2) and the silver contents of **Fonaby G43 (1)** (also associated with type D2) and **Asgarby 1** (type D4) are nearly as high. 362 samples have a mean silver content of 0.21 % $\pm$ 0.22, although with the very high values removed the value of the mean is 0.19%.

Traces of silver and gold in copper alloys are a special case

as they could be expected occasionally as indicators of recycling if silvered or gilded objects were remelted. However, silvering was not frequently used for decorating copper alloy artefacts during the earliest phases of the Anglo-Saxon period. Furthermore, if there was a thick layer of either silver or gold present on articles to be recycled, it may have been worthwhile to scrape it off or recover it in the melt.

Since gilding at this time appears to have been performed using gold-silver alloys rather than pure gold[13], silver and gold would be positively correlated in copper alloys from technologies that recycled gilded scrap. Gold traces occur only infrequently amongst the database and they are not normally correlated with high silver concentrations. In fact, few of the silver concentrations seen amongst this data group are sufficiently high to be attributed to re-melting of silvered artefacts. Northover comments that silver-rich inclusions were noted in the saucer brooches from the Upper Thames Valley (Northover unpubl).

One exception appears to be the type A brooch group, to which the relatively high-silver, high-gold content brooch **Spong Hill C2656** belongs. The other 13 microprobe samples of this artefact type also have a degree of correlation between gold and silver (0.689). Since gold only occurs at very low levels,

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[13] As seen on many saucer brooches, e.g. those discussed in Mortimer 1988

the correlation is really between higher levels of silver (in excess of 0.2%) and the detection of any gold at all. It is unlikely this constitutes evidence for the re-use of gilded objects at this early time; instead several type A brooches may made of metal from one particular copper ore source.

Recycling artefacts with silver coatings is unlikely to be the source of silver in the copper alloys of this period. Instead, these small but consistently-present quantities of silver must relate to copper ore sources.

Iron

Duplicate microprobe and atomic absorption figures for iron showed that there are difficulties in comparing results from the two methods. The overall distribution of 343 samples has a mean iron content of 0.22% ± 0.15, with quite a long tail towards the higher values. **Mucking 6 and 7** (type D5b), **Holme Pierpoint 3** (type D5) **and Unknown provenance 4** (type Z3) have in excess of 0.6% iron present.

A correlation between iron and zinc contents was seen at low concentrations of zinc (i.e. in bronzes) amongst samples from Sleaford, Morning Thorpe, Spong Hill and Little Wilbraham (Little Wilbraham is used to provide an example, Fig 4.19). More than 0.1% iron in copper alloys may correspond to the use of low-grade, high-iron copper ores or to the use of iron

minerals as slag formers (Craddock and Meeks 1987)[14].

However, Craddock and Meeks' research was concerned with bronzes, and with absolute quantities, rather than the relationship of iron with other elements. It is possible that the presence of iron may relate to the type of copper ore used, in addition to, or instead of, being related primarily to the type of processing that took place. If both zinc and iron were accidental inclusions in Anglo-Saxon bronze melts, then their correlation in artefacts can be explained by these elements having similar chemical reactivity in high-temperature processes. The evidence gained from experimental melts, so far seems to indicate this may be possible (e.g. Tylecote et al 1977). That this correlation occurs in several sites suggests a degree of similarity between the bronze sources that supplied these sites and that the high-temperature processes were also similar in each region, since they did not affect the final correlation.

Some compositions with very high iron concentrations could be due to recycling processes in which complete brooches or other artefacts with ferrous attachments were melted down.

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[14] This would mean that any metal smelting would have resulted in large amounts of slag. If this is the case, then the early Anglo-Saxon lack of non-ferrous primary metal-working evidence is more significant and could be used to confirm that most copper alloys were made of re-used scrap or imported material.

Nickel

Results of analysis by AA are not strongly correlated with duplicate results by microprobe. It is most likely that the poor accuracy of both techniques (at concentrations close to the detection limits) is to blame. This means the figures are less precise as well as less accurate. Few cruciform brooches have significant quantities of the element. 103 microprobe samples have a mean nickel content of 0.04% ± 0.01 and only four examples have more than 0.09% Ni present - **Girton G39(2)** (type D3), **Unknown provenance 3** (type D), **Rudston 1** (type A2), **Spong Hill G2 (1) and (2)** (associated with type Z1b), **Spong Hill G57** (type Z1b) and **Fonaby 2** (associated with type D2).

Antimony

Again, levels of this impurity are low, 0.07 ± 0.03 being the mean value for 129 microprobe results on English material. It is obvious there is little variation within the database and the results are skewed towards the lower end of the range by a large number of samples with Sb contents around or just above the minimum detectable limits (MDL) of the methods. **Fonaby 5** (large type B3), **Little Wilbraham 2** (associated with type C2), **Girton 11** (associated with type D5), **Fonaby G38** (type Z4), **Spong Hill C2656** (associated with type A2 or A3), **Spong Hill C2997** (associated with type A1) have antimony in excess of 0.12%. However these samples do not exceed this figure by much, the highest content being that of **Spong Hill**

C2997 (0.21%).

Arsenic

Many of the microprobe samples have less than the MDL present. 98 samples have an mean content of 0.17% ± 0.12, being significantly skewed towards the lower end of the range. **Cleatham G30(4)** (large type B2), **Laceby G1 (1)** (type Z1b) and (again) **Spong Hill C2997** have high arsenic contents (more than 0.4%).

Discussion

The low concentrations and low levels of variability of trace elements in the metal used for alloying cruciform brooches means that it will be difficult to characterise alloy stock by the use of trace element patterns on their own. It is interesting to note that a number of brooches have high concentrations of more than one trace element, especially as several of these come from Spong Hill and Fonaby. Several type D brooches were also noted to have high concentrations, although the actual frequency represents a small proportion, considering the large number of type D brooches in the corpus. This gives some hope for pattern seeking, with respect to both findspot and type/date.

The very low level of trace element concentration of most cruciform brooches means it is unlikely that the original ore

source used was a high impurity ore body, such as those known in southern Germany, since elements such as arsenic, nickel and antimony would have been retained within the copper. The original source of the copper could only have been from within these ore bodies if considerable high-temperature processing has now all but removed the trace elements.

On the whole, these figures and tables show a large degree of homogenity in the trace element content of copper alloys used in this brooch type. The consistent occurence of antimony, iron and silver is of interest. As the distributions of several trace elements are skewed towards the lower value range, the use of analytical methods with lower MDL might reveal compositions with concentrations around and below the microprobe MDL, thus producing a more normal distribution.

None of the trace elements analysed are closely correlated (either positively or negatively) with each other, overall[15]. In binary plots of elements (silver vs antimony etc.), there is always a large mass of values clustered around the respective mean values of the elements and a small number of outliers.

[15] The iron/zinc correlation is only observed at low levels of both elements, see further discussion below.

Conclusions

In the preceding sections, a description was given of the alloying and trace elements of copper alloys, as relevant to Anglo-Saxon cruciform brooches. The practical approaches taken in this discussion and the alloy typology outlined may be relevant for other early medieval copper alloys.

The trace element concentrations are low and rather consistent. A few outliers have been noted, but within a large database, these may be expected from a statistical point of view, as artefacts of the analytical method.

E. Regional patterns of alloy use

The chemical data were sorted according to the site groupings used in Chapter 2. Some characteristic patterns can be seen (Fig 4.10).

Kent is a region peripheral to the central cruciform brooch distribution area, for which there are only small numbers of sampled brooches. The Kentish cruciform brooches seem to have an unusual balance of alloy types, with a relatively large number of zinc-rich alloys.

Similarly, the samples from the western and Midlands sites include very few true bronzes. This sample is small, but the results are probably sufficient to hint that the alloys used

in these areas differ from the overall chemical composition, which is dominated by bronze brooches from the CSNE site area.

There appears to be little difference between the CSNE pattern of alloy use and that in Lincolnshire or south Humberside, or probably from that in north Humberside.

There is an insoluble problem here - one cannot increase the cruciform brooch database for peripheral areas in order to increase statistical certainty, for obvious reasons. Unfortunately few other artefacts from south-east England have been analysed. The available analyses do not repeat the high-zinc pattern observed in the cruciform brooches. Wilthew's XRF analyses of material from Finglesham, Kent suggests that very few brasses were used[16]. Most of the pieces from Highdown Hill, West Sussex were made from leaded bronze[17]. On the other hand, the artefacts analysed may have different technical requirements. Further analytical programmes on other cast material from these areas are required.

In conclusion, one may say that the types of alloy used in most areas within Anglian England were similar, but the ratios

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[16] It is significant that Wilthew estimated the type of alloy of two Morning Thorpe cruciform brooches correctly using non-destructive XRF, although the internal compositions by AA (see compositions in catalogue) are very different to the XRF results (Wilthew 1985b).

[17] Information on ten AA analyses kindly provided by Jon Wallis, Field Archaeology Unit, Institute of Archaeology, UCL.

in which the alloy types were used differed. The Kentish brooches seem to be a little higher in zinc, as do the western/Midland brooches. Both these sub-sets are rather small.

Other databases

Two databases exist with which to compare our new findings. From the Upper Thames Valley area, Northover analysed 30 saucer brooches and four other items (Northover unpubl), also using the Dept. of Metallurgy, Oxford microprobe. The range of alloy types used to cast these brooches was similar to that used in cruciform brooches, with a number of significant differences (Fig 4.13). The saucer brooches all have low lead concentrations. This may be connected to the technical requirements of gilding.

Further analyses were carried out on 33 saucer brooches (including 13 pairs) from Lechlade (Mortimer 1988). These brooches have recently been examined and dated to phases within the same period as the cruciform brooches, with the addition of a late sixth-/early seventh-century pair - from grave 1104 (Dickinson pers comm). Although the method used was XRF with surface cleaning, the patterns of alloy use detected are comparable to the other Upper Thames Valley material. Most of the alloys were bronze. The analysis programme on Lechlade material all demonstrated low levels of alloying contents, producing four coppers.

The results of a survey of Anglo-Saxon brooches from the Avon Valley (Brownsword 1986) show different proportions of alloy type (Fig 4.13). Most of the bronzes are lower in tin than either the saucer brooches or the cruciform brooches and quite high in zinc. The brasses are higher in zinc and lower in tin than the Upper Thames Valley material. The continuum running between brass compositions and bronze compositions is also more evident, possibly as a result of a larger database.

The observed differences between the analyses of Brownsword and Northover may be entirely due to technical factors, if low-zinc alloys were selected for saucer brooches. No clear preference was observed for gilded artefacts or for saucer brooches from the Avon valley sites (Brownsword 1986, figs 36, 38 and 40), although some selection was indicated at Lechlade (Mortimer 1988, figs 1-4). Clearly further work has to be done on archaeological aspects, e.g. provenance, type and date, to understand this data.

In summary, the available information suggests that the types of alloy used are similar throughout Anglo-Saxon England. There may be some subtle differences between patterns of alloy use in the east and the west of England, but, at present, the material tested from other areas is technologically and typologically too varied to be directly compared. Certainly, the available data do not demonstrate that pure bronzes were more frequently used in Saxon areas than in the Anglian ones.

Therefore we cannot employ the alloy use data to support the case that significant proportions of the metal supply to the Saxon metalsmiths came from Celtic regions. Some indication of continental imports may be proposed for the Kentish material, as a higher zinc content was observed, but this needs to be confirmed.

Chronological patterns in alloy type use.

Chemical analyses performed on saucer brooches suggested that detailed examination of the patterns of alloy use within each archaeological type may reveal relatively short-term changes in metal availability or in technical practice (Northover unpubl). Cruciform brooches were given positions in a relative chronology in Chapter 2.

The typological sequence has been noted to be one of overlapping types and should be seen as a continuum, rather than consecutive periods. The production of some types continued over a long time. This type of uncertainty could be seen to have a parallel in the 'grey areas' in the chemical data, between a tin brass and a zinc bronze or a zinc bronze and a true bronze.

Data from archaeological types with a low frequency of occurrence (i.e. types A, C and Z) are here, of necessity, compared with types with higher frequency of occurrence and the probability applicable to each group description will be

different. In view of the practical limits of the data, it is not possible to improve this situation. The previous section suggests that sub-division by typology should not be affected unduly by the place of manufacture.

There are some distinctive patterns that emerge when the dataset is divided by typological methods and compared with information from the chemical data base (Table 4.2, Figs 4.14a, b and c). The overall impression is that each of the major typological groupings A to Z have some examples of each of the common alloy types. The sources of supply to the Anglian region did not change radically over the period in question.

The clearest differences can be seen between the proportion of alloy types used for the earliest and latest brooch styles. Type A brooches tend to be made either of leaded bronze or of brass. Eight of the twenty-eight alloys have more than 8% zinc present, six of these being quite high-zinc, low-tin brasses. Nineteen remaining alloys are rather high in tin, averaging 10.3% $\pm$ 1.7. Six of these bronzes are amongst the small group of high-tin, low-zinc bronze compositions commented upon above.

The type Z samples include two high-zinc tin brass ((**Laceby G1 (1), Morning Thorpe 353 (1)**) both type Z1b) and one which should probably be classed as a copper in this typology (**Longbridge** (type Z3)). Bronzes are still the most frequently

used alloy type for these brooches. Twenty-five samples lie in a well-defined bronze group but the type of bronze here is quite different, tending to be high in zinc (2.8% ± 2.0) and low in tin (7.8% ± 1.4). There are no high-tin, low-zinc bronzes amongst the type Z brooches sampled.

Type Z brooches are often gilded and/or silvered/tinned, in which case, the observed compositions may reflect the requirements of the surface treatments to be carried out. A Chi-squared test suggests there is a detectable difference between the lead content of type Z brooches and contemporary, ungilded type D brooches. However, the low probability (a = 0.05) and the histograms of Fig 4.14b suggests the difference is not very great.

It is possible that the mixed alloys of type D and type Z brooches merely reflect the fact that large brooches would need more metal, hence metal from more than one source is more likely to have been used in the melt. However, since large type B brooches are no more likely to be made of mixed alloys than small type B brooches, this does not seem to be an important factor[18].

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[18] 41 type B2 brooches and 21 type B3 brooches were tested and showed no significant correlation between size (estimated by overall length in mm) and alloy type (i.e. tin and zinc contents).

Type Z brooch forms have unusual distributions, to the north or west of the CSNE group of sites, but most of the sampled type Z brooches came from CSNE sites, so that regional supply characteristics are probably not significant in this consideration.

Conclusions

Type A and type Z brooch forms are chronologically the most well separated forms, within the relative typology. Their alloy compositions have distinctive identities. This can be described as a shift, from an apparently discontinuous compositional range (i.e. either bronze or brass), to continuous one (from bronze through to brass).

Copper alloys used in the manufacture of cruciform brooches became more impure during the sixth century. There is certainly no indication of fresh brass being produced or imported. It is unlikely that much fresh bronze was introduced into the system. If any fresh bronze was added to the supply system, it must have been of lower quality or very quickly assimilated into the system.

As the direction of change is away from pure alloys, it is safe to say that the technology of copper alloy production did not 'improve' (from a modern day point of view). The simplest explanation is that few fresh metal resources were available. By the sixth century, mixing and recycling within the metal

supply system had caused this pattern of impure alloys. The patterns observed in the data are probably economically-derived rather than technically. This implies few imports and little alloy control - for this particular artefact type.

Comparison with other datasets

Only a small amount of chronological speculation was possible for the parallel study of saucer brooches (Northover unpubl) as there were so few samples. Bronze and copper were slightly more likely to be used in earlier forms of saucer brooch than in later ones, whereas brasses and 'mixed' alloys were used throughout the period. It is difficult to decide which factors might be suggested to be most significant, in explaining the differences between this and the cruciform brooch dataset. The small database and the fact that 'later' saucer brooches are probably late-sixth/early-seventh century rather than mid-sixth century (as for the cruciform brooches) may be relevant.

Trace element information

A picture of intensive recycling is strengthened by the trace element data. No obvious regional or chronological patterns were seen through simple graphical representations of the

data, e.g. bi-variate plots[19]. It is still possible that there is information in the trace element concentrations, but that patterning is only perceivable when information from several elements are considered together. In other words, multivariate analysis must be performed (Shennan 1988).

If bronze and brass alloys were re-melted together, the resultant mixed alloy composition (tin brass, gunmetal, zinc bronze) would carry trace element information from both sources. Trace element information from mixed alloys should therefore be avoided. Bronzes were selected for detailed study. They are the most common alloy within the dataset and it is possible that their compositions represent distinguishable, coherent sources. Iron, nickel, silver, antimony and arsenic were used as variables, since they are consistently present, throughout most of the dataset.

The results of multiple efforts to run discriminant analysis and cluster analysis on the bronze data were not successful in showing patterning. Scatterplots, dendrograms and plots of discriminant functions showed very poor resolution between samples from various areas, sites and types. This suggests that metals were thoroughly mixed by the prevailing alloy supply and use systems. The chemical 'signatures' of the original ore sources were not detectable.

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[19] Using LPLOT, CORREL, REGRESS in the MINITAB package, on the VAX cluster

Briefly, the data showed that,

1) Samples from individual sites do not cluster together[20]

2) The trace element contents of bronzes from regions did not allow differentiation using discriminant analysis[21]

3) Bronzes from East Anglia did not cluster together according to type, nor could the chemical signatures of type A brooches be distinguished from the signatures of type Z brooches.

From these results, one may suppose that it will be difficult to find significant chemical patterns within material which originated in particular areas or workshops. However, this assumption must be rigorously tested.

Geographical pattern

Although the alloy use within Lincolnshire and East Anglia was shown to be similar, the data should be examined for further detail. The large number of samples means the CSNE site area can be sensibly sub-divided geographically into four tightly bunched groups of sites and several less closely associated

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[20] Cluster analysis on material from 50 samples from Cleatham, Fonaby, Ruskington, Sleaford (Lincs/S Humbs), Girton, Little Wilbraham and Spong Hill (Cambs/Norfolk) (CLUSTAN package)

[21] SPSSx package

sites lying between these groupings (Fig 4.11). Both the group dominated by 24 samples from Spong Hill and that composed of 35 samples from around Lakenheath have more zinc bronzes than normal. The group dominated by 27 samples from Morning Thorpe has more tin brasses than normal. Hence, there seems to be some small-scale variation within the region.

When large datasets from the individual sites of Spong Hill, Little Wilbraham and Morning Thorpe are compared (Fig 4.12), a significant proportion of tin brasses and gunmetals is observed at all three sites[22].

For comparative purposes, two further northern sites may be considered. Fonaby and Cleatham are sites about 30 miles to the north of Sleaford. Both Sleaford and Cleatham have a preponderance of bronzes. At Fonaby, however, there are four gunmetals amongst the 11 samples analysed. Again, neither of these samples would be unexpected in statistical terms, when compared with the overall pattern.

In the samples from Sleaford and Cleatham, a positive correlation can be seen between zinc and silver, largely influenced by the fact that there is a small number of samples

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[22] The range of sampled brooches at these sites includes both typologically early and late examples and, from Spong Hill, brooches from both cremation and inhumation graves. It does not seem likely that the sample from each of these areas is subject to chronological bias, due to different periods of production, since the range of typological groups sampled in each of these sub-groups is similar.

at each site which have high zinc and high silver concentrations.

One may conclude there are hints of patterning at a very local level. Supplies to individual sites seem to have particular characteristics, although neighbouring sites did not share these characteristics.

Alloy use in workshops

In Chapter 2, the existence of workshops was discussed on typological grounds, based on details of the production of type D brooches, especially types D1, D2 and D5a. When the chemical evidence is examined in detail, it appears that type D1, D2 and D5a brooches do not use similar alloys.

The discussions in Chapter 2 emphasised that types and sub-types (as defined in this research) were not likely to have been the product of a single workshop. Brooches within types do not have distinctive chemical characterisitics, even where they come from the same site[23]. Brooches from putative workshops (see Chapter 5) do not have similar compositions, either. Equally, chemical compositions cannot be used to deny associations between brooches. The character of metal input

[23] For example, at Morningthorpe, two type D2 brooches from Graves 208 and 209 are both made of bronze. But the bronze used in **Morning Thorpe G208** is high in tin (10.6%) and low in zinc (0.09), whereas **Morning Thorpe G209** has a more normal 2% zinc, 8% tin content. The type D2 brooch from Grave 253 was made of a gunmetal however.

into casting processes was highly variable at this time and was not subject to much control.

As a result of the increasing use of mixed-alloy compositions in copper alloys during the sixth century, trace element contents, which may have given characteristic 'signatures' are likely to have been confused. Testing using cluster analysis and discriminant analysis showed it is indeed difficult to form groupings on the trace element information[24].

F. Copper-alloy usage on the continent and in Scandinavia

The problems encountered in determining the sources of original raw material for English cruciform brooches may be lessened, if we can assess which factors primarily determined the patterns of English copper-alloy use. Interaction of economic, cultural and technical factors may be reflected in the chemical output. It is difficult to disentangle the effects of each variable, and none of these variables is likely to have remained constant over the period of discussion, even within a deliberately restricted database such as this one.

Fortunately, the production of English bow brooches did not occur in isolation. It may be placed in the context of other

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[24] Correspondence analysis will be explored as the next possible route to establishing patterning in this data.

Migration Period evidence, specifically in this case, the context of cruciform brooch production in Scandinavia and on the continent. Attitudes to resource management may have been different in each area, according to the prevailing conditions.

Examination of copper-alloy production systems on the continent and in Scandinavia starts with a review of chemical data already published. This will establish which alloys are already known to have been used.

A review of analysed Migration period copper alloys from Scandinavia and the continent.

There are several small groups of published chemical analyses for late Roman Iron Age and Migration period Scandinavian and continental copper alloys. Many of the problems previously discussed with respect to the English cruciform brooch data also arise in studying data from abroad e.g. analytical comparability, the influence of manufacturing processes and the amount of archaeological detail supplied. This means that much of the information gained from these analyses is irrelevant to our purpose here and difficult to use constructively.

Copper alloys used in Late-Roman and Migration period material

It has been said that brasses were used in Scandinavia during the Roman Iron Age but that bronzes become more prevalent during the Migration Period (Arrhenius 1982, 16). During the Vendel and Viking periods brasses again became predominant, which Arrhenius assigns to a eastern trading influence. This overview has parallels in England, where brass is significant for the production of later Anglo-Saxon material (Caple 1986). However, definitions of 'brass' and 'bronze' differ widely between individual workers and access to the raw data is needed to check the evidence behind these general themes (Arrhenius does not quote references and her paper is presumably based on unpublished data).

Amongst a set of Danish brooches, the process of manufacture appears to have been significant (Näsman 1973[25]). 10 late Roman and early Germanic tendril and ribbon style brooches are either low tin bronze or 'copper'. These items were worked into shape after casting. Brass is the most commonly used alloy amongst the 28 cast cross-bow brooches (57% of the total); bronzes, zinc bronzes and gunmetals are also used.

Analysis has shown that fourth- and fifth-century cast bowls from Belgium are normally bronze, although there are small amounts of zinc present in some cases (Werner 1957). This

[25] The figures themselves remain unpublished but have kindly been made available by the author.

latter alloy type is roughly similar to the low-zinc bronzes used in Anglian cruciform brooches. Various bronzes, leaded bronzes and leaded brasses were employed in making the component parts of Norwegian vessels (Rosenquist 1970).

Lamm (1973) shows that the range of copper alloys employed in the manufacture of jewellery at the Migration Period workshops of Helgö is not dissimilar to the range known in English cruciform brooches. Twelve analyses show that bronze, zinc bronze, gunmetal, brass and copper were used in bars, rods, runners and dress pins.

This situation of variable alloy types may be contrasted with 31 brooches from Öland, some which were 'coppers', i.e. low in alloying contents (Arrhenius 1975, 98). Arrhenius attributed this to a lack of knowledge of alloying techniques but the Helgö samples showed that other alloys were also known (Lamm 1980, 106). These compositions may have been linked to a particular method of construction.

Resources and recycling Roman scrap

There is a small amount of contemporary evidence for metalworking activity from sites such as Helgö (Lamm *op cit)*. This includes ingots, miscasts, offcuts and droplets. Since there appear to be few traces of moulds for ingot-making at Helgö, it has been assumed that the ingots at the site came from external sources. The variety of alloy types, detected

within the ingots, could mean a variety of sources or a variable source. The ingots seem to have a higher zinc content, whereas the runners and dress pins have higher tin contents, which suggests that at least two types of alloy may be proposed as input to the site.

One of two Danish ingots analysed for this project (possibly associated with a brooch from Sebbersund, Ålborg) is a low-zinc bronze, with low levels of tin and lead, but high levels of iron (1.21%). The other, an ingot with a triangular cross-section, was a leaded bronze with very high levels of arsenic (1.8%), antimony (4.86) and nickel (1.3%). None of the analysed cruciform brooches resemble these trace element compositions. It is likely that the composition of finished articles was influenced by the addition of several components (i.e. not just a single ingot) and by the effects of remelting (see section above, on trace element content). These two compositions are enigmatic within the context of this project; further research into Danish material is necessary.

It is likely that Roman material may have been available for recycling in Scandinavia and on the continent. Relatively large amounts of Roman artefacts have been found in these areas, including some in Migration Period contexts. A selection of Roman material from Scandinavia shows the presence of brass and other zinc-containing alloys (Stjernquist 1977). A small number of other analyses suggest that other Roman artefacts found in such contexts were made of bronze or mixed

alloys (Oddy 1983, 946).

Overall, the copper alloys of the early migration period on the continent and in Scandinavia are surprisingly under-explored[26]. The published database is rather patchy and not very appropriate to the current project. It is difficult to know what the nature of the supply system was at this time, without a large-scale analysis project. At the simplest level, we can say that both bronzes and brasses were known in the north of Europe and in Scandinavia, during the Migration period, and that the presence of mixed alloys may reflect recycled Roman scrap.

Chemical analysis of non-English cruciform brooches

Our requirement within this project is to determine what metals were used in the production of fifth and sixth-century cast artefacts, for the purposes of comparison with the English material. Chemical analysis of fifth- and sixth-century cruciform brooches from non-English production areas seems the ideal solution. Reichstein's 1975 typology may be employed to give approximate relative chronological points. Recent finds and those brooch forms not given types or phases by Reichstein are placed into the sequence as closely as possible.

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[26] Research is currently in progress on Roman material from Scandinavia, by J Bollingberg, c/o National Museum, Copenhagen.

Techniques of casting brooches in Reichstein's earliest Norwegian and continental style groups are not dissimilar to those used on early English brooch styles, especially in terms of the thickness of casting and the lack of working after casting. Hence technical requirements could be considered as uniform throughout cruciform brooches of this date. This is not to suggest that the techniques of achieving such standards were uniform throughout. Later cruciform brooch styles become very regionally distinct and possibly more technically demanding, in the case of Norway.

Forty-four copper-alloy cruciform brooches were analysed from Denmark, thirty-two from Germany and fourteen from Holland. These will be considered together below. A further forty-five samples were analysed from Norway.

Composition of continental cruciform brooches (Fig 4.16)

As in the English corpus, bronzes are the most commonly used alloy[27]. However, amongst the German, Danish and Dutch brooches, high-tin, low-zinc bronzes are more common than in England[28]. The presence of high-purity, high-tin bronzes means that the continental bronzes are also higher in tin and lower

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[27] 65 out of 90 samples, or 72%

[28] 37% of the continental bronzes have less than 1% zinc and more than 11% tin present. This can be contrasted with the material from England, where only 16% of the bronzes have high-tin, low-zinc compositions. Type A brooches are the only English examples to have so many high-tin, low-zinc bronze compositions (Table 4.2).

in zinc, overall. The highest proportion of high-tin, low-zinc bronzes appears amongst German brooches and in Reichstein's Stufe D2 brooch forms[29]. Clearly there was a reliable and strong supply of high-tin, low-zinc metal to this part of the continent.

Apart from the bronzes, there are a small number of samples which represent each of the other classes of alloy defined. The use of these alloy types does not appear to have any particular regional affiliation, with the exception of Holland, where only seven of the fourteen analysed alloys were bronzes. The high zinc content of the remainder of the Dutch alloys is of some interest, in view of the Kentish compositions (Fig 4.10).

In addition to the unusual distribution of zinc/tin ratios, the lead levels amongst Dutch brooches appear to be rather high. Half the samples have more than 5% lead present. Five of the fourteen Kentish brooches (i.e. 35%) also have high levels of lead, compared with only 8% in the CSNE area and the western/Midland group and 14% in South Lincolnshire. It may be significant that Roman vessels from Holland included heavily-leaded high-tin bronzes and high zinc brasses (Boesterd and

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[29] 56% and 61% of the total number of bronzes in these categories, respectively.

Hoekstra 1965)[30].

Conclusions and discussion

We can see that zinc bronzes form a very small proportion of the total number of alloys, when compared with the English data overall. Together with the high frequency of high-tin, low-zinc bronzes, this may indicate an easier access to bronze supplies. Alternatively or additionally, since production traditions evidently did not exclude the possibility of mixing sources, the rate of recycling of alloys may have been less intense than that in Anglian England.

The differences in major element concentrations may also be used to suggest a distinctive alloy supply system prevailed for the Dutch metalworking environment, which differs from that of northern Germany and Denmark but may have parallels with Kent. A more zinc- and lead-rich supply of metal must have been available in Frisia.

The chemical composition of German, Danish and Dutch brooches has shown us that the fifth- and sixth-century metal supply system on the continent had some features which allow distinction between it and the English situation. However, it is reasonably safe to say that these differences are not major

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[30] However, the unusual alloy preferences in Holland may be partly due to the predominance of late (i.e. Reichstein *Stufe* D3) brooch styles amongst the sampled Dutch items, since high levels of lead also occur amongst other late continental brooches.

enough to imply changes in technical requirements or traditions. They are expressions of the prevailing economic situation.

Norwegian data

With the Norwegian data, there are a number of technical and stylistic factors to consider; a) the more-or-less total conversion to thin-casting during the sixth century, with the attendant technical difficulties, b) the movement towards stylistic repetition c) the strongly regional nature of the type distribution, especially in the latest phases. These features may imply a different approach to metal supply and use.

Stufe	Bronze	Zn Br.	Gunm	Tin Br	Brass
C3/D1	2	0	2	0	0
D2	7	2	0	0	1
D3	16	7	1	2	0

Norwegian alloy types

Amongst the Norwegian samples, a high proportion of the bronzes were high-tin, low-zinc (11 samples, 37%). The brooches analysed were mainly late, including sixteen examples from Reichstein's *Typ* Mundheim. There is little evidence for typologically- (hence chronologically-) linked change in the types of metal used. The introduction of thin-casting techniques was not caused by, nor did it cause, major changes in

circulation.

Similarly it is difficult to discern regional differences within Norway[31]. The sample size is not adequate to prove that zinc bronzes were more common in the north than in the south. In any case, the differences were not great.

Trace element evidence

Evidence from trace element concentrations were considered using the same methods as were employed for the English dataset. The absolute concentrations observed in Germany, Holland and Denmark can be compared with the Norwegian situation in Figs 4.17-4.18. There appears to be very little difference in the levels of trace elements found in each area. The iron and antimony concentrations may be slightly higher and arsenic concentrations rather lower in the Dutch artefacts than in the German and Danish samples.

Norwegian bronzes were shown to have a positive correlation between zinc and iron at most levels of concentration (Fig 4.20). Correlation at high levels may have occurred by chance, since there are relatively few compositions with high zinc concentrations and a wide spread of iron concentrations. The

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[31] Samples from the north of Norway (Nordland and Finnmark) include five bronzes (of which two are high-tin, low-zinc bronzes), four zinc bronzes, one tin brass and one brass, whereas a selection from Rogaland, in the south-west have nine bronzes (of which three are high-tin, low-zinc bronzes), two zinc bronzes, two gunmetals and a copper composition.

positive zinc/iron correlation at low concentrations may suggest that the combination of several factors - the chemical pattern of the ore source and the traditions of copper-ore refining and alloying - were sufficiently similar in both England and Scandinavia to give a similar chemical signature. However, since we cannot definitely attribute the zinc/iron correlation to any one factor, it is possible that two different processes (or combinations of processes) caused a similar elemental correlation. No evidence for this correlation can be seen in the Dutch, German or Danish datasets.

The use of discriminant analysis, cluster analysis and factor scores demonstrated that the products from each of the non-English areas cannot be differentiated by their trace element content. For the same reasons that were outlined in the discussion on English cruciform brooches, this may be due to one or more factors. The metals used in each area may have had the same original sources. Metals may have been mixed before or after reaching the area of use, thus scrambling the chemical 'signature' of the ore sources. If little fresh metal came into these northern areas, then recycling of existing supplies would also eradicate any trace element information.

Conclusions on metals used in casting cruciform brooches

In the chemical compositions of the fifth- and sixth-century Anglian cruciform brooches, we are seeing the metallurgy of

survival - adequate but not technically fastidious. There is little evidence for the importation of metal from sources external to the Anglian area. If any metal was brought in from outside, the alloys were added haphazardly to the melting pot. The effect of recycling became pronounced in the production of large brooches in the mid-sixth century.

Throughout Norway, Denmark and Germany, sources of alloys for cast brooches were similar. The pace of recycling was generally less intensive than that in England. The earliest English brooches (type A brooches) have chemical characteristics which link their production to continental production traditions (low zinc and high tin contents). Kentish brooches have unusual alloying element contents, rather similar to those found in Frisia.

The chemical analyses involved in this project have provided a unique database for the archaeology of this period. At present the figures rest in a vacuum, with few contemporary parallels in this country or abroad. It would be extremely informative to analyse a wider selection of artefact types from this country and abroad. Without further data, it is difficult to be know if the approaches to casting non-ferrous metals in Anglian England were unique or whether this is a pattern replicated in other forms of metal use in Migration period Europe.

G. Postscript - Pairs of brooches

Evidence from pairs of brooches may give further information on the methods of metal stock management. It is difficult to state what level of chemical similarity has to be achieved before one can be sure that it is not only the same melt, but the same occasion of melting - i.e. that the two brooches were cast one after another from the same crucible load. Northover found that five of thirteen pairs of saucer brooches matched, six pairs were rejected and two were uncertain (Northover unpubl), on the basis of zinc/tin ratios (to within 5% variation in the zinc content), impurity patterns, especially nickel, silver and antimony, and isotope ratios. The matched pairs were more likely to be amongst alloys with both zinc and tin present, than for brasses or bronzes.

There are twenty-nine sampled pairs of English cruciform brooches in this dataset. Of these, ten appear to be unlikely candidates for a close match; the difference between pairs of elements is greater than 10% of the larger figure for all, or all but one of six analysed elements; zinc, tin, lead, iron, nickel and silver (table 4.4). These pairs are **Barrington 10 and 12, Howletts G1 (1) and (2), Kenninghall 10** and 11, **Mucking G825 (1) and (2), Newnham Croft** 1 and 2, **St Johns** 10 and 11, **Soham G16 and G12, Spong Hill G22 (1) and (2), Cleatham G30 (4) and (5)** and **Rudstone** 1 and 2. These brooches belong to types A2, B (2 examples), small B3 (3 examples), D4, D5 and Z2a. They come from sites distributed throughout most

of the Anglian area, with the exception of the western/Midlands area.

Ten brooch pairs have good or very good matches between their compositions (i.e. all or all but one of the elements match); **Bifrons G15 (1) and (2), Haslingfield 12 and 13, Holme Pierpoint 1 and 2, Little Wilbraham G31 (1) and (2), G95 (1) and (2), G105 (1) and (2), 3 and 4, Rothwell 1 and 2, Cleatham G34 (1) and (2)** and **Linton Heath 1 and 2.** These brooches are of C2 (2 examples), D5 (2 examples), large B2, D6, small B3, small B2 (2 examples) and spatulate foot brooch forms and are also well distributed geographically.

The remaining examples have compositions whose comparison gives ambivalent results, of which a further four - **Bergh Apton G6 (2) and (3), Holywell Row G99 (1) and (2), Little Wilbraham G95 (1) and (2)** and **Spong Hill G2 (1) and (2)** (of types D2 (2 examples), C2 and small B3) - are likely candidates for matching. The compositions of **St Johns 10 and 11, Cleatham G30 (1) and (2)** (types D3 and D5) seem more likely to mismatch.

In summary, the compositions of brooch pairs are equally likely to be matched or mismatched. Although the database is rather small, it seems that the type of brooch is not significant, nor is the region of burial.

The greatest number of mismatches occur within the lead

concentration data, as would be expected in copper alloys with more than a trace of lead, as a result of inhomogenity within the metal. In addition, brooch pairs with low concentrations of major elements (e.g. less than 2% zinc) are more likely to show variety, as are trace elements. This type of feature is not unexpected within such a chemical analysis programme, since small errors in the calculations could cause relatively large differences between the analyses of pairs. Hence the number of observed matches may be an underestimate.

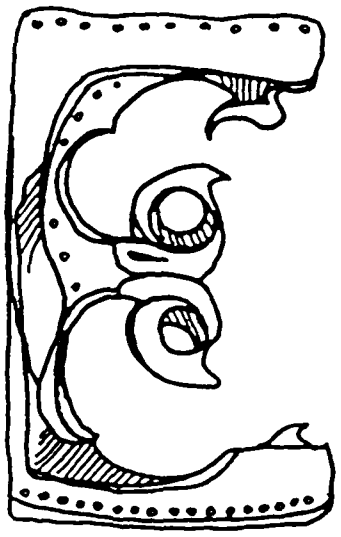
These results suggest that brooch pairs were sometimes, but not always, cast using the same melt. The fact that some of the brooch pairs were cast using different alloy compositions does not mean the brooches were made at very different times or places. The data could be used to suggest a) that moulds were reused, b) that the first brooch was used as a model for the second c) that more than one crucible was kept at melt temperature during any one casting occasion or d) that one small crucible was used, the capacity being inadequate to complete both brooches, which was recharged with metal between castings.

That large crucibles were available is demonstrated by the large size of some of the late brooch forms - so d), the use of two crucibles or recharging of a single small crucible seems unlikely in the case of small brooch forms. In view of the large amount of variation observed amongst the brooches in general, it has been shown that the supply of metal to an

individual metalworker or workshop may have been quite variable. If this is so, then it is unlikely that methods of metal stock management could have caused any systematic patterning in the chemical signatures. The chemical data from pairs of brooches does not provide further help in the understanding of modes of production.

Chapter 5

Synthesis



vidence relating to the Anglian cruciform brooch has been retrieved using three different methodologies. The data produced has been correspondingly multifarious. Treatment within the preceding chapters has ordered the data and drawn out patterning. A careful utilisation of this patterning can give information on the manufacture and use of cruciform brooches. From this we may be able to infer certain facts about the character of copper-alloy artefact production in early Migration Period society, both as a 'system', existing at a particular time and as a 'transformation', occurring over time (Kristiansen 1984, 72-3).

A. Production

To understand the importance of a production system within a society, the physical processes behind its existence must be examined. Logically, the first component to be commented upon must be the raw materials. The means with which to make moulds and to heat metal (i.e. clay, temper, water, wood) were

available locally throughout the regions in question[1]. Non-ferrous ores are not found naturally within East Anglia, hence access to copper-alloy metal supplies requires special consideration, since it implies the existence of an acquisition system.

Next, the ways in which these raw materials were deployed must be determined. Cruciform brooches require rather complex casting and finishing techniques. We lack any structural evidence for metalworking in early Anglo-Saxon England, so we cannot prove where brooches were made. There are datasets from other periods and regions for comparison but the bulk of our information comes from the brooches themselves.

There is a great deal of variability in the style and method of production. It is essential that we assess the probable sources of this variation. Evidence for the 'mode of manufacture' must be assessed, in terms of location, size, frequency of operation and intensity of operation. We need to clarify what 'workshops' were, how we can identify workshops through their products and how identifications based on stylistic criteria can be integrated with information on technical variation.

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[1] Ease of access does not necessarily imply lack of selectivity. It is clear that the components used during mould-making in the Migration and Viking periods were liable to careful control, for example, the selection of particular types of clay (Brinch Madsen 1982, 498).

Copper-alloy supply

Chapter 4 indicated that any fresh metal input into the early Anglian economy must have been of variable composition and quality. It is likely that the bulk of copper-alloy production was supported by recycling. Cruciform brooch manufacture represents one example of a process that was so metallurgically tolerant that the available copper-alloy supplies could be utilised very efficiently. Other datasets concerning metalworking processes that have more stringent chemical requirements indicated that it was possible to exert some control over copper-alloy composition, at this time - but the types of artefact preferred for frequent manufacture may have been influenced by the nature of the supplies available.

Access to non-ferrous metal supplies must have been similar throughout the central Anglian region since there are few clear regional or sub-regional distinctions in the chemical compositions. A bronze with 8% tin, 2% zinc and 4% lead may be taken as the 'average' alloy used in cruciform brooch manufacture. Brasses were very unusual, although mixed alloys (with zinc and tin present at similar levels) were common. Without precise information on the ratio of bronze to brass usage in Roman artefact manufacture (and subsequently in scrap), it is difficult to tell whether the compositions of cruciform brooches resembles a random selection from the range of alloys available. Certainly the compositional evidence from this research shows no innovation or improvement and little

control over content.

The unusual balance of alloy compositions in Kent may suggest that a different system prevailed there. There is also evidence that the pace of recycling intensified during the sixth century.

Further evidence for the sources of metal supply at this time may be considered to come from a piece of negative evidence; there is no evidence for metal hoards dating from this period and very few examples of 'votive deposits' consisting of useful quantities of scrap. Most non-costume metal items buried in graves may be assigned superstitious or religious connotations (i.e. bag collections, pierced coins (White 1988)). This contrasts with the late Roman deposition of large amounts of silver and gold, in lowland Britain (e.g. Water Newton, Northants; Thetford, Norfolk), as well as in the Celtic areas (e.g. Trapain Low, East Lothian) and with evidence from later periods in which silver was also found in hoards (e.g. Cuerdale, Lancs).

This information has various economic implications. It seems probable that the resources used to make Anglian cruciform brooches were mainly local, with the non-ferrous metals probably originating from Romano-British scrap and from recycled Germanic artefacts. The mechanism envisaged for accumulating supplies could be simply scavenging by individuals, who would then supply some raw materials to the

smith (Rowlands 1972, 211). Later Anglo-Saxon and Anglo-Scandinavian metalworking sites show that Roman scrap was still available for recycling, two or three centuries later (e.g. White 1982).

These conclusions appear to downgrade the supply system for non-ferrous metals. However, a lack of ingots could also represent the fact that, although ingots were in circulation during this time, their use was so efficient as to leave no trace in the archaeological record. It has been suggested that utilitarian metal deposits (e.g. hoarding and other features involved with the organisation of metalworking) relate to periods of socio-economic discontinuity and economic stress (Knapp 1988, 151). This would certainly seem to be a reasonable proposition in the case of late Roman hoards. Where the majority of metal deposition occurs in non-utilitarian contexts (and in our case, the amount of metal deposited is also increased), we may be seeing a period of relative social stability and continuity. Certainly, the emphasis in expenditure of metal may be said to be on the living, not the dead (Kristiansen 1984), and on social display rather than secular manipulation (Rissman 1988, 209).

Comparison with non-English data

The compositional variability in English cruciform brooches may be compared with the situation in Scandinavia and on the continent. Non-English cruciform brooches (and other cast

items) were often made from good quality bronze. Since the type of alloy is not related to the type of casting process (i.e. the thin-casting technique did not require special alloys)[2], the compositions of cruciform brooches in these areas represent economic, not technological factors.

The source of these non-English bronzes may be partly indigenous - one might suggest the resources of Falun in Sweden and even those on Heligoland, northern Germany. Tin, however, would still need to be imported. So far, no Scandinavian or continental evidence of primary metal extraction has been found dating to this period. It is quite likely that there were important external sources of copper alloy for the manufacture of non-English brooches. The widespread availability of non-ferrous material of Roman or Romano-Germanic origin in Scandinavia has often been stressed. The supply of copper alloys, in the form of vessels and other artefacts, seems to have reached far into the Scandinavian region (Hedeager 1978, 208ff).

It seems this type of importation would have introduced several types of copper alloy[3]. From the cruciform brooch data, access to zinc-containing alloys in particular seems to have been fairly good (and similar) in Scandinavia and on the continent.

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[2] See Chapter 4, 394ff

[3] See Chapter 4, 385ff

Given the distance between the sampling areas and the likely Roman or Germanic source areas, the large number of zinc-containing alloys assumes importance. It is known that contemporary Swedish crucibles had lids (e.g. at Helgö). This may have increased the efficiency of recycling processes for scrap material and of melting ingots, by preventing volatilisation. This feature has not been positively identified amongst the Anglo-Saxon material (Brown 1986, 199), in spite of its presence on contemporary Celtic sites. This may explain the relatively frequent Scandinavian production of zinc-rich brooches, despite the distance from 'fresh' supplies of recyclable zinc-containing material from the Roman world. On the other hand, it seems likely that all possible steps would be taken to reduce losses in heating episodes, in any non-metalliferous area.

An explanation for the unusual Frisian/Kentish situation may be sought in supply mechanisms. Frisia's position, on a trade route along the Rhine, could have given access to late Roman artefacts. Settlements such as Dorestad may have acted as distribution points for trade. Although it's celebrated merchant character did not emerge fully until the seventh century, this site had trading importance since the Roman period. Sixth century Roman coins have been found along the whole length of the Rhine, as far as Frisia (Hodges 1989, 31). Although the north German plains might have been expected to have also benefitted from any such northern trade, most of the artefacts tested in this study come from sites in Schleswig-

Holstein, further from such contacts. Metal supplies from France, where the production of zinc-based artefacts appears to have had an earlier re-emergence (or simply a continuity)[4] could also have lead to the frequent use of brass during the casting of new artefacts in Frisia.

Alternatively, local artefacts of Roman date, known to have included good-quality brass and heavily leaded bronzes (Boesterd and Hoekstra 1965), may have been re-melted to make Frisian cruciform brooches. Since both Kent and Frisia have few sampled artefacts, the compositional patterns indicated here should be backed by further analysis, before basing too much supposition on their coincidences. If the compositions of other cast artefacts of this date prove to be similar, then it may be possible that Kentish cruciform brooches were imported from Holland or that the two areas shared a similar metal source.

Manufacture

What levels of organisation seem appropriate for the production of cruciform brooches? Information may be gained by evaluating how well the observed patterns fit with hypotheses which are the results of particular theories. Archaeological and ethnographic information suggests that metalworking systems may occur at various levels of intensity; part-time/

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[4] See Chapter 4, 358ff

full-time/seasonal, specialist/non-specialist, individual/ workshop, itinerant/settled (Brown 1986, 329ff). It is feasible that, within any particular region, metalworking may have occurred simultaneously at several different levels of organisation. It is also likely that such patterns will not be constant.

For most methods of investigation into models of production systems, access to information about size and layout of the production site, intensity of occupation and waste distribution patterns is required (Brown 1986, 336ff). This evidence is lacking in early Anglo-Saxon England so the dataset which is available (i.e. the artefactual data) has to be used in a creative, although still pragmatic manner.

The concept of a 'workshop' is perhaps the simplest starting point. Information relating to typological and technical variation may be used. If workshop production can be proved, various other facts about the scale, location and style of production may be inferred.

Workshops

A 'workshop' is a convenient term for a production unit, which can be discovered archaeologically by having products with distinctive characteristics in common. The detection of workshops is a difficult task, due to the existence of various practical constraints. Firstly, the corpus of brooches known

to modern research must contain at least two examples from the workshop, and preferably many more. Hence, only production units which had relatively lengthy or intensive use will normally be detected as workshops in the archaeological record. The disadvantages of this situation will be relieved when structural evidence of the workshops themselves is discovered in England. In addition, workshops will only be noted if and when a) the production of an artefact type was capable of being controlled and b) it was thought such control was appropriate.

Items produced in a workshop will have stylistic and technical characteristics in common, due to similar socio-economic influences. It is generally assumed that the output of a production unit consisting of several individual workers will also have characteristics in common. The term 'workshop' will be taken here to mean a production unit consisting of one individual worker or of several workers.

Artefacts from a workshop have a coherent group identity, so that they may be discerned from within the total output of the type. If the output was relatively large, the workshop may have supplied the local population, producing an distinct geographical clustering of artefacts with this identity. The search for patterning in the data (Chapters 2-4) is the method by which we discover such group identities.

Dynamic development (stylistic or technical) within a workshop

produces a chronological dimension. Workshops may have produced several artefact types and may have used several methods of production at any one time. Some production methods may have been common to several workshops or to the culture as a whole. These factors may obscure patterning.

The Anglo-Saxon cruciform brooch dataset may be explored to determine whether the existence of 'workshops', as defined above, may be supported.

Typological and distributional evidence for workshops

Several very common themes were observed in the decoration of cruciform brooches (Chapter 2). When using stylistic data, the requirement for positive identification of workshops is that the typological data must be capable of demonstrating peculiarly close affinities between several brooches. This limits the features studied to those which are unusual within the database, and the brooches studied to a small fraction of the total corpus. Geographical patterning may be of some assistance [5].

The simple styles of brooches from types A and B make the detection of distinctive typological characteristics within this part of the dataset very difficult. Widespread

[5] It must be initially assumed that there were no mechanisms which caused cruciform brooches to be found far from their origins; see below, 420f.

distribution means that type B forms were probably produced throughout the Anglian area. Variety in artistic styles and standards of accomplishment suggests that numerous production units were engaged in manufacturing brooches of these styles. Type B cruciform brooches were probably a continuous feature of Anglian metalworking, over a long period of time[6].

With few exceptions, type C and D brooch styles also do not have very strong associations with particular areas. If type C or D sub-types represent the products of individual production units, these products are now very widely dispersed. It seems more likely that each brooch type was produced in more than one workshop. Typological similarity between products found in several areas, relates to similarity of artistic influences which were operating upon several production areas.

Observation based on idiosyncratic decorational motifs supports the existence of workshops, producing several types of cruciform brooches. The St John's type topknob ending is probably too common to be used on its own[7] but it is well localised (i.e. primarily found in the CSNE area)[8].

The combination of this knob style and other design elements

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[6] Chapter 2, 109ff

[7] It occurs in a clearly identifiable form on at least fourteen diverse type C and D brooches in the catalogue.

[8] The exceptions are 3 brooches from Holme Pierpoint, Notts.

is much more informative. The fine detail, overall proportions, double knob collars and animal head detail strongly suggest that **Holywell Row G48 (1)** (large type B2), **St Johns G1** (type D1) and **Girton 2** (type D5a) came from the same workshop. Further examples may be added to this group, by using good but slightly less precise links, for example, through the similarities of foot and topknob forms of **St John's 1** (type D1), **Holywell Row G79 (3)** (type D5a). A likely location for this workshop would be in east Cambridgeshire or west Suffolk. For brevity, this workshop will be referred to as the Holywell Row workshop. Several additional brooches from within types D1, D2 and D5a were noted (Chapter 2) to share further typological peculiarities with these brooches, e.g. square bosses at the bow and flat, sub-rectangular fans on the knobs.

Further information may be gained from individual graves or cemeteries. Where artefacts come from the same site and have been well preserved and illustrated, it is easy to see 'family resemblances'. Workshop origins for several small groups of brooches can be proposed. For example, Grave 30, Morning Thorpe provides a set of two large type B1 brooches and a brooch associated with type C (Green *et al* 1987, fig 305). Here the bow forms and punch marks may indicate a single source. Even the annular brooches from this grave seem to fall into place. Graves 80 and 90 at Morning Thorpe both have brooches with indents at all the knobs, yet one is type D6 and the other type B2 (*ibid*, figs 321 and 323). Three type D2 brooches (**Morning Thorpe G208, G209** and G253) have different

lappet and foot forms, but the same triangular punch mark and similar proportions (*ibid*, figs 360, 362 and 380).

Another possible workshop grouping can be seen within the south-west of the CSNE group of sites. **Tuddenham** 2 (type D1) and **Tuddenham** 3 (type D5a) have common knob styles, punch marks and a boss at the bow. These two brooches can be closely linked to **Lakenheath** 7 (type D5a).

Some types of brooch are found in relatively high abundances at individual sites - 4 type D1 brooches at St John's, 3 type D2 brooches at Driffield, 3 type D3 brooches at Little Wilbraham, 3 type Z1b brooches at Sleaford, 3 type Z3 brooches at Market Overton, etc. The population buried at these sites had better than average access to brooches of these types; a local source is probable. A single metalsmith could have produced three or four brooches over a short period of time. Even the variation between the type D5 brooches at Lakenheath or the type Z3 brooches at Market Overton could be explained by the relatively short-term stylistic progression of an artist. Most of these sites are amongst those which have been extensively (if not completely) excavated. The partial nature of our database may explain the infrequent observation of such concentrations.

Are these typological features truly 'signatures' (of a workshop) or are they idiosyncrasies common to a number of individuals within a region? The solution is to define the

membership of a workshop precisely, using many typological attributes[9].

The typology evidence seems to be adequate to suggest workshops existed, at least in the later phases of production. Using the data with care, one may conclude that;

i) workshops producing particular type D brooch sub-types also produced other type D sub-types and other types of cruciform

ii) individual styles of brooch were produced by more than one workshop

iii) there was considerable stylistic development within individual styles at local level, possibly by individual workers

iv) design elements could be combined in several ways on a cruciform brooch

v) design themes and motifs were known and utilised very widely, but there are a few exceptions which are more obviously localised.

Serial production

'Serial production' normally means a particular form of workshop production, in which a single form is taken as a

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[9] For example, it seems likely that the pair of small type C2 brooches from Snape could have been made by the workshop that made the type D1 brooch from Grave 131, Morning Thorpe. Although brooches from this group and from the Holywell Row workshop have knobs with double collars, other typological attributes are similar only at a very general level. Hence the Morning Thorpe and Snape examples should not be added to the Holywell Row workshop.

prototype for a large series of brooches. Most of Hines' Phase 3 square-headed brooch types are thought to exhibit this feature (Hines 1984, 148ff). There are few sets of cruciform brooches with close enough typological similarity to warrant the suggestion of this type of production; most brooches within the types defined in Chapter 2 show similar motifs and decorational elements but different styles of execution.

A possible exception is the type Z1 brooch forms **Felixstowe 2, Snape 04211, Sporle 2** and **Wakerley G74** (to be referred to as the Felixstowe series), where the form and style of decoration appear to be extremely similar on each brooch. In the midlands, type Z3 brooches **Baginton 4, Brixworth 2, Duston, Wakerley G42** and **Wychnor** (to be referred to as the Baginton series) seem to represent a series of brooches very closely related to each other, technically and typologically. The zoomorphic decoration has the same basic elements in each area of the brooch form and a similar style of execution.

In many cases, however, workshop origins seem plausible but slavish copying of a prototype cannot be proved. For example, the CSNE pair **Kenninghall 4** and **Mitchell's Hill 6** (type Z1a brooches) are extremely similar. It is possible these brooches represent two examples from a serial production output. However, serial production cannot be proved if only two brooches are known. Other type Z1a brooches are more distantly related with these brooches and introduce different foot, lappet and knob forms. Similarly, amongst type Z1b brooches, a distinct

south Lincolnshire preference for certain mannerisms can be observed[10], but the individual type members express themselves in many different ways. A workshop is likely, serial production is not. The well-localised forms type Z4a and Z4b brooches are not sufficiently closely related to each other to suggest serial production.

There are two possible reasons why serial production is not widely observed amongst the cruciform brooch dataset. Firstly, large parts of the cruciform brooch dataset are inadequate to provide evidence for serial production, through lack of appropriate decorative detail. Secondly, most of cruciform brooches are earlier than the square-headed brooch types which show serial production. If serial production was a mid- to late-sixth century Anglian feature, most cruciform brooch production may not have been liable to it. Against this may be set the fact that there are more examples of cruciform brooches than were found to be adequate in Hines' research on square-headed brooches.

We have seen two examples where serial production is an appropriate description for the manner in which brooches may have been made. These examples are not abundant enough to merit the description 'mass production'. The exigence of metal-supply demands in the sixth century may have removed further examples from circulation and hence from possibilities

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[10] From the Sleaford examples, and others

of deposition. With each additional example found, and with every fresh study, further information is gained.

Causes of typological patterning

Taking the typological dataset overall, there were some areas of the cruciform brooch form which were considered more suitable for innovation and some areas which only rarely received attention. The 'mental template' for cruciform brooches allowed for stylistic development but restricted the areas on which this occurred. Motifs which occurred on other brooch styles were transferable to cruciform brooches (e.g. those seen on small-long brooches, square-headed brooches).

The simplest explanation for this cross-fertilisation of motifs and themes is that manufacture occurred in production units which were structured so that ideas could be freely borrowed and lent i.e. workshops produced several types of cruciform brooch, as well as other artefact types.

A lack of regional trends in the majority of cruciform brooch production may imply similarity in initial technologies and styles throughout the study area and a subsequent degree of conservatism which produced parallel development. Alternatively or additionally, there may have been an efficient system for communication of ideas (although not sufficient to bring ideas from as far away as Norway or the continent).

It is not certain which mechanisms might have allowed transference of ideas within the Anglian area. Brooches taken out of the original area of production, through processes such as exogamy, may have acted as accidental 'samplers' for smiths. To take the case of type D5a, examples from the CSNE area are more closely associated typologically than those from other areas. For example, **Brixworth 3** has double collars on the knobs and **Barton Seagrave** has a close approximation to the D5a lappet form but in both cases the execution is less bold, giving one the impression that the idea, not the brooch, was transferred.

On the other hand, a much closer affinity exists between the central type D5a grouping and **Holme Pierpoint 4**, notably in terms of proportions, knob and lappet style and method of casting (with hollow indents behind both knob and knob extension). This brooch could easily have been brought from Cambridgeshire. Similarly, **Wakerley G74** (type Z1) was shown to be very closely associated with the other members of its grouping, i.e. the Felixstowe serial production grouping, with it's most frequent occurrence in the CSNE area.

The decision to chose a particular motif or style may have been made in order to convey cultural information about the wearer. An overall interpretation of burial rituals based on this dataset alone was shown to be hazardous (Chapter 2, 185ff). The concepts of social identity and social context will be discussed below, after evidence about the technical

environment has been considered.

Technical information on workshops

Chapter 3 concluded with a summary of the technical variation observed in English cruciform brooches and parallels abroad. A variety of casting and construction methods were observed. It was clear that there was considerable technical variation within individual brooch types and that each method was used on more than one brooch style. This could support the hypotheses that many production units were in operation and that individual units had wide ranges of technical style.

In particular typological groupings, techniques of construction are more restricted. For example, the technical variation amongst the brooches which belong to the proposed Holywell Row workshop group is less than that of the database as a whole, but in no way could their production be said to be standardised. The observed degree of technical similarity in this typologically-based workshop group is comparable with that between brooches of types D1 and D5a, in general[11].

The method of casting and finishing type Z3 brooches is also notably idiosyncratic, especially the silvering and sideknob

[11] For example, the productions of type D1 and D5a brooches share a preference for some unusual combinations of technical features (specifically, the use of two pin lugs and sideknobs cast with the headplate) but also employ several of the more common techniques (see Table 3.11).

attachment. Although none of these unusual practises are applied in every example, even amongst those quoted above to be part of a serial production process (the Baginton series), the attachment of silver strips using rivets is unique to this grouping. Unfortunately, neither the Baginton nor the Felixstowe series is adequately sampled to allow an assessment of the prevailing alloy supply to the workshops, through chemical composition studies.

Hence some aspects of technical variation appear to confirm the existence of workshops in the archaeological record, but, even within stylistically closely-related examples, considerable variation often occurs.

Sources of technical variation

The technical status of an artefact may be influenced by several factors; the technical demands resulting from its form, the socio-economic constraints on the production (resource availability, size of operation, social conditions etc), tradition (i.e. previous methods of artefact manufacture), current forms of other artefacts, expediency[12] and

[12] Many decisions may have been taken at the time of manufacture, purely on grounds of expediency. For example, if casting failed to fill attached side knobs fully, the headplate edges may have been cleaned off and separate side knobs attached instead. If a mould cracked along the axis of the catch, the resultant metal flange may not have been totally removed during cleaning. Similarly, it is unlikely that a metalsmith would have rejected a casting merely because the bow was accidentally cast solid, during a phase in which hollow-cast bows were the norm. We can see that the process of casting was not undertaken lightly, from brooches such as

function (practical or symbolic). Clearly these influences are interdependent. Moreover, technical attribute states do not have a simple 1:1 relationship with any factor. For example, although sideknobs are normally cast with headplate in both Norwegian Stufe D3 brooches and English type Z brooches, it was suggested (Chapter 3) that the most logical production causes were different in each case.

Most of the discussion within Chapters 3 and 4 related to practical function and to the possible advantages of alternative manufacturing strategies for different typological styles. All cruciform brooches were functional at the most basic level, in that they could have been used as an 'ornamented safety pin'. The quality of copper-alloy available was probably not germane to decisions on method of construction, since all the copper-alloy types used for English brooches were approximately equally suited to the prevalent styles of casting and construction (Chapter 4, 354ff).

This type of logical, economic approach assumes that metalworkers would have organised manufacture so that there was minimum variation or adaptation needed, so as to produce the maximum number of brooches with the minimum amount of risk. It

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Holywell Row G99(2), where a great deal of intricate sheet metalworking was carried out to disguise a failed casting. This sort of unusual occurrence, produced by expediency, should not disguise overall directions of development, nor should the output of one particularly inept or skilful worker affect the overall picture but it does explain some of the observed variability.

is quite likely that brooch manufacture was not seen in these terms. Diversity in production styles may be seen as a beneficial feature in a system. The resultant technology may have robustness, akin to that observed in biological populations with a large range of genetic variation. The existence of more than one method of manufacture may enable the development of styles, whereas over-specialisation may be more risky and restrict the options for development.

The manufacturing traditions of this period were also influenced by those of the preceding generations - certainly, the methods selected to make bow brooches are not the most 'cost-effective'. Moves towards making the production more streamlined may be indicated by the evidence of serial and workshop production and by evidence of certain technical traits (e.g. increasing preference for casting sideknobs with the headplate, thus removing one step of the assembly process).

Speculation of this nature must be put into context. We are observing these features after a long time lapse, using a small dataset. In the case of cruciform brooches, the observed examples of technical diversity are 'micro-details' within a limited repertoire. The metalworking skills displayed on English cruciform brooches represent only a small proportion of the total range displayed on English jewellery of this period. This in turn is only a small proportion of the total range of skills known to English metalworkers overall. By using the data from non-English cruciform brooches, we saw

that similar attitudes to brooch production prevailed throughout Germany, Denmark and Holland and that thin-casting was used as a rather extreme solution in Norway and Sweden.

Organisation

Some workshops have been identified, but what was the scale, standard and location of these and any other production units? These factors were not independent, neither is their discussion. Despite the large number of production models from ethnography and archaeology (Brown 1986, 335ff), it is difficult to maintain an unbiassed view of the Anglo-Saxon evidence. For example, we intuitively expect that complicated methods of production necessarily imply large, permanent workshops and full-time production.

Scale of production

The absolute scale of production cannot be easily estimated from the evidence as it stands, since there are too many unknowns. An estimate of 1 square-headed brooch per day (Leigh 1980, 11) seems fair if each brooch was manufactured singly, from model to final brooch. If serial production prevailed, however, the amount of time spent per brooch would be decreased. In this case, it might be feasible to suggest a doubling the output, if the amount of design and 'thinking time' was thus minimised.

Typological and technical evidence shows the inhomogeneous nature of the output of most Anglian cruciform brooches. A lack of systemised production suggests small-scale output, perhaps on infrequent or part-time basis, is appropriate for most cruciform brooch production. Good technical standards in such production systems need not surprise us, since high quality and high volume of output is not enough to constitute specialised production (Johansen 1988, 73-4).

There is technical variation within the examples of workshop and serial production discussed above, but it is less than that observed overall. Together with the typological details, these features may be taken to imply a particular style of operation. It would seem that these artefacts represent a fairly good degree of product control. With such consistency of style and production, it could be inferred that manufacture was carried out in a single location and that an individual worker may have spent a large proportion of his/her time on such craftworking. However, any such innovation has not produced an overwhelming impression on the archaeological database, and may have been practised in few workshops.

We should not neglect the possibility that the infrequency of the most complicated typological forms (i.e. type Z brooches) is a result of the fact that these types were the occasional products of units which normally manufactured other brooch forms. Since most other type D and Z brooches are much more individualistic, stylistically and technically, than the

workshop and serial products, contemporary production of most type D and Z brooches is likely to have occurred within systems which had less highly-organised modes of production.

There are a number of technical changes detected over the period of study. Casting methods closer to lost-wax processes would have been suitable for being carried out at a less intense scale of production[13]. Hence the manufacture of early cruciform brooches may have been carried out in a different manner to that suggested for the latest brooch types.

Range of skills

Typological evidence suggests that workshops that produced cruciform brooches also produced other artefact types. Iron-working and non-ferrous metalworking occurred on the same site, in later Anglo-Saxon periods (Brown 1986, 331), so that the attachment of iron pins or sideknob assemblies and other finishing treatments (Chapter 3) could have been carried out at the same workshop that cast brooches.

Amongst the cruciform brooch data, there is evidence for infrequent use of high-status skills, in particular, the casting of intricate zoomorphic detail, surface treatments, such as gilding and inlay work. The regional nature of the

[13] See Chapter 3, casting techniques

distribution of brooch styles with these treatments (type Z brooches, Maps 2.9-2.10) shows that the workshops which were able to perform such work had distinctive characters. The low frequency of such labour-intensive treatments implies that few workshops were able to do such work. However, the demands of type Z brooch production did not result in a change in casting styles (i.e. towards casting sideknobs with the headplate), which would have been more efficient and produced a more robust artefact. The method selected for attachment of the sideknobs on type Z brooches (Chapter 3, 252) was an extension of the normal methods of attachment but not an improvement, refinement or development. In addition, the chemical composition of type Z brooches is not particularly unusual, nor would it have had distinctive working properties.

Hence type Z brooches were made within the same manufacturing traditions as other types of cruciform brooch (and many other Anglo-Saxon brooches) and possibly within the same workshops, albeit less frequently. These brooches represent the specialisation of a small number of brooch workshops but not necessarily the establishment of workshops producing these types alone. The methods of manufacture were based on those used for all other cruciform brooches (and other brooches), with the addition of a relatively small number of extra techniques, most of which were only mechanical e.g. attaching silver strips. Even allowing for the use of high temperature techniques (gilding) and stone-cutting (garnets), the technical complexities of Kentish disc and composite garnet

brooches are not equalled (Avent 1975).

Location

The broad geographical distribution of most cruciform brooch types, together with the wide range of technical attribute combinations, suggests that brooches were probably made in many locations. Identification of workshops has allowed some production centres to be pinned down, but the exact nature of metalworking units is still in doubt. It is most probable that production occurred in farms or small settlements. This is suggested by the current consensus on the Helgö evidence (see Lundström (ed) 1988). As far as we can tell, the unique factor about Helgö is its excavation, not necessarily the site itself (Carlsson 1988)[14]. Presumably, further English excavation will produce similar evidence. Small-scale, erratic oscillation of influences, involving local exchange of brooches or short-distance travel of metalworkers, seems adequate to explain most of the technical and typological variation. Introduction of the concept of the itinerant smith is not necessary here.

Comparison with other brooch types

The technical skills displayed on cruciform brooches are parallelled by those shown on contemporary saucer and square-headed brooches, with the exception of those skills needed for

[14] Further examples of many farm-based manufacturing systems have recently been investigated in Sweden.

the attachment of separate sideknobs. However, it may be seen that the modes of production for each of these brooch types are not necessarily equivalent.

Leigh deduced that all three Kentish series of square-headed brooches were made in one workshop, which also made disc brooches and buckle plates (Leigh 1980). This implies a stationary workshop, with relatively high output. However, his data was particularly well-suited to this type of research, since it is thought that production spanned only 60 years - 500-560 AD (*ibid*, 504) - and that Kent forms a relatively isolated cultural entity at this time (*ibid*, 502).

Although a change in technology has been observed within the sequence of their production, saucer brooches from the Upper Thames Valley are thought to have been manufactured in workshops from the beginning of the sixth century (Dickinson 1982, 36). Explanation of typological variation in the dataset did not require the existence of itinerant workers, indeed, variation observed between most pairs implies that workshop production is the mode involving the least strain of the dataset.

Strong parallels exist between the production of cruciform brooches and that of Anglian square-headed brooch forms (Hines 1984). Regional characteristics emerge in the sixth-century production of square-headed brooches, as they do within the cruciform brooch dataset. In the latest phases, there are also

more square-headed brooches belonging to each type, which may correspond to a move towards serial or 'mass' production (*ibid*, 180). Although the high frequency of type C, D and Z cruciform brooches in the archaeological record could also be suggested to be evidence of an increase in output during the sixth century, true mass production cannot be proved and only a small proportion of brooches show serial or workshop production. It is possible that many cruciform brooches were still produced in small-scale production systems and this is sufficient to blur the patterning produced by more complex and intensive production systems.

Comparison with data from other countries

Of the available material from abroad, the most direct comparisons are those with other cruciform brooch production systems. The scale of late Norwegian manufacture and the type of burial rituals employed resulted in a large database for study and Chapter 3 demonstrated the potential for comparative work. The Danish, German and Dutch datasets are less expansive.

In situations where metal supplies are scarce, the techniques of production may be adapted to allow production to continue. It seems that, in England, the major contribution to continued and expanding production was ensured by increasingly efficient recycling, lesser contributions were made by changes in scale

and organisation of production. A lack of thin-casting (indeed, possibly movement towards even thicker brooches) shows there was no concession to increased size. A more extreme situation may be seen in Norway, where production was maintained through a change in casting technology i.e. adoption of thin-casting techniques. This shift did not necessitate or develop from a change in alloy usage.

The large numbers of closely-comparable examples of Reichstein's *Typen* Mundheim and Lima, which dominate the use pattern in the south-west of Norway in the sixth century, may represent limitation and standardisation of the production range. These are features linked to development of technological specialisation (Brown 1986, 337). However, this impression of a major increase in volume of output may be misleading since it seems that the popularity of the inhumation rite increased and that inhumation was increasingly likely to be accompanied by brooches, during this time (Hines pers comm).

Workshop evidence from abroad

None of the hundreds of moulds from Helgö, Sweden have been matched to completed brooches in the archaeological record. This implies there was a large output from this one site - even though the current tendency is to downgrade the status of the Helgö site from 'proto-town' to agriculturally-based farmstead with part-time manufacture of specialised goods (see

various papers in Lundström (ed) 1988). This information means it is perhaps less surprising that it has proved difficult to establish workshop groups within the English cruciform brooch dataset.

The site of Helgö is the primary source of contemporary evidence for workshop organisation at this time. Clarke (1988) compares Helgö with West Stow, Suffolk, with its less well-defined manufacturing base and an agricultural system reliant on sheep-farming. With so little English information, it is difficult to compare economic bases, but it seems likely that the hypotheses based on evidence from the Malåren area could apply to the English data as well. We can only wait for further excavations of Anglo-Saxon farmsteads or other settlements of a parallel nature to produce evidence.

B. Use - The position of cruciform brooches in early Migration Period society

The discussion of the typological and technical data has brought to light information on the manner in which artefact manufacture may have been perceived during this period.

Manufacture of brooches and other non-ferrous artefacts may have taken place at several levels of production intensity at the same time. Cruciform brooch production may have occurred in several locations in a region, conceivably on a part-time or seasonal basis, at the same time as a smaller number of

production units operated at a larger scale.

The artists had a fairly free approach to interchange, both of artistic motifs and of techniques. The contrast with the restricted style range and more technically-advanced Norwegian production is a powerful reason to state that, in Anglian England, the primary interest seems to have been in the appearance of the brooch, not in the manner in which it was manufactured. Although the external decoration is highly expressive and innovative, production was efficient but conservative.

It remains to consider what information may be gained by studying the manner in which cruciform brooches were used and disposed of.

Social circumstances - use and burial

The production of jewellery represents a willingness as well as an ability to expend resources on items which were not necessary for mere survival. During the late fifth and sixth centuries AD, there was an increase in the size (and therefore the weight) of brooches - of all types[15]. The practical functions of these large brooches may have been subsidiary to such symbolic functions as expression of wealth. Other artefacts in the 'kit' of an Anglian women were available to allow closure of a cloak (pins, pairs of annular brooches etc). If any equivalence exists between the number of brooches recovered and the number produced[16], we may propose the existence of some variable social influences, by combining typological and technological evidence.

The archaeological connotations and technology of type A brooches are rather separate from other cruciform brooches found in England. Type A brooches are small, infrequently found and many may have been imported. The symbolic importance of such unusual brooches, as ethnic markers, could have been considerable and they do appear to have been worn for a long time. If we accept that the individuals who wore them were not embedded in a fully-fledged Germanic society (i.e they were the wives of mercenaries not settlers (Böhme 1986)),

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[15] E.g. Saucer brooches - but not until the second half of the sixth century (Dickinson pers comm)

[16] See Chapter 4, 379f

further production of similar items may not have occurred locally.

When a larger population base was settled in this country, many more brooches were made. In an area so far from metal ores, the use of any copper alloy is an expression of some social order. The production and deliberate burial of so many brooches expresses the extent of this order. An overall increase in display by burial of metal artefacts in female graves (amongst other methods) may be related to a consolidation of a social grouping's position. There may also be evidence for increasing social importance attached to women, due to their position in assisting production and defining social alliances (Kristiansen 1984,94). Supply difficulties may be marked by increased female ranking and wealth display[17] and Kristiansen draws some parallels between the Bronze Age situation and the first millenium AD, in northern Europe (*op. cit.*, 95)[18].

The small number of cruciform brooches with adequate contextual records and the lack of an overall framework for Anglo-Saxon women's burial rites were noted in Chapter 2[19]. This means that it is difficult to judge whether particular

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[17] See Chapter 2, 186

[18] However, there are significant differences in depositional patterns between England and Scandinavia at this time, notably the total lack of weapon burial rituals in England.

[19] Page 185ff

brooch types or sizes were associated with particular social groupings.

However, it is certainly not appropriate to apply a simplistic correlation between brooch size and individual status, without allowance for context. The zoomorphic cruciform brooches represent a high input of resources per unit output, including the application of rarefied skills such as gilding and intricate cast detail. Although we see these brooches as part of a natural progression of increasing elaboration within the sequence of cruciform brooches, these brooches may not have been regarded by the Anglo-Saxons primarily as large cruciform brooches, but simply as large brooches. Square-headed brooches may have had an equivalent position. These brooches may represent one of the top levels of individual purchasing power (Holmqvist 1972).

It is likely that the period of production and use of several type D brooch styles overlapped with the type Z brooch production period. Since the average weight of many, common type D brooches is not dissimilar to that of type Z brooches, we cannot prove that control over copper-alloy supplies was held by a small section of the population. Access to gold, silver and garnets does seem to have been restricted, however.

Social information

Some thought must be given to the possibility of symbols in

brooch decoration. It is difficult to know which elements of a design may have had any symbolic significance to the Anglo-Saxons. A variety of causes have been suggested to be behind the predominance of animal iconography in early medieval Germanic art, including talismanic and apotropaic meanings, personal identification and even just for amusement (Vierck 1978; Speake 1980, 77-8; Leigh 1980, 508ff). The continual use of an animal head in earlier designs (e.g. Style I, on zoomorphic cruciform brooch) may also have had significance for one or more of these reasons. However, it is very difficult to tell what sort(s) of animal might be intended. Similar animal heads were also used very frequently on other contemporary brooch forms in this country and abroad and were not always clearly present on cruciform brooches.

Other areas of the brooch form, especially lappets, also become centres of attention, with elaborate decoration again with variable proximity to the original animal-based forms. Much of the purpose behind embellishment below the bow could be to balance[20] the overall design. To modern taste at least, a brooch with similar enlargement at either end is more aesthetically appealing than one with a wide headplate only. Similarly decorative elements repeated in more than one area on a single brooch 'tie' the parts of the design together. The mental template of Anglo-Saxon metalsmiths must have included

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[20] Literally as well as aesthetically. The centre of gravity could be kept near the bow by increasing the weight of the foot, thus preventing the brooch from pivoting awkwardly.

this sort of information, whilst allowing considerable free-will. The purpose of such decoration within Anglo-Saxon society can only be guessed at, but may have included cultural information.

Punch marks could also carry symbolic meaning of this sort (Chapter 3, 280ff). From the database as it stands, it is not possible to identify individual tools. Correlations between punch mark style and brooch style are slight, as are the regional associations of particular punch types (tables 3.90 and 3.91). The variety of punch mark styles and their distribution over the surface of cruciform brooches is strictly limited. I would suggest that the punch mark data collected so far is too obscure to give any information on 'social identity'.

Vierck has selected the sixth century Anglo-Saxon preference for 'bichrome' styles of jewellery decoration as a significant chronological indicator (Vierck 1977) but the possession of brooches with gold and silver coatings may also relate to a social distinction. Brooches which are otherwise typologically similar may be distinguished by the use of surface coatings. Further research into other artefact types with bichrome decoration is necessary for a fuller understanding of this aspect.

Symbolic information in construction

It is difficult to suggest areas in which symbolic information may be detected from within the technical data. For example, apart from the techniques necessary to produce the gilding and other surface treatments, type Z brooches do not consistently possess technological attributes which set them apart from other types of cruciform brooch.

Given the pre-eminence of decoration over technique, it seems unlikely that the method of construction of cruciform brooches had any symbolic significance. However, it is all too easy to be subjective - influenced by modern day attitudes, by the mainly English dataset or by the contrasts shown in the Norwegian dataset. Furthermore, although the precise method of construction may not have any discernible symbolic significance, this is not to deny that the act of manufacture itself may have had some such significance.

A number of practical considerations may be shown to make it difficult to investigate such theories. One way in which to begin to investigate this is by comparison with the manufacture of ceramics at this time.

Ceramics - the comparative situation

Richards emphasises the potential of ceramic decoration and form for expressing social information (1987). Ceramic and

non-ferrous metal artefact productions may be contrasted at several levels, using, in the main, evidence from cremation urns and cruciform brooches. It seems that these differences may be sufficient to illustrate a lesser potential for the detection of social identity in the archaeological record of cruciform brooches, than in that for cremation urns. Our information on burial associations is not yet sufficient to determine whether size or style of brooch is correlated to age or other status indicators, so our discussions must be at a general level.

Decorational aspects of the cruciform brooch may well have displayed social information. However, the amount of decoration and of decorative variety amongst cruciform brooches compares poorly with that on some other brooch forms (e.g. square-headed brooches). If wax was used during the manufacture of brooches, there would have been a great capacity for invention and individualism in metal casting. In the case of cruciform brooches, this potential was evidently not taken up[21]. There was a mental template which restricted development.

In addition to this factor, items of non-ferrous personal ornament were worn/kept in circulation for variable lengths of time (heirlooms), and could be recycled at any time. If one woman owned the brooch throughout her life, the social

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[21] The comparative lack of decoration on cruciform brooches may itself be a social identity indicator.

information displayed on a brooch is quite likely to be of a rather general nature (e.g. a regional production style), or to be distant from the social identity of the wearer at the time of acquisition. Precision in allowing brooches to define or reflect social identity could only be achieved if either a) alternative brooches could be acquired frequently, as a woman's status changed (on marriage, motherhood, bereavement etc) or b) extra brooches could be held in reserve for these purposes, or for the purpose of burial alone. Both these situations would require surpluses, either of non-ferrous metals or of both metals and the resources to make further brooches. The data so far available is not adequate to suggest whether this may have occurred.

The modes of manufacture of cremation urns and brooches are likely to have been quite different. The raw materials for cremation urns are likely to have been freely available locally[22], presumably with few restrictions, whereas the raw materials for cruciform brooches are likely to have been difficult to acquire, under some stress[23] and possibly therefore under more control. The technical requirements of the raw materials are less demanding in ceramic production than in metal artefact production. The tool set used in

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[22] Our simplistic view of early Anglo-Saxon ceramic production being carried out at very local levels is currently being updated by petrological research. Vince 1988, 165-8 suggests that some of the vessels at Barrow Hills, Oxon were made using clay sources up to 40-50km distant from the site.

[23] See Chapter 4, 376ff

ceramic production could have been less extensive and specialised than that used in metal artefact production. The technical requirements during production of cremation urns are simple, compared to those required in cruciform brooch manufacture (i.e. the control of mould tempering, higher operating temperatures and control/knowledge of the effects of furnace environment in high-temperature processes).

Non-ferrous artefacts therefore have a number of technical requirements and symbolic limitations which are unparalleled in the cremation urn corpus. Ceramics are more likely to have been produced at a very local level and at a greater frequency and intensity of production, allowing greater precision in social identification.

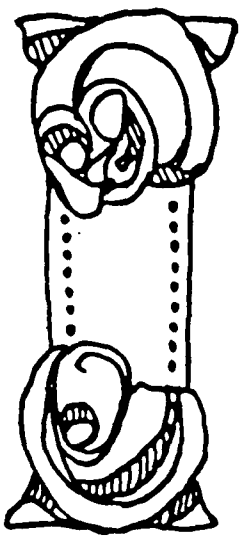
There is some evidence for similarity between the characteristics of the two systems, through examples of production using workshops (even of individual workers e.g. the Illington-Lackford potter, Myres 1977, 343ff). If the decoration and form of cremation urns primarily represents social identity, with workshop identity being relegated to a minor role (Richards 1987), it becomes more difficult to understand some distribution patterns of some decoration types, except in terms of very restricted ethnic groupings. Until the dynamics of early Anglo-Saxon ceramic production are thoroughly investigated, it is a matter for personal interpretation to decide whether a grouping of material possesses sufficient similarity to suggest an individual or workshop

produced it.

In conclusion, it seems that 'modes of production' and social inferences for ceramics and cruciform brooches are quite strikingly different and one should not necessarily expect to discover similar patterns in both sets of data.

Chapter 6

A. Assessment of success; philosophical and methodological thoughts for the future



I feel justified in claiming some successes in this study, in a number of respects. Firstly, this work can be cited as a case study for a genuinely inter-disciplinary combination of archaeology and science. Scientific methods were applied to defined archaeological problems and some answers emerged. Naturally, the process resulted in further questions as well, but these were tackled by fresh explorations of the data. This cyclical system has drawn a maximum amount of information from the dataset - as it stands today. I fully expect that further attributes, not appreciated or recorded today, will be discovered and discussed in future studies.

The project has produced information of use to both sides of the discipline. This type of work may encourage the meeting of minds and even a more widespread adoption of the middle ground - true archaeological science. The technological discussion has shown how much more information is stored at the back of a brooch, the inside of an artefact or other neglected areas. This data is often simply retrieved and easily quantifiable. The necessary explanation is however complex and is liable to simplistic functional analysis.

Before this study, it was impossible to tell whether a single artefact type could reveal any technical attributes of any consequence. In the event, information from cruciform brooches stimulated discussion in several topics. Diversity in the constructional evidence shows how much scope was available for personal decision or chance happenings in the casting and finishing processes. The alloy technology of English cast brooches shows the metallurgy of survival - any available copper alloy went into the melt. Overall, the cruciform brooch has proved to be an apposite form to study and technical studies evidently form useful tools for the exploration of the copper alloy industries of the early medieval period, while we await excavations of English metalworking sites.

It must be admitted that the project revealed a number of areas in which science cannot assist. Previously, archaeologists have stated chemical analyses 'can give us an insight into metallurgical skills' (Arrhenius 1982, 16) or 'provide a different division of the material' (Hines 1984, 114). In this particular case, analysis reveals a fiendishly complicated system of metal mixing and remelting which is largely intractable even with careful typological and archaeological consideration. Neither the technical data nor the alloy typology provide methods of subdividing the archaeological dataset, that is any more 'correct' than the typological methods. The chemical data cannot date or provenance brooches but it does give valuable insights into the source of the copper alloys of this period and the attitudes of the metalworkers.

The amount of detail observed in this small research area justifies a concentration on a single type. The amount of variation observed within this small region and restricted time period, indicates future overviews of long-term sequences of production are in danger of missing significant patterns. Tight compositional groupings easily disappear within larger groupings. If location, date, technical requirements, workshop affiliation and factors of depositional significance are all taken into account, the number of descriptive variables may become overwhelming. But each of these factors has great potential importance for understanding the material. For large-scale projects, sampling biases must be carefully noted so that the questions asked are appropriate from all points of view.

Typological study allows the exploitation of material from 19th century excavations. For determining dates, typology is far more precise than any scientific method at this time. Typology also allows areas of the continent and Scandinavia to be directly contrasted. These areas thus act as controls, during testing for socio-cultural and environmental factors.

The discussion on grave good associations revealed the problems of 'terminus post quem'. Through technical and chemical analysis we are discovering the situation at the time of production, but final burial may not occur for some time - years, decades or centuries. This is significant in every

deposition context[1].

The present study shows an understanding of the typology and archaeology of a material dataset is essential. To take a simple case, many type B brooches could be said to be 'early forms', yet their production and use continues into the sixth century. Giving a uniformly early date to all type B brooches would be misleading. The high frequency of these brooch types would lead to a significant blurring in any study of chemical or technical attributes, if this factor is not controlled for.

Technological and chemical data may become yet another set of data which are different things to different people. Depending on personal opinions, they may be ignored or portions will be used selectively. The data presented in this thesis now belongs within the field of archaeology and open to alternative interpretations.

Retrospective on sampling scheme and methodologies employed

1) From the point of view of academic curiosity, one would have preferred to have more samples from peripheral areas of the cruciform brooch distribution area, specifically Yorkshire and the west Midlands. Restrictions of time did not permit a full sampling program. However, the sample is in fact statistically representative as it stands at the moment, with

[1] Including workshop sites

the number of brooches sampled from each area approximately in proportion to the number of brooches known from each area. Similarly the small number of type A and Z brooches sampled reflects the small number of these brooch types known.

It was also noted that certain brooch types will be under-represented in large-scale technological comparisons as they were normally made with separate side knobs, prone to loss. We have seen that the ability to deposit and the rate of metal recycling may have varied, so that at certain times fewer brooches were buried. What we have available is only the archaeological record and only a very small part of it, at that.

Refinements of statistical treatments are advisable, including the investigation of better standardisation and normalisation methods, and the application of more advanced packages.

2) Although they are an archaeologically significant form, cruciform brooches are not the only important artefact forms produced at this time. It was a simple matter to justify the choice archaeologically, but many of the technical aspects were new to this discipline. At the time of selection, little was known about the technical aspects of the type, but it has proved to be a fortuitous choice. The Anglian cruciform brooch was made in such a way that there are a comparatively high number of technical characteristics to study, even without destructive sampling.

Similar studies on other brooch forms have shown other patterns of technical detail which are liable to different interpretations. Until further technological studies are carried out, it is difficult to assess whether observed/ observable technical features in cruciform brooches (or on brooches as a whole) are significant in the context of other early medieval artefacts. It is possible that the high diversity we observe in this form is replicated in other forms, or that this diversity is so small as to be insignificant when compared with that shown on other forms. At this point in the study, it is possible to suggest that we are looking at the dataset in too much detail - the 'angels-dancing-on-pinheads' syndrome.

Do the results of this study have any general relevance, to other brooches, other copper-alloy artefacts or the metal industry as a whole? By the sixth century, the 'safety pin' function of cruciform brooches became largely secondary to the visual impression given. Some suitably contrasting items might be sheet metal vessels and iron blades, which are of a more directly functional nature. Alternatively, further brooch types could be examined, and the results contrasted with those from cruciform brooches. This may be preferred, since brooches are generally amongst the better-understood artefact forms, archaeologically, of this period.

We await the results of Blades *et al* (forth) for an overview of the copper alloys of the medieval period. Cruciform brooches have

proved a fairly useful topic for the first attempt. The choice removed some practical and methodological variables, notably those of sampling, technological change and distribution.

3) The suggested SEM studies of punch marks could be very informative - if an appropriate sample could be taken. Type D brooch forms, especially distinctive ones such as type D1, D5a, D5b and D6a would be ideal candidates for this treatment. Simple punch mark forms are used very frequently and have only a small amount of scope for variety. The number of samples needed would be very large indeed to give any chance of successfully identifying individual tools.

Further technical studies of methods of silvering and gilding would be interesting but probably not essential to our overall appreciation of production.

4) The amount of analytical data gained from material from other countries was of necessity limited, providing no more than a brief 'snap-shot'. Future plans (outlined below) include a survey of other continental datasets. For the present project area, data on fifth- and sixth-century production in Sweden might be especially instructive, if it could be linked up with the Helgö information.

5) It proved difficult to link up scientific and technological data with archaeological data. This is partly because the evidence seems to be contradictory, e.g. technological

stability at a time of stylistic diversification. It is also difficult to compare the datasets and remain unbiased towards data which come from very disparate sources.

There are few precedents for this type of project. In this case, it is fortunate that the direction of enquiry was clear from the start, i.e. that scientific and technological data was to be gathered in order to answer archaeological questions. No scientific breakthroughs were anticipated.
It seems that work towards establishment of 'terms of reference' for a methodology of archaeological science should be considered a priority. The discipline lacks a theoretical structure and is therefore at a considerable disadvantage, when applied to artefacts from a period of archaeology which is also rather formless. Reference to archaeological research in other periods is likely to be beneficial.

Future studies

Dark Age and early medieval Europe is a fascinating area for inter-disciplinary studies of this nature. It is also important as a time of social and political development which affected the way in which European nations were formed. At this time, groups acquired names by which we still know their territories, the Franks in France, the Angles in England/East Anglia etc..

From a 'migration period' through to early kingdoms, the centuries after the collapse of the Roman Empire form a period of dynamic change. It is clear that regions developed at differing rates, towards higher levels of social organisation. Gaining an understanding of the modes of production is one route to investigating socio-cultural processes, and one in which artefacts can play a central role. The artefactual evidence of the period is rich and heterogeneous. Items of personal ornament were worn and buried by most sections of society, so they are perceived as a substantial source of information.

Archaeology shows that lifestyles of cultural groupings were diverse, yet many shared similar ethnic origins e.g. 'Germanic', or 'Celtic'. How similar were the products of these groupings? Were there different standards of technical knowledge? Can technical and scientific data demonstrate inter-cultural influences, from within the 'barbarian' world

or from outside? Where did these people acquire their metal resources and how was this supply controlled?

A study of the period in which European states gained their identities is politically appropriate at this time and it is an aspect as yet undeveloped by most European academic bodies. I would like to outline a structure for future study, which will capitalise on many types of information, locked inside archaeological artefacts.

It was observed above that the chemical data available for this research provided a partial and incomplete idea of European and Scandinavian copper-alloy technology. But these glimpses are tantalising enough, in providing hints of wide-varying practise. I believe the simplest way of gaining a clearer picture is to examine in detail a small number of regions, whose socio-economic characters provide good archaeological contrasts. The evidence of artefacts of each region could be assessed individually and then brought together by common themes.

These themes are:

i) the impact of social changes on modes of production

ii) ethnic identities

iii) inter-regional contact, development of trading routes and relationships

Three regions considered appropriate are France, Ireland and Norway; their cultural characteristics are described below, in an admittedly simplistic manner.

The Franks were originally of similar cultural grouping to the Anglo-Saxons, arriving in France at a similar point in time. However, an identifiable kingdom emerged much earlier than in England. The influence of Gallo-Roman technological and stylistic traditions appears to have been deeper and more persistent. The production of both brass and bronze seems to have continued throughout the period. Links with other parts of the continent were more probably direct, in terms of metal supply and of typological influence.

In Dark Age Ireland, we are in a purely Celtic area. Society remains feudal for much longer. Even after the Viking development at Dublin, the impact of urbanism was limited. The distance from other areas may have caused relative isolation but various systems result in Irish products being exported to remote areas (e.g. trade/exchange bringing hanging bowls to Sutton Hoo, Viking raids bringing church items to Norway and Sweden). There is little chemical data as yet, but it seems that bronze was normally used. The island has its own resources for some non-ferrous metals, including gold and copper alloys but tin must have been imported. Archaeological evidence for workshops exists from two widely different social environments - secular and sacred. Irish metalworkers developed an individual artistic style and a technically sophisticated production system (Craddock 1989).

The small number of chemical samples from Norway indicated that the country did not have problems of metal supply in the fifth and sixth centuries. Indeed, brass may have been produced by the Viking period (Addyman *et al* 1982; Arrhenius 1982, 16). The extreme change observed in production methods of cast brooches could relate to changes in social organisation. The mountainous character of the country led to a maximisation of exploitation of seaways but also to 'land-hunger' and population movement.

Comparative data for the mid and late Anglo-Saxon periods in England and for the early Byzantine world should be available in the near future (Blades, forth. and Mortimer, forth(c)). This evidence will go some way to completing two more discrete cultural groupings. The mining areas of southern Germany and western Austria are of central interest in the consideration of metal supply[2].

[2] Prof. Steuer and colleagues are currently working on this area

By this region-by-region consideration, archaeological and technical variables could be controlled and information maximised. At this point, the addition of documentary evidence could be of some assistance.

In conclusion, there is much still to be done in this area but I hope that this project has shed some light on a small area of the Dark Ages.

Bibliography

Bibliography

Abbreviations

Antiq J	Antiquaries Journal
Arch J	Archaeological Journal
BAR	British Archaeological Reports
BNJ	British Numismatic Journal
BM Occ Paper	British Museum Occasional Paper
Cam Ant S P	Proceedings, Cambridge Antiquarian Society
Cam Ant S Q	Quarto Publ, Cambridge Antiquarian Society
Cam Ant S C	Comms, Cambridge Antiquarian Society
Arch Cant	Archaeologia Cantiana
EAA	East Anglian Archaeology
FS	Frühmittelalterliche Studien
J Hist Met	Journal of Historical Metallurgy
J Arch Science	Journal of Archaeological Science
KVHAA	Kungl. Vitterhets Historie och Antikvitets Akademiens Årbok, Stockholm
MASCA J	Journal, Museum Applied Science Centre for Archaeology (Philadelphia)
Med Arch	Medieval Archaeology
NAR	Norwegian Archaeological Review
Oxford J Arch	Oxford Journal of Archaeology
Proc Preh Soc	Proceedings, Prehistoric Society
Proc RIA	Proceedings, Royal Irish Academy
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