

**The theory and methodology of classifications
of the fifth and sixth centuries A.D.
in Anglo-Saxon England
with reference to great square-headed brooches**

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ABSTRACT

This thesis seeks to establish how to set up chronologically reliable classifications of fifth- and sixth-century metalwork, using square-headed brooches as the principal example. The problem arises from the absence in this period of the usual, more reliable, dating tools such as documents, coins and pottery. As a primary dating tool metalwork is therefore unsupported, and it is crucial that classification is carried out with great rigour and objectivity. The first half of this thesis (chapters 2 to 7) discusses various requirements which need to be met if classification is to be rigorous and objective. The overall conclusions are that:

- existing classifications, not just of square-headed brooches but of all fifth- and sixth-century metalwork, may be unreliable;
- reliance on existing chronologies, not just of square-headed brooches but of all fifth- and sixth-century metalwork, should be suspended for the time being;
- the entire system should be re-assessed from first principles.

The first stages of such a re-assessment are attempted in the second half of the thesis.

Chapter 8 attributes much of the faulty existing methodology to a misunderstanding of the method devised and practised by Montelius in the late nineteenth century, compounded by a false analogy with biological evolution; and in chapter 9 a revised version of Montelius' actual method is proposed as a sound basis for re-assessing early Anglo-Saxon metalwork classifications. Chapters 10 to 12 then exemplify various attempts to classify a corpus of 95 complete great square-headed brooches by rigorous, objective methods. In chapter 13, however, it is shown that further progress is likely to be limited, for the time being, to applying the suggested methods to other artefact-types, thus producing groups of various artefacts all free-floating and awaiting evidence that will tie them down chronologically. Finally, in chapter 14 it is recommended that classifications of early Anglo-Saxon metalwork currently in use should be re-examined and if necessary revised; that (except for tentative dates for the beginning and end of Salin's Style I) the attaching of even suggested dates to artefacts of this period and their find contexts should be suspended; and that archaeologists should make an urgent search for objective methods of demonstrating contemporaneity of objects in addition to decorative similarity, especially toolmark links.

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Four notes on terminology

1. 'Great' square-headed brooches

These artefacts, which are referred to with great frequency in this thesis, were so called by Leeds (1949), and almost all the brooches he dealt with were large, that is at least 7.8 cm in length (see further chapter 2). Though all those dealt with by Hines (1984) were large, he called them simply square-headed brooches. In this thesis those either he or Leeds dealt with will, except where appropriate in quotations, be called great square-headed brooches, abbreviated to GSHBs. Leigh (1980), on the other hand, was dealing mainly with a corpus in which only a minority were GSHBs, the rest being smaller. He therefore logically called them simply square-headed brooches. When either his corpus or the totality of square-headed brooches is being referred to, that is what they will be called, with SHBs as the abbreviation.

2. Brooch names and references

The standard archaeological system for referring to metalwork objects is name of cemetery plus grave number, with adjustments for objects whose findspots are uncertain or unknown; brooches which are the only representative of their type from a cemetery may be known simply by the name of the cemetery. However, several of the cemeteries which have yielded more than one GSHB were excavated before rigorous recording of findspots or allocation of grave numbers was routine, so that there are, for example, several brooches known simply as 'Ipswich'. Also, none of the three previous classifiers of SHBs followed this system exclusively, and each adapted it in a different way.

(1) Leeds (1949) used, overlappingly, both the standard system, where he could, and a system of his own. The latter was the sequence of ordinary numbers, allotted to brooches in the order in which they appeared in the Plates at the back of his book. These ran from 1 to 143, with four late additions to the corpus distinguished by an A suffix (12A, 15A, 59A, 107A). This system seems to have been partly intended to avoid confusion where there was more than one brooch from a cemetery and grave numbers were unknown.

(2) For brooches outside his main corpus, Leigh (1980) followed Leeds' practice. For brooches in his main corpus, however, he used the standard system only for reference within his Catalogue. For references to the brooches in his main corpus throughout the rest of his thesis, he gave each cemetery represented in that corpus a two-letter code, and then added either a decimal point plus numeral, for brooches whose grave numbers were securely known (e.g. Sa.159 for Sarre 159), or a numeral without decimal point, for brooches whose grave numbers were not known (e.g. He2 for Herpes 2).

(3) Hines (1984) also followed the standard system where he could. Where grave numbers were not known, and there was more than one GSHB from the same cemetery, he suffixed to the cemetery name in square brackets the Roman number of the group within his own classification to which he had allocated the brooch, e.g. Chessell Down [III]; or one of the suffixes [sb] (for 'small brooch') or [uc] (for 'unclassified') for brooches which he had not allocated to groups.

Even though cross-references between these systems are given in the various parts of Appendix 1, an attempt has been made to adopt a consistent system for use in the text, so that the same brooch is not referred to in different ways, and so that references to other authors' work can be followed up as easily as possible.

Since Leigh's codes are more easily understood from the full cemetery names than *vice versa*, his system is not followed, and references to brooches in his main corpus are converted into the more familiar form of cemetery name plus grave number, where known, or Leigh's distinguishing numeral, where the grave number is not known. For a few of the brooches which are in both his and Leeds' corpuses this makes the references less ambiguous, and easier to use to refer between the two corpuses.

It is not necessary to use Hines' bracketed suffixes, because all the brooches in his corpus have either a Leeds number or a grave number (or both). There are some brooches in Leeds' corpus whose grave numbers were not stated by him but are deducible from Hines; wherever appropriate, these are added to Leeds' brooch names.

Two systems, appropriate to different contexts, are therefore used in this thesis:

- In several of the Appendices and in some of the Tables and Figures, Leeds' numbers are used alone because full brooch names would be cumbersome. Occasionally this is also done in the text where a group of brooches are referred to and/or the reference is obvious from the context;
- Otherwise, that is in most references in the text to individual brooches, the system is cemetery name plus grave number where known (or Leigh number, where needed) plus Leeds number where it exists. Every such brooch reference is thereby provided with at least one distinguishing suffix (e.g. Dover 1), and many with two (e.g. Finglesham D3 [1]).

There are a few cemeteries which have two names, e.g. Richborough/Goldstone Cop Street. Where essential, both are given.

3. Montelius (1885/1986)

The book by Montelius published in 1885 is referred to several times in this way, especially in chapters 8 and 9. This form of referencing is used to make explicit the fact that exact details and verbatim quotations are taken from the English translation of 1986.

4. 'Typology'

In most varieties of English, this term means little more than 'classification', and it is sometimes used in this sense in archaeology, e.g. '... a classification based on types' (Vossen, 1970: 31-2); a method of grouping 'specifically for the purpose of sorting entities into mutually exclusive categories' (Adams, 1988: 43; cf. Dunnell, 1971; Klejn, 1982: 1).

However, among the archaeologists discussed in this thesis it is more often used in the sense of a sequenced, i.e. chronologically ordered, classification, e.g. 'A first rapid survey of the members of this group suggests little difficulty in arriving at a conclusive typological arrangement in accordance with a process of artistic evolution' (Leeds, 1949: 45; cf. Fish, 1978). The term is used in the latter sense in this thesis.

*"Man approaches the
unattainable truth through
a succession of errors."*

Aldous Huxley.

PART A: DEFINING THE PROBLEM

Chapter 1: The problem and its background

1.1 How can chronologically reliable classifications be devised?

The question that this thesis seeks to address is how to devise reliable classifications of Anglo-Saxon artefacts of the fifth and sixth centuries in order to provide an outline chronology for the period. By a reliable classification is meant one that is arrived at in such a way that any information that is derived from it reflects the situation as it was when the artefacts were made.

Put in this way, the question may seem both unsettling and out of date. Why should such a study be necessary when classifications of fifth- and sixth-century artefacts have existed, and have been providing outline chronologies for the period, for many years? (See, for example, Åberg, 1926; Leeds, 1936, 1949; Kendrick, 1938; Evison, 1955, 1958, 1963, 1967, 1968; Swanton, 1973; Avent, 1975; Avent and Evison, 1982; Hines, 1984). There are two reasons, one general, the other more specific, why this study is necessary.

The general reason is that no discipline is ever so securely based that its practitioners can afford to rule out re-inspection of their assumptions.

The more specific reason is that existing classifications of fifth- and sixth-century artefacts, and the chronologies based on them, may not be as reliable as they are generally thought to be: the purpose of sections B and C of this thesis is to explore this issue.

1.2 Dating the Dark Ages

In fact, this whole thesis arose out of concern with the problems of dating in Britain in the fifth and sixth centuries AD, and about the reliance that was being placed on artefact classifications for this purpose. About twenty years ago, some scholars seemed to believe

that, because of apparent advances in the interpretation of both archaeological and historical evidence, a connected account of this period was at last possible: the apogee of this approach was *The Age of Arthur* by John Morris (1973), in which, among other things, archaeological data were used to produce maps of the extent of Anglo-Saxon settlement at various (approximate) dates and of its relentless march from eastern and central England westwards.

More recently, much of this optimism has gone, dampened by more cautious research. The documentary evidence for the period was always acknowledged to be thin: but the only surviving British text from the period, Gildas' *De excidio Britonum*, has been shown to be a political sermon, not a history (Brooks, 1983/4; cf. Lapidge and Dumville, 1984); and the high value placed by Morris on later texts has been shown by, for example, Dumville (1977) to be greatly exaggerated. Successive attempts to derive historical information from placenames have foundered (Higham, 1992, chapter 7).

Archaeological evidence has also been subject to more stringent interpretation. For example, in the 1970s and 1980s several archaeologists specialising in the Romano-British period (e.g. Wachter, 1974; Biddle, 1976; Frere, 1983) convinced themselves and others that life in Roman towns in Britain had survived the end of Roman rule, and that therefore continuity of settlement into the Anglo-Saxon period was a possibility. This belief has since been shown to rest on far too strong an interpretation of sparse evidence (Brooks, 1986, 1988).

A warning about the archaeological evidence for the period should have been taken from the earlier re-assessment of the coinage: since Kent's (1961) overturning of Mattingly and Stebbing's (1931) theory it has been known that no indigenous coinage was produced in Britain in this period, and any imported coinage provides only the vaguest of *termini post quos*.

When a period is almost totally lacking in documents and coinage, the next resort for dating purposes is usually pottery. But again, for these two centuries pottery (in general)

cannot play its usual role. A very small quantity of fairly precisely datable Mediterranean wares has been found in the west of Britain (C. Thomas, 1976, 1981): but the amounts are small, and the entire set of evidence is in the wrong area to support any account of the early Anglo-Saxons. Locally-produced Anglo-Saxon wares of this period are largely unclassifiable. The analysis by Macpherson-Grant (1984-5) of local wares found in Kent seems reliable - cf the use made of this evidence in Brooks (1988) - but it still illuminates only one small part of the country and for only a few decades.

Dating methods derived from the natural sciences are in no better position. Thermoluminescence, remanent magnetism and radiocarbon dating may, in favourable cases, lead to a reasonably confident attribution of some remains to the fifth and sixth centuries as a whole: but their inherent errors of measurement are too large ever to permit more precise dating within the period. Dendrochronology may permit this, if securely-dated pieces of timber can ever be tied into a sequence stretching back so far: this may soon be possible, but seems not yet to have been achieved. Even when it is, it may not provide an outline chronology for the early Anglo-Saxon period because the amount of timber may be too small, and/or may not provide cross-dating for settlements or cemeteries. Arnold, while analysing data from late Roman and early Anglo-Saxon cemeteries, speculated that

particularly useful would be an accurate means of dating skeletal material from cemeteries, which would make the nature of the accompanying grave-goods irrelevant in understanding their chronology; but scientific methods of dating are not sufficiently precise to make this possible.
(Arnold, 1982: 134-6)

It is uncertain how soon this may be possible.

1.3 Dating from metalwork

Those attempting to provide even an outline chronology for this period are therefore at present forced to look solely to metalwork for an answer. The implied chain of reasoning appears to be as follows. Styles of ornamentation change within the lifetime of any type of artefact. It should in theory be possible to use the different styles of ornamentation found on any one type of Dark Age metalwork to classify that type of metalwork into

groups. Then, if it were possible to deduce the sequence in which the various groups occurred (in other words, to set up a typology, in the specific sense that term has acquired in some archaeological usage), and also to peg the two ends of the sequence to rough dates, then an outline chronology would have been achieved. Typologies of different types of metalwork could be set up independently and then checked against each other.

Two problems with this chain of reasoning need to be pointed out. First, for the Dark Ages it may not be possible to peg the beginnings of sequences of artefacts. This is because not even the apparently earliest Anglo-Saxon artefacts are found reliably associated with late Roman or immediately post-Roman material. Archaeologists can therefore only guess at the length of time that separates what are perceived as the latest Roman sites and the earliest Anglo-Saxon ones, or whether they perhaps overlapped in time (cf. Hills, 1979).

The problem that this creates for the Dark Ages was pointed out by Wilson:

If typology is to be used for dating purposes, we must have two fixed starting points, a known starting point (prototype) and a known point later on, preferably at the end of a phase. If we have not these two points we cannot use typology, for differences may be contemporary branches from the main root.

(Wilson, 1959: 115)

The implication is that, even if a valid classification and sequencing of early Anglo-Saxon metalwork types could be arrived at, it might still not be possible to say more about them than that they belong somewhere within the fifth and sixth centuries, thus denying both archaeologists and historians of the period the much more finely differentiated chronology that they need.

Secondly and even more crucially, the later part of the chain of reasoning sketched above depends absolutely on the earlier part. If reliable classifications of types of metalwork cannot be arrived at, no amount of sequencing or of pegging of the ends of sequences will be worthwhile in any case. That is why this thesis concentrates on the methodological question of whether reliable classifications of undated metalwork can be achieved.

The inclusion of 'undated' in the previous sentence is intended to reinforce the attention that is being drawn to an oddity in this whole process. In periods for which documentary, numismatic and ceramic evidence exists, metalwork derives its dating from them, through correlation and co-occurrence, and can then be used reliably as a dating tool when found alone (as Adams was able to use Nubian pottery - see Adams and Adams, 1991). The fifth and sixth centuries AD in England are manifestly not such a period. Failing this, in a period where such primary dating material is lacking, but its metalwork's developmental sequence can be deduced and tied into the preceding and following periods, then (as the quotation above from Wilson implies) some outline division of the period might be achievable. But again the fifth and sixth centuries AD in England are not such a period.

However, the fifth and sixth centuries on the continent have been thought by some to meet this description. The amount of documentary, numismatic and ceramic evidence is small, but attempts have been made to devise a rough chronology for brooches starting from the late Roman period (where such goods can be reasonably securely dated) through the fifth and sixth centuries (where most such indicators are absent) to the seventh century (where datable objects begin to be found in association with brooches again). Some British archaeologists (Leigh, 1980, in particular) have therefore attempted to make good the deficiencies of the Anglo-Saxon material by trying to show similarities in the stylistic development of Anglo-Saxon and continental metalwork and deducing the chronology of the former from the latter. It will be argued in chapters 6 and 7 below that this attempt has not succeeded, because the continental chronologies are themselves not as reliable as has been thought.

In its use as a primary dating tool, early (fifth- and sixth-century) Anglo-Saxon metalwork is therefore unsupported. As such, it is being subjected to a great, perhaps an excessive, interpretive weight. It is therefore crucial that the process of classification is carried out with great care and as rigorously and objectively as possible, so that sources of error are avoided wherever possible, and so that the classifications are not themselves 'artefactual', that is, created by the process of arriving at them and not inherent in the material.

The possibility that dating by artefact classifications in the fifth and sixth centuries is unreliable has already become a source of concern to some archaeologists (e.g. Dickinson, 1979). Arnold (1982, 1984: 14), on the other hand, while recognising the unreliability of dating in this period, attempted to sidestep the issue, both by claiming to be interested in much broader questions and by analysing a whole century's-worth of data at once. Yet even his analyses were often dependent on being able to ascribe early Anglo-Saxon material to either the fifth or the sixth century: but recognition of the unreliability of the dating should lead logically to abandoning even this minimal partitioning of the evidence.

Having, earlier in his book, rehearsed many of these problems, Arnold (1982: 164) concluded that the fifth century (though not, for some reason, the sixth century) merits the description 'proto-historic'. The position adopted here is that even this description is insufficiently radical. Given the absence of the usual materials for writing a connected history of the period, or even for providing independent dating of metalwork, it seems more prudent to treat both the fifth and the sixth centuries as though they were *prehistoric*. That is, it seems advisable to treat the dating of the artefacts as though no other information at all were available, as though archaeologists of the period were being forced to return absolutely to first principles. If existing classifications then turn out to be reliable, this 'back to square one' approach will have done no harm, and may even increase confidence in the classifications. But if analysis demonstrates that confidence in the existing classifications is misplaced, then this approach will have been shown to be absolutely essential to any attempt to reconstruct them on a sounder basis.

So far from being an old-fashioned topic, therefore, an investigation into the methodology of classifying Anglo-Saxon metalwork is fundamental to any analysis of the period, and more necessary today than it has ever been, if only because of the quantity of excavation of sites of this period that has recently been undertaken, and the numbers of reports and analyses that are arising from these excavations.

1.4 Why great square-headed brooches?

Much of this thesis (except chapter 7) focuses on just one type of metalwork, GSHBs (which will be defined in chapter 2). There are four reasons for this emphasis:

(1) GSHBs are of great interest in their own right because, as Leeds (1949: vi) said, they 'provide one of the principal fields for the study of Teutonic zoomorphic art as practised in England'. This opinion was echoed by Leigh:

The square-headed brooch provides the medium, *par excellence*, for the understanding of Style I art. We do find the style on other objects - sword fittings, buckle-plates, saucer brooches, clasp buttons, drinking-horn mounts, and so on - but not in anything like such abundance and variety as on the square-headed brooch. It was probably also used on material of organic origin - wood, leather, textiles and tapestries - but few of these survive. In their absence we must see the Style I of the square-headed brooch as the highest form of visual art in the sixth century of which evidence survives.
(Leigh, 1980: 423)

(2) SHBs are important to the theory of archaeological classification, since they have been classified on three previous occasions (Leeds, 1949; Leigh, 1980; Hines, 1984), and always with the needs of chronology in mind.

(3) It would have been impossible to apply the analyses in this thesis to more than one form of metalwork satisfactorily. It has proved more fruitful to apply them in full to one brooch type; the conclusions seem applicable to all Dark Age metalwork classifications.

(4) Finally, GSHBs turn out to be pivotal in a network of interdependences of existing classifications - see chapter 7, where a necessary but strictly limited amount of broadening out from SHBs is undertaken.

However, this thesis is principally concerned not with the classification or chronology of GSHBs, but with the theory and methodology of classification. But to discuss that in the abstract would be vacuous. Therefore GSHBs have been used only to demonstrate methodological deficiencies and to illustrate methodological improvements.

1.5 Structure of this thesis

The thesis consists of six Parts, A to F.

Part A consists of this chapter, 1, which sets the scene and defines the problem to be addressed.

Part B consists of chapters 2 to 4:

- chapter 2 sets out a number of requirements on classifications of metalwork, and provides a detailed analysis of existing definitions and corpuses of SHBs, plus the definition and corpuses to be used in this thesis;
- chapters 3 and 4 give a detailed analysis of the clarity and consistency of existing methods of arriving at classifications of SHBs, and find them lacking.

Part C consists of chapters 5 to 7, and contains a consideration of three defences of existing classifications, and of the chronologies based on them, leading to the rejection of all three defences.

Part D (chapters 8 and 9) provides an analysis of the historical reasons for the failure to produce reliable classifications, in the hope of avoiding them, and a proposal for starting again.

In Part E (chapters 10-12), several new methods of classification are tried out and evaluated, and the results of the most promising (analysis of decorative similarity measures, plus similarity clustering) are compared with existing classifications of GSHBs.

Part F (chapters 13 and 14) provides suggestions for further progress, plus overall conclusions and recommendations.

PART B: EVALUATING EXISTING CLASSIFICATORY METHODS

Chapter 2: Defining and compiling artefact-types

2.1 Requirements on classifications of metalwork

What are classifications of fifth- and sixth-century metalwork required to do?

Unsupported, subdivide the (roughly) 200 years into subperiods, as a basis for drawing historical inferences:

The map of Anglo-Saxondom in Bede's day is reasonably agreed; ... the boundaries of the different kingdoms were fairly well established ... To draw such a map for the period between 500 and 650 is not so easy a task, so any factor that may contribute towards a determination of the divisions between the various groups is worthy of examination. (Leeds, 1949: 105)

The aim is clear, and must be extended to cover the fifth century too. But how many subperiods of how many years? Three of about 70 years? Six generations of about 35 years? Phases of variable length? Arnold (1982, 1984) operated with the minimal division of the material into two centuries, but probably few other archaeologists would be content with that. At the other extreme, as will be shown in chapter 6, Leigh (1980) attempted to produce a sequence in which every one of 98 brooches had an individual position within the 70-year timespan he posited for SHBs. If that is thought to be going too far in the other direction, where in between can archaeologists decide that they have enough subperiods to write a plausible, connected account?

To this basic question perhaps the only defensible answer, in the present state of knowledge, is *only as many subperiods as seem to emerge reliably from the material*. An immediate prerequisite for allowing this to happen is that the analysis (classification) of the material should be separated as far as possible from the drawing of chronological conclusions from the classification, in order to avoid biasing the classification or the process of arriving at it, i.e. to avoid building chronological conclusions into the

assumptions on which the classification is based. This is a reasonable requirement on the procedure; it can be considered as acting in an objective and scientific manner.

In this section, therefore, existing methods of classifying Anglo-Saxon metalwork, using SHBs as the example, are evaluated for their scientific rigour, without reference to the chronologies that have been derived from them.

2.2 Archaeology and science

Most archaeologists would agree that their subject should be scientific. By this some might mean adopting a hypothetico-deductive approach (e.g. Binford, 1968; Clarke, 1968; Hill, 1968, 1972; Fritz and Plog, 1970), others a less stringent approach concentrating on full explanations, that is a 'process that is rendered public and communal' (Doran and Hodson, 1975: 344), and others again an objective (as opposed to a subjective) approach to constructing classifications and chronologies (for example, Dickinson, 1976). Immediately, therefore, a 'scientific approach' in archaeology may not mean the same thing to one archaeologist as it does to another. However, in practice there is a considerable amount of consensus on the basic features of a scientific approach (see, for example, Popper, 1959, 1963), which most archaeologists aim to follow, and for present purposes this consensus will be relied upon. It is common ground, for instance, that all scientific work should keep subjectivity to a minimum, and be set out as fully and clearly as possible, so that future scientists can both evaluate it and if necessary replicate it, and that scientists should strive to be rigorous - in particular, that they should actually follow the procedures they lay down for themselves.

Existing classifications of SHBs are examined from this point of view in the next three chapters, as follows:

- chapter 2: how explicit were previous definitions and corpuses of SHBs?
- chapter 3: how explicit were previous classifiers of SHBs in setting out their methods?
- chapter 4: how rigorous were previous classifiers of SHBs in applying their stated methods, or, to put that another way, how internally consistent were they?

2.3 Need for definition

When an artefact-type is being compiled and defined, it is necessary to decide which artefacts should be included (and which others should therefore be excluded), and why, for two main reasons. First, this is one of the agreed requirements of scientific method, as pointed out above. Secondly, the act of definition is by no means neutral: the act of choosing which artefacts count as undoubted members of a corpus may itself constrain or at least predispose the possible outcomes of the analyses applied to that corpus. Choice is, of course, inevitable: it is impossible to treat all artefacts as one undifferentiated corpus. But provided that the choices, and the reasons for them, are set out fully and clearly it is possible for later classifiers to re-work the field with secure knowledge of what has already been done.

For the purposes of this thesis, the question 'What is an Anglo-Saxon GSHB?' will be addressed via an analysis of four previous definitions and corpuses, those of Åberg (1926), Leeds (1949), Leigh (1980) and Hines (1984), followed by a statement and justification of the definition to be used in this thesis.

2.4 Åberg's definition and list

Many SHBs were of course known before 1926, but Åberg was the first to publish an extensive list of such brooches. He included most of them in a much larger category to which he gave the label 'brooches with downward-biting animal heads between bow and foot' (Åberg, 1926: 61). In this category he listed about 180 brooches in all, and provided illustrations of 47. The first two had semi-circular headplates. All the remaining brooches in the group had square or, more accurately, rectangular or near-rectangular headplates, but there was great variety in size among them. A comparison with Leeds' corpus shows that Leeds included 82 of Åberg's 'brooches with downward-biting animal heads' in his corpus of GSHBs. These all appear to be the larger brooches.

Immediately before his list of 'brooches with downward-biting animal heads' Åberg provided an even longer list of cruciform brooches. He divided these into five groups:

within Group V were some with footplates akin to those of other cruciforms but with headplates devoid of the usual knobs or large plates. Without such embellishments, these headplates are as rectangular as those of square-headed brooches, and Leeds incorporated eight of Åberg's Group V cruciforms with such headplates into his corpus of GSHBs.

Within his brooches with downward-biting animal heads Åberg distinguished 11 groups. The last of these was an overtly miscellaneous category ('brooches of different types'), but even some of the other groups were identified by demonstration rather than by definition. That is, he called them, for instance, 'brooches of the types of figs. 112-115' (1926: 70).

It would be fair to say, therefore, that Åberg did not have an artefact-type corresponding directly to GSHBs or even to SHBs more generally, and that his list including them did not advance far beyond a catalogue, with some categories sketched out, but left for others to work out more fully. His work will therefore feature in this thesis as background, not as one of the main classifications to be analysed.

2.5 Leeds' definition and corpus

Leeds' classification of GSHBs, in his book *A Corpus of Early Anglo-Saxon Great Square-headed Brooches*, has proved very influential since its appearance in 1949, principally because of its (then) completeness and his intimate knowledge of the material. The book contains photographs and descriptions of 147 GSHBs defined as such by Leeds, a classification of the brooches, and an interpretation of what information could be gained both culturally and chronologically from the classification.

Leeds (1949: 1-2) defined the 'basic form' of the square-headed brooch as

composed of three elements, a rectangular head-plate, an arched bow, and a lozenge- or diamond-shaped foot-plate. On this foundation the artificer proceeded to build up his brooch, concealing the attachments for the spring-coil behind the head-plate, and the pin-catch behind the foot-plate.

A typical example, Bidford-onAvon [71], is shown in Figure 2.1, and Leeds' corpus is listed in Appendix 1.1.

Figure 2.1: **Example of a great square-headed brooch**
(Bidford-onAvon [71])



Neither the labelling of the brooch type as 'square-headed' nor the description of the headplate as rectangular need be taken too literally. Many of the headplates are sub-rectangular, even trapezoidal; some have wavy or crenellated sides; some have protuberances at the corners; a few have a protuberance in the centre of the top edge. However, none of these variations has caused any misgiving or confusion amongst classifiers of the artefact type.

Figure 2.1 serves to illustrate a further feature mentioned by Leeds that he seems to imply all GSHBs share, namely 'the animal heads springing from or clinging to the upper edges of the lozenge' (1949: 4). These are, in other words, Åberg's 'downward-biting animal heads', but not so called by Leeds because he interpreted some of them differently, as 'rampant beasts'. However, it is not true that all the artefacts counted by Leeds as GSHBs have animal heads on the upper edges of the footplate. Some of those with cruciform foot (particularly in his group C1) have no decoration on the upper edges of the footplate that can by any stretch of definition be called 'animal heads'.

Leeds went on to say that

only from a full appreciation of the above-mentioned features in the construction of these brooches is it possible to proceed to a satisfactory classification of the large number of examples found in this country.
(1949: 4)

So this description of the brooch would seem to represent the common denominator for entry to his corpus, or what might be called his formal criteria.

How far do these criteria apply to the brooches in Leeds' own corpus? This question may seem superfluous, since if Leeds included a brooch then it might seem that it qualified as a GSHB by virtue of his including it. However, there are brooches in Leeds' corpus to which his own criteria do not apply straightforwardly. In particular, the description of the footplate as 'lozenge- or diamond-shaped' fits one of the three main classes of Leeds' corpus (class C, brooches with 'cruciform' foot) less well than the other two (A: brooches with undivided foot; B: brooches with divided foot).

Leeds expanded his description of the shape of the footplate as follows:

Except late in its known history, when it diverged from the traditional form, this was lozenge-shaped and, in the series under review, equilateral, if straight lines are drawn from a point just above the junction of the bow with the foot-plate and from a similar point on the terminal lobe, to corresponding points on the lateral lobes.
(1949: 3)

In analysing GSHBs for this notional lozenge, it has to be assumed that the points Leeds described as 'just above the junction of the bow with the foot-plate' and 'on the terminal lobe' are on the mid-line of the brooch. Then the four sides of the resulting rhombus can be seen as joining those two points to the mid-points of the inner area of the side lobes where they touch the main body of the footplate. Since the three points of the lozenge that are envisaged as being near the lobes are on the inner edge of those lobes, the shape of those lobes was immaterial, as Leeds went on to say:

The addition of disks as lateral and terminal points of the lozenge represents ... embellishment, and they are lacking on the prototype.
(1949: 3-4)

All the complete brooches in Leeds' classes A and B (A: 29; B: 66; total: 95) have a footplate of sufficient width to allow a notional lozenge to be drawn on them. In some cases the sides of the footplate curve inwards so much that the sides of the notional lozenge would actually pass outside the body of the footplate. Nevertheless, the footplate of GSHBs of classes A and B is always widest at its mid-point, half-way between the bow and the end.

The 15 complete brooches of Leeds' class C resemble those of classes A and B closely in having a rectangular headplate and an arched bow, but in most cases the footplate is wider just below the bow and near the end than at the mid-point. In this respect the brooches of class C have a much closer resemblance to florid cruciform brooches, as Leeds said. Because of their narrowing at the mid-point, it is therefore difficult to see how a notional lozenge could be drawn on the footplates of class C brooches. This can be seen clearly in the typical example, Kempston [141], reproduced as Figure 2.2.

Figure 2.2: Example of a hybrid square-headed/cruciform brooch (Kempston [141])



Source: Leeds (1949: Plate 141), enlarged to full size

These brooches with cruciform foot seem to be those which in Leeds' opinion were 'late in [the artefact-type's] known history, when it diverged from the traditional form' (1949: 3). Leeds (1949: 78, 80) did express doubts about the inclusion of groups C1 and 2 (brooches 127-137) in his corpus, partly on stylistic grounds. About group C3 (nos 138-143), on the other hand, he seems to have had no doubts. Yet the looseness of the fit of the 'lozengiform foot' criterion to the brooches with cruciform foot must raise a doubt over Leeds' inclusion of them in the artefact-type, or at least over the consistency with which he applied his own criteria.

In contrast with the hybrid square-headed/cruciform brooches, there are brooches which undoubtedly are GSHBs by Leeds' criteria but which he nevertheless did not deal with. He pointed out that his corpus was

more restricted than Åberg's, because its primary concern is with the examples found outside Kent. Only such portion of the Kentish material is included as has a direct bearing upon the problems involved in this survey.
(1949: 5)

Leeds nowhere defined what distinguished Kentish GSHBs from others: those without his access to and knowledge of the material have to deduce it or take it on trust.

It should also be noted that Leeds included in his survey of this Anglo-Saxon brooch type one example from outside England, found at Herpes, Charente, France (Herpes 2, [83]). This brooch bears so many similarities to English GSHBs, and is so unlike corresponding continental types, that its inclusion seems entirely reasonable.

Leeds split the square-headed brooches listed by Åberg (and those he had added) into GSHBs and others, thus implying a size criterion for distinguishing them. He alluded to such a criterion (e.g. 1949: 5, 25, 29, 78), but he nowhere actually stated what the size criterion for qualification as a GSHB was. However, the smallest brooches in Leeds' corpus are the pair to which he gave the joint label Guildown 206 [7]: these brooches are almost exactly 7.5 cm long. The second smallest is Fordham [16], at 7.8 cm. Otherwise all Leeds' brooches are at least 8.3 cm long.

In common with all classifiers of brooches, Leeds included in his corpus various incomplete brooches (see Appendix 1.1). It is, of course, not to be expected that every brooch should have survived complete, and it is remarkable that as many as 110 of those Leeds illustrated have done so. However, since Leeds' criteria relate obviously to complete brooches, his inclusion of 37 brooches for which the complete form cannot be deduced creates a problem. Despite the damaged state of these brooches, Leeds was sufficiently sure of his identification of most of them to assign them to the corpus. The implication of this must be that he felt that the corpus was distinctive enough and sufficiently clearly differentiated from other brooch types for identification of GSHBs to be unarguable.

The clue to his confidence seems to lie in a remark in his Foreword (1949: vi), following the reference, already quoted, to the fact that 'these square-headed brooches provide one of the principal fields for the study of Teutonic zoomorphic art as practised in England'. He continued by saying that this art is 'otherwise restricted to some saucer and applied brooches, mounts, drinking vessels, belt trappings, and other such gear.' (Compare the very similar sentiments of Leigh already quoted in chapter 1.) This seems to imply that in Leeds' opinion the decoration on the incomplete brooches he included was sufficiently distinctive to rule out their belonging to any other artefact-type. Inspection of the incomplete brooches within Leeds' classes A and B suggests that, with the exception of Barrington A [125] and Barton Mills [126], about which Leeds did express doubts (1949: 77), they resemble the complete brooches so closely that Leeds' conclusion was justified.

However, this does mean that in the case of fragmentary brooches Leeds was operating an extra, decorative, criterion in defining his corpus. The style of classification Leeds was practising, characterised by Hines (1984: 111) as 'one of authoritative pronouncement rather than methodical exposition', uses whatever information, however limited, is available even from small fragments. In such a method it is clearly an advantage to enlarge the corpus by including incomplete brooches. In methods of classification which rely on the analysis of all the characteristics of every brooch, however, incomplete brooches cannot be used.

Within Leeds' total of 147 brooches, the three main classes of his classification were: A (brooches with undivided foot: nos 1-40, plus 12A and 15A, total 42); B (brooches with divided foot: nos 41-126, plus 59A and 107A, total 88); and C (brooches with cruciform foot: nos 127-143, total 17). The three main classes were subdivided into several smaller groups (five for class A, eight for class B - with a further set of six unclassified brooches at the end of class B - and three for class C); see again Appendix 1.1. The six unclassified brooches constituted 4% of the corpus. Within class A there were two brooches, Little Wilbraham 6 [26] and Barrington A [27], with divided foot; Leeds felt that their other similarities with brooches with undivided foot overrode this difference.

In brief, therefore, Leeds did state a largely explicit and clear general definition of GSHBs, but

- he stretched the main definition to include a number of brooches with cruciform footplates
- there were a number of Kentish brooches he did not deal with even though they fell within his definition
- he omitted to state how large a brooch needed to be to be considered a great square-headed, and
- he operated an extra unstated criterion (decoration), in order to include incomplete brooches.

2.6 Leigh's definition and corpuses

Leigh's classification of SHBs formed part of his Ph.D. thesis, *The Square-headed Brooches of sixth century Kent*, completed in 1980. He defined the SHB as

a somewhat ornate safety pin, the pin spring or axle being hidden by a usually rectangular headplate; the pin catch being similarly disguised by a lozenge-shaped footplate; and these two components being joined by a forward curving bow, the curve permitting room for the bundle of cloth spanned by the pin.
(1980: 2)

This was very similar to Leeds' definition, but added to it the functions of the bow and of the brooch as a whole.

Leigh omitted any reference to the 'animals on the upper edges of the footplate' in his definition of SHBs (though giving them copious attention, under the name 'below-bow animals', in his analysis). For him the criterion was perhaps superfluous, since in his work all the brooches which are SHBs by the form criteria and of which the footplate upper edges survive have animals in that position.

This was a more logical position than that of Leeds, who had stated the animal heads criterion but had included some brooches which did not meet it. It might be argued that Leigh could have included the animal heads criterion without difficulty, precisely because it would not have altered the membership of his set of SHBs: but he may not have wanted to mix decorative criteria with those based on form and function; and there is always the possibility that a brooch may be found which is an SHB by the form and function criteria but which lacks the animal heads. The brooch-type should not be so defined as to exclude such a brooch.

Leigh did not extend his definition of SHBs to cover square-headed/cruciform hybrids. Indeed, when he dealt with Leeds' corpus, he excluded Leeds' class C brooches from consideration. Again, this seems a more logical position than Leeds'.

As would be expected from the title, Leigh's work dealt mainly with Kentish SHBs. However, in his chapter II Leigh did deal also with non-Kentish brooches, and there were therefore in effect two (slightly overlapping) corpuses within his thesis. The first consisted of the 130 brooches of Leeds' classes A and B, together with 16 more recent discoveries, most from the Upper Thames region. (The figure of 16 is deduced from the 12 non-Leeds brooches named by Leigh in Tables 4 and 5 in volume II of his thesis, plus four others mentioned in his Table 1; the figure of 14 given in his main text (volume I, p.42) appears to be an error.) These 16 brooches are listed in Appendix 1.2. Like almost all of Leeds' brooches, these 16 are over 8 cm in length. Leigh provided illustrations of six of them, within his Plates 69, 70 and 72.

Leigh's second (and principal) corpus consisted of 86 definitely and 13 possibly Kentish SHBs, as defined by him, and which he catalogued and illustrated. These 99 brooches are listed in Appendix 1.3. Leigh's definition of 'Kentish' is difficult to establish. In his Appendix 1 was the assertion that:

Even a novice in the field of brooch studies could fairly readily distinguish between [other] English, Kentish and Scandinavian brooches. His or her chief means of doing this would be by assessment of the overall proportions of the brooch. The distinction can often be made on the basis of the silhouettes alone, without any consideration of appendages, decorative motifs or technique. What is more, any experienced researcher will know that if he meets a brooch of unknown provenance (or even of known provenance) the property which gives that brooch its distinctive regional character or 'feel' can usually be narrowed down to its overall proportion.
(Leigh, 1980: 551)

Yet the evidence of his own analysis in the following pages was that regional groups of SHBs cannot rigorously be distinguished on this basis. (On this, and for an analysis of non-Kentish GSHBs by proportion, see chapter 10.)

More prominently, at the very beginning of his main text, Leigh declared that for him the term 'Kentish'

refers not wholly to the present county of Kent, but to the probably shared cultural origins of brooches from cemeteries whose greatest concentration is found in present north east Kent, while other examples come from the Isle of Wight, Sussex, Essex, Cambridgeshire, and France... A few of the brooches ... are unprovenanced and are designated Kentish by common consent, according to acknowledged, though as yet undefined qualities which they share with the more securely provenanced brooches... [and which are] elaborated later in this work.
(1980: 1)

Leigh elaborated the qualities at great length, but nowhere set them out concisely, and it would require the detailed analysis of hundreds of pages of his thesis to deduce them. It is clear that they consisted largely of methods of working and stylistic qualities which might be unmistakable to someone with intimate knowledge of the brooches, but which would have been more useful to others if made explicit and therefore more accessible, e.g. in a summary.

The 'expert knowledge' nature of 'Kentishness' is illustrated by part of Leigh's judgment on one of the brooches which he classified as possibly but not definitely Kentish:

Its discovery in a Kentish grave, combined with a certain Kentish quality in its general proportions incline me to think of it as Kentish, but this is a subjective judgment, and itself begs the question of what is meant by this term in this context.
(1980: 122-3)

Though more honest, this represents little advance on Leeds' method of distinguishing Kentish and non-Kentish brooches.

However, whatever their criteria were, Leeds and Leigh seem to have largely agreed on where the boundary lay: the overlap between Leigh's Kentish corpus and Leeds' (and therefore Leigh's) mainly non-Kentish one consisted of only 10 brooches. (These are indicated in Appendices 1.1 and 1.3.)

Within his Kentish corpus, Leigh included 11 brooches from outside England. From the cemetery at Herpes in France he included not just the one large example picked out by Leeds but all 10 SHBs found there, and he added Preures 65, found in Haut-Boulonnais, also in France. As with Herpes 2 [83], the separation of these brooches from continental series, and their inclusion in Anglo-Saxon corpuses, seems fully justified.

Leigh's term for all other, that is non-Kentish, Anglo-Saxon SHBs was 'English'. This usage appears not to have found any followers, and will not be followed here.

Leigh implied an average size difference between Kentish and other SHBs (The other English brooches, being generally larger, are conventionally described as "great", 1980: 2), but did not quantify this. Kentish examples are indeed shorter on average than non-Kentish ones, but the ranges overlap considerably: Leeds' brooches (excluding Kentish ones) range between 7.8 and 22.5 cm, while Leigh's Kentish examples range between 3.7 and 13.7 cm. As Leigh implied, not all non-Kentish SHBs are GSHBs - indeed Leigh himself discussed (1980: 564-5) and illustrated a few 'imitations' of Kentish SHBs that are definitely small.

As already mentioned, Leeds included in his corpus a pair of brooches to which he nevertheless gave a single label. Leigh also followed the convention of giving a single label to multiple but very similar brooches reliably recorded as found in the same grave. Indeed, within his Kentish corpus multiples are very frequent. Of his 99 'brooches', 57 are singletons, 39 are pairs, and there are even three 'trios', sets of three very similar brooches found in the same grave. There is a noticeable tendency for Leigh's larger brooches to be singletons. Also, his smaller singletons often look so similar to pairs of a similar size that one suspects the surviving small singletons were originally members of pairs. In fact, in one case, Leigh 're-constructed' a pair (Stowting 2/9) which, though now in separate museums and not explicitly recorded as having been found together, are so similar that he considered they must have come from the same grave.

Leigh's treatment of the brooch fragments was similar to Leeds': he accepted all of those in Leeds' classes A and B into his corpus, and indeed added at least two non-Kentish fragments unknown to Leeds (see again Appendix 1.2). His Kentish corpus contained 12 brooches for which the complete original form cannot be seen or deduced (see again Appendix 1.3 - one of these was also in Leeds' corpus). It seems therefore that Leigh was using decorative criteria in the same way as Leeds to justify the inclusion of fragments in his corpuses.

The total number of SHBs discussed by Leigh in his two corpuses was 235 (130 from Leeds, plus 16 later non-Kentish GSHBs, plus his 99 Kentish examples, minus the overlap of 10). The problem of how many of the Kentish group might be considered GSHBs will be discussed later in this chapter.

Because non-Kentish brooches were not his principal concern, Leigh did not seek to re-classify them, but used Leeds' groups when he needed to. In his Table 1 he assigned eight brooches unknown to Leeds to groups within Leeds' classification, but left the other eight 'new' brooches unassigned to any of Leeds' groups. Of the eight he did assign, he explained the basis of his decision in only one case. He described in some detail (1980: 52) the points of resemblance between Bidford-on-Avon 88 [71] and Beckford A11 which

led him to assign the latter to group B3. Leigh's non-Kentish corpus totalled 146, and the eight unassigned brooches increased the number of unclassified brooches in that corpus to 14 (10%).

Within his Kentish corpus, Leigh distinguished four groups: three main Series (I - 23 larger silver brooches; II - 35 smaller silver brooches; III - 28 copper alloy brooches), plus an ungrouped residue of 13 possibly but not definitely Kentish examples, of which seven are silver and the rest copper alloy. The non-Series set constituted 13% of this corpus.

In general, then, Leigh provided a clear and consistent set of criteria for defining SHBs as an artefact-type. His criteria justified the inclusion of certain SHBs found on the continent, and the exclusion of square-headed/cruciform hybrids. However, within the artefact-type so defined,

- the distinction between Kentish and non-Kentish brooches was described at great length and never summarised
- the distinction between great and small SHBs was not explained, and
- like Leeds, he operated an extra unstated criterion (decoration), in order to include incomplete brooches.

2.7 Hines' definition and corpus

Hines' classification was contained in his Ph.D. thesis, *The Scandinavian Character of Anglian England in the pre-Viking Period*, published in 1984 as BAR British Series no.124. He gave the following definition of 'the common characteristics' of SHBs:

Principally a headplate, behind which the spring or axis of the pin is fixed, of fundamentally quadrangular form, usually rectangular or trapezoid, separated by a bow from a footplate, covering the catch for the pin, of fundamentally rhomboidal form.
(1984: 110)

Like Leigh's definition, this was similar to Leeds'. It was clearer than Leigh's in defining the shape of the headplate. On the other hand, it was less explicit than Leigh's about the shape and function of the bow.

Just before giving his definition of SHBs, Hines gave a list of terms which he implied had all been used for this type of brooch. In the list he included Åberg's 'brooches with downward-biting animal heads between bow and foot': but in fact Hines' corpus was, like Leeds' and both of Leigh's, confined to one part of the group to which Åberg had applied that label.

Like Leigh, Hines omitted any reference to the 'animals on the upper edges of the footplate' in his definition of SHBs, probably for the same reasons.

Hines appears to have had doubts about most of the hybrid square-headed/cruciform brooches in Leeds' class C: he omitted from his corpus 14 of the 17 in this class (see Appendix 1.1). Of nos 127 and 128 he said: 'They have nothing to contribute to a study of Anglo-Saxon square-headed brooches' (1984: 163); of nos 129-137 that they 'have no place, as far as I can see, within a corpus of square-headed brooches' (1984: 165); and of nos 138-140 that they are 'too dissimilar to [nos 141-143] to be counted as one group' (1984: 165). However, he said of the remaining three hybrids (nos 141-143):

There are a few ... examples of hybrids of the square-headed brooch ... with the florid cruciform brooch which ought to be included in any corpus of either brooch type.
(1984: 110)

This does not seem to constitute a reason for choosing just these three hybrid brooches to include in a corpus of SHBs, and the procedure seems inconsistent: it would be more consistent to include all of the hybrid brooches rather than just a few. More consistent still, since none of the hybrids conforms to Hines' own form criteria for SHBs, would have been to include none of them.

Hines' aim was to concentrate on the Scandinavian influence on *Anglian* England in the pre-Viking period, and he therefore excluded from his corpus

(1) all but five of Leigh's Kentish brooches - the five he included had all been in Leeds' corpus too, and are indicated in Appendices 1.1 and 1.3. However, like both Leeds and Leigh, Hines did not set out clearly how he distinguished Kentish from non-Kentish brooches;

(2) Leeds nos 1-5 and 7, on the grounds that they were of foreign origin. These constituted all but one of Leeds' group A1.

Of the SHBs found outside England Hines included, as Leeds had, only Herpes 2 [83], but among those he added (see below) was a lead model of an SHB recently found in Geneva, Switzerland.

Unlike Leeds and Leigh, Hines gave an indication of the size criterion he used to distinguish great from small square-headed brooches:

Small ... square-headed brooches ... are ... diminutive brooches, usually less than [7.5 cm] long, related to the larger series ..., but generally simpler and often found in pairs.
(1984: 176)

Hines pointed out that some possible GSHBs are not much larger than this: his 'possible small-brooch group' are

relatively small, generally between 9 and 12 cm long, although such sizes are not terribly unusual for square-headed brooches: 11-12 cm, for instance, is the average length of brooches of [Hines'] group XVII.
(Hines, 1984: 168-9)

This group contained (in addition to six not listed by Leeds) Leeds nos 32-39, or the whole of Leeds' group A4. Moreover, Hines included some quite small brooches in his corpus: the smallest was Fordham [16], 7.8 cm long. The implication seems to be that for Hines the size boundary between great and small SHBs fell between 7.5 and 7.8 cm.

Small SHBs would therefore include many of those listed by Åberg but excluded by Leeds and Hines. The pair Leeds called Guildown 206 [7] would, by Hines' criterion, fall close to the upper limit of the small square-headed class, and most of Leigh's Kentish brooches would be small SHBs by Hines' criterion.

Hines' treatment of the brooch fragments was similar to Leeds' and Leigh's: he accepted almost all of Leeds' fragments in his corpus, plus the two non-Kentish fragments added by Leigh, and indeed added four more not previously published (see Appendix 1.4). It seems therefore that Hines was using the same decorative criteria as Leeds and Leigh to justify

their inclusion. Hines omitted only two fragments that Leeds had included, Barton Mills [126] and Darlington [134]. As already mentioned, Leeds had had doubts about no. 126, but Hines seems to have had none: it did not qualify. No. 134 Hines omitted because it was a hybrid.

Of Leeds' 147 brooches Hines dropped 21, for the various reasons mentioned; but he also added 50 brooches (see Appendix 1.4) unknown to, or at least not discussed by, Leeds. These included 13 of the 16 added to Leeds by Leigh. (Hines' reason for not adding the other three is unclear.) Of his 50 non-Leeds brooches, Hines provided illustrations of 19 (his Plates 3.1-3.13 - four of these were also in Leigh - and Figures 3.2, 3.5, 3.6, 3.7, 3.8a and 3.9), and gave references to previously published illustrations of most of the remainder. Thus

- Hines' corpus consisted of 176 brooches
- 126 of these had also been in Leeds' corpus
- 123 of these 126 (all but the three hybrids) were also in Leigh's first (largely non-Kentish) corpus
- of the 50 GSHBs in Hines' corpus that had not been in Leeds, 13 were also in Leigh's first corpus
- 37 of Hines' corpus were in neither Leeds nor Leigh
- of Hines' total of 176, only five were also in Leigh's Kentish corpus, and all five of these had also been in Leeds' corpus

and the total number of SHBs discussed by one or more of Leeds, Leigh and Hines was 272 (Leigh's 235, plus Hines' 37 not discussed by either Leeds or Leigh), though the line between great and small SHBs has still to be firmly drawn. (The total number of brooches discussed, including hybrids, was 289.)

Of the 176 brooches in his corpus, Hines included 146 in the 22 groups of which his main classification consisted (1984: 118-68). The remaining 30 brooches (17%), including 20 that Leeds had placed in groups, Hines placed in a variety of categories peripheral to his main classification: six he placed in a 'possible small-brooch group' (1984: 168-9); two he considered 'enigmatic' but so similar they they formed a possible group of their own

(1984: 169-70); 12 he put in a list of 'individualistic' brooches (1984: 170-3), followed by two further 'highly individualistic pieces' (1984: 173-4); finally there were eight brooches he considered too miscellaneous to place even in the other peripheral categories (1984: 175-6). Hines' main groups and other designations are marked in Appendices 1.1 and 1.4.

Hines remarked (1984: 115) that 'there is a good measure of agreement between [Hines'] groupings and Leeds's', and the truth of this can be seen in Table 2.1, which lists the 126 brooches common to the two corpuses and shows the groups to which Leeds and Hines assigned them. The groups to which Hines assigned these brooches are set out in four columns so that their members can be traced more easily.

For the purposes of comparison, Hines' groups XII and XVIII cannot be counted, since they consist (within this set) of one brooch each. Nor can the 22 brooches he or Leeds or both did not assign to a group. Within the remaining 102, the correspondence between their groups is close. There are several cases of coterminous groups (A2/III, A4/XVII, B1 normals/XVI (one exception), B5/XI, B7/XIII, C3/XXI), accounting for 41 brooches; and several cases of Hines' groups which are pure subsets of Leeds' groups (A3(a+b)/IV, A3(ci)/IX, A3(cii)/XV, A3(cii)/XIX, B1 hybrids 1/XIV, B3/VI, B3/VIII, B4/II, B6/VII, B8(i)/V, B8(ii)/X (one exception), B8(ii)/XXII) - these account for another 46. Together this is 85 of the 102 brooches (83%). This will perhaps seem less remarkable when the essential similarity of their methods is analysed (see chapters 3 and 4). It is also noticeable in Table 2.1 that the line between undivided and divided foot, which falls between groups A5 and B1 in Leeds' classification, also falls between two distinct sets of groups in Hines' (groups III, IV, IX, XV, XVII and XIX on the undivided side; all others on the divided side). So there are no groups in Hines' classification which contain brooches with both types of foot, despite Hines' (1984: 110-1) having criticised Leeds for the overriding importance he attached to this distinction.

Table 2.1: A comparison of the classifications of GSHBs of Leeds (1949) and Hines (1984)

(Hines excluded from his corpus Leeds' nos 1-5, 7 and 126-140.)

Brooch	Leeds' group	Hines' group	
6	A1		enig.
8	A2	III	
9	A2	III	
10	A2	III	
11	A3(a)	IV	
12	A3(a)	IV	
12A	A3(a)		indiv.
13	A3(b)	IV	
14	A3(ci)	IX	
15	A3(ci)	IX	
15A	A3(ci)	IX	
16	A3(ci)		indiv.
17	A3(ci)		indiv.
18	A3(ci)		indiv.
19	A3(cii)	XV	
20	A3(cii)	XV	
21	A3(cii)	XV	
22	A3(cii)	XV	
23	A3(cii)	XV	
24	A3(cii)	XV	
25	A3(cii)	XV	
26	A3(cii)		indiv.
27	A3(cii)		small
28	A3(cii)	XV	
29	A3(cii)		indiv.
30	A3(cii)	XIX	
31	A3(cii)	XIX	
32	A4	XVII	
33	A4	XVII	
34	A4	XVII	
35	A4	XVII	
36	A4	XVII	
37	A4	XVII	
38	A4	XVII	
39	A4	XVII	
40	A5		misc.
41	B1 normals	XVI	
42	B1 normals	XVI	
43	B1 normals	XVI	
44	B1 normals	XVI	
45	B1 normals	XVI	
46	B1 normals	XVI	
47	B1 normals	XVI	
48	B1 normals	XVI	
49	B1 normals	XVI	
50	B1 normals	XVI	
51	B1 normals	XVI	
52	B1 normals	XVI	
53	B1 normals	XVI	
54	B1 normals	XVI	
55	B1 normals	XVI	
56	B1 normals	XVI	
57	B1 normals	XVI	
58	B1 normals	XVI	
59	B1 hybrids 1	XIV	
59A	B1 hybrids 1	XIV	
60	B1 hybrids 1		indiv.
61	B1 hybrids 1		indiv.
62	B1 hybrids 1		indiv.

63	B1 hybrids 2		XVIII	
64	B1 hybrids 3			indiv.
65	B1 hybrids 3	XVI		
66	B2		I	
67	B2		I	
68	B2		I	
69	B2		I	
70	B2		I	
71	B3	VI		
72	B3	VI		
73	B3	VI		
74	B3	VI		
75	B3	VI		
76	B3		I	
77	B3	VIII		
78	B3	VIII		
79	B3		I	
80	B3		I	
81	B3		I	
82	B3			small
83	B4	II		
84	B4	II		
85	B4	II		
86	B4	II		
87	B4	II		
88	B4		I	
89	B4	II		
90	B4	XII		
91	B5	XI		
92	B5	XI		
93	B5	XI		
94	B5	XI		
95	B6	VII		
96	B6	VII		
97	B6	VII		
98	B6	VII		
99	B6	VII		
100	B6	VII		
101	B6			small
102	B6			small
103	B6		I	
104	B7	XIII		
105	B7	XIII		
106	B7	XIII		
107	B7	XIII		
107A	B7	XIII		
108	B8(i)	V		
109	B8(i)	V		
110	B8(i)	V		
111	B8(i)		I	
112	B8(ii)	X		
113	B8(ii)	X		
114	B8(ii)	X		
115	B8(ii)	X		
116	B8(ii)		I	
117	B8(ii)	XXII		
118	B8(ii)			misc.
119	B8(ii)	XXII		
120	B8(ii)	XXII		
121	B unc.	X		
122	B unc.			indiv.
123	B unc.			misc.
124	B unc.		I	
125	B unc.			misc.
141	C3	XXI		
142	C3	XXI		
143	C3	XXI		

In general, therefore, Hines provided a very clear set of criteria for defining GSHBs as an artefact-type, including a size criterion. Like Leeds and Leigh, he broadened his criteria to include a number of incomplete brooches, but also like them did not make the distinction between Kentish and other SHBs clear. The only inconsistency in his application of his criteria was his inclusion of three hybrid brooches.

2.8 The present definition and corpus

An amalgamation of the form criteria within Leigh's and Hines' definitions will be used in this thesis as the defining characteristics of SHBs; that is, an SHB will be defined as

a brooch with a headplate of fundamentally quadrangular form, usually rectangular or trapezoid, separated by a forward-curving bow from a footplate of fundamentally rhomboidal form.

The function of such brooches as safety pins, of the bow as accommodating a fold of cloth, and of the headplate and footplate as concealing the pin spring and catch respectively will not feature in the definition of the brooch type for present purposes. This is because this thesis is concerned with the theory of classifying brooches according to their form and the decoration of their fronts, not with the practicalities of their manufacture and use.

The 'animal heads' criterion will not be applied. That is, brooches lacking this feature will not be excluded solely on that account (though in fact all the known brooches lacking it will be excluded for other reasons). As already implied, this stance has the advantage of not closing the corpus to the possibility that a brooch might be discovered which lacks the animal heads but is an SHB in other respects.

Hybrid square-headed/cruciform brooches will not be included in the corpus: the form criteria used exclude them. This position, which was also Leigh's, is clear, and more consistent than that of either Leeds or Hines.

Both Kentish and non-Kentish brooches will be included. However, no attempt will be made to specify what distinguishes Kentish SHBs from others. Where it is necessary to

consider Kentish brooches separately, the opinion of Leigh on this matter will be accepted as a pragmatic basis for proceeding, though without implying that his judgment is carved in stone for ever.

All 11 of the evidently Anglo-Saxon SHBs found in France (Herpes 1-10 and Preures 65), plus the lead model found in Switzerland (Geneva), will be accepted as rightful members of the corpus. Also, the lead model will routinely be counted as a brooch, following Hines' practice.

The size boundary between great and small SHBs will be set at 7.8 cm. This is the upper end of the range within which Hines set his boundary, and is the exact length of the smallest brooch in his corpus, Fordham [16], which is also the second smallest in Leeds' corpus and therefore in Leigh's first corpus. Also, within Leigh's Kentish corpus 7.8 cm is the exact size of the smallest of the larger singletons (Herpes 1): below this there is a noticeable gap in the size distribution, the next largest Kentish singletons being Howletts 1 and Sarre 4-2, at 6.9 cm long.

Of the 130 (non-hybrid) GSHBs discussed by Leeds the size criterion excludes only Guildown 206 [7], which is the only pair in his corpus. All of Leigh's 16 non-Kentish additions and Hines' further 37 additions are included, bringing the total of GSHBs so far to 182.

The size criterion has its biggest impact on Leigh's Kentish corpus. Of these 99 brooches, only 23 qualify as GSHBs (see Appendix 1.3) - and since 10 of these were already in Leeds' corpus the total rises by only 13, to 195. (Five of Leigh's GSHBs were also in Hines' corpus.)

Of these 195 GSHBs, 191 are singletons, two are pairs (Bifrons 64, Lyminge 44), and two are trios (Chessell Down 45, Milton-next-Sittingbourne 1).

All the incomplete brooches within this set accepted as SHBs by Leeds, Leigh or Hines are accepted here as part of the main corpus. However, some of the analyses described later in this thesis rely on the analysis of all the characteristics of the brooches: for these, most incomplete brooches cannot be used.

It has thus been shown that

- the total number of brooches discussed by any one or more of Leeds, Leigh and Hines was 289
- within this, there are 17 hybrids and 272 SHBs
- within the 272 SHBs
 - there are 195 GSHBs and 77 small SHBs (there are, of course, other small SHBs, mostly non-Kentish, but these were not discussed by Leeds, Leigh or Hines)
 - there are 99 definitely or possibly Kentish SHBs and 173 others
 - 183 were found in England, 11 in France and one in Switzerland
- within the 195 GSHBs, 23 are Kentish, 172 not
- of the 77 small SHBs, 76 are Kentish, the exception being Guildown 206 [7].

Corpuses within corpuses

In the research reported in this thesis it has proved necessary to use different subsets of these brooches for different purposes. When SHBs in general are discussed, all 272 are meant; when GSHBs as a whole are discussed, generally the 195 so defined above are meant, but when discussing Leeds the square-headed/cruciform hybrids have sometimes to be included.

Kentish corpus

When Leigh's classification is being considered, the discussion will be relevant to the whole of his corpus of 99 Kentish SHBs, great and small, including the 13 of whose 'Kentishness' Leigh was unsure and the 10 counted as GSHBs by Leeds.

'Non-Kentish' corpus

Correspondingly, this consists of 183 brooches, namely the 173 SHBs not in the Kentish corpus plus the same 10 just mentioned - the overlap exists in the literature and cannot be wished away.

'Common' corpus

The analysis by decoration in chapter 12 was designed to have implications for both Leeds' and Hines' classifications, and begins with a listing of the decorative features on all the non-hybrid brooches that occur in both of their corpuses (except Chessell Down 6 [6], the only member of Leeds' group A1 included in Hines' corpus; to include this would have been artificial). This therefore defines a 'common' corpus consisting of Leeds nos 8-125, including the four with the A suffix, a total of 122.

For other analyses, it was necessary to use only complete or all-but-complete GSHBs, and to exclude fragmentary ones: when this is the case the set of brooches under consideration will be an

'Inner' corpus

of 95 brooches, consisting of the 123 in the common corpus minus the 28 within that set marked in Appendix 1.1 as incomplete and not usable.

The total number of brooches within Leeds nos 8-125 marked as incomplete in Appendix 1.1 is 31, and an explanation is therefore needed of why four of the incomplete brooches can be used for analyses where all the characteristics of the brooch need to be known. The four brooches concerned are Ipswich [32], Faversham [55], Market Overton [62] and Offchurch [72]. In each case enough of the brooch survives for all its characteristics to be visible; in particular, in each case the terminal lobe is present - nine other apparently less incomplete brooches (38, 43, 53, 74, 77, 78, 105, 117, 118) lack only the terminal lobe but have to be excluded on that ground alone.

Within this inner corpus, for certain computer analyses it proved necessary to use only a subset, though steps were taken to make the results applicable to all 95 brooches. Where this was the case, it is indicated and the reasons are given.

2.9 Summary and conclusions

This chapter has examined Åberg's list of SHBs in outline, and Leeds', Leigh's and Hines' definitions and corpuses in detail, and provided new and clearer definitions of SHBs and GSHBs.

Of the three previous definitions, Leeds' was the least explicit, Hines' the most. Leigh alone was consistent in excluding hybrids. None of the three defined the distinction between Kentish and non-Kentish brooches clearly. Only Hines indicated a size distinction between great and small SHBs.

In the new definition, hybrid square-headed/cruciform brooches, over which practice has varied, are excluded; a line is drawn between Kentish and non-Kentish brooches, though admittedly by stipulation rather than on any principled or argued basis; certain brooches found abroad are included; a lower size limit for GSHBs of 7.8 cm in length has been defined and justified; and previous consistent practice over multiple brooches and incomplete brooches has been followed.

The process of definition has been lengthy and detailed. Yet the length and detail have been necessary because of the imprecision of at least some aspects of previous definitions and lists, and in order to demonstrate the methodological point that this degree of rigour is inescapable if confusion is to be avoided.

The process of definition has yielded a corpus of 195 GSHBs and a Kentish corpus, partly overlapping with the GSHB corpus, of 99 SHBs. Within the corpus of GSHBs, a common corpus of 122 brooches and an inner corpus of 95 brooches have been defined. The inner corpus in particular is the subject of analyses in later chapters.

Chapter 3: Explaining methods

Once an artefact-type has been defined and its corpus compiled the classifier is ready to begin grouping the artefacts. Methods of classification vary, and it is important that classifiers fulfil a second requirement of explicitness, namely setting out their methods clearly and fully.

Of the four previous classifiers, Åberg will not be evaluated on this aspect: as shown in section 2.4, his list of SHBs did not advance much beyond a catalogue. However, he did set a precedent of defining some groups in terms of overall similarity to one or more brooches which he considered to be paradigm cases for their groups, while defining others in terms of particularly salient shared characteristics.

3.1 Leeds' method

Leeds did not formally or clearly set out the procedures which he followed to assemble his groups. In the felicitous description already quoted from Hines (1984: 111), Leeds' method was 'one of authoritative pronouncement rather than methodical exposition'. His method therefore has to be deduced from his text. When this is done, it is seen to be a fluctuating and eclectic mix of at least the following procedures (varieties of the second and third have already been mentioned in connection with Åberg):

- giving a reasonably full description of each brooch, though not in any consistent order of characteristics or in any tabular or other organised form
- defining some groups in terms of overall similarity to a paradigm case (often called by Leeds 'the prototype')
- defining some groups in terms of particularly salient shared characteristics
- defining some groups in terms of chains of characteristics, overlapping from one brooch to the next, but in such a way that the last brooch in a group may share no characteristics with the first
- arranging brooches within groups from finest (in his opinion) to poorest
- arranging brooches within groups, and groups within classes, from simplest (in his

opinion) to most complex

- making deductions from the findspots of brooches
- making deductions from brooches' positions in the chronological sequence as he himself determined it.

The procedure that Leeds highlighted at any point seems to have been whichever best suited his argument at that point.

Since one major aim of the exercise was precisely to deduce the chronological sequence, Leeds introduced an element (to put it no stronger) of circularity into his method with the last procedure mentioned in the list above.

In brief, Hines' description of Leeds' method seems entirely justified.

3.2 Leigh's principal method: stylistic analysis

Leigh used a range of different methods, some computer-based and others manual, with both his non-Kentish and Kentish corpuses. Some had implications for neither classification nor chronology, and these will not be discussed at all. Computer-based methods he used only for investigating chronology, and these will be discussed in section 6.3. He gave a sketchy description (1980: 551-6) of a manual analysis of brooch proportions; this will be discussed in chapter 10, in the context of a renewed attempt at this form of analysis. This section will be concerned only with the principal manual method that Leigh used to produce classifications of brooches with chronological implications, namely stylistic analysis.

Non-Kentish brooches

The stylistic analysis Leigh used with non-Kentish brooches was a reduced version of the main stylistic method which he applied to the Kentish brooches, and therefore does not require separate treatment. One of his results from non-Kentish brooches needs to be noted, however, namely his identification of 17 possible separate workshops outside Kent covering 54 out of the 136 brooches.

Kentish brooches

These were Leigh's main concern, and he dealt with them at great length (pp.64-515 of his main text, plus most of the other two volumes). The methods he used to group Kentish SHBs in ways which had implications for chronology concern identification of Series, possible workshops, European parallels and possible individual artisans. In practice, the methods Leigh used for the first three of these were identical.

Series, workshops and European parallels

Leigh first classified the brooches by main metal content: silver or copper alloy. Of the 99 which were his principal concern he was unable to determine the metal content of two; these he cautiously included among the copper alloy set. That set totalled 34, and the silver brooches 65. Then he used forms of decoration and tooling techniques to identify Series, groups of brooches which he felt could only have been produced by the same group of artisans. This resulted in partitioning the silver brooches as follows: 23 to one series (Series I), 35 to another (Series II), and seven to no series. Of the copper alloy brooches 28 formed a series (Series III), while six joined the seven unassigned silver brooches in the set of possibly but not definitely Kentish brooches. Series I consisted mainly of the larger and more ornate silver brooches, and Series II mainly of the smaller and less ornate ones, but the size ranges overlapped: 6.5-13.7 cm in Series I, with six below 7.2 cm and the next smallest at 8.6 cm; 4.2-9.1 cm for Series II, with four above 7.8 cm and only one other above 6.4 cm.

The significance of the distinction into Series was low, however, since Leigh concluded that all three Series were in fact the products of a single workshop: this conclusion was also based on similarities of decoration and tooling. These similarities were less close than those which had impelled him to discriminate three Series and a non-Series group in the first place, but still sufficiently close for him to identify all three Series as definitely Kentish and different from non-Kentish examples. In a long Appendix (number 1), Leigh extended this 'accumulation of stylistic similarities' method into a consideration of parallels between Anglo-Saxon SHBs and equivalent brooch types found in Scandinavia and on the continent.

In effect, Leigh's stylistic method was Leeds' method writ large. He began each Series with one brooch he considered central, then found another which was most similar to it, and discussed the points of similarity (and difference); then added a third, etc.; and gradually added brooches that, though less similar, still had enough similarities to the central ones to be counted in. When he judged that the similarities were no longer sufficient he declared a Series closed and started another. Judgments about similarities were also at the heart of his postulation of a single workshop, and of his analysis of European parallels. But like Leeds again, he nowhere set out succinctly the 'raw data' on which the judgments of similarity were based, so that those data have to be either unearthed at great effort from the lengthy and detailed descriptions, or taken on trust.

Individual artisans

Leigh's method of identifying individual artisans was a subset of his method for identifying Series, workshops and European parallels: it also relied on similarities of decoration and tooling, but of what Leigh claimed (circularly?) was a much more individualistic nature. This approach was also not set out clearly, and has to be deduced from scattered hints. He drew attention to differences between right-angled and sloping notching (1980: 68, 71, 75); to a 'blockish quality' of the working of certain brooches and of the motifs this builds up (1980: 71, 88, 112-4, 325); to the unusual grooved eyebrow ridges of Finglesham D3 [1] and Bifrons 42 (1980: 79); to different methods of chip-carving (1980: 101-2); and to a style equivalent to Kendrick's Helmet Style on a couple of SHBs and other pieces of metalwork (1980: 114-9). From this evidence, he felt he could distinguish three artisans, one of whom he identified with Bakka's (1958) 'Kentish Master' (Leigh, 1980: 120, 498). Almost all of this has to be taken on trust.

Overall, then, Leigh's principal method was described extremely fully, but not clearly or in a manner helpful to other researchers.

3.3 Hines' method

Hines' method was a development of that employed by Lundström (1972) at Helgö, Central Sweden, to classify brooch moulds:

This involved the consecutive subdivision of the material according to A-, B-, and C-elements. The A-elements are the headplate, bow and footplate which one may use to define 'the square-headed brooch'. The B-elements are various elements which are assembled in the composition of the A-elements. In [Hines'] analysis and classification of the Anglo-Saxon square-headed brooches something much the equivalent of the Helgö B-elements is used, namely a limited range of distinct elements or fields of ornament which are likely to occur in the composition of these brooches, e.g. the frame [etc] of the headplate. (Hines, 1984: 111-2)

Hines did not explain what Lundström's C-elements represented, but from her article it is clear that they were decorative variants found on the B-elements or fields of a brooch.

Lundström did not use the A-elements in setting up groups within the Helgö material, presumably because the A-elements merely defined the brooch-type and therefore provided no new information. She did use both the B- and C-elements, independently, and found that incompatible classifications were arrived at from the two sets of information.

Hines also did not use the A-elements in setting up groups, but did use a modified version of the B-elements:

The compositional elements listed [by Hines] add a number to the Helgö B-element range, and re-name others... There should be no part of the brooch which is not covered by this analytic system, and the range of B-elements used in the published Helgö analysis is deficient in this respect. (1984: 112)

Hines set out his system of B-elements in a diagram (Hines, 1984: 394, Figure 3.1) on which the various 'fields' of a typical GSHB are shown and labelled. This part of his method was clearly and fully described, and much use will be made of it in this thesis - see especially chapter 12.

However, it is also clear from Hines' text that, despite making no overt reference to Lundström's C-elements, he made copious use of information about the decorative variants of each of the fields of the GSHB. Given the frequency with which he refers to decorative features, it is clear that, in the process of constructing his groups, he must have named and listed the decorative variants of each field, and tabulated which fields, and which variants of them, occur on each brooch, in the form of an undifferentiated listing preceding the assignment of brooches to groups. If Hines had set out his method fully, this tabulation would appear in the text. However, it does not. What appear instead are listings of *some* of the decorative elements (the 'equivalent' elements discussed below), within the groups to whose construction they have contributed. Other types of element ('related' and 'common') were not systematically listed, though 'related' elements were discussed, for *some* groups (all except III, IV, VIII, XI, XII, XIX, XX, XXI), in the passages giving the reasoning behind the setting up of the groups. Hines' method would have been easier to follow if he had listed all the elements, even though this would have taken up a great deal of space.

Inspection of Hines' lists of equivalent elements within his groups reveals a further obscurity. From the lists it seems that Hines often distinguished more than one form of equivalent element within one decorative field. For instance, within 'Headplate frame' for Group I (1984: 118), the layout and punctuation seem to show that he considered the headplate frames of Alfriston 28 [66], Alfriston 43 [68], Alfriston 43 [69], Guildown 116 [70], Berinsfield 102, Coleshill [103] and North Luffenham [124] equivalent; while those of Chessell Down [79] and Fairford [80] were also equivalent, but in a different manner from that in which the other six were equivalent. This aspect of the lists of elements was not stated; nor were the different variants of each field (if that is what they are) named.

A further aspect of the B- (and, presumably, C-) elements was that, in Hines' view,

these compositional elements ... do not ... divide simply into two categories of 'similar' and 'dissimilar'... In comparing the whole corpus of Anglo-Saxon square-headed brooches with one another, the distinction of three grades of positive similarity was found satisfactory:

- (a) equivalent: elements which are identical, or attempts to reproduce a single 'prototype'
 - (b) related: elements which are different modifications of a single 'prototype';
 - (c) common: elements which may be identical on different brooches, but which are characteristic of square-headed brooches in general, not of significant sub-groups.
- (1984: 112-3).

Hines gave one example of each grade of similarity, but no further explanation of the grades, or of how he had arrived at them. He did, however, go on to say that

In certain cases, of course, the interpretation of the similarity between features as 'equivalent', 'related', or 'common', is a subjective one.
(1984: 113)

This part of Hines' method, therefore, was described only in outline, and most of it has to be taken on trust.

Hines then gave a description of how he used his grades of similarity:

The procedure of classification is first to establish 'similarity coefficients' between all individual square-headed brooches, consisting of the number of shared 'equivalent' features, as a guide to the best grouping. This is then supplemented with the evidence of the 'related' features, which in fact generally confirms the clustering observed through the first stage... No especial significance is attached to the exact value of the similarity coefficient between two brooches.
(1984: 113)

In principle, this stage of Hines' method is clear: it is an attempt to quantify the similarity between brooches in a more objective manner, rather than relying (as Leeds entirely and Leigh mostly had) on impressions of overall similarity or on particularly salient details. However, Hines did not give the 'similarity coefficients' between all the individual GSHBs in his corpus, but only within 15 of the 22 groups he established (not groups IV, VIII, XII, XIV, XVII, XX, XXI - he admitted group IV had no equivalent features, and groups VIII, XII and XIV consisted of only two brooches each and the table of coefficients would therefore have consisted of one entry) - this is presumably because most of the unstated coefficients would have been zero. Also, it is clear that the validity of this part of Hines' method depends entirely on that of the previous stage.

Some of Hines' method, therefore, was explained clearly and very fully. However, the listing of elements was incomplete; he did not make the variants of equivalent elements clear; and at the centre of his method was a fundamental methodological step, the distinction between 'equivalent', 'related' and 'common' elements, which was barely explained at all.

3.4 Summary

This chapter has evaluated the clarity and completeness with which Leeds, Leigh and Hines set out the methods they used. It was concluded that Leeds had not set out his method at all, that Leigh's exposition of his main stylistic method was very extensive but not at all clear, and that Hines had explained his method clearly and quite fully but with some gaps. A major conclusion that can be drawn about the principal method of all three, however, is that they were all very similar in essence, namely their close attention to stylistic detail and reliance on art-historical knowledge of the material in arriving at classifications. All three approaches were therefore similar in another important respect, namely subjectivity.

In the analyses of both requirements of explicitness Leigh has come out better than Leeds, and Hines better than either. Hines, moreover, was the only one to incorporate a quantitative and therefore quasi-objective element (similarity coefficients) within the otherwise subjective main method. The lessons learnt about the need to be full and clear, and as objective as possible, will be applied later in this thesis.

Chapter 4: Internal consistency

4.1 Definition of internal consistency

The extent to which previous classifiers of SHBs met the requirement of internal consistency is considered in this chapter. They will be considered to have acted with internal consistency if in arriving at their classifications they in fact applied the method(s) which they claimed to be applying.

4.2 Consistency of Leeds' approach

Given that Leeds did not set his methods out clearly, it will necessarily be difficult to evaluate how consistent he was in applying them. This difficulty is compounded by his having used several methods, in a fluctuating and interwoven manner. It would be tedious and excessive to pursue every detail of Leeds' approach; accordingly, what appears to have been his principal method has been singled out for scrutiny. This is the method which was described in the previous chapter as allocating brooches to groups on the basis of particularly salient decorative features. Leeds gave reasonably full descriptions of every brooch in his corpus. By noting systematically for each brooch the features he mentioned, and by accumulating the features described for each group, it should be possible to deduce what Leeds felt were the salient features of each group.

A problem encountered while doing this was that Leeds was concerned to justify his groups not only from decorative features but also from other information, e.g. their findspots, their stylistic resemblances to Kentish brooches, and their quality of design and/or manufacture. Since these sources of information were of a different order from brooch decoration, and because Leeds himself, despite including them, seemed to treat them as less important, criteria deduced from such information were not included in this analysis.

Each brooch was described by Leeds in terms of three areas - headplate, bow and footplate. As the first stage in analysing Leeds' procedures, each time a decorative feature of one of these areas was mentioned in connection with a particular brooch, that feature

was set down as a possible criterion for the group to which that brooch belonged. When all the features Leeds mentioned in connection with a group had been collected together, all the brooches in the group were examined to see which of the features each brooch possessed. Each feature was entered in a list (see Appendix 2). A feature was attributed to a brooch by inspection of the photograph in Leeds' book, irrespective of whether or not Leeds actually mentioned in his text that the brooch possessed the feature: he frequently omitted to mention all the relevant features of particular brooches, but to count only those he mentioned would be to underestimate the features of the brooches in his groups. Because he would have seen all the features of the brooches, Leeds would have been influenced by them and used them in his classification.

The corpus of brooches to which this analysis was applied was defined as follows. Incomplete brooches were omitted because they might seem to fall outside the defining criteria for a group only because information about them was missing. The hybrid brooches of class C were omitted. Because this analysis was carried out in terms of the homogeneity of Leeds' groups, the six brooches he called 'B unclassified' could not be used. Thus the resulting corpus consisted of the 98 complete brooches within Leeds' groups A1 to B8.

The result of the analysis was in effect a measure of the homogeneity of Leeds' groups. This provided a satisfactory test of Leeds' consistency in applying his principal method, for the following reason. If he had consistently applied the principle of constructing groups around shared features, then each group should exhibit a reasonable number of such features. For each group or subgroup, a 'reasonable number' was taken to be at least three; but then, since this is a modest criterion, in order not to overestimate the amount of homogeneity, this test was not applied to groups or subgroups consisting of fewer than three complete brooches.

Features possessed in common by a group, or in some cases by a subgroup, are shown in bold in Appendix 2, and the results of this analysis are set out in Table 4.1.

Table 4.1: Homogeneity or otherwise of Leeds' groups and subgroups

Group	No. of complete brooches in group	No. of features shared by all brooches in group
A1	5	1
A2	3	2
A3	19	0
A4	7	3
A5	0	-
B1	21	2
B2	5	3
B3	8	1
B4	8	2
B5	3	8
B6	7	2
B7	4	4
B8	8	1
Subgroup	No. of complete brooches in subgroup	No. of features shared by all brooches in subgroup (including any shared by all brooches in group)
A3(a)	2	-
A3(b)	1	-
A3(c <i>i</i>)	5	1
A3(c <i>ii</i>)	11	0
B1 normals	15	6
B1 hybrids 1	4	3
B1 hybrids 2	1	-
B1 hybrids 3	1	-
B8(i)	2	-
B8(ii)	6	1

The results showed that only four of the 12 relevant groups (discounting A5) exhibited even the modest degree of homogeneity represented by three shared features. Because Leeds divided three of his groups (A3, B1, B8) into subgroups, these were also examined. Of the 10 such subgroups, five consist of only one or two brooches and therefore could not be analysed in this way. Of the other five subgroups, only two (B1 normals, B1 hybrids 1) could be considered homogeneous. This is not enough to modify the conclusion that Leeds was not particularly consistent in the application of his principal method of classification.

4.3 Consistency of Leigh's approach

It is even more difficult to estimate Leigh's internal consistency than Leeds'. As shown in the previous chapter, Leigh set out his principal, stylistic method at great length - but within the mass of detail it is for the most part impossible to keep track of whether he was consistent in using particular features only in a certain way. However, on the most general plane there is the oddity of his having reached different conclusions at three levels:

- at Series level, that there were three
- at workshop level, that there was only one
- at artisan level, that he could distinguish three hands.

The use of essentially the same forms of evidence to reach such radically different conclusions leaves room for doubt. Since he also concluded that all the earliest brooches in his corpus, his 'Jutlandic' group, had been made in southern Scandinavia and imported into Kent, it is difficult to see how he could consistently have concluded that all 86 definitely Kentish brooches had been produced by a single workshop.

Similarly, he used essentially the same method to investigate possible workshop groups both in and outside Kent. This produced one workshop with 86 products and only 13 outliers in Kent, but about 17 possible separate workshops outside Kent covering only 54 out of 136 brooches.

Also, it is difficult to reconcile statements Leigh made in different places about the three artisans:

- (1) On pp.78-82 he seemed to attribute Finglesham D3 [1], Bifrons 41-1, Milton-next-Sittingbourne 1, Bifrons 63 [2] and (cf. p.120) Chessell Down 22 to Bakka's 'Kentish Master'; on p.498 this man's output seems to be wider but unspecified, and it is unclear whether it includes Goldstone Cop Street 1 ['Richborough', 5] and Dover 20-1, mentioned on p.87 as being by one hand.
- (2) On pp.71, 88 and 112-4 a 'blockish quality' was said to link Sarre 4-1, Chessell Down 45, Finglesham 203-2, Bekesbourne 30, Howletts 2, Dover 1 and eight disc brooches; on

pp.498-9 this artisan is said to have made most of Series I from Chessell Down 45 and Sarre 4-1 to Sarre 159 [84], but not Lyminge 44 or Herpes 2 [83], while he or possibly an apprentice is credited with most of the class 2 keystone garnet disc brooches.

(3) On pp.114-9 a different hand was identified on Howletts 3, Chessell Down 4, three belt-buckles, the Taplow horn-mounts, various other items and possibly Herpes 2 [83], all said to be decorated in Kendrick's 'Helmet Style'; on p.499 this artisan becomes the maker of some of Series II and III plus a number of the finest garnet-set rectangular buckle-plates, Herpes 2 [83] and the earliest Taplow material.

(4) On pp.68, 71 and 75, right-angled notching is said to link Sarre 4-2 and Chessell Down 45, while sloping notching is characteristic of Bifrons 42 and Sarre 4-1, the implication appearing to be that these show different hands; but all four brooches are elsewhere attributed to the artisan whose work has the 'blockish quality'.

All of this raises doubts about Leigh's consistency.

4.4 Consistency of Hines' approach

Since Hines set out his method so much more clearly than either Leeds or Leigh, it is easier to evaluate his consistency. It will not be necessary to set out here an evaluation of every element of his method separately: it can be said at once that much of what he did was in accordance with what he said he was doing. However, attention needs to be drawn to a small number of problems that became apparent while evaluating his consistency.

First, Hines (1984: 117) seemed to imply that he discussed related features for each of his main groups. In fact, however, for eight of his 22 groups (III, IV, VIII, XI, XII, XIX, XX, XXI) there is no discussion of related features. This is unsatisfactory, because there is no way of knowing whether these groups, in Hines' opinion, did not have any such features, or if he merely decided not to discuss them even though they were present.

Secondly, Hines (1984: 113) claimed that

The procedure of classification is first to establish 'similarity coefficients' between all individual square-headed brooches, consisting

of the number of shared 'equivalent' features, as a guide to the best grouping.

However, one of Hines' groups was not constructed in this way: his group IV has no equivalent features at all, and is based solely on related features.

Thirdly, Hines himself pointed out that not all his groups were as homogeneous as his stated method would lead one to expect, and that some groups were constructed by a different method:

Other groups, group I for instance, are relatively loose and heterogeneous, with chains of brooches linked together by low similarity coefficients supplemented by related features. The phenomenon of chaining may link together brooches within the same group which have no shared equivalent features through an intermediary brooch... This can give rise to the situation that two brooches in different groups have a higher degree of similarity to one another than two other brooches within a single group.
(1984: 114-5)

He claimed that

this phenomenon is, however, of interest in its own right, and a valid basis for grouping the brooches concerned,
(1984: 115)

without giving any justification for this being a 'valid basis'.

Overall, then, Hines applied his stated method fairly consistently, but with a number of small inconsistencies. He was himself aware of some of these, and they may reflect the fact that total consistency is very difficult to achieve, so that some compromise is inevitable.

4.5 Summary

In so far as Leeds' principal method can be deduced, he seems not to have been very consistent in applying it. Of Leigh it is perhaps simplest to say that his consistency is largely impossible to evaluate but seems suspect. Hines was much more consistent than either, and only small inconsistencies can be detected in the way he applied the methods which he stated that he was using.

4.6 Conclusions on Scientific Procedure

In chapters 2 to 4, the following results have emerged.

Leeds provided a reasonably clear but somewhat incomplete definition of GSHBs; gave no clear description of his methods; and was inconsistent in the application of what appears to have been his principal method.

Leigh's definition of SHBs was clear and consistent, though still not complete; his description of his principal method was painstaking but unfortunately not summarised or clear; and the consistency with which he applied his methods is therefore very difficult to estimate.

Hines gave the fullest definition; he also gave the fullest description of method, but even this had crucial gaps in it, though it did incorporate a quantitative element; and he was also largely, though not quite entirely, consistent in applying his stated methods. Though not entirely explicit and consistent, Hines was therefore the most rigorous of the three. However, even his procedures were not fully rigorous.

Moreover, at the heart of the principal method of all three classifiers was the subjective use of knowledge of the material.

The analyses in chapters 2-4 have been predicated on the assumption that reliable classifications can only arise from rigorous procedures, and that classifications arising from even slightly flawed procedures should not be relied upon. From a strictly logical standpoint, rejection of all three previous classifications, and hence of the chronologies based on them, would now be justified. However, no case in defence of these classifications and chronologies has yet been put. In chapters 5 to 7, therefore, three counter-arguments are examined.

PART C: ARGUMENTS IN DEFENCE OF EXISTING CLASSIFICATIONS AND CHRONOLOGIES

Chapter 5: Obviousness of classifications

5.1 Archaeological classification on the defensive

In chapters 5 to 7, various fall-back arguments in defence of previous classifications of SHBs, and of the chronologies based on them, are considered, as follows:

- chapter 5: that the general outlines of a classification of SHBs are sufficiently obvious that rigorous scientific procedure is not needed to demonstrate them;
- chapter 6: that the chronologies based on previous classifications of SHBs have stood the test of time or are otherwise convincing, even if the methods by which the underlying classifications were arrived at were not as rigorous as might be desirable;
- chapter 7: that the chronologies based on previous classifications of SHBs have been validated by their congruence with those based on other types of metalwork, and with continental chronologies.

5.2 Importance, and a previous study, of obviousness

This chapter seeks to investigate whether the general outlines of classifications produced by experts are obvious to others handling some of the same material. The question is of interest because, if classifications are obvious, it may not matter that the methods by which they are arrived at have not been set out very clearly, or used very consistently.

The fact that groupings within artefact-types are not self-evident was first demonstrated by Hodson, Sneath and Doran (1966; cf. Doran and Hodson, 1975: 222), who presented six academic archaeologists with the same group of data. No two of the resulting classifications concurred. It was a demonstration which was particularly important when

one remembers that the interpretation of the development and spread of any artefact is drawn from its classification. Hodson et al's experiment, however, had a major limitation: the number of subjects was very small. An experiment was therefore set up to test whether a larger group of subjects coming fresh to a set of artefacts would produce classifications similar to those produced by experts.

5.3 Experiment on obviousness

Method

Subjects

There were 82 subjects, drawn from three departments in two universities: 11 archaeology students from Reading University (group A), 56 archaeology students from University College London and the Institute of Archaeology (group B), and 15 psychology students from Reading University (group C). Group A comprised one first-year undergraduate, three second-years, four third-years and three postgraduates. All members of groups B and C were first-years. All the subjects were volunteers: this accounts for the disparity in the size of the groups. No experienced or academic archaeologists were included: this was partly because it would have been difficult to assemble a large enough group, but mainly because they would probably have known enough about the existing expert classifications to have been influenced by them.

Materials

The materials consisted of a questionnaire (see Appendix 3.1) and photocopies of photographs of 30 brooches (see Appendix 3.2). For ease of handling and sorting, each photocopy was on a separate slip of paper, and for ease of reference by the subjects the slips were numbered from 1 to 30. (The Leeds numbers of the brooches, shown in Appendix 3.2, were not marked on the slips used in the experiment.) The brooches chosen were all complete, and comprised 26 chosen by a random number generator from the main corpus of GSHBs described by Leeds (1949), and four, also randomly selected, from the hybrid square-headed/cruciform brooches included in his corpus but excluded from the later classifications of Leigh (1980) and Hines (1984). The number of brooches

was set at 30 in order to be manageable within a reasonable time. The random method of selection ensured that the numbering of the brooches for the experiment did not reproduce their ordering within Leeds' and Hines' classifications, but also ensured that the experimental set was representative of the groups within both classifications.

Procedure

Each subject was given the questionnaire and set of photocopies of brooches. A standard set of instructions (see Appendix 3.3) was read out. The task was not expected to take more than one hour. Subjects were free to leave the room as soon as they had completed the task.

Results and Discussion

In order to test the hypothesis that the subjects' classifications would resemble those set up by the experts, the criteria that each of the 82 subjects claimed to have used in classifying the brooches were examined: these are listed in Appendix 3.4, and summarised in Table 5.1.

Table 5.1 Characteristics of GSHBs mentioned as principal classifying criteria by subjects in experiment on obviousness

Characteristic	Frequency
Form	29
Decoration	5
Size	0
Form and decoration	29
Form and size	6
Decoration and size	0
All three	3
No information given, or too vague to categorise	10
Total	82

The results show that the predominant criterion was form, mentioned by 61 subjects. Decoration was mentioned by 37 subjects, and size by only nine. This contrasts strongly with the classifications of Leeds, Leigh and Hines, in all of which form played a very minor role, and there was a heavy concentration on decoration. It is especially noticeable that no subject picked out the feature of divided versus undivided footplate, which lay at the heart of Leeds' approach, and featured strongly in Leigh's and Hines' results. None of these subjects' classifications, even if extrapolated to the full corpus, would resemble the expert classifications at all.

5.4 Conclusion

The outlines of the expert classifications therefore do not seem to have been obvious to these subjects, and this line of defence of existing classifications cannot be sustained.

Chapter 6: The reliability of previous chronologies of SHBs

This chapter examines the idea that the chronologies based on previous classifications of SHBs have stood the test of time or are otherwise convincing, and therefore reliable, even if the methods by which the underlying classifications were arrived at were not as rigorous as might be desirable. This question is addressed by examining both the methods by which previous chronologies were arrived at from the underlying classifications and the resulting chronologies themselves.

6.1 Åberg's view

Method

Åberg's discussion of the chronology of brooches with downward-biting animal heads consisted of only a few sentences, and he did not state how he reached his chronological conclusions, but in the main it seems that he relied on stylistic parallels and differences between Scandinavia and England. However, for the first statement given in the next paragraph no justification is to be found in Åberg's text.

Chronology

In England these brooches appear at a very much later time than in Scandinavia...

Their development presents analogies to that in Scandinavia from the period following the middle of the sixth century...

Their first appearance in England may ... be dated towards the middle of the sixth century, and their development embraces a period of only a little more than 50 years, or to about the year 600 or shortly after.

Hence the short duration of the period of development precludes chronological classification.

(Åberg, 1926: 62-3)

Thus Åberg thought that SHBs were of little value for chronology. He was assisted to this conclusion by the fact that all brooches of this type from England are decorated in Salin's Style I, which in turn Åberg (1926: 167) considered started in England just before 550 and lasted until 600 or just beyond.

The nearest he came to distinguishing a sub-period within the development of SHBs was when he suggested that the flowering of the Kentish subgroup had occurred in the last quarter of the century (1926: 154-7). (It is curious that Åberg thought that the Kentish SHBs began slightly later than the rest, when all other archaeologists consider them to have begun slightly earlier.) With this slight exception, Åberg's classification was completely non-sequential: all groups within the type were in his view contemporary with each other, regardless of the degree of similarity or difference between them. The implication would be that fine chronological differentiations within the type cannot be made: at best such brooches would date the burials in which they occur to a period of perhaps somewhat less than a century beginning just before 550.

Lundström's opinion on sequencing the Helgö moulds was quite close to Åberg's on SHBs: 'It is still not possible to construct chronological series' (Lundström, 1972: 158). She was driven to this conclusion by the finding (already mentioned in section 3.3) that incompatible classifications arose from considering the B-elements (fields) and C-elements (decoration) separately. This provides a warning against relying solely on art-historical features in setting up sequences.

6.2 Leeds' chronology of GSHBs

Leeds' views on the worth of GSHBs for chronology could hardly have been more different from Åberg's (and Lundström's) - his entire book is studded with references to the history of the brooch type.

Method

As with his method(s) of classification, Leeds did not set out the method(s) by which he arrived at a chronology. In much of his book, as implied in chapter 3, the two processes were in fact closely interwoven. While describing the brooches in his corpus he made numerous allusions to their relative chronological positions, giving the impression that he was reaching conclusions about the membership and about the sequence of groups concurrently. Implicitly, therefore, Leeds' sequence of groups and of brooches within

them were also based on his knowledge of the material, and on his subjective judgment of the art-historical development of styles and motifs.

However, he did discuss explicitly the diffusion of subtypes of the GSHB (1949: 90-107), the evidence for relative chronology (1949: 108-16) in which, he pointed out, 'there are many deplorable lacunae' (1949: 108), and the evidence for absolute chronology (1949: 117-22).

Chronology

In outline, the chronological conclusions Leeds felt could be drawn about GSHBs were that they appeared in England somewhat before 500 (1949: 102, 108, 120-1) - distinctly earlier than Åberg had thought - and lasted until somewhat after 600 (1949: 111, 121).

The latter conclusion appears to have been based on two assumptions:

- that no GSHBs exhibit any features of Style II
- that Salin's Style II came into use early in the seventh century (cf. Åberg, above).

The second assumption may have been a compromise, since he was aware of uncertainties over the date of the beginning of Style II:

It is now known that elements of Salin's 7th-century Style II in Scandinavia were in vogue even earlier in central Europe and could have reached this country long before A.D. 600, the round date for the beginning of Style II.
(Leeds, 1949: 90)

Leeds' earlier starting date for GSHBs was based on the associations of what he thought were the earliest Kentish examples, especially Finglesham D3 [1] (1949: 7). He drew attention to this discrepancy between his and Åberg's systems, and argued (1949: 112-3), rather allusively, that the stylistic innovations seen on the earliest GSHBs in England could not have been so similar to those in the rest of Europe and yet several decades later. Leeds' resulting longer overall timescale for GSHBs ('a period of 100 to 150 active years', 1949: 88) enabled him to posit a fairly lengthy sequence of development within the type.

It would be more accurate to say that Leeds detected several sequences within his corpus: in several places he indicated where he thought groups had split into more than one line of

development (e.g. 1949: 20, 38, 49-50), or where there were similarities between brooches in separate groups, and he made it clear that he thought that both group A1 and group B1 were present in England from the earliest appearance of the type (1949: 120-1). However, if all Leeds' scattered references to chronology are collected together (see Appendix 4), a somewhat awkward position is reached. It is just about possible to set out the majority of Leeds' chronological ideas in a diagram - see Figure 6.1. To do this, however, it has to be assumed that in most cases the period of manufacture of particular classes or groups can be compressed or stretched to fit the statements Leeds made. For instance, the whole of class A has to be compressed into the period from just before 500 to about 525: the start of A1 has already been mentioned, and Leeds' view on the end of A4 is deduced from his statement (1949: 104-5n) that the latest GSHBs of Kentish type were made about 525 and were out of fashion by about 550.

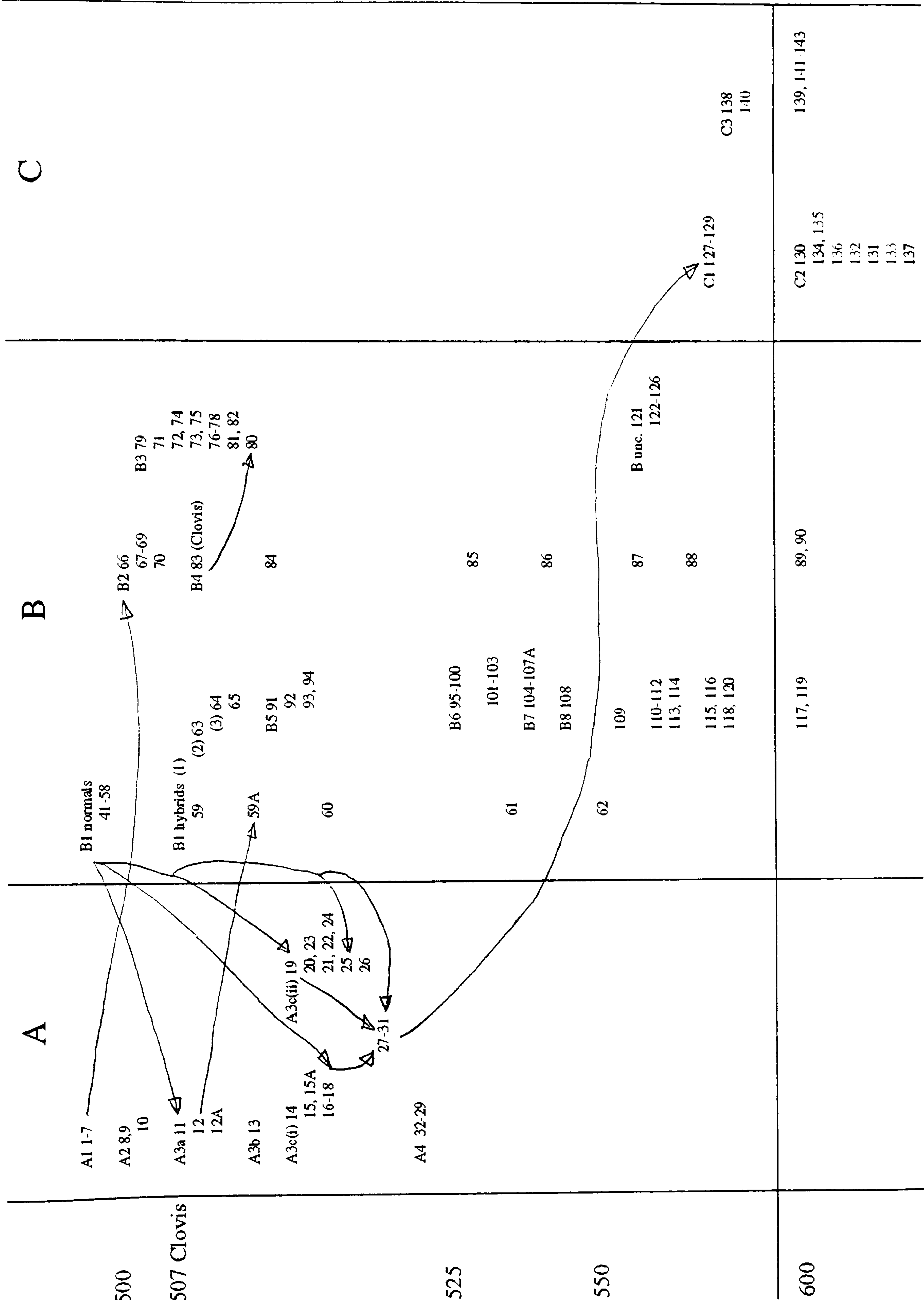
The most extreme example of having to stretch a group to fit in with all that Leeds said about it concerns group B4. On the one hand, he speculated that the presence of Herpes 2 [83], the earliest brooch in the group, in France might have had something to do with Clovis' campaign of 507 (1949: 54); on the other, that the brooch which is by implication the latest in the group, Norton [90], was seventh century (1949: 121). Hence the stretching of group B4 in Figure 6.1 over about 100 years.

In fact, it is logically impossible to reconcile all Leeds' statements about the chronology of GSHBs. For instance, he stated that 'the groups within the main classes have been arranged in what, so far as the initial appearance of each is concerned, seems to accord closely to their historical sequence' (1949: 89), and in particular (1949: 89) that C3 was later than C2; but later (1949: 121) he seemed to imply that, whereas all the brooches in C2 were seventh century, some of those in C3 were not.

Similarly, Leeds made two irreconcilable statements about class B:

- that a few brooches of groups B4 and B8 were seventh century (1949: 121);
- that about 550 the Angles (by implication, the main owners of class B brooches) had dropped conventional GSHBs in favour of class C hybrids (1949: 104-5).

Figure 6.1: Diagram of Leeds' chronological ideas



Leeds' method of arriving at a chronology was therefore of a piece with the rest of his methodology, allusive, piecemeal and unsystematic, so that the results are confused and cannot be relied upon. Moreover, in parallel with his earlier starting date for GSHBs, more recent scholarship seems to have brought the end date forward.

6.3 Leigh's chronology of SHBs

Leigh was, at least initially, pessimistic about drawing historical conclusions from SHBs:

Nor will there be found [in his thesis] more than a soupçon of historical or contextual discussion... It is my opinion that a mere hundred brooches of one very restricted kind are not sufficient alone to provide a basis for drawing wide-ranging archaeological conclusions. (Leigh, 1980: 3)

This disclaimer on historical conclusions was disingenuous. Leigh's main discussion of chronology ran to over 50 pages (1980: 436-84 and 498-501). Even though this was only about 10 per cent of his main text, it was more than a soupçon, and it contained wide-ranging archaeological (and historical) conclusions. Moreover, this was just the main chronological discussion; chronological concerns pervaded many other sections.

Computer-based methods

Non-Kentish brooches

Leigh (1980: 41-50) applied one computer method to his non-Kentish corpus, including most of the 16 brooches he had added to Leeds' corpus. This involved

- analysing the standard form of the GSHB into a number of 'fields'
- identifying the decorative variants ('motifs') which could appear in each of the fields
- listing in a matrix the fields and motifs which occurred on each brooch
- entering the matrix into a database
- using a program which had originally been developed to seriate artefacts within grave assemblages from single cemeteries to seriate instead motifs on brooches within the corpus of GSHBs.

This 'seriation of motifs' method was described clearly and fully enough to allow

replication or development. Even so Leigh was careful not to claim too much for it, describing it as 'a trial-run [which] has been shown to have considerable potential for artefact analysis' (Leigh, 1980: 50).

A very helpful feature of the clear way Leigh described this approach was that he named and listed both the fields into which he divided the GSHB (though without providing a diagram), and the decorative variants of each field (his Table 3), and then tabulated which fields, and which motifs on them, occur on each brooch, in the form of a matrix which is reproduced in his thesis (Table 4). Thus he provided the raw data on which his seriation of motifs was based, in the form of an undifferentiated listing preceding the results of the seriation.

Kentish brooches

Leigh's treatment of the chronology of Kentish SHBs by computer methods was confined to his Appendix 5 (Leigh, 1980: 566-7) with associated Tables and Figures. Two techniques were very briefly summarised. The first was described as 'a single-cluster analysis on ... a presence/absence record of 35 attributes' of first 95, then 63 brooches, and the second as 'a non-metric multi-dimensional scaling ... on the 63 brooch set'. Neither approach was described fully enough to allow replication; but as Leigh went on to explain, he abandoned computer methods because his opinion of their value sank as he became better acquainted with the brooches.

Manual method: stylistic analysis

The manual method Leigh used to derive chronologies was essentially the same stylistic analysis as he used for classifying brooches. His application of it to the chronology of his non-Kentish corpus was very brief (1980: 28-33), while his treatment of the Kentish corpus was enormous (much of his main text). In the process, he valuably cleared away a lot of confusion. He noted (1980: 436-7) the absence of any useful coin-dating associations for this period in England (the only late Roman coin found reliably associated with a Kentish SHB is one of Anthemius, AD 467-72, found with Chatham Lines 2: it provides only a remote *terminus post quem*; Leigh, 1980: 443). He showed

(1980: 438, 443) that Continental coin-dating fails to provide any reliable chronological background for English material of the sixth century. He argued that Continental named graves do not provide precise dating for England, because

the chains of association from these graves to even the most closely related English material are too long and too weak.

(Leigh, 1980: 439)

He lamented (1980: 439-40, 442) the lack of material for seriation in England, and demonstrated in detail (1980: 443-74) how little dating information can be derived from the very few reliable associations of SHBs. He pointed out, and avoided, the trap of circular argument, that is of dating one type of artefact by a second and then the second by the first (see next chapter). He accepted (1980: 441-2) the uselessness of dating by received opinion or (cf. especially Leeds) by the perceived degree of 'degeneracy' of brooch decoration. He accurately showed (1980: 480-2) how overstretched and poorly supported the latter part of Leeds' chronology had been. And he demonstrated how useless for chronology are the degree of abrasion on artefacts (1980: 484-90), the assumed position of wear of brooches (1980: 488-93), and supposed changes in fashion deduced from the assumed chronology of the artefacts (1980: 493-5).

On the other hand, Leigh used two received opinions with substantial implications for his own chronology:

- He cited Haseloff (1974) as his authority for dating the beginning of Style I to about 480 (Leigh, 1980: 25, etc), and used this (1980: 474-7) to provide a 'chronological marker' of 480-500 for the manufacture of Finglesham D3 [1]. The use of continental dating evidence is discussed further in the next chapter.

- He accepted Dickinson's observation (no reference given) that

the absence from ... graves [containing SHBs] of any conventionally dated fifth or seventh century material strongly suggests that [these] burials must have taken place well within the bounds of the [sixth] century.

(quotation from Leigh, 1980: 474)

This observation relies entirely on scholars' judgments that certain other classes of artefact can reliably be dated to the adjacent centuries.

Also, despite the low value he put on Continental associations for precise dating, Leigh

did use one such chain of associations (1980: 475-7). This began from the Cologne princess's grave (Doppelfeld, 1964; Werner, 1964) which contained a coin of Athalaric, AD 526-34; accepted the arguments based on this burial by Neuffer (1972) and Haseloff (1974) for dating a burial at Donzdorf to between 500 and 520/5; and then argued on stylistic grounds from that grave's goods for a date of 510-530 for the Kentish SHBs Dover 1 and Howletts 2. Leigh did enter large caveats about this chain of argument when first deploying it (1980: 476), but then described 510-530 for these two brooches as a 'chronological marker' (1980: 477), and later narrowed it to 'around 530' (1980: 483). This chain of associations would appear to deserve his own condemnation as 'too long and too weak'.

Chronologies

Non-Kentish brooches

Leigh refrained from drawing any chronological conclusions from his seriation of motifs analysis alone, except that the overall trend of the results was quite similar to Leeds' ordering of his groups. However, it is worth listing the three ideas which Leigh mentioned as arising from this procedure and for which he provided other evidence later in the thesis:

- that some SHBs might have been produced in England before the pieces which Leigh (following Haseloff, 1974) labelled 'Jutlandic' were imported into Kent (though not before those pieces were manufactured). This was suggested by the fact that, in the re-ordering by seriation of motifs, group A3 opened the sequence (1980: 49; cf. pp.302, 308, 503);
- that Herpes 2 [83] and Sarre 159 [84], placed by Leeds at the beginning of group B4 and early in the entire sequence, might be considerably later (1980: 49-50; cf. pp.13, 434, 482);
- that 'the time-span of the latest [non-Kentish] brooch sequence was not as long as Leeds thought' (1980: 47; cf. p.481).

From the brief application of stylistic analysis to the chronology of his non-Kentish corpus Leigh concluded only that Leeds' group B1 (the earliest non-Kentish GSHBs with divided foot) should be placed somewhat later than in Leeds' chronology. However, in

combination with other evidence this later enabled him to claim that all the earlier SHBs in England had undivided foot, that the divided foot arrived considerably later (despite both forms being current throughout in Scandinavia) and perhaps simultaneously in Kent and the rest of England, and that almost all later SHBs in England had divided foot (Leigh 1980: 503, with his Figures 86 and 88).

Kentish brooches

From the first of the two computer methods he used with Kentish SHBs Leigh concluded only that the similarity groupings produced 'bear relation with the arrangement of brooches as I now have them' (Leigh, 1980: 566) from the principal, manual method, and that these groupings showed an acceptable level of agreement with the results of the second computer method.

Leigh stated that the two Figures resulting from the second method showed

a kind of seriation, ... though differing in important respects from that proposed in the body of this thesis... Th[is] seriation progresses in a clockwise direction, beginning with the Jutlandic brooches but at least one other sequence occurs in parallel.
(Leigh, 1980: 566)

Some of this can be interpreted in relation to Leigh's Figures. They both have several Jutlandic brooches near the top left, and a roughly circular sequence could be read off clockwise from each of them.

However, in both Figures Herpes 2 [83] and Sarre 159 [84] appear early, in contradiction to Leigh's main analysis (1980: 13, 49-50, 434, 482). Moreover, only in one Figure is there is any trace of 'the other sequence [which] occurs in parallel', and this seems rather to form a tangent to the main sequence. And the fact that in both Figures the sequence is circular leaves it without a clear beginning or end. Leigh himself set no store by these results, and there is no reason to disagree.

Leigh's chronological conclusions therefore arose principally from his stylistic analysis of

the Kentish corpus. He summed up the results in his Figure 86. In this he represented all but one (Suffolk 1 [13]) of the 99 brooches in his corpus by his abbreviated reference for it, and 85 of the 86 definitely Kentish SHBs also by a drawing (the exception being Preures 65), and put them all into a broad sequence. Leigh's Figure 86 is adapted here as Figure 6.2. In that Figure, brooch names are given rather than drawings or Leigh's abbreviations. The line marking the change from undivided to divided foot is reproduced from the original, but the absolute dates and the identification of the Jutlandic group are deduced from Leigh's text. Because of confusion surrounding them (cf. section 3.2), no attempt has been made to indicate Leigh's putative artisan groups. It would also be impossible to represent here Leigh's belief that the Jutlandic brooches were all made in southern Scandinavia and imported to England, presumably by their migrating owners.

It is evident that Leigh came to believe that he knew the brooches so minutely that he felt he could place them, not only in Series, but in sequence both within and across Series.

His broad sequence may be wholly or largely correct, as may his overall date-bracket of 480-560 for the manufacture of Kentish SHBs. However, in interpreting his voluminous analyses of the artistic and technological features of SHBs, 'the burden of belief is always on the reader', as he himself put it (1980: 65). For this reader the burden of belief proved too heavy to remove doubts about several aspects of Leigh's theories, namely

- his theory that some SHBs might have been produced in England before the Jutlandic pieces were imported - this relies entirely on an argument from silence;
- the dating of the beginning of the Jutlandic group precisely at 480;
- the sequence in the earlier parts of his Series, where he admitted that 'the connecting links are somewhat sparse' (1980: 474; cf. p.13);
- the notion that the manufacture of Series III began recognisably later than not only the Jutlandic group but even the indigenous members of Series I and II;
- the attempt to deduce an absolute date for Howletts 2 and Dover 1;
- his arguments for placing Leeds' group B1 later than Leeds had, and therefore for an abrupt and almost total change from undivided to divided foot;
- the date of the end of SHBs, on which he gave only stylistic arguments (1980: 423, 482).

Figure 6.2: Schema of Leigh's chronology of Kentish SHBs

480	Undivided foot		Divided foot		560
OTHER 'KENTISH' BROOCHES					
Gilton 48	Faversham 3 Barrington 1 Faversham 5	Chessell Down 6 Stodmarsh 1-2 Chatham Lines 1	Bifrons 2	Kent 1 Stowting 3 Mucking 102	
SERIES III					
		Alfriston 47 Chessell Down 8 Chessell Down 12 Ickham 1 Sarre 1 Bifrons 4 High Down 1 Mucking 99	Lyminge 60 Howletts 23 Herpes 7 Stowting 1 Barrington 2 Chessell Down 9 Howletts 1 High Down 2-1 Mucking 99	Sarre 2 Lyminge 39 High Down 2-2 Bifrons 3 Chatham Lines 2 Preures 65 Chessell Down 11 Howletts 21 Chatham Lines 6 Faversham 2 Droxford 1 Bifrons 1	
SERIES II					
	Stodmarsh 1-1 Dover 20-1 Goldstone 1 (Richborough) Kent 2 Bifrons 64	Finglesham E2-2 Herpes 1 Herpes 3 Kent 3 Howletts3 Chessell Down 4	Chatham Lines 18 Herpes 6 Faversham 4 Eastry 1 Herpes 5 Bekesbourne 30 Mucking 843 Herpes 9	Howletts 12 Chessell Down 10 Mersham 1 Chessell Down 5 Bifrons 51 Bifrons 41-2 Unknown site 1 Faversham 1 Herpes 8 Chessell Down 7 Chessell Down 40 Chessell Down 55	
SERIES I					
Canterbury 1	Chessell Down 22 Milton 1	Sarre 4-1 Howletts 2	Finglesham E2-1	Howletts 17 Lyminge 44 Bifrons 42 Howletts 7 Hythe 1 Sarre 4-2 Gilton 1 Howletts 18	Herpes 2 Sarre 159
Finglesham D3	Bifrons 63	Chessell Down 45			Stowting 2/9
Bifrons 41-1		Dover 1			
480	500	510	530	540?	560

Source: Leigh (1980: Figure 86)

For the time being, therefore, both Leigh's chronological conclusions and the way he arrived at them can be given only qualified assent. As he himself put it,

any attempt to draw far-reaching conclusions on the basis of one, poorly represented class of Kentish metalwork ... can only be undertaken in a most tentative manner. Any chronology propounded by me must be viewed as little more than a stop-gap.
(Leigh, 1980: 441)

6.4 Hines' chronology of GSHBs

Method

In general, Hines (1984: 176-80) used the features he categorised as 'equivalent' to put his 22 brooch groups into four broadly contemporary sets arranged in three phases in a honeycomb matrix; and then used the 'related' features, and/or what he deduced were developments in equivalent features, to determine the sequence of the sets of contemporary groups. He next checked his sequence against the (admittedly very sparse) evidence for relative chronology provided by find associations in England (1984: 180-2): this resulted only in the negative conclusion that there was nothing against his sequence. Finally, he checked his sequence against the much more plentiful evidence of European, principally Scandinavian, analogies (1984: 184-97, especially 188-9, 193-4 and 196-7) to arrive at suggested absolute dates. In particular, following Haseloff (1981: 540-673) and in contrast to Leigh, Hines (1984: 30-2) used Continental coin-dating as well as stylistic arguments for dating the end of Style I and therefore of GSHBs (though on this see the following chapter).

In setting up his chronology he too was aware (1984: 181) of the danger of circular argument, and in drawing on continental and Scandinavian parallels used hardly any brooches other than the equivalents of GSHBs: those brooches had not been dated by reference to GSHBs.

Certain oddities about Hines' procedure should be noted:

- He subdivided some of his groups (I, II, III, IV, XXII) between rows of his matrix. These were in all cases groups in which he had distinguished chronological subgroups;

- Hines assigned positions within his matrix to two 'enigmatic' brooches (Chessell Down 6 [6] and Empingham I) which he had been unable to assign to groups. Most other unclassified brooches were not included in the matrix even when Hines had discussed where they stood in relation to the main groups;
- in particular, in the text, though not in the matrix, Hines effectively made a fifth row out of two other brooches (Thornborough [122] and Ruskington) which he had been unable to assign to groups. He described these two brooches as a latest subphase of his phase 3. The justification was that only these two of all the GSHBs in Hines' corpus showed evidence of the 'interlace' stylistic development that comes so late in Salin's Style I that Haseloff (1981: 222-30) had actually re-designated it as very early Style II;
- for several groups Hines did not discuss any evidence from related features;
- there seems to be a possibility that chronological considerations may have influenced Hines' definition and identification of equivalent and related features, and some of his decisions about boundaries between groups;
- as with other classifiers, the acceptability of his chronological judgments relies heavily on acceptance of his stylistic insights.

The last two points require more extended explanation.

As quoted in chapter 3, Hines (1984: 113) defined equivalent and related features as grades of decorative similarity. However, he went on to say that

Two or more brooches sharing an equivalent feature have to be regarded as chronologically "contiguous", or broadly contemporary, (1984: 116)

and that

The occurrence of related features on different brooches is potentially a key element in determining their relative chronology. (1984: 116)

This is close to saying that by definition equivalent elements are contemporary and related elements are not: there is therefore the risk that Hines may have classified some features as equivalent because he thought the brooches exhibiting them were contemporary.

Similarly, he said:

The separability of ... groups [IV, IX and XV] is argued to reflect clear stages in the typological and chronological development of these brooches,
(1984: 115)

which is close to admitting that his view of their chronological sequence led him to keep these groups separate, rather than any great difference in their characteristics.

More deeply still, Hines' uncovering of the equivalent and related features and their chronological implications relies heavily on assertion about his insights into them. A few phrases characteristic of his argument (1984: 119-64) are: 'probably earlier', 'cannot be divided', 'relatively late', 'must be reckoned broadly contemporary', 'seem to represent the earliest form', 'looks to be later', 'chronologically close', 'imply that it is a later form', 'may therefore appear to be broadly contemporary developments in craft and taste', 'clearly coarser copies of the prototype', 'carries an ancestral form of [a feature]', 'aligns chronologically with', 'could be an indication of a later stage', 'must be chronologically contiguous with', 'would appear to belong in the same horizon as'.

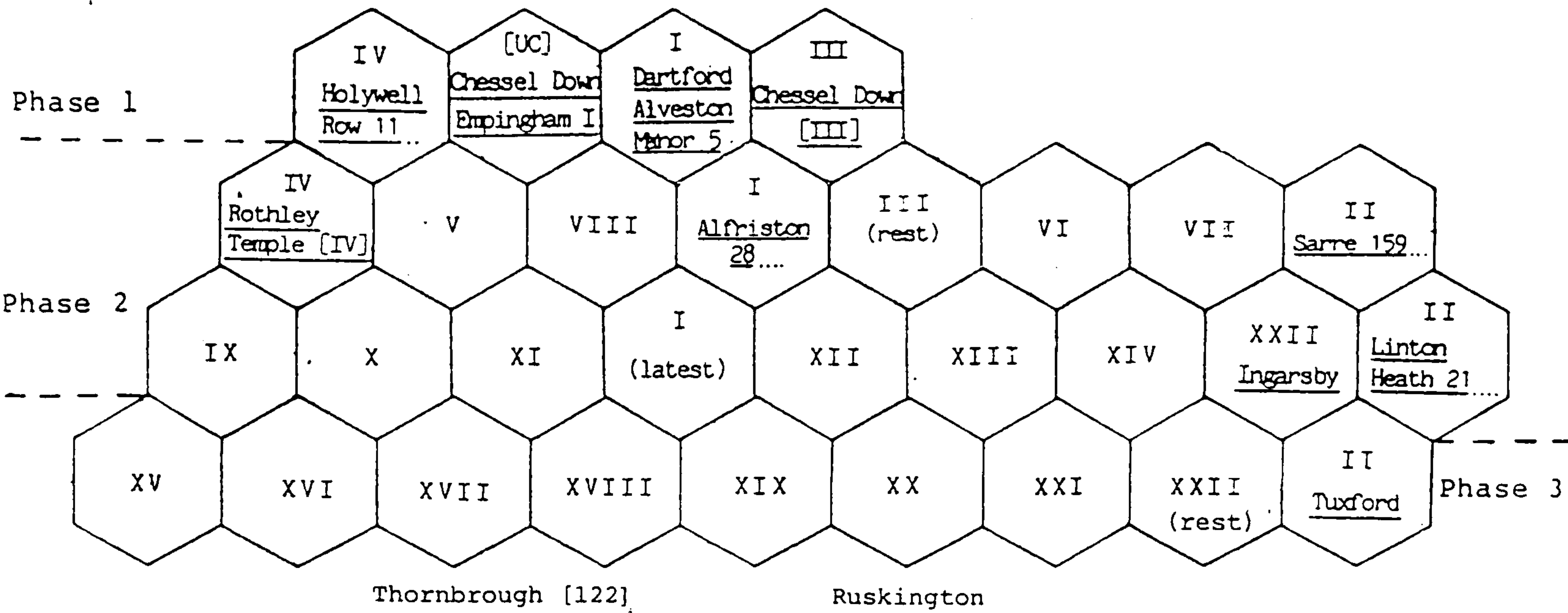
Essentially, therefore, Hines' method of deducing a chronology was as subjective as Leeds' and Leigh's - as distinct from his method of arriving at a classification, which did incorporate a quantitative element.

Chronology

Hines' investigation of chronology resulted (1984: 180) in the matrix reproduced here (slightly modified) as Figure 6.3. The modifications are:

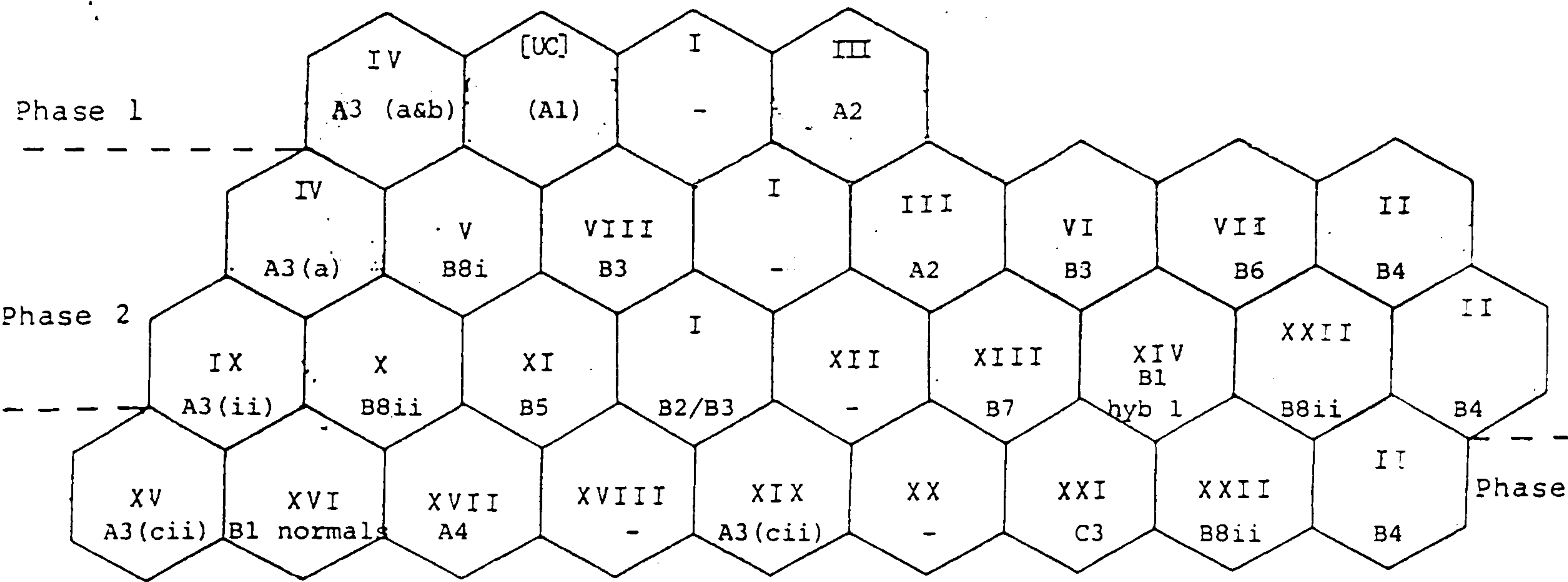
- the word 'rest', omitted in the original, has been added to the lower of the two cells containing group XXII;
- the fifth row consisting of Thornborough [122] and Ruskington has been made explicit;
- the absolute dates Hines arrived at for the three phases (1984: 197) have been added.

Figure 6.3: Hines' chronological matrix of GSHBs



Source: Hines (1984: 180), slightly modified

Figure 6.4: Superimposition of Leeds' groups on Hines' matrix



Source: Adapted from Hines (1984: 180) and Figure 6.1 above

As Figure 6.3 shows, the first and last rows of the matrix were designated by Hines as phases 1 and 3 of the development of GSHBs, while the middle two rows were designated as phase 2. (He offered no explanation for designating two rows of the matrix as phase 2, when the other two phases consisted of one row each.)

Hines' classification covered much of the same material as Leeds', and was based on broadly the same decorative features of GSHBs as Leeds' had been. It was shown in section 2.6 that because of this there was a high level of correspondence between Leeds' and Hines' groups. Despite this, they arrived at substantially different chronologies. The discrepancies in the sequencing of the groups can be deduced from Figure 6.4, in which the nearest equivalents among Leeds' groups to Hines' groups have (wherever possible) been indicated within a version of Hines' matrix. Relative to Figure 6.1, it can be seen that many of Leeds' groups have been shuffled, stretched or compressed. This further highlights the subjectivity of the allocation of stylistic features to positions in a sequence.

Hines' dates of c.500 and c.570 for the emergence and disappearance of GSHBs respectively corresponded very closely with those already suggested by Leigh, given that both authors considered that SHBs had both come into and gone out of use slightly later in the rest of England than in Kent. This congruence is, however, entirely unsurprising since both relied explicitly on Haseloff's estimated dates for the emergence and disappearance of Style I.

Hines (1984: 111) also agreed with Leigh that Leeds had placed group B1 too early. Hines' argument was based on interpreting non-zoomorphic bichrome ornament as late in the sequence. But Hines (1984: 194) considered Herpes 2 [83] and Sarre 159 [84] to be relatively early, whereas Leigh (in his main analysis) had placed them late. Whether agreeing or not, both reveal their reliance on subjective judgment.

As with Leigh, therefore, so with Hines. His broad phasing may be wholly or largely correct, as may his overall date-bracket of 500-570 for the manufacture of non-Kentish GSHBs. But the allocation of groups and subgroups to phases, and the (admittedly

tentative) absolute dates attached to the phases, do not wholly convince, because of the subjective manner in which they were arrived at. Given these doubts, it is best to adopt the same degree of reservation towards Hines' chronology and the way he arrived at it as towards Leigh's.

6.5 Conclusions

It is clear that neither Åberg's nor Leeds' chronology has stood the test of time. Leigh's and Hines' are too recent for that test to be relevant to them. The fact that their overall date-brackets for SHBs agree provides them with no confirmation, since they are both dependent on the same external authority. They may be correct in outline, and even in some details, but the essentially subjective manner in which they were arrived at makes it legitimate to withhold assent, at least for the present.

Therefore none of the previous chronologies based on classifications of SHBs seems convincing enough to be considered reliable despite a lack of rigour in the construction of the underlying classifications and/or of the chronologies themselves. However, the analysis, particularly of Leigh's approach, has provided a considerable amount of ground-clearing which will be useful in any attempt to devise a sounder method of constructing chronologies.

Chapter 7: Mutual validation of existing chronologies

7.1 The danger of circular argument

This chapter examines the third defence of existing chronologies based on classifications of SHBs, namely that they have been validated by their congruence with those based on other types of metalwork, and by their congruence with continental chronologies. If chronologies for the fifth and sixth centuries based on different types of metalwork are to confirm each other validly, it is extremely important that each is arrived at independently, so that circular arguments are avoided. This chapter will show that this pitfall has not only not been avoided, but fallen into at almost every opportunity; and that no greater reliance can be placed on continental chronologies.

The danger of circular argument was recognised by Hines (1984: 181) and particularly clearly by Leigh (1980: e.g. p.36). While discussing the relative chronology of Kentish SHBs, Leigh (1980: 440-1, 451, 453 (twice), 455 (twice), 461-2, 564-5) drew attention to several instances where dating them by association would be unreliable because the associated objects might be datable only by their association with the SHB in question; in some cases the associated objects already had been dated by reference to Leeds' dating.

7.2 Relative dating

The analysis in this section is concerned with relative chronology, that is with whether or not co-occurrences of different types of metalwork in closed grave assemblages are compatible with the positions of the various artefacts in their separately sequenced classifications. The next section takes up the question of absolute dating.

It is very rare for the relative chronologies of different types of Anglo-Saxon metalwork to produce contradictions - but the reasons for this are not far to seek. First, the quantity of reliable closed finds in England is small; in the previous chapter it was pointed out that Leeds, Leigh and Hines all drew attention to this. Secondly, the relative chronologies all appear to be interdependent. This point will require extensive demonstration.

All relative dating of Anglo-Saxon metalwork depends ultimately on Salin's (1904) classification of Germanic metalwork into the three broad categories which he labelled Styles I, II and III, and on his demonstration that these Styles were not merely artistic varieties but a developmental sequence. That typology *has* stood the test of time, in that it still provides the framework within which archaeologists strive to produce more finely differentiated, and dated, classifications of particular artefact-types. For instance, given the unanimous view of archaeologists that SHBs in England are decorated almost exclusively in Style I, any attempted sequencing of this type must fall within the relative-chronological period of that Style (whatever absolute dates scholars attempt to attach to Style I overall and to groups within their sequences by other means).

However, it is noticeable that Salin's remains almost the only overall study of brooch types throughout Europe: since 1904 archaeologists have tended to specialise on one brooch type and/or geographical area, and to build on their predecessors' work, assuming that its chronological foundations are firm.

Åberg (1926) produced the first influential classifications based solely on the English material. He studied the English finds of a number of brooch types, but his principal work was on one, the cruciform. He concluded that cruciform brooches found in Kent formed one group, while those found north of the Thames fell into five. He set these latter five groups into a (mainly) chronological sequence that developed from the earliest and least elaborate brooches (which had parallels in Scandinavia and on the Continent) to the latest and most ornate (which had no such parallels).

Åberg's typology (sequenced classification) of cruciform brooches has been very influential in England. It has been used not only as a primary dating scale in its own right, but also to set up chronologies of other brooch types which have subsequently themselves been used as supposedly independent dating sources. For instance, Leeds (1945) published a comprehensive survey of small-long brooches together with a classification of them into seven major groups, several of which showed considerable independent development (e.g. group 2: the cross-potent and its derivatives). He resorted to three

strategies to date his groups: first, comparison with similar or prototype continental examples; second, cross-dating within the corpus of small-long brooches; third, associations with the cruciform brooches classified by Åberg. The first two methods yielded little useful material. Continental associations were either absent or limited in number and provided little more than a rough starting point for the chronology. Cross-dating the small-long brooches that had been buried together produced even less of value, because graves with more than one small-long brooch were rare. Only associations between the small-long and cruciform brooches proved fruitful for chronological purposes: the square-headed group of small-long brooches were found with group 2 cruciform brooches, and the trefoil, cross-pattee and cross-potent types, plus the derivatives of the cross-potent, with cruciform groups 3, 4 and 5.

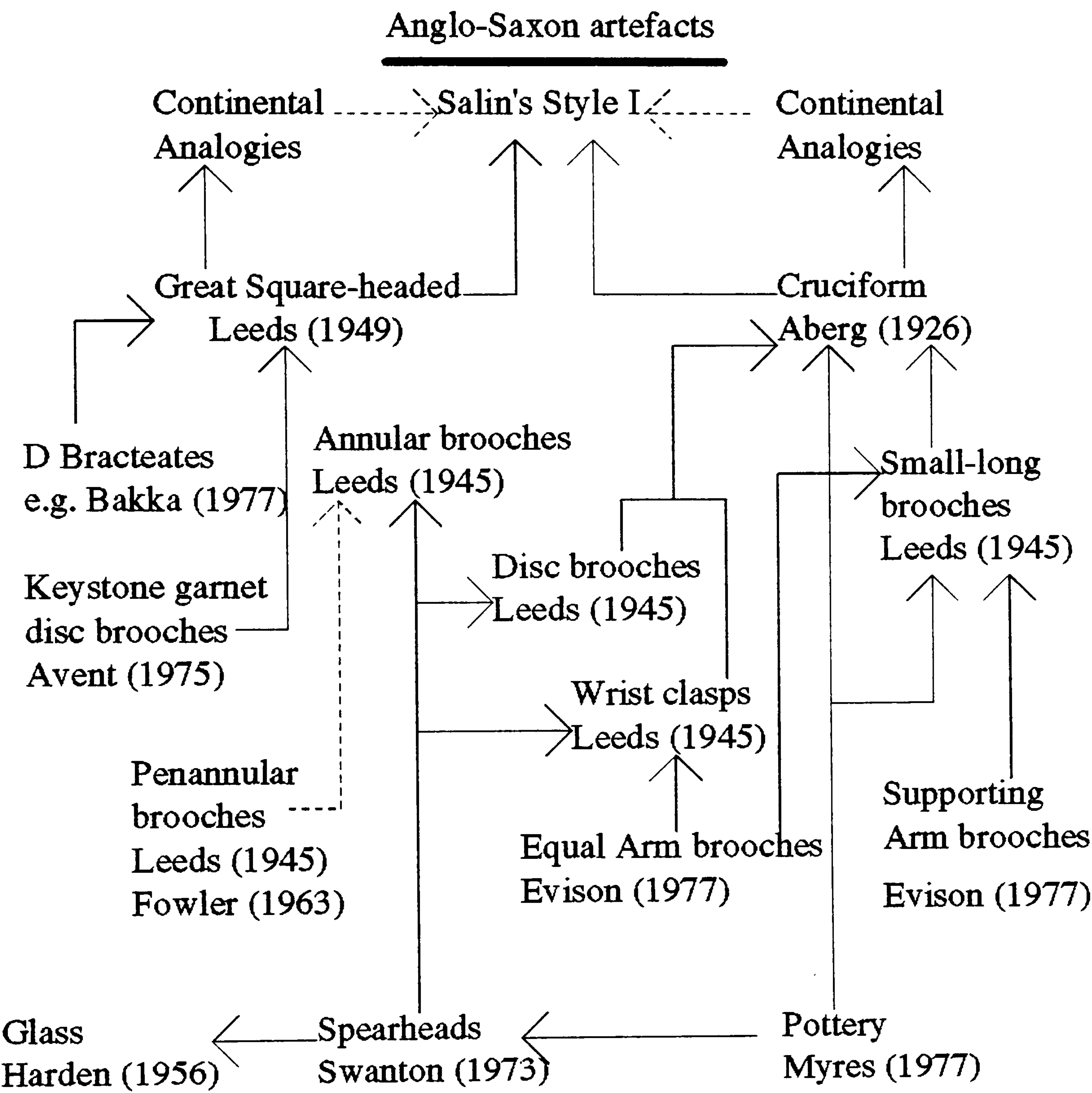
By similar methods, Leeds (1945) also produced chronologies for annular, penannular and disc brooches and wrist clasps. Thus the dating of these artefacts is also dependent upon Åberg; and the tendency to hitch one dating scale to another has continued, to the point where they hang in clusters. For example, in one complicated nest of dependencies Swanton (1973) derived the dating of various groups of spearheads as follows:

spearhead groups A, B, C1, C2, D3, H2	from small-long brooches
spearhead groups G1, C1	from disc brooches
spearhead group H2	from annular brooches and wrist clasps.

Many other classifications and chronologies can be linked to Åberg (1926) in this way by tracing their authors' references and indebtedness to previous classifiers: see Figure 7.1.

The interdependence of chronologies can sometimes defeat the best efforts of later classifiers to start afresh. For instance, Avent (1975) produced a new classification of Kentish garnet disc brooches. A less complete collection had been classified and dated by Leeds in 1936. When Avent revised Leeds' typology he followed a different approach and arrived at a substantially altered classification. Despite this his dating remained

Figure 7.1 : Interdependence of chronologies of early



remarkably similar to Leeds', particularly at the beginning and the end - principally because both classifications had relied on the same dating associations (Leeds covertly and Avent explicitly) and the dating for these had not changed.

However, there is one important class of Anglo-Saxon metalwork whose dating cannot be traced back entirely to Åberg, and that is precisely the SHB. It is true that Leeds' identification of his class C, the square-headed/cruciform hybrids, as late in the sequence was partly dependent on Åberg's dating of his group V cruciforms. However, in constructing his chronology Leeds largely diverged from the practice of dating his classification by reference to English grave associations (mainly because there were so few), and chose to rely instead on the stylistic developments and dating scales already assigned to continental brooches related to the SHB. This made the derivation of his relative time-scale largely independent of Åberg's, though still contained within Salin's overall scheme.

Just as with cruciform brooches, the chronology of SHBs has been used to date other artefacts - see again Figure 7.1. For example:

As the square-headed brooch appears to have been introduced into east Kent in the last quarter of the fifth century (Haseloff, 1974: 13-14) such an adaptation of this design in the miniature saucer brooch might well take place in the late fifth century or early sixth century.
(Welch, 1983: 54)

In one particularly complicated instance, both Åberg (1926) and Leeds (1949) were used. Dickinson (1979) cited 39 examples of early Anglo-Saxon disc brooches found in graves with datable associations, of which 17 were metalwork. Of these, six were dated by reference to GSHBs, one by a cruciform brooch, and two by a chronology which was dependent on both of these.

Thus archaeologists who have studied Anglo-Saxon metalwork have remained dependent to a large degree on Åberg (1926) and Leeds (1949). In the absence of independently confirming evidence, this means that the structure hangs largely on the judgement of these authors. Leeds' chronology has been shown to be thoroughly unreliable (see Leigh, 1980:

28-33; Hines, 1984: 110-1; and section 6.2 above). This does not directly affect those chronologies dependent instead on Åberg's, and it is logically possible that Åberg got it completely right first time. However, it has already been mentioned that his absolute dates for the beginning and end of brooches with downward-biting animal heads have been substantially revised, and it is therefore highly probable that Åberg's relative chronology is also in need of revision. Indeed, strains are becoming evident in datings dependent ultimately on his. Two examples must suffice.

Hills noted a small example. In two overlapping graves at Spong Hill, the chronology was confused because

the most straightforward stratigraphical relationship ... is apparently reversed by the typological sequence of their shield bosses.
(Hills et al, 1984: 15)

It could be that one object was an heirloom manufactured earlier than the other but buried later. But alternatively and more seriously it could indicate that the sequence deduced from art-historical considerations and embodied in the existing typology is wrong.

A more substantial example can be inferred from Leigh (1980: 461-72). Having established his own sequence for Kentish SHBs, he examined their grave associations. Some of these involved garnet disc brooches, which had been classified and sequenced by Avent (1975). However, the two sequences could not both be correct, because that was incompatible with the grave associations. Naturally preferring his own sequence, Leigh offered a solution which involved unpicking and re-arranging Avent's.

The analysis in this section does not necessarily show that the largely congruent relative chronologies of Anglo-Saxon metalwork are wrong. What it does show is that it would be unsafe to rely on them, and that they should preferably be re-examined *ab initio*.

7.3 Absolute dating and the *adventus Saxonum*

Even if the congruence of relative chronologies were reliable, there would still be a problem with the absolute chronologies attached to them, namely a dislocation between

those based on the assumption that the *adventus Saxonum* was a clear-cut event which occurred about 450, and those based on the possibility that Anglo-Saxon settlement had begun considerably earlier.

The traditional date for the *adventus* is AD 449. Historians have known for a considerable time how this date was arrived at. In his *De excidio Britonum*, written about 540, Gildas mentioned an appeal by the British, under attack by Picts and Scots, to 'Agitius, three times consul' (chapter 20). The appeal went unheeded, and some time later in Gildas' narrative, as part of measures for their defence, the British invited in 'three keels' of Saxons (chapter 23).

No person named Agitius is known from any other source. Many later historians, beginning with Bede, therefore assumed that this was a (corrupt or dialect) form of the name 'Aëtius', since a military leader of that name is known from other sources to have been active in Gaul in the 440s, and to have been consul for the third time in 446, and for the fourth time in 454. The identification of Agitius with Aëtius gave a date-bracket for the appeal to him of 446-453, and the coming of the three keels was assumed to have taken place soon afterwards, even though this meant compressing or ignoring the apparently long series of events which Gildas had placed between them.

At some point, an early chronicler (whether Bede himself or one who copied much of Bede's early narrative into the *Anglo-Saxon Chronicle* is unclear) ascribed the appeal to Aëtius and the coming of the Saxons to consecutive Olympiads (the periods of four years defined by occurrences of the Olympic Games). The eight-year date-bracket for the appeal to Aëtius overlapped three Olympiads (445-8, 449-52, 453-6), but the chronicle form constrained the writer to choose just one, and he chose the first. The *adventus* then fell into the next. At a further stage, AD dates were added to or substituted for the dating by Olympiads. But AD dates required events to be ascribed even more narrowly, to single years. The appeal was therefore attributed to 446, the earliest possible year, and the *adventus* to the first year in its Olympiad, 449.

It is therefore clear that between Gildas' outline narrative and the fixing of a precise date for the *adventus* there occurred, over several centuries, a process of over-simplification and of building on possibly unreliable assumptions. Moreover, the date chosen involved ignoring contradictory evidence, such as the entry for AD 441/2 in the document known (from the date of its last entry) as the *Gallic Chronicle of 452*; that entry speaks of Britain having fallen 'into the control of the Saxons' (*in dicionem Saxonum*), when, according to the traditional dating, they had not yet arrived.

One of the unreliable assumptions on which the traditional dating was based was that the *adventus* was a single, precisely datable event - it is clearly much more likely to have been a gradual process. Another unreliable assumption was that Gildas was writing a history, in which events were mentioned in chronological order. But it is clear from internal evidence that Gildas was writing a political tract (Brooks, 1983-4), and that his narrative is not in entirely chronological order (Ward, 1972; Miller, 1975). Perhaps the clearest indication of the latter point is that Gildas (chapter 23) said 'the Saxons ... [were] let into the island to beat back the peoples of the North' (*Saxones ... in insulam ad retundendas aquilonaes gentes intromitterentur*). But in his two previous mentions of the peoples of the North (chapter 20, 2; chapter 21, 1) he said that they had already been successfully beaten back.

Thus the traditional date for the *adventus* is a thoroughly unreliable construct (see also Harrison, 1976; Dumville, 1977). However, in Britain until the 1960s, it was treated as a reliable indication that Anglo-Saxon remains could not be dated earlier than about 450.

Outside Britain, however, there was less attachment to this date. Salin, for instance, deduced from his studies that, although Style I was late in coming to England, relative to the continent and Scandinavia, its arrival could not have been as late as 450. He claimed (Salin, 1904: 144) that early equal-arm and supporting-arm brooch types found in England must imply that Anglo-Saxon settlement had preceded 450 - and that a few examples might even have been late fourth century.

Åberg, on the other hand, considered that there was very little evidence of settlement before 450:

It is not until the latter part of the [fifth] century that Germanic civilisation in England presents itself distinctly in the archaeological material.

(Åberg, 1926: 1)

He did concede the presence of one brooch type, a prototype cruciform brooch, which he dated 'to the time round the year 400' (1926: 14), but he explained it away as 'not giving evidence of real colonisation' (1926: 1). As a consequence, Åberg dated the introduction of group 1 cruciform brooches into England to 'about the middle of the fifth century' (1926: 29), and other types later still.

Leeds (1945) used Åberg's chronology to put absolute dates on his own typology of small-long brooches, and until the 1960s, most British archaeologists, like him, ignored the position taken by Salin, and followed Åberg in accepting the traditional British dating of the *adventus*.

More recently, however, some archaeologists have concluded that to treat 450 as an absolute, clear-cut divide is unreasonable, and have begun to recognise that some types of Anglo-Saxon artefact must be dated earlier. Yet for other types of artefact, classified and dated before this realisation, the earlier chronologies remain in place. This has led to absurdities where the dating of some classifications begins at 450 and others pre-450 but all attempt to co-exist within the same framework. This is becoming more noticeable to discerning archaeologists. In 1984 Hills noted a contradiction in the dating of the inhumation graves from Spong Hill:

A comparison of suggested dates for male and female graves shows an odd situation, in that the male graves seem slightly earlier than the female, although both focus on the sixth century. This might be because work on shields and spears is more recent than work on some types of brooch, and we now allow for an earlier starting date for Anglo-Saxon typological sequences.

(Hills et al, 1984: 15)

Another reason for the discrepancy is the wholesale movement forward, over the years since Salin, of the dating of Style I that is evident from the analysis in the previous chapter (and documented by Speake, 1980). The dislocation between the two groups of chronologies cannot be solved by sliding those which assume an *adventus* of 450 bodily earlier, since then their end-points might be too early; or by stretching them to start earlier but still end where they currently do. The whole system should be re-appraised.

7.4 Dating by Continental associations

Some archaeologists, especially those concentrating on the fifth century, have attempted to by-pass this problem by replacing English chronologies and dating methods with more recent continental chronologies. These go back beyond Åberg's opinion on the thinness of Anglo-Saxon settlement in the earlier fifth century, and revive Salin's view that such settlement must have begun well before 450. They therefore allow the placing of some Anglo-Saxon artefacts earlier than 450, and provide a basis for revised chronologies (e.g. Evison, 1977) in which artefacts found in England are dated fifty, or in some cases even more, years earlier than on the usual English scales. This approach was enthusiastically advocated by Evison (1963, 1965, 1968, 1977), Hawkes (1975), Dickinson (1976) and Welch (1983, 1987, 1992); also by Ager (1985, 1987) with reservations. It was shown in the previous chapter that both Leigh and Hines used recent continental scholarship in dating SHBs.

Perhaps the strongest advocate of this approach was Myres, who claimed that

a vast interlocking chronological network has been built up by continental scholars for dating the typological sequences of many sorts of products. While differences of opinion may persist on the position of any particular object in its appropriate sequence, and while the grounds for giving it a rough date may often appear flimsy, yet the main chronological framework is now so extensive and so firmly established that it is most unlikely to be overturned, or even to be shifted as a whole either forward or backward by an appreciable period of time.

(1986: 25)

Those who adopted this strategy were greatly aided by the work of Böhme and Haseloff.

Böhme's chronology

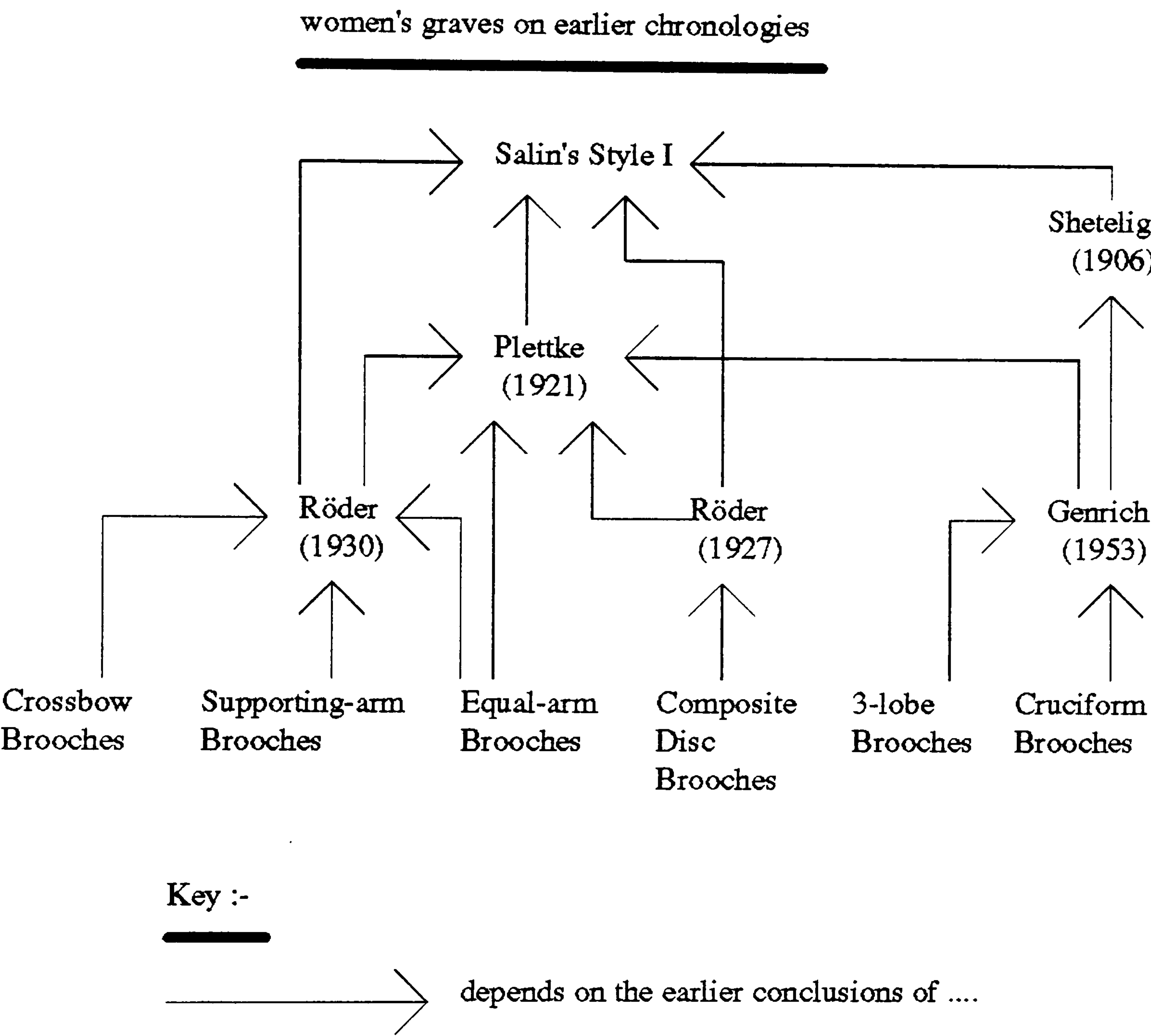
Böhme (1974) produced what seemed like an independent chronology which was based on large numbers of graves from many cemeteries and which stretched from the late Roman through to the early migration period. He had studied Germanic grave-finds of the fourth and fifth centuries between the lower Elbe and the Loire, and the main value of his work lay in the revised classifications he set up (e.g. for *Armbrustfibeln* and for supporting-arm and applied brooches). The importance of his chronology for Britain was that it covered the period within which the end of Roman Britain fell, and might therefore assist the dating of the *adventus*.

However, Böhme experienced problems in setting up his chronology. He explained (1974: 151) the difficulties in using as dating material the graves in his series which contained coins. There were very few of them, and some of those which contained metalwork normally assigned to the fourth century also contained second-century coins. Even those which contained late fourth- and very early fifth-century coins provided no more than a vague *terminus post quem* in what seems to have been a non-coin-using society (Werner, 1935: 21). The Gallic mints all ceased production by 406 at the latest, and the very few slightly later issues that can be reliably dated (those of the pretenders Constantine III, 407-11, and Jovinus, 411-3) are found in only a handful of graves and in a restricted area (the former Roman province of Belgica). The graves in what Böhme, on stylistic grounds, called his Phase III contained no coins - but this need not automatically mean that they were later than those of his Phases II or even I. Even if definitely later, there was no saying how much later.

Therefore, when it came to dating his material Böhme largely relied on earlier work - see Figure 7.2. In fact, his text is studded with references to the opinions of previous scholars on the dating of various classes of metalwork. Such opinions are therefore part of the generally accepted continental framework which ultimately derives from Salin (see above). Böhme did attempt to validate his metalwork chronologies by comparing them with the dates given to pottery items found as associated grave-goods. The pottery dating scales were those set up by Plettke (1921), and it has been claimed (e.g. by Hawkes, 1975:

334) that Böhme had thereby confirmed both his own and Plettke's chronologies by showing that they were in close agreement.

Figure 7.2: Dependence of Böhme's chronology of brooches from



This result is less surprising when it is realised that Plettke's datings were also dependent on Salin. Plettke had no independent method of dating his pottery and used grave-associations to calibrate his chronologies with the scales already set up for equal-arm brooches by Salin (1894) and for cruciform brooches by Salin (1904) and Shetelig (1906) - and Shetelig in his turn had also based his chronology on Salin's. Therefore it seems premature to claim that Böhme had independently validated Plettke, and wiser to recognise that Böhme's chronologies also depend ultimately on Salin's judgement.

Moreover, there was a dislocation at the heart of Böhme's chronologies. In the grave-assemblages he studied, the most significant women's and men's grave-goods were brooches and belt-fittings respectively. Böhme first considered the two series of graves separately and set up separate time-charts for them, each with three phases, as follows:

[Women's graves]

Phase I first half - last third of fourth century

Phase II last third of fourth century - beginning of fifth century

Phase III first half - last third of fifth century

(Böhme, 1974: 34)

[Men's graves]

Phase I c.350-400

Phase II c.380-420

Phase III c.400-450

(Böhme, 1974: 80-1)

But he himself then pointed out a problem in making this system cohere:

There are difficulties in comparing the two chronological systems, because brooches and large belt-buckles (with insignificant exceptions) do not occur together in graves. A comparison of the two [time-]charts ... shows that the middle phases roughly correspond, while the first phase of women's graves ... begins a generation earlier than that of men's graves. Also, for women's graves the third phase lasts nearly a generation longer than for men's graves.

(Böhme, 1974: 155)

Not finding a motivated solution to these discrepancies, he adopted a compromise, starting his Phase I half-way between the separate dates he had originally suggested for the two series of graves, and giving his Phase III two end-dates:

Phase I (c.330-400 AD)

Phase II (c.380-420 AD)

Phase III (c.400-450 AD or to the end of the fifth century)

(Böhme, 1974: 155)

(Though this problem resembles that found at Spong Hill by Hills et al (1984), it is not necessarily the case that they have a common cause.)

Perhaps partly in response to this problem, Böhme has more recently moved parts of his chronology:

In a recent discussion in March 1987 H. W. Böhme indicated to the present author that he now favours a significantly later dating for his three *Stufen* or phases, with *Stufe* II placed in the first third and *Stufe* III in the middle third of the fifth century.
(Welch, 1987: 382, note 39)

All of this means that Böhme's chronology is much less reliable as a background for very early Anglo-Saxon dating, especially of the *adventus*, than some British scholars purport to find it. In particular, even if the coin-dating were taken more seriously than it deserves, the end of his chronology would have nothing to anchor it, nothing to make it more precise than 'some time within the fifth century'. Since the chip-carved belt-fittings within his material are widely recognised as the immediate inspiration of Nydam Style, and that in turn as the immediate precursor of Style I, the knock-on effects of the imprecision of the end of Böhme's chronology potentially ripple through the whole fifth century, including the dating of the beginning of Style I, most recently studied by Haseloff.

Haseloff's chronology

Haseloff's work was predominantly concerned with Style I. Its culmination was his monumental 1981 book, *Die germanische Tierornamentik der Völkerwanderungszeit: Studien zu Salin's Stil I*. Hines (1984) made copious use of this, and Leigh (1980) of earlier summaries, especially Haseloff (1974). Haseloff's approach was also predominantly stylistic, finding sequence in differences of decoration. For dating he relied partly on his own insights, partly on the opinions of other scholars - both therefore largely art-historical and subjective - and to a minor extent on such objective evidence as coins, which are admittedly rare in graves of the period he was studying. He dealt mainly with continental and Scandinavian material, and references to Anglo-Saxon objects were few. In his lists of objects characteristic of his four 'style phases' within Style I, for instance, Anglo-Saxon items were mentioned only in style phase A (Haseloff, 1981: 174-205).

However, those items included Finglesham D3 [1], Bifrons 41 [3], Gilton 48 [4] and Richborough [5] (Leigh's 'Goldstone Cop Street 1'), all supposedly early SHBs and crucial for the chronology of the whole artefact-type, especially in Kent. Haseloff included all of

these within a subclass of style phase A which he named 'jütländisch' (translated by Leigh as 'Jutlandic' - this is the usage followed here - but by Hines by the potentially confusing 'Jutish'). Haseloff identified the Jutlandic group as the earliest examples of Style I, and both Leigh and Hines relied on his dating of the beginning of that group to date the beginning of the SHBs they studied. Leigh placed the beginning of the manufacture of the Jutlandic group of his Kentish series (that group being a subset of Haseloff's Jutlandic group) at c.480, and both he and Hines therefore placed the beginning of manufacture of SHBs in England at c.500.

However, this was rather more precise than Haseloff intended. He described his date of c.475 for the beginning of (Jutlandic) Style I initially as a 'working hypothesis' (1981: 17), and his main reference to this dating was as follows:

According to my evaluation the transition [from Nydam Style to Style I] must have taken place in the second half of the fifth century. If in addition I have accepted the year 475 as the approximate turning-point, such a number must be taken *cum grano salis* [with a pinch of salt]. In any case I am of the opinion that early Style I existed fully developed in the last decades of the fifth century.
(Haseloff, 1981: 172)

He went on to place the manufacture of Jutlandic Group B, including Finglesham D3 [1], in the years 480-500, and of Group C, including Bifrons 41 [3], in the years 500-520. In the final summary of his findings (1981: 706-10), however, he gave no dates whatever.

Haseloff was therefore much more tentative about this dating than Leigh and Hines. His caution seems justified, since his dating was based solely on feel for the material, and in particular on what length of time might be considered reasonable for the developments within Nydam Style, the precursor of Style I. Great caution needs to be exercised over deriving any fifth-century Anglo-Saxon dates from continental systems because fifth-century continental dates, despite the claims that have been made for them, have not yet been brought into one comprehensive system. In particular, Böhme's chronology and Haseloff's are still unco-ordinated, and attention needs to be given also to the Nydam Style which falls between them and is seen as linking them.

On the end of Style I Haseloff was more definite. He based his reasoning in particular on a brooch-find of his 'continental type'. A pair of brooches found at Klepsau, Baden grave 4 were decorated in a mixture of Style I animal ornament and early Style II interlace, and thus represented, in his opinion, the cusp between the two Styles. They were also reliably associated with a copy of a coin issue of Justinian I, a *solidus* type minted officially between 555 and 565. This association gives a *terminus post quem* of 555 for the coin copy and thus for the grave. Haseloff (1981: 614) argued that the coin copy and the brooches were all very new when buried, and from this deduced a date of manufacture for the Klepsau pair, and for the transition to full Style II, of 'around the turn of the second to third third of the sixth century'. Hines (1984: 30) expressed this as 'c.565'.

However, this date is also too precise. The Klepsau *solidus* copy actually provides a *terminus post quem* of 555 only for the *burial* of the brooches, and there are only stylistic arguments for Haseloff's dating of their *manufacture* to c.565 - on any other grounds they could be up to a few decades earlier or later. Even if the dating of their manufacture is accurate, deducing that the Style I - Style II transitions on the continent and in England were virtually simultaneous may not be wholly reliable. As Hines conceded:

We cannot simply assume [the adoption of Style II] to have been contemporary in all areas... In suggesting ... this ... , one is forced back onto the rather weak argument that there is no sign of the development of the styles anterior to ... Style II (e.g. ... non-zoomorphic interlace, and the bichrome style) any later in ... England than anywhere else.
(Hines, 1984: 31-2)

Thus the framework of continental dates is neither as interlocking nor as fixed as Myres claimed, and the caution that was urged above over the dating of the emergence of Style I needs to be applied also to the dating of its disappearance. As Speake (1980, especially chapter 2) has demonstrated, the date-bracket for the entire Style, in particular for the transition to Style II, has already slid considerably forward this century, and it is not certain that its journey is over yet.

7.5 Conclusions

In the circumstances it seems reasonable to conclude that the mutual validation of Anglo-Saxon chronologies by congruence may be illusory, and that the support claimed for them from continental evidence should be put into abeyance until the continental systems themselves are more firmly established.

Before leaving this topic, however, it is necessary to mention two inferences which are *not* being drawn from this analysis.

(1) Whatever else may be uncertain, whatever else may move around or be revised, Salin's original identification and labelling of the three Styles is not being called into question here. Furthermore, since it is universally accepted that the stylistic development of SHBs (with the slight exceptions noted in earlier chapters) falls entirely within Style I, it is also accepted here that the finer dating of SHBs, whenever it is achieved, will necessarily fall within the wider date limits set for that Style. However, it is also clear that at present those wider date limits are not yet fixed; they provide at best a form of relative-chronological envelope. When a firmer consensus is achieved on the absolute dates for the emergence and disappearance of Style I, and possibly of some significant 'markers' within it, it will be time to try to attach firmer absolute dates to Anglo-Saxon material decorated in that Style.

(2) Also, it is *not* being argued here that the finer relative-chronological details of Leigh's and Hines' chronologies are necessarily wrong; only that they have not yet been proved correct beyond reasonable doubt. But that seems a perfectly logical ground for withholding assent from them, and for seeking a firmer justification.

7.6 Summary of findings and implications of chapters 3 to 7

In the course of the last five chapters, the following conclusions have been reached:

- that no existing classification of SHBs is based on a fully and clearly explained methodology

- that no existing classification of SHBs was arrived at by a fully consistent approach
- that the reliance on stylistic criteria that is central to the method by which all the existing classifications were created renders them all vulnerable to the charge of subjectivity (though Hines' approach is least vulnerable in this regard)
- that the outlines of existing classifications of SHBs are not obvious to students coming fresh to the material
- that older chronologies of SHBs (Åberg, Leeds) have not stood the test of time and are unreliable
- that recent chronologies of SHBs (Leigh, Hines) may be correct in overall timespan and in some details, but as a whole have not been proved correct beyond reasonable doubt
- that the stylistic analysis method by which both older and recent chronologies were largely arrived at is also vulnerable to a charge of subjectivity
- that the congruence of chronologies of SHBs with chronologies of other forms of Anglo-Saxon metalwork is robbed of significance by their lack of independence from them, and
- that their congruence with continental chronologies should not be relied upon for the time being.

From this it seems reasonable to infer that

- existing classifications, not just of SHBs but of all fifth- and sixth-century Anglo-Saxon metalwork, may be unreliable
- reliance on existing chronologies, not just of SHBs but of all fifth- and sixth-century Anglo-Saxon metalwork, should be suspended for the present, and that the entire system (with the exception of the containing of SHBs within Style I) should be re-assessed from first principles.

How to go about that re-assessment is the concern of the remainder of this thesis. Given the mainly dismal list of findings just catalogued, the most reasonable starting-point would seem to be a consideration of how this situation could have come about: this is the subject of the next section.

PART D: HOW DID WE GET HERE?

Chapter 8: Montelius' Legacy

8.1 What is needed

From the findings listed at the end of the previous chapter it can be inferred that what is needed is a theory and methodology of archaeological classification for unsupported chronological purposes that will

- be fully and clearly explained, so that it can be understood, evaluated and if necessary replicated
- be arrived at by an approach that is, as far as possible, implemented consistently
- reduce the element of subjectivity to a minimum
- be clear to both novices and experts
- as far as possible, keep the devising of classifications methodologically distinct from the deriving of chronologies from them
- enable classifications of different artefact-types to be devised independently, so that when chronologies derived from them are compared any congruence between those chronologies is genuine
- be ready for coordination with continental chronologies when they too are reliable
- be based on a re-examination of the topic from first principles, and
- avoid possible sources of error uncovered by an examination of the history of the topic, of how the situation analysed so far has arisen.

This thesis has therefore so far been concerned with standards of scientific enquiry and how far archaeological classifications fulfil those criteria. It has highlighted flaws in the methods used by archaeologists both for constructing classifications and for dating artefacts. If flaws in the methods are so apparent, there must have been what seemed like compelling reasons why archaeologists accepted and implemented them. This section of the thesis seeks to make these reasons clear, not for antiquarian reasons, but in the hope of discovering a new way forward.

8.2 Montelius' method

Montelius (1885, 1903) was the first archaeologist to publish (in addition to practising) a detailed method for sequencing metalwork within periods for which other dating sources are not available. In 1885 he successfully defined six periods within the Scandinavian Bronze Age, which in common with the Bronze Age elsewhere had previously (i.e. since the first published labelling and sequencing of the Three Ages by Thomsen in 1836) appeared undifferentiated. Klindt-Jensen (1975: 91) has stated that

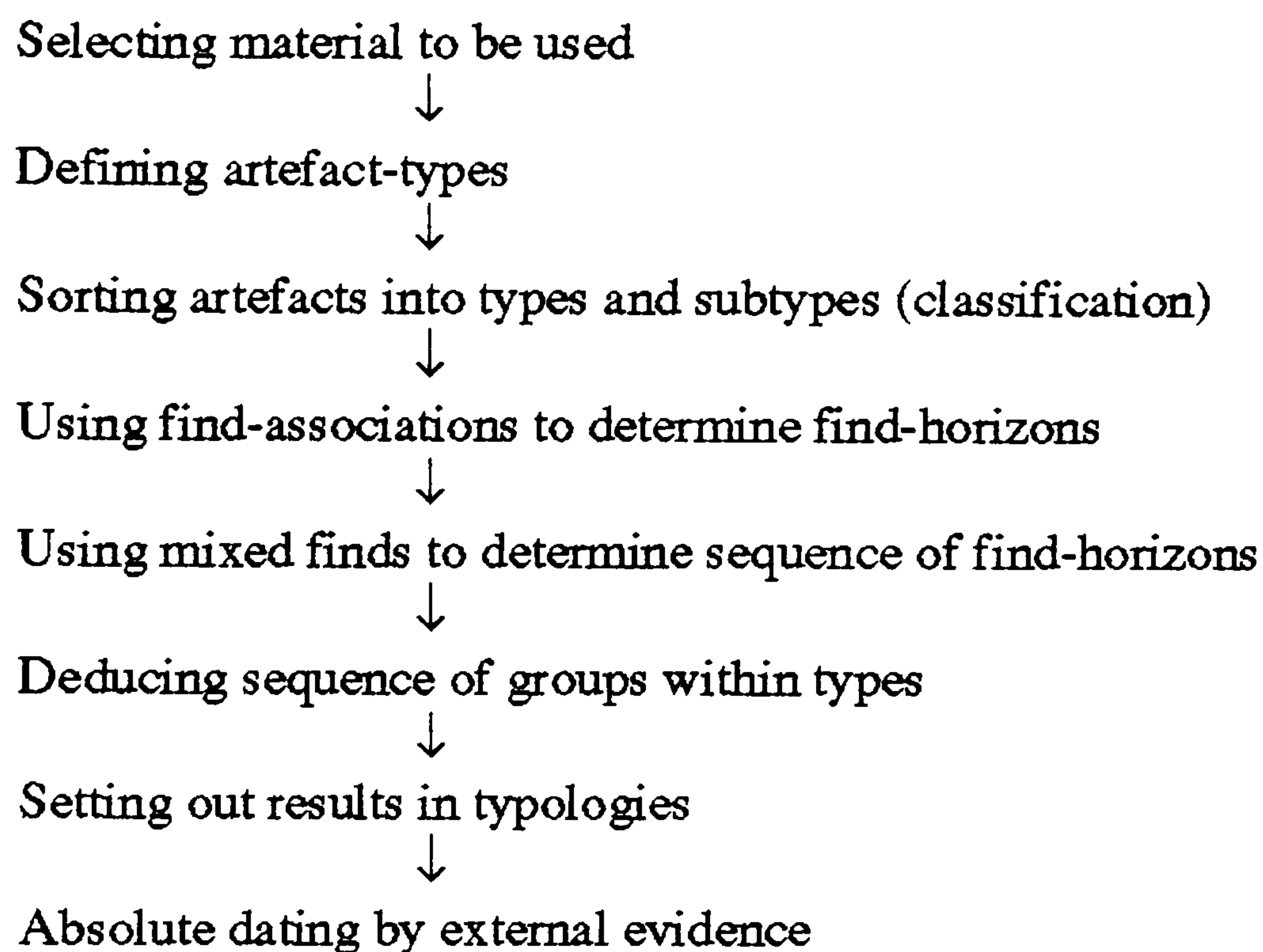
the influence [Montelius] exerted on archaeological research has hardly a parallel among the Scandinavian publications. In a single bold advance it brought this ... long period, previously so vaguely understood, into clear focus.

In 1903 Montelius wrote an account of his method in German in a book called *Die typologische Methode: die älteren Kulturperioden im Orient und in Europa*, and it is this version which popularised his method outside Scandinavia.

In his 1885 book Montelius described his method as 'very simple in principle' (1885/1986: 26), but this was donnish self-deprecation. Montelius had been studying the Bronze Age of the whole of Scandinavia and most of central Europe for over 15 years; his knowledge of the material was unrivalled; his book contained extensive catalogues, illustrations and analyses; and he had applied rigorous principles to the selection of material most likely to yield reliable results.

An outline of Montelius' method may be deduced from his 1885 and 1903 books, and from the commentaries of Gräslund (1986, 1987). It can be considered as consisting of eight stages (see Figure 8.1): selecting the archaeological material to be used; defining artefact-types; sorting the artefacts into the types and into subtypes (groups) within them (classification); using find-associations to determine find-horizons; using mixed finds to determine the sequence of the find-horizons; from that sequence, deducing the sequence of groups within types; setting out the results in typologies; absolute dating by external evidence.

Figure 8.1 Outline of Montelius' method



(1) Selecting the archaeological material to be used

Montelius applied very strict criteria in selecting material for sequencing. In general, only multiple instances of co-occurrences of artefacts within authenticated closed grave finds were to be considered for inclusion in the basic data (1903: 11; cf. 1885/1986: 127). He rejected all single finds, occupation finds that were clearly not deposited at the same time, and single examples of combinations of finds within closed grave assemblages. These high standards were to eliminate, as far as possible, coincidence or chance from affecting the outcome of his procedure:

One find gives only an indication of the contemporaneity of the types belonging to it. It is possible that two objects from different periods have come together by chance.

However, when we meet the same combination of two or more types in *two* finds, the probability that these types really are contemporary increases; and if we find the same types together three or four times it is hardly possible that this could be a coincidence. The higher the number of finds with the same combination, the more confident we can be that we are dealing with objects which were manufactured in the same period.

(Montelius, 1903: 13)

(2) Defining artefact-types

Next, Montelius defined a type as a group of artefacts with similar distinctive characteristics (1903: 14).

(3) Sorting the artefacts into the types and into subtypes (groups) within them (classification)

When the material had been selected and the artefact-types had been defined, the artefacts were sorted into the types and, within the types, into subtypes or groups. His method of classification was based, like every other archaeologist's, on similarity - in this case, principally of form, secondarily of decoration. When first defined, groups were not sequenced: they were 'free-floating' in the way certain dendrochronological sequences have been in recent years.

(4) Using find-associations to determine find-horizons

Next, Montelius deduced a set of find-horizons cutting across all types. The principal evidence used here was co-occurrences within the closed-grave assemblages. This approach yielded a set of horizons, bundles of co-occurrences which effectively defined sets of artefact subtypes which characteristically were found together, and rarely, if at all, with subtypes from other horizons (1885/1986: 42-4). For the Scandinavian Bronze Age this procedure yielded six horizons which Montelius implied, and Gräslund explicitly pointed out, were almost unconnected. Also, these horizons were still, as the groups had been at the end of the previous stage, unsequenced.

(5) Using mixed finds to determine the sequence of the find-horizons

In a further important stage, therefore, Montelius deduced the sequence of his horizons from the few cases of mixed finds, that is assemblages containing objects of two of the horizons. Gräslund (1986: 13) pointed out that in the case of Montelius' Periods 1 and 2 there were (then) *no* mixed finds, and the sequence had to be deduced from the fact that a very few early graves of Period 1 contained objects characteristic of the latest Stone Age. This stage was therefore an early form of seriation, yielding in effect a relative chronology.

(6) From that sequence, deducing the sequence of groups within types

Each type was then examined separately and its groups placed in a sequence deduced from the sequence of horizons (1903: 17; cf. 1885/1986: 26).

(7) Setting out the results in typologies

The subtypes of each type could then be set out in a typology, in the Scandinavian sense of that term, that is, a sequenced classification. Montelius gave each subtype of each artefact a letter (A, B, C, etc) in the order of subtypes within its typology.

(8) Absolute dating by external evidence

Finally, an absolute chronology was devised by using datable imports found within Scandinavian assemblages (1885/1986: 95-115).

A central feature of Montelius' method was its objectivity. The definition of types, the sorting of artefacts into groups within them and the setting up of horizons were all based on forms of evidence that could be publicly demonstrated and illustrated. Another crucial feature was that the determination of stylistic progression within each type was deduced from the sequence established by find associations, and not *vice versa*.

An important factor specific to Montelius' investigation aided its success, namely the combination of a large number of reliable closed finds (342 - see Gräslund, 1986: 12) and a relatively small range of artefact-types (principally, nine). This has meant that both Montelius' relative-chronological 'horizons', which constituted his six Bronze Age periods, and the absolute chronology he based on imports have stood the test of time. The model predicted that no future finds would contradict his conclusions and as recently as 1975 Klindt-Jensen wrote that 'these results are still a fundamental part of the structure of modern archaeology' (1975: 92).

Gräslund pointed out in his introduction to the 1986 translation of Montelius (1885) that this book

was the first large detailed chronological investigation devoted to purely prehistoric material to be based on careful scientific method. (Gräslund, 1986: 7)

Montelius had recognised that art-historical knowledge of the material alone was not enough to convince others, and had therefore produced a methodological framework that was explicit, and aimed to place archaeological dating on a scientific basis. The two most important aspects of this were that only demonstrably reliable evidence was used, and that the relative chronology was deduced from mixed closed finds.

8.3 Criticisms and misunderstandings of Montelius

However, this account of Montelius' method is to some extent a modern reconstruction, largely based on Gräslund's analyses. Montelius' own accounts were less clear, and tended to veer between that given above and a contradictory position, in which

- the order of stages 4-5-6-7 was instead 6-7-4-5
- stages 6 and 7 assumed much greater importance, and were supposedly independent of (the archaeologist's knowledge of) find-associations
- stage 6 consisted of deducing the sequence of subtypes within each type directly from its classification, that is, from 'developments' in its form and/or decoration
- stages 4 and 5 acted only as a check on the sequences thus established.

The flavour of this alternative account can be sensed in these passages:

Firstly, I have defined the most important series of [artefacts] and decorative styles in order to understand the course of development and to see, based on their own criteria, in which order the types follow each other. Then I have gone through the grave-finds and all other finds from the Scandinavian area which may throw light on the date of the particular types. (Montelius, 1885/1986: 26)

The find circumstances ... are definitely relevant to the [dating] question but their importance is not great enough for them to be used alone as the basis for the [time] divisions. (Montelius, 1885/1986: 26)

In this version, Montelius' method attracted criticism even in his own day, especially from Müller (1884, cited in Klindt-Jensen, 1975: 87 and in Gräslund, 1986: 12). Müller was criticising earlier published versions of Montelius' method; his grounds related to, first, the supposed independence of the sequencing (typological) and find-association stages of the model. If archaeologists were to know all the finds well enough to select only those closed-find assemblages that met Montelius' stringent requirements, they would already be well acquainted with the material. In that case, they might well find it impossible to proceed, as Montelius' typology-first model required, as if they did not know the closed-grave assemblages. They could never be sure how far their knowledge of find associations might influence the devising of typologies, thus compromising the supposed independence of the typological stage from that involving find associations.

Gräslund summarised Montelius' reaction to Müller's allegation that the typological and find-association stages were not independent as follows:

In a very defensively written article Montelius in [1884] admitted that in principle Müller's criticism was correct and that he actually worked with both methods in parallel. When Montelius was here for the first and only time criticized for his description of method he admitted that it was pure chance that he presented the typological analysis first and not *vice versa*.

(Gräslund, 1986: 12)

Montelius' words were:

These two investigations should always proceed in parallel.
(Montelius, 1884: 25; quoted in Gräslund, 1987: 88)

Gräslund concluded that:

Undoubtedly, the fact that Montelius had familiarised himself with the find circumstances from the beginning of his chronological work ... contributed to his own difficulty in distinguishing between cause and effect in his chronological lines of thought and in keeping separate the elements of find-combination dating and grading type analogy [typology].

(Gräslund, 1987: 89)

This account would seem to produce a model in which the two methods (typology and find-association) were operated in parallel, and their results were then compared.

However, this still seems not to be the full story. Gräslund (1986: 12) reports a deeper version of Müller's criticism, namely that the published accounts of the method could not be accurate because the method was impossible: facts established by find association could not be reversed by typology, whereas if typology suggested a sequence that contradicted find association then typology would have to give way. Gräslund therefore reports that, logically,

Müller thought that [Montelius'] good results were achieved by setting out from the find context itself, and that the typological seriation ... was largely a later rationalization.
(Gräslund, 1986: 12)

And elsewhere in his introduction to the translation Gräslund states that this was in fact the truth about Montelius' method:

For his successors Montelius's Bronze Age chronology has often come to stand as the incarnation of a lucky use of typological dating methods. This is a misapprehension which can largely be blamed on Montelius's own unclear description of his chronological method. Although in all his works ... Montelius always set out primarily from the find contexts, he loved ... to give the impression that he worked in two stages: firstly a typological analysis and only then using the finds to check that the typological and chronological order was the right one.
(Gräslund, 1986: 11-12; cf. the fuller account in Gräslund, 1987)

Gräslund went on to point out that Montelius' find-association method had actually been sufficient, *alone and without typology*, to arrive at the division of the Scandinavian Bronze Age into six periods; and that the typology prominently presented at the beginning of Montelius (1885) was only a descriptive list, not an analytic procedure - in other words, that it was only a presentation of the conclusions he had arrived at, not of the reasoning behind them.

It seems, therefore, that Montelius was still obscuring the truth when he claimed that he used the two methods in parallel, and that it was pure chance that the typology was presented first. Actually, as already stated, analysis of find associations came first, *or was even used alone*, and the presentation in Montelius (1885) was in reverse order, or even completely misleading. It is noticeable that in Montelius (1903) the find-association stages are described before the typological ones, but that Montelius then describes the

latter as the more important. He therefore carried on working in fact from find-associations, but stating his method as though his results were derived primarily from typological analysis, with find-associations used only as a subordinate check. In so doing, he seems to have set an unfortunate precedent, the effects of which have lasted a century: the brilliance and trustworthiness of his conclusions cast a glow over the misleading statement of method, which some of his successors took at face value and therefore misapplied.

8.4 Montelius' successors

The early Anglo-Saxon period is similar to the Scandinavian Bronze Age in that there is no independent chronology for the artefacts. One important difference is that the early Anglo-Saxon period (the supposedly 'pagan' period of furnished burials) was much shorter than the Scandinavian Bronze Age (about 200 years vs about 1300 years). However, there is an even more important difference between the two periods: the early Anglo-Saxon period has more types of artefact and fewer incontestably closed finds to work with (an estimate of the number of reliable associations for SHBs is given in chapter 13). This made alterations to Montelius' model necessary and inevitable when applied to Anglo-Saxon material. First, it was impossible for Åberg, Leeds and others to operate Montelius' strict rules about the selection of examples from authenticated closed-grave assemblages. Inadequate nineteenth-century excavation and recording techniques meant that this rule had to be relaxed so that any example of the type to be sequenced was included in the exercise - in fact among SHBs single finds predominate. In so doing, one of the safeguards Montelius had incorporated into his method was significantly weakened because there was now no effective check on coincidence or chance affecting the results.

Secondly, the same lack of reliable closed finds meant that the stage of allocating artefacts to 'horizons' by find-association could not fulfil the role in later practice that it had had in Montelius' actual method. Relative chronology all too often became only a minimal negative check on the conclusions drawn from typology.

Correspondingly, reliance on Montelius' typological stage increased. Leeds in particular assumed that the decorative motifs on artefacts 'evolved' from simple to more complex designs over time, and that artefacts could therefore be placed in sequences that showed this development. To this he added his characteristic belief in the increasing 'degeneracy' of style. Though rejecting this bias, many Anglo-Saxon archaeologists act on the assumption that they can detect the direction in which decorative motifs developed, and that these sequences can provide a chronology for the fifth and sixth centuries. These assumptions re-create the very notion that Montelius' actual method rejected, namely that *art-historical* knowledge of the material is a sufficient basis for constructing a typology. The pervasiveness of this attitude can be seen in this quotation:

Pottery from cemeteries can be arranged in typological series which ...
may be easily related to an absolute time-scale.
(Myres, 1986: 27-8)

It is above all the subjective character of this procedure that has led to the problems analysed in the preceding chapters.

8.5 The influence of the theory of evolution

Another influence which seems to have been at work in enabling British archaeologists to accept the plausibility of a pure typological method is the seductive attractiveness of the biological theory of evolution. Gräslund (1987: 101-8) shows that this influence, too, can be traced back to the great Scandinavian archaeologists of the late nineteenth century. Both Hildebrand and Montelius on occasions drew an analogy between artefact types and their development on the one hand, and biological species and their evolution on the other:

Under the influence of two factors - the practical need and the craftsman's taste - a great many forms [of artefact] arise, each of which has to struggle for its existence; one does not find what it needs for its existence and succumbs, but the other moves forward and produces a whole series of forms. If any science at present needs its Darwin, it is comparative archaeology.
(Hildebrand, 1873: 16-7, quoted in Gräslund, 1987: 101)

[Archaeologists] stand, in respect of the theory of evolution, on a purely Darwinistic ground. That, as regards the productions of nature,

it is possible to follow the evolution of one form from the other has ... long been known. But it is only recently that we have discovered ... that a quite similar development can actually also be shown as regards the productions of human labour...

It is also an extremely wonderful thing that man should in his work be subject to an evolution governed by laws. Is human freedom so restricted that we could not freely make whatever forms we wished? Are we compelled to go, step by step, from one form to another that is only slightly different?

Before one has investigated the matter more closely, one would certainly be tempted to answer 'No' to these questions. But when one has become ... familiar with the [material], one finds that the answer must be 'Yes'... Man is always compelled, in his creation of new forms, to follow the law of evolution.

(Montelius, 1899 - entitled 'Typology or the theory of evolution applied to human labour': 267-8, quoted in Gräslund, 1987: 103; cf. Montelius, 1903: 20)

Both of these quotations are, admittedly, taken out of context, and Gräslund makes a case for believing that neither Hildebrand nor Montelius meant these remarks as more than a metaphor.

Later archaeologists, however, seem to have believed much more firmly in the parallel, not just as an analogy or metaphor but as part of the explanation for the development of artefact-types, and as part of a method for discovering sequences. In particular, Åberg (1929: section 3) opened his definition of typology with the statement 'Typology is the application of Darwinism to the products of human labour', and Gorodzov even attempted to apply the analogy literally and to analyse artefacts as if they were organisms:

At the basis of the theory of the typological method as applied to the industrial material dealt with in archaeology lie: (1) the principle of causality, (2) the principle of evolution, (3) the principle of borrowing, (4) the principle of the 'struggle' for survival of artefacts.
(Gorodzov, 1933: 95)

He, along with other classifiers, attempted to incorporate archaeological artefact-groups into a hierarchical framework, based on the Linnaean system:

At the basis of this classification is placed the 'type' which is understood as a collection of objects similar in function, material and form.

The types connected by one quality - outside their form - compose the genera. The genera connected by one quality, outside their

material, form the categories. All archaeological simple objects (traits) then, may be divided into categories, categories into groups, groups into genera, and genera into types.
(Gorodzov, 1933: 98)

Since the extreme position taken by Åberg and Gorodzov archaeologists' belief in the applicability of evolutionary theory to archaeology appears to have been waning, though a quite recent statement of it is this:

I should here like to draw attention to one commonly used assumption about the relationships of surviving objects, especially jewellery, from Anglo-Saxon graves.

It is that in linking all surviving objects of a particular type there is some kind of organic progression, a Darwinian thread of development, one brooch having developed by some natural process from the next, each contributing something to the make-up of its successor. It is this parallelism with the living world and life processes which has underlain more recent attempts to use taxonomic methods for brooch analysis. In a very general sense these assumptions must be true, for clearly brooches that existed side-by-side in a single land during the same period must have been subject to mutual influences in the course of their development.

(Leigh, 1980: 10)

Leigh went on to play this down, but the whole thrust of his method was the belief that he could discern the 'thread of development'.

Yet, as Gräslund (1987: 103) pointed out, 'The analogy ... between the evolution of organic life and that of the cultural products is certainly basically false', above all because artefacts are not self-reproducing. Nevertheless, it seems clear that the background assumption of an evolutionary process at work in the development of artefacts has been part of the 'taken-for-granted' nature of archaeologists' application of the typological method: if artefacts 'develop', then it is thought to be possible to read off the direction of that development from the artefacts themselves. Besides being irredeemably subjective, this assumption incorporates a misapprehension about the biological theory of evolution: the broad outline of evolutionary sequences is provided, not solely by deduction from the fossils themselves, but also, perhaps even primarily, from the fossils' positions in a well-understood and documented sequence of geological strata.

8.6 Conclusion

It seems, therefore, that British archaeologists had reasons for adopting the stylistic development approach. However, it also seems that part of the solution to the methodological problems to which this has led could consist in starting again free of the chronological and evolutionary pretensions of the typological method.

Chapter 9: A proposal for a revised approach

Since the current method for producing a chronology for the fifth and sixth centuries in Anglo-Saxon England has been shown to be flawed, the problem of setting up a secure chronology for this period is acute. But without a secure chronology how can one be sure that any of the interpretive work done on the period is worthwhile? No-one can be secure in that knowledge until a reliable dating strategy has been produced that is both theoretically and methodologically sound. The answer is not easy. However, the drawing board is not entirely blank. It will be argued in this chapter that a revival and application of Montelius' actual original method, suitably modified, offers the best prospect for a new way forward.

9.1 Reviving Montelius' actual method

One implication of the argument of the previous chapter is that the typological method which has been traditionally applied to early Anglo-Saxon material is a derivative of the misleading version of Montelius' method which was not in fact the source of his successes. Another is that Montelius' actual method has never been fully implemented with early Anglo-Saxon material. As Hines (1984: 19) put it, 'no thorough or systematic periodizing of Anglo-Saxon archaeology seems ever to have been attempted.' Given, however, that the largely objective method Montelius actually used was so triumphantly successful for the Scandinavian Bronze Age, it may be worth considering the extent to which it might now be possible to apply it in full to Anglo-Saxon material for the first time. The following analysis refers back to the stages of Montelius' method defined in section 8.1 and Figure 8.1.

(1) Selecting the archaeological material to be used

For the early Anglo-Saxon period, as has already been noted, reliable find-associations are scarce (just how scarce for SHBs will be estimated in section 13.3). For the early Anglo-Saxon period, therefore, it will be necessary to define two levels of material selection:

- for defining artefact-types and classifying objects within them, all available (complete) examples can be used;
- for analysing find associations, however, a smaller selection will have to be made - see the description of stages (4) and (5) below.

(2) Defining artefact-types

Artefact-types would be defined as in the original method, and in standard practice.

Where GSHBs are concerned, stages 1 and 2 of this revived approach have already been carried out, in chapter 2.

(3) Sorting the artefacts into the types and into subtypes (groups) within them (classification)

This stage would in principle operate as in current practice, but shorn of the attempt, which has bedevilled Anglo-Saxon archaeology, to read development into a classification, and therefore relative chronology off from a classification. It is therefore necessary to state immediately that the outcome of a classification of any one type of metalwork by (a revival of) Montelius' actual method would be, as in Montelius' best practice, not a *sequence* (typology), but a *set of unsequenced groups*. They would need to be considered 'free-floating', in the way that some dendrochronological findings have been, until they can be tied in more rigorously to a sequence justified by the next two stages.

This method of classification, like all others, inherently involves grouping by similarity - one possibly problematic aspect of this process is discussed in the next section. A fully-worked-through example of objective classification by similarity without chronological preconceptions is given in chapters 10-12.

Another important requirement of the current proposal for a new way forward is that this method of classification would need to be applied to several artefact-types independently before any attempt was made to move to stages 4 and 5. This is so that those stages could be in their turn used without preconceptions to discover which groups of different types of metalwork were contemporary, and not merely as mutual but circular reinforcement, as so

often hitherto. However, it would make pragmatic sense to select for classification along the new lines those artefact-types which are known to feature in the most numerous available set of reliable closed finds.

(4) Using find-associations to determine find-horizons

(5) Using mixed finds to determine the sequence of the find-horizons

When sufficient types have been classified using, for each type, all its available complete exemplars, all the resulting classifications would be used in an analysis of reliable closed-grave assemblages, in an attempt to establish either (as was possible for Montelius) a set of find-horizons and their sequence, or (more probably) to use seriation to produce the most likely sequence of associations. As mentioned above, a further stage of material selection would be needed at this point. Though (contrary to Montelius' practice) all complete examples of each type would be used for classification, only reliable closed finds could be used here. This would undoubtedly make these stages the most problematic part of any attempt to apply Montelius' actual method to Anglo-Saxon material, and aspects of this problem are therefore discussed in chapter 13. Part of that discussion will focus on whether any alternatives to the analysis of closed-grave assemblages are available in the search for contemporaneous types and groups. But it needs to be said even in advance of that discussion that the shortage of material for horizoning or seriation must not become an excuse for relapsing into stylistic sequencing; that would be a counsel of despair, and lead straight back to the subjective approach which is at least partly responsible for the present situation. The attempt must be made to find a better way.

(6) From that sequence, deducing the sequence of groups within types

(7) Setting out the results in typologies

In principle, these stages would be unproblematic within the revived/adapted method, because the order of groups within types would be read off from the sequenced find-horizons or seriation, and the typologies listed. In practice, neither of these stages could be validly attempted until the previous stages had been successfully completed.

(8) Absolute dating by external evidence

This stage is also straightforward in principle but problematic in practice. It would have to await not just the successful completion of all the previous stages, but also the achievement of consensus on the chronologies of imported objects found in Anglo-Saxon contexts and/or of the nearest continental associations or parallels.

9.2 Classification by similarity

This process underlies all attempts at archaeological classification, and its centre is the assumption that a high degree of similarity between objects implies contemporaneity. No attempt is made here to dispute this assumption, not only because without it no self-standing dating of artefacts would be possible at all, but also because it seems a wholly plausible assumption, at least for high-status objects. Mundane objects may continue to be made almost identically over long periods of time, and therefore be useless for close dating; but for the types of metalwork with which this thesis is concerned short-lived fashions seem to have been the rule: 'Close similarity implies contemporaneity'.

However, it is necessary not to fall into the fallacy of deducing that the opposite is true: dissimilarity manifestly does not imply non-contemporaneity. It is common ground among classifiers of SHBs, for instance, that at any one point in the SHB's history several dissimilar types were being produced. Proof of this, at least in one highly suggestive instance, comes from Leigh's discovery that the same punch tool had been used on two Kentish SHBs, Chessell Down 12 and Stowting 1:

Their stamped headplate borders apart, these brooches could not be much more typologically disparate.
(Leigh, 1980: 269; cf. p.106)

Yet the use of the same tool implies that these brooches were contemporary, at least within the broad meaning of that term in archaeology.

(The profound implications of this discovery by Leigh are discussed in section 13.5.)

A similar conclusion about the simultaneous manufacture of dissimilar types can be drawn from the Swedish evidence. The excavations at Helgö produced evidence of two workshop sites for producing SHBs (or relief brooches as they are called in Sweden): 227 headplate fragments (from 23 different types) were found together with 13 fragments of bows and 395 footplate fragments (from 29 different types). From this evidence it was concluded that at least 211 different brooches had been cast at Helgö, although only about 50 have been found in Sweden. After analysing the moulds the excavators concluded that

These brooch types are independent of one another by virtue of a larger or smaller number of common or characteristic form elements but they are not typologically bound to one another. The Helgö artists created or formulated the different brooches freely by combining different form elements... That both old and new elements are combined in one and the same brooch has been shown by an analysis of one of the headplates from Helgö.
(Lundström, 1972: 158)

So it seems clear that many different stylistic elements were in use in Helgö at the same time. The relevance to England is that it reinforces Leigh's evidence that dissimilarity does not imply non-contemporaneity.

9.3 Conclusion

Thus far, this is only a sketch of the proposed revived method and of its main principle. However, stages 1 and 2 have already been exemplified, using GSHBs as the material, in chapter 2, particularly section 2.7. And in the next three chapters various approaches to stage 3 are exemplified and evaluated. Then in chapter 13 the prospects for the further stages of the new method are discussed. Finally, in chapter 14 conclusions are drawn and recommendations made.

PART E: STARTING AGAIN

Chapter 10: Classification of GSHBs by proportion

10.1 Introduction to chapters 10-12

These chapters apply various methods to the classification of different aspects of GSHBs. The aspects analysed are proportion, form and decoration. The methods used are principal components analysis (pca), transfer of variables (tvar), k-means cluster analysis, jaccard analysis, scattergramming, similarity measures, and similarity clustering. Pca, k-means and jaccard are existing statistical techniques, and tvar and scattergramming existing graph-making techniques. Similarity measures and similarity clustering, though like methods used by other classifiers, are in a form devised specifically for this study.

The aspects to which the different methods are applied are:

proportion (chapter 10)	pca, tvar, k-means
form (chapter 11)	jaccard, scattergrams
decoration (chapter 12)	similarity measures, similarity clustering.

Different methods were used, partly to try out and evaluate them, but mainly because the methods seemed particularly suited to the brooch aspects to which they were applied.

This whole enterprise was undertaken in order to exemplify and evaluate the form of objective, non-typological classification which was argued for in earlier chapters.

Of the seven methods used, six (all except similarity clustering) were computer-based. The use of computer methods was intended as part of the aim of achieving greater objectivity than is possible through essentially subjective art-historical methods. That aim is important, and involves moving beyond previous use of computers to analyse metalwork. Leeds was working and writing long before appropriate computers were available. Hines was working when appropriate technology was available, but did not use it. Leigh experimented with (but then abandoned) computerised methods, but to sequence motifs or brooches, not to generate classifications.

10.2 Previous analyses of SHBs by proportion or size

Lundström (1972: 133, Figure 59) provided both a diagram of measurements made on the Helgö brooch moulds, and a rationale for applying an analysis by proportion or size to them. Despite this, she found it impossible to carry out such an analysis because the moulds were fragmentary. Also, no further information seems to be available on the research (mentioned by Hines, 1984: 113) of Sjøvold on brooch measurements.

However, Leigh carried out a manual analysis of SHBs by proportion. He discussed this approach only in a small section of his Appendix 1 (1980: 551-6), with three associated Figures. He made various measurements of brooches, and calculations based on them. Although the detail given is insufficient to replicate the approach, the account shows that he dealt successively with

- the 'centre of gravity' of the footplate (the intersection of the midline with the line joining the tips of the side lobes), which in general over the history of the artefact-type moved, in his opinion, from a low starting point to a position at or just above centre, but which showed no strong regional tendencies;
- the ratio of the width of the footplate to its length, in which he thought he could 'discern a few tenuous regional and chronological trends' (1980: 552);
- the ratio of the width of the headplate to its height, where he noted that non-Kentish 'English headplates are ... distinguished, by their deviation from truly rectangular shapes' (1980: 553) - on which see the next section - but otherwise the range of ratios of regional groups overlapped; and
- the relationship between the size of the headplate and that of the footplate, where 'there appears to be no regional or chronological significance' (1980: 553).

From his description, Leigh seems to have used these calculations more to confirm chronological conclusions he had already drawn than to arrive at them. And his inability to pick out firm regional differences seems to belie his own assertion, already noted in chapter 2, that even a novice could distinguish regional groups on the basis of overall proportions.

10.3 Procedure for present classification of GSHBs by proportion

Stage 1

The 95 brooches of the inner corpus were used, because the form of analysis attempted inherently required data from complete artefacts. For each of these brooches, measurements were made from the photographs in Leeds (1949). Since all the relevant photographs in Leeds are at two-thirds real size, each measurement was multiplied by 1.5.

Photographs were used, rather than artefacts, largely for the pragmatic reason that access to even a representative sample of the artefacts themselves was not possible. However, it is also the case that this analysis was a trial of a method, not a full-scale experiment. As such, it was not intended to yield definitive results, but only to evaluate the method. If it had suggested that the method was useful, it would have been necessary to make measurements of actual artefacts in order to draw definitive conclusions.




For each brooch, seven measurements were made:

total length	
length of headplate	width of headplate
length of bow	width of bow
length of footplate	width of footplate.

These correspond largely to the dimensions measured by Lundström (1972: 133), and are the obvious dimensions to measure. Any more complicated measurements (e.g. diagonal of headplate) would be a mathematical function of the simpler dimensions already defined, and would therefore add no information. This set of measurements was chosen because the original intention was to investigate the analysis of GSHBs by size.

All length measurements were made along the midline of the brooch. If there were crenellations along the top edge of the headplate, these were included in the total length and in the length of the headplate; a protrusion at the centre of the top edge was not. The end of the headplate and beginning of the bow was defined as the (notional) line across the upper part of the bow joining the lines of the lower edge of the footplate on either side of the bow. Similarly, the end of the bow and beginning of the footplate was defined as

the (notional) line across the lower part of the bow joining the points where the 'animal heads' forming the upper borders of the footplate met the sides of the bow. The width of the headplate included crenellations, where present, but not embellishments to the corners. Where a bow disc was present, the width of this was taken as the width of the bow, since the width of the underlying bow could not be seen or measured. The width of the footplate was measured at the widest point: in all cases this was at the tips of the side lobes. In a few cases, where part of one side of a brooch (e.g. a side lobe) was missing, a full width measurement was obtained by doubling the measurement for the undamaged half.

A problem that emerged in making the measurements was that some headplates are not rectangular: some become narrower towards the bow () , and others wider () , while a very few, though of equal width at top and bottom, curve in towards the centre and then out again () .

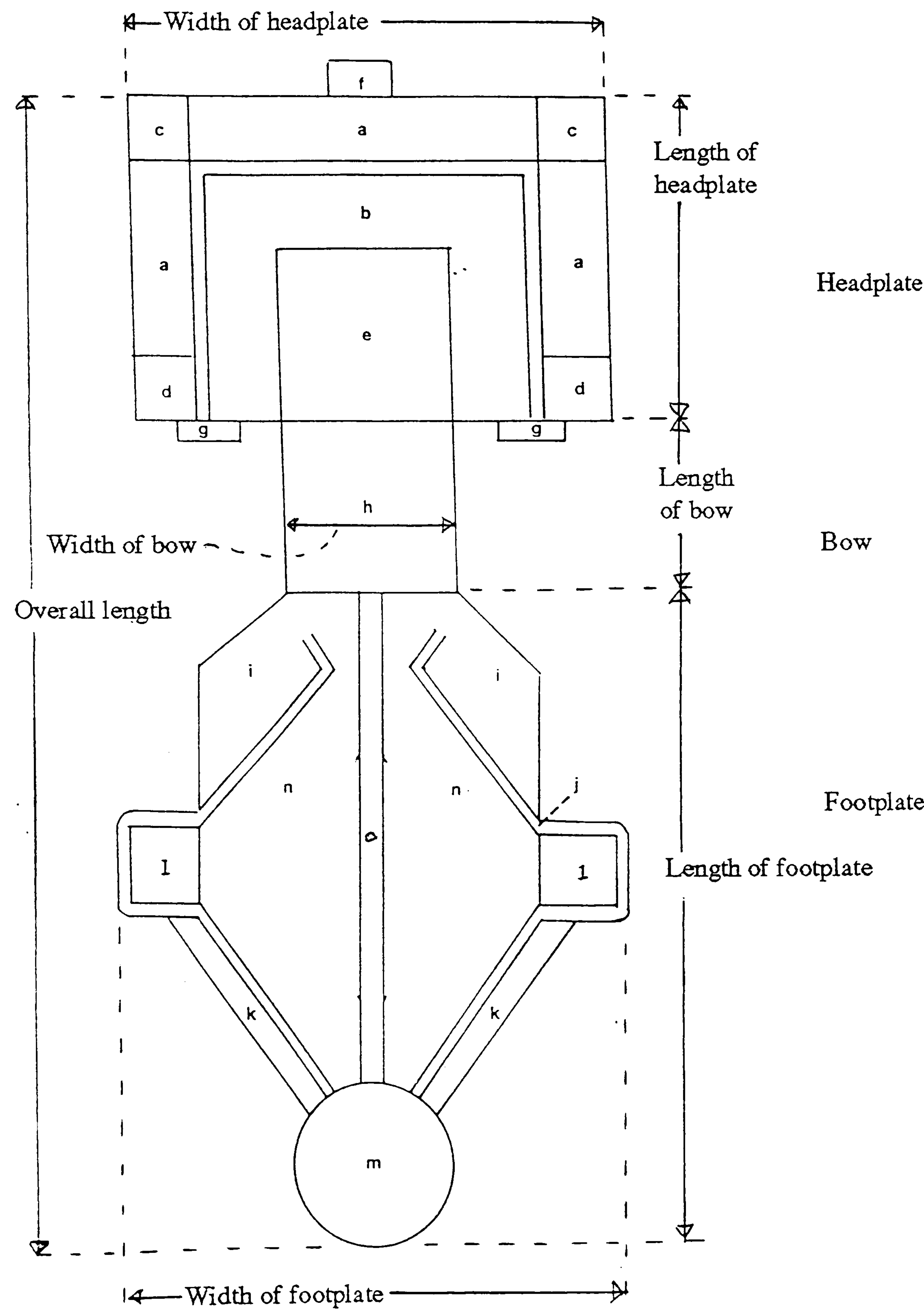
Because of these variations it was decided that, where they differ, the widths of the upper and lower edges of the headplate should both be measured, and then that the analysis should be run twice, first using the width of the upper edge of the headplate, then the width of the lower edge. This had two advantages. First, as all the other measurements remained the same it was possible to assess the effect of introducing a minor adjustment into the data. Secondly, it was possible to compare the two sets of solutions offered by the computer.

The measurements taken are schematised in Figure 10.1 , and the resulting raw data are given in Appendix 5.1.

Stage 2

An attempt was made to analyse (separately) the two complete sets of seven measurements for all 95 brooches. However, the data set proved too large for the computer program to handle. Trial-and-error showed that the program would be able to handle 75 brooches. Data for 20 brooches were therefore removed. The brooches chosen were

Figure 10.1: Schema of measurements of GSHBs used in analysis by size and proportion



Source: Adapted from Hines (1984: 394, Figure 3.1)

those with measurements very similar to another brooch; another condition for choosing them was that they should have identical measurements for upper and lower headplate widths. These brooches, and those to which their measurements were similar, are indicated in Appendix 5.1.

Stage 3

The two sets of seven measurements for the 75 brooches were analysed by means of computer programs using principal components analysis (pca). Pca can be described at a simple level as exploiting any correlation between the original attributes and replacing them with one simpler uncorrelated attribute or component (Doran and Hodson, 1975: 91). For example, in both analyses here there was a strong correlation between the width and total length of the brooches, so this became a single, separate component. In the first run, this component also accounted for 86.7% of the variance, and was so overwhelming that it obscured any other factors.

Stage 4

So a further pca was conducted in which overall length was dropped as a separate factor, and the other six dimensions were divided by it; that is, the other dimensions were effectively 'sized', or converted to ratios over overall length. This meant that what was being investigated were the relative values of the dimensions or, in other words, the proportions of the brooches. This allowed other factors, less obvious than overall length, to emerge.

Two uncorrelated principal components emerged in the new analyses of both sets of 'sized' measurements. One was found to relate to the proportions of headplates: it placed brooches on a scale with those with (relatively) short and wide headplates at one end and those with long and narrow headplates at the other. The other factor combined information from the bow and footplate, such that brooches with short bows and wide footplates were placed at one end of a scale and those with long bows and narrow footplates at the other.

Stage 5

The 'sized' data of both sets of measurements were next transformed using a 'transference of variables' (tvar) program. Tvar changed the information in such a way that values along the two pca dimensions were allotted to each brooch. Inspection of the two sets of tvar data (not reproduced here) showed that there were considerable differences between them in the values assigned to particular brooches, thus showing that even small changes in just one of the six measurements for a minority of the brooches caused substantial changes, not in the principal components themselves, but in the values along them assigned to individual brooches.

Moreover, in both sets of data there were instances of brooches allotted identical scores on the two principal components. In the dataset using upper headplate width, there were six instances of pairs of brooches with identical values (brooches 9/84, 14/95, 15/75, 19/71, 30/45, 57/92), and even two triples (nos 10/21/66, 58/59A/63). Similarly, in the dataset using lower headplate width there were eight such pairs (nos 10/80, 21/87, 22/31, 59/107A, 67/73, 69/93, 89/91, 95/104).

Stage 6

So far, the computer analysis had merely found two principal components and allotted brooches values on them. Next, the two sets of tvar values for the 75 brooches were analysed for possible groupings. This was done using k-means cluster analysis. This form of analysis interrogates the data points and attempts to discover the most coherent way of clustering them. No assumption is made in advance about the number of clusters that would be best: the program allows the investigation of any number of clusters from two upwards. 'Goodness of fit' of the solutions to the data is judged from the amount of variance that the solutions account for.

Cluster analysis (including k-means) is a technique whereby an object is assigned to a group whose centre it is nearest to, but as more objects are added to the group the centre of each cluster is recalculated and then objects are possibly re-assigned to other more appropriate groups. In view of this it is no surprise that Shennan (1988: 228) has decried

the theoretical foundation of many of the methods of cluster analysis as uncertain. Methods have been suggested for evaluating the results of cluster analysis (cf. Gordon, 1981; Aldenderfer, 1982), so that the results can be shown to have come from the data and not to have been dictated by the program (as D. Thomas, 1978, was able to demonstrate), but this does not sort out the problem of the instability of clusters. It is therefore still the case that results that accrue from cluster analysis must be treated with caution unless they have been tested independently.

For the present data, solutions were calculated for both sets of measurements for each number of clusters from two to 10. Those with two, three, seven, eight, nine, and 10 clusters were rejected as accounting for relatively low amounts of the variance, and it was felt appropriate to analyse the four-, five-, and six-cluster solutions for both sets of measurements in further detail. The clusters into which the brooches were grouped for each of these six solutions are shown in Appendix 5.2. It is evident that, just as with the tvar data, the composition of the clusters differs to some extent between the upper and lower headplate width solutions.

10.4 Discussion of results

The next problem was to decide which, if any, of the three possible solutions for each set of measurements seemed the most appropriate for the classification of the brooches.

A criterion that has often been used to test for the validity of possible groups has been Doran and Hodson's (1975: 159) proposition that 'a group should have internal cohesion and external isolation'. By this the authors presumably meant that when a group is plotted on graph paper it should be seen to be compact in area and distinct from other groups.

Unfortunately none of the cluster solutions suggested by the computer was satisfactory in this regard, because in each of them there were two or three instances of brooches being allotted the same values but nevertheless allocated to different clusters.

The first set of solutions to be examined were those using the upper width measurement for the headplate. In each solution five of the eight 'multiples' were unproblematic: both (or all three) of the brooches with the same values were allocated to the same cluster. However, the set of problematic multiples was different in each solution. Thus none of the three possibilities using the upper headplate width measurement seemed more suitable than another. All were equally incommoded by problematic multiples. None showed clusters with compact distributions clearly separated from other clusters (Doran and Hodson's criterion).

When the upper headplate width measurement was replaced by the lower one, the composition of the clusters altered to some extent (see again Appendix 5.2). Problems of brooches with the same values being allocated to different groups persisted. In the four- and six-cluster solutions there were three problematic multiples, and in the five-cluster solution two. Clearly the allocation of a pair of scores to brooches by tvar represents a mathematical compromise which k-means analysis does not observe when allocating clusters. To the computer, although not on the two-dimensional graph, the brooches presumably do not have the same values at all.

Of the lower-width solutions, the four-cluster grouping seemed the least acceptable. All had problems with external isolation of some of their clusters, but the five- and six-cluster solutions had the closest fit statistically. Initially, the five-cluster allocation seemed to be the more attractive, chiefly because it had two rather than three problematic multiples. However, the overall spread of its clusters was not noticeably more compact than the rest. So it was decided that, on balance, none of the lower-width solutions could be considered more satisfactory than the rest.

When the two sets of computer clusters were compared further points became apparent. First, a change in only one of the measurements involved a wholesale movement of the brooches relative to each other. It also caused considerable alteration in the membership of clusters. The implication is that new brooches could not be included within a cluster without re-running the whole program. But this defeats one of the objects in classifying

artefacts, namely the possibility of being able to include new members easily. This makes the method cumbersome and 'user-unfriendly', since anyone wishing to update it would need not only the original and the new measurements but also the same program to conduct the classification. On this ground alone the results of this computer method have been found wanting.

A second problem lies in the clusters themselves. As the program stands, it is impossible to establish the measurement tolerance between one cluster and another, and where two measurements are combined (as in the case of the bow and footplate) this problem is made even more difficult. This means that several solutions have to be inspected before the most suitable is chosen, and that a strong element of subjectivity enters what was intended to be a highly objective procedure. This problem is potentially very serious if one wants other archaeologists to be able to replicate a method and (all being well) arrive at the same results. This further weakens the case for choosing any one of the six solutions in preference to the rest.

10.5 Evaluation of the procedure

In fact, much of the procedure seems to have been called in question. One of the measurements could not be rigorously defined, there was no principled reason for picking one quantity of clusters rather than another, brooches with apparently identical principle component values were allocated to different groups, and the clusters were not stable. This seems to confirm the outcome of Leigh's analysis, namely that no strong deductions can be made on the basis of brooch proportions, and suggests that the attempt to do this should be abandoned, at least for the time being, and the results not used. Also, part of the instability of the results arises from k-means cluster analysis, the use of which should be abandoned. However, principal components analysis and tvar were in themselves perfectly reliable within this analysis, and could be used in other contexts, preferably with a different technique for discovering groups or clusters within the data.

Chapter 11: Analysis of GSHBs by form

11.1 Procedure

In the second computer-assisted classification of GSHBs the aspect analysed was form. By 'form' was meant the outline of the brooch, but not any decoration within that outline.

Stage 1

The outlines of GSHBs were considered and analysed into 27 elements (12 for the headplate, two for the bow and 13 for the footplate): these are listed in Appendix 6.1.

As far as possible, these elements of form were defined purely in terms of shape, and without reference to decoration. However, in a few cases distinctive types of outline could not be defined easily without referring to the decoration that gave the outline that form: see elements 5, 6 and 23 in Appendix 6.1.

Stage 2

Next, a matrix was compiled in which the form elements present on each of the 95 brooches of the inner corpus were indicated: see Appendix 6.2. Clearly, only complete brooches could be used for this type of analysis: hence the use of the inner corpus.

Stage 3

For the computer analysis of the data, a jaccard analysis program was used. This form of program ignores absences of features of the material and uses the characteristics that are present to calculate similarity indices between pairs of items; following this, like pca, it searches for principal components in the data, and allots each item a value against each principal component identified. On this occasion an analysis of the complete 95 x 27 matrix was attempted. However, the inclusion of all 95 brooches in the matrix made it too large for the computer to handle. So all brooches with sets of form elements which were duplicated by at least one other brooch were dropped from the analysis: these brooches numbered 35, and they are indicated by asterisks in Appendix 6.2. This reduced the

number of brooches in the set to be analysed from 95 to 60, without loss of information since duplicates could be assigned to the same point in subsequent analyses as the brooches of which they were duplicates (at the level of analysis involved here). A jaccard analysis of the reduced matrix was then successfully carried out.

Three principal components were identified. The first (here labelled "x") was concerned with the distinctiveness or otherwise of the terminal lobe in relation to the rest of the footplate. At one extreme of this dimension, the terminal lobe could barely be distinguished from the rest of the footplate; at the other, it was circular (or some other very distinctive shape), and attached to the rest of the footplate along only a short section of its periphery. The two poles of this dimension can be called 'very indistinct outline of terminal lobe' and 'very distinct outline of terminal lobe'.

The second principal component (here labelled "y") highlighted the elaboration of form present on the terminal lobe. At one extreme, the outlines of terminal lobes were very plain, e.g. a straight line, a simple curve, a circle; at the other, very elaborated, e.g. a lappet, a scythe shape. The two poles of this dimension can be called 'plain outline of terminal lobe' and 'elaborate outline of terminal lobe'.

The third principal component (here labelled "z") concerned the elaboration of form of the headplate. At one extreme, the outlines of headplates were very plain, i.e. straight lines; at the other, very elaborated, e.g. crenellated, or embellished at the corners. The two poles of this dimension can be called 'plain outline of headplate' and 'elaborate outline of headplate'.

The first two of these components might seem highly correlated. Both to investigate this, and to attempt to find similarity groupings in the data, a further stage of analysis was carried out.

Stage 4

Again using the computer, the jaccard results were re-cast as scattergrams. Each brooch was positioned along a dimension for each of the components "x", "y" and "z". Then the data from two components at a time (i.e. "x"/"y"; "x"/"z"; "y"/"z") were plotted on two axes as on a graph.

The first attempt to do this revealed that six brooches were so isolated from the rest on each of the three scattergrams that they were plainly very unlike all the other brooches in the set from this point of view. Moreover, they distorted the scattergrams to such an extent that they impeded the search for larger groupings. They were therefore considered as 'isolates' and removed from this stage of the analysis. The brooches concerned were Market Overton [17], West Stow [18], Little Wilbraham 6 [26], Welbourn [29], Nassington [64] and East Shefford [123].

The transformation of the data into scattergrams was then completed, and the resulting scattergrams, each based on the same 54 brooches, are shown in Appendix 6.3. It should be noted that the numbers of individual brooches do not appear on the scattergrams, only numerals indicating how many brooches occur at any point within them: the identification of which particular brooches occurred at each point was done by comparing the relevant two of the listings of brooches along the three main dimensions generated during the jaccard analysis.

The first finding was that components "x" and "y" were not particularly highly correlated. If they had been, the first scattergram would have shown a strong tendency for brooches to fall along one of the diagonals: there was no such tendency.

Stage 5

Next, each of the scattergrams was analysed into groups, by eye. The numbers of groups identified in this way from the three scattergrams were six, five and six respectively: the brooches constituting each group are listed in Appendix 6.4. In each case, the brooches which formed part of the reduced matrix are listed first, and those which joined groups by

virtue of being 'duplicates' (having identical sets of characteristics at this level of analysis) are listed second, in brackets.

Some of the groups were easily identified, being closely aligned together and physically separated from others, but others were more loosely constructed. Where the groups showed 'internal cohesion and external isolation' they are marked with an asterisk in Appendix 6.4, but where groups were more loosely constructed the asterisk is omitted.

11.2 Results

Between them, the three axes corresponding to components "x", "y" and "z" can be seen as defining a three-dimensional space within which 89 of the 95 GSHBs of the inner corpus are located. Within this space, some brooches have close neighbours on one dimension, others have close neighbours on two dimensions, others again may have close neighbours on all three dimensions. Subgroups of brooches which turned up in the same main groups from all three scattergrams must clearly be close together in all three dimensions. The three sets of groups were therefore inspected for groupings which turned up in all three: the results are shown in Table 11.1, where brooches included in the jaccard analysis are shown on the left, and those which joined groups by virtue of being 'duplicates' are on the right.

Seven of the 54 brooches showed up in this analysis as 'relative isolates': they had no neighbours which occurred in the same main groups in all three scattergrams (unless they had duplicates).

Some of the groupings are fairly familiar: for example, the third subgroup listed contains, counting duplicates, 11 of the 19 complete brooches of Leeds' group A3. But in other respects the groupings are unfamiliar: also from Leeds' group A3, for instance, brooches 17, 18, 26 and 29 are isolates, Holywell Row 11 [11] and Rothley Temple [12] form a consistent but tiny grouping of their own, and the two remaining complete brooches, Tuddenham [25] and Barrington A [27], turn up in quite different groupings.

Table 11.1: Concurrence between scattergrams based on analysis by form

8, 9, 32, 37, 49, 50	+ 27, 58, 60, 82				
11, 12					
13, 14, 19, 20, 23, 30, 31	+ 15, 16, 21, 22				
25, 59A, 79, 92	+ 80				
33, 34, 42, 47, 51, 54	+ 35, 36, 52, 62, 122				
39, 41, 63, 96	+ 45, 46, 103, 107A				
48, 67, 69, 71, 112, 119	+ 70, 72, 73, 75, 120				
59, 66, 86, 88, 104	+ 68, 76, 87, 107				
83, 85, 90	+ 93				
89, 91	+ 106, 116				
108, 114					
Relative isolates:					
10	+ 101				
55	+ 56				
84					
85					
95	+ 97, 98, 102				
109					
113					
Isolates:					
17	18	26	29	64	123

11.3 Discussion and evaluation

The computer techniques used to analyse GSHBs by form appeared largely reliable in identifying principal components, allocating values of those components to individual brooches, providing the values of individual brooches on those values, and displaying the results as scattergrams. However, they did not provide raw data on the amount of similarity between brooches; and, more worryingly for the present enterprise, the final stage of identifying clusters had to be carried out by eye, in other words subjectively. A more objective method of clustering will be presented in the next chapter.

The results themselves also appeared quite plausible, given that the principal components identified were intuitively reasonable, and the groupings produced by correlating the three scattergrams were also reasonable and, to an extent, familiar.

Clearly, however, it would be unwise to push this form of analysis too far, given that the maximum number of data-points for each brooch was only 27; ideally, substantially more are needed to avoid chance correlations. Again, the analysis reported in the next chapter tackles this. Provisionally, however, a spatial image for these results may help. They seem to present a scatter of items in a conceptual 'universe' of (at least) three dimensions. The groups which have emerged are quite unlike galaxies: they do not exhibit close clustering with huge amounts of space between. Rather, if the brooches could be displayed in a three-dimensional array, there would be some far outliers (the isolates); there would be some fairly distinct clusters; but many of the groups would 'straggle' towards each other in one or more of the dimensions. And there would be no obvious way in which any one of the dimensions, or any 'diagonal', would correspond to time, that is to the order in which brooches were made.

Beyond that minimal conclusion no inferences will be drawn from this analysis, and it is not recommended as a satisfactory basis for the uncovering of contemporaneous similarity groups.

Chapter 12: Analysis of GSHBs by decoration

Classifying by decoration is one of the methods most widely used by classifiers. It was used by all three previous classifiers of SHBs (Leeds, Leigh and Hines). Given that many SHBs are so lavishly decorated, it is natural that decoration should feature prominently in attempts at classification. Therefore, of the three analyses presented in this part of the thesis, this is the closest in content to previous classifications. However, the method used is distinct from subjective, art-historical procedures where the classifier's judgment is the only criterion for the allocation of brooches to groups (Leeds) or to positions in a sequence (Leigh). Hines did incorporate a quantitative measure of decorative similarity into his method, his 'similarity coefficients', which were calculated on the basis of his 'equivalent features'. But since those were dependent on the prior division of decorative elements into 'equivalent', 'related' and 'common', and that division was inherently subjective, Hines' procedure was still not as objective as it might have been. In the analysis reported here, an attempt was made to reduce subjectivity to a minimum.

12.1 Procedure

Outline

Several decorative 'fields' within GSHBs were defined. Then the decorative variants or motifs used on those fields were listed, and a matrix was compiled of which variants occurred on each field of each brooch of the common corpus. A specially-devised computer program was used to calculate measures of similarity between GSHBs of the inner corpus. Finally, a largely objective method of clustering the brooches according to their similarity measures was applied.

Stage 1

The outline drawing of a 'typical' SHB devised by Hines (1984: 394, Figure 3.1) was used as the starting-point for the analysis. As in Hines' approach, the bow was treated as a unit, but the headplate and footplate were analysed into small decorative fields, both to facilitate description of the brooches and to aid the analysis of the decorative features.

Hines' division of the typical SHB into fields was used, but slightly modified:

- 1) Hines applied the label 'area g' to two knobs on the lower side of the headplate, where they were present. This label was used instead, in this analysis, for the 'innermost field' occasionally found within area e, the 'inner field'.
- 2) Hines' distinction between inner and outer areas in the main field of the footplate was found to be unworkable. Hence his areas n ('inner panel frame') and o ('inner panel(s)') were combined and labelled n. Consequently, the median footplate bar became area o.

Also, a number of changes were made to Hines' names for the decorative fields, in line with more recent usage (Graham-Campbell, personal communication):

- 3) Area a of the headplate, called 'frame' by Hines, became 'outer field'
- 4) Area b, Hines' 'second panel', became 'intermediate field'
- 5) Area e, the 'inner panel', became the 'inner field'
- 6) Area n, Hines' 'inner panel frame' and 'inner panel(s)', now combined, was renamed the 'inner field'.

This resulted in the set of fields, and of labels for them, schematised in Figure 12.1.

Thus the following analysis was based on a subdivision of a typical GSHB into 15 possible decorative fields. Of these, only seven are present on all (complete) GSHBs, namely the bow (h) and the following parts of the headplate and footplate:

Headplate: the outer field (a) and intermediate field (b)

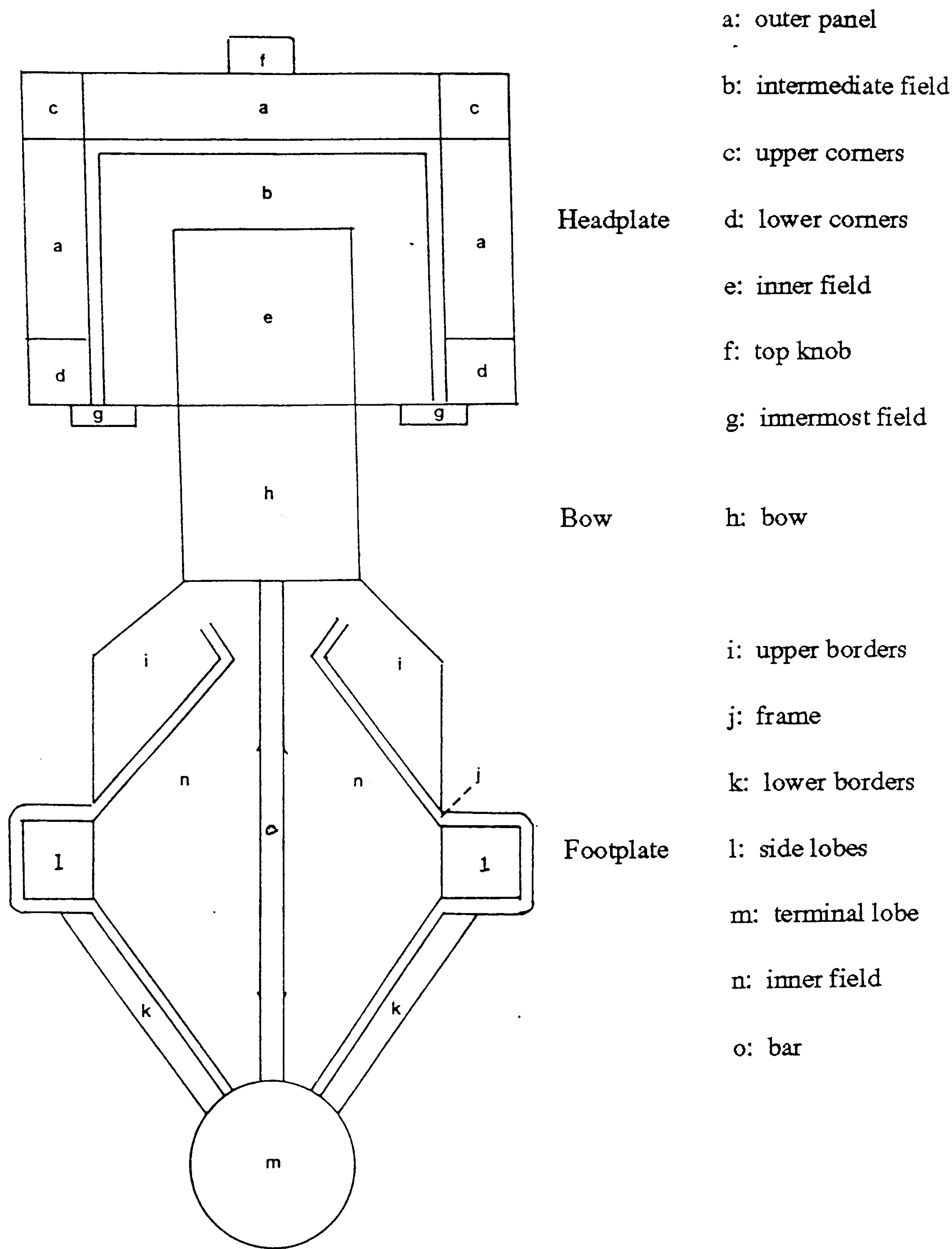
Footplate: the upper borders (i), side lobes (l), terminal lobe (m) and inner field (n).

All other decorative fields are optional, in the sense that they occur on only some GSHBs.

Stage 2

Then a list of the fields present on the 122 GSHBs of the common corpus was compiled: the list is given in Appendix 7.1. The list covers both complete and incomplete brooches, even though the computer analysis to which this listing was leading was to be carried out only on complete brooches.

Figure 12.1: Schematic outline and decorative fields of a great square-headed brooch



Source: Adapted from Hines (1984: 394, Figure 3.1)

The list in Appendix 7.1 shows, among other things, that field g is found on only two brooches (Lackford 50/126 [15A], which is incomplete, and Norton [90]). No brooch has all 15 possible decorative fields, though three (Kenninghall [49], Lakenheath [54] and Nassington [64]) have 14, the absent field in each case being g. Of the 95 complete brooches of the inner corpus, none has the minimum number of fields, seven. The smallest number of fields found on any single complete brooch is nine, and this number of fields appears on six complete brooches: Fordham [16], Londesbrough 6 [59], Unknown site [59A] (labelled "Yorkshire" by Hines), Woodstone [88], Thornborough [122] and East Shefford [123].

Stage 3

Next, for each of the 15 decorative fields, a description of the field with an outline of its decorative variations was compiled (see Appendix 7.2).

Stage 4

Once the decorative fields had been described, a list of the variants noted was compiled, and each variant was given a number: see Appendix 7.3. The resulting list draws on the descriptions of Leeds and Hines but is more comprehensive than either. A total of 153 decorative variants was identified and numbered, an average of just over 10 per field, with a range from three on field f, the headplate top knob, to 15 on field b, the headplate intermediate field.

Stage 5

Then a matrix was compiled of the decorative variants so defined that are present on each of the 95 complete brooches of the inner corpus: see Appendix 7.4. Because listing all the features, even coded as numbers, in one undifferentiated row for each brooch would have in many cases meant running beyond the edge of one page, for convenience Appendix 7.4 presents the data separately for the headplate, bow and footplate. Combining the three lists, however, shows that the number of features present on brooches ranges from 14 (East Shefford [123]) to 31 (Herpes 2 [83]).

Stage 6

The data in Appendix 7.4 were then entered into a computer, and analysed for the degree of similarity between brooches. The program that was used ignored absences and, on the basis of features that are present on the brooches, calculated similarity measures for each of the 95 x 94 pairs of brooches in the inner corpus. First, the number of decorative features present on each of the two brooches being compared was counted. Then the two sets of features were compared, and any features in common were counted; simultaneously, the total number of features possessed by the two brooches together was reduced by the number in common, so that it represented only the total number of distinct features possessed by the two brooches. Then the number in common was divided by the total of distinct features and (purely as a arithmetical convenience, to avoid decimal points) multiplied by 100:

$$\text{similarity measure} = \frac{\begin{array}{c} \text{number of features in common} \\ \text{between two brooches} \end{array}}{\begin{array}{c} \text{total number of distinct} \\ \text{features of two brooches} \end{array}} \times 100.$$

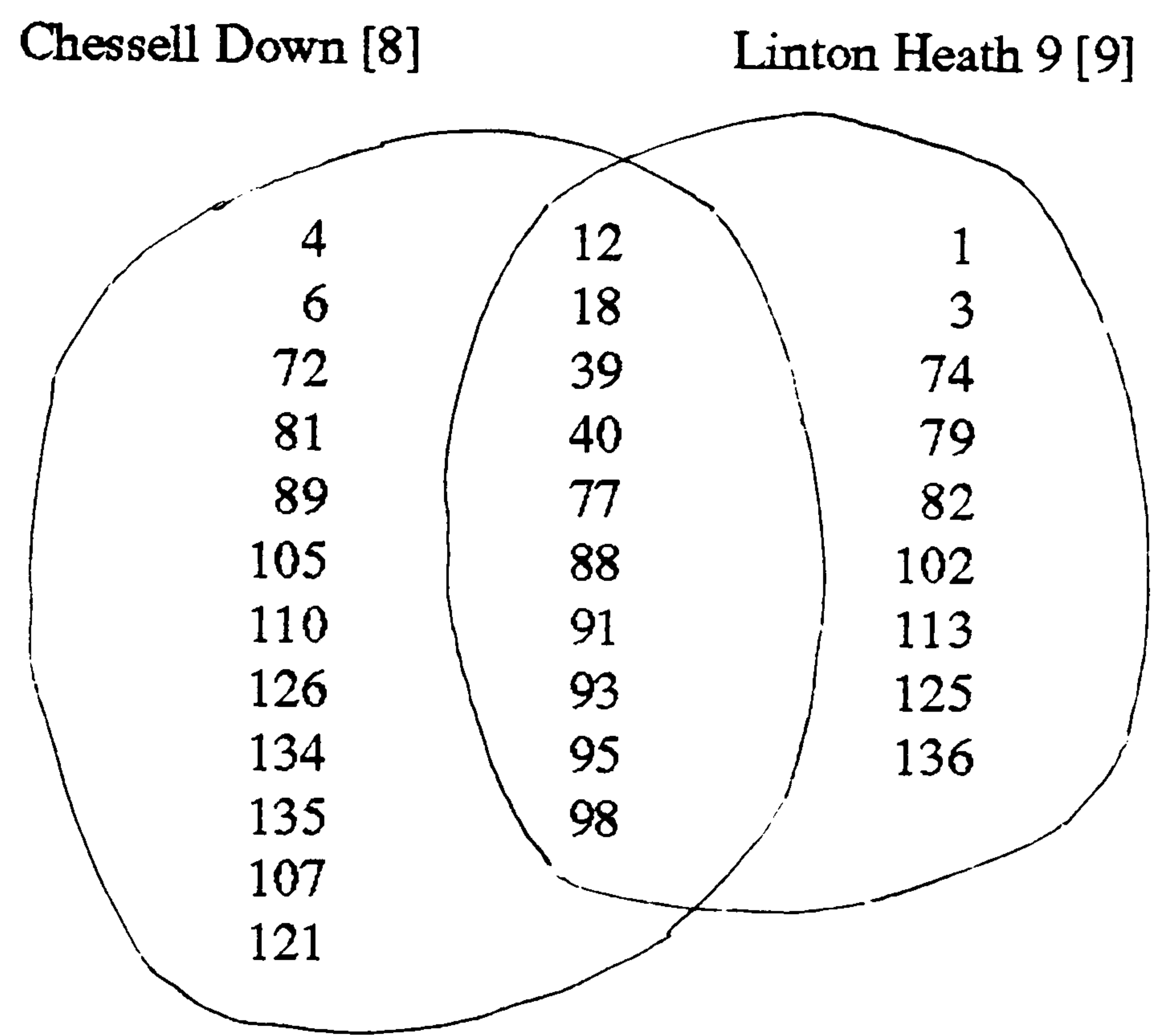
In set theory terms,

$$\text{similarity measure} = \frac{\begin{array}{c} \text{intersect} \\ \text{union} \end{array}}{\text{union}} \times 100.$$

An example and a Venn diagram will help to make this clear. Figure 12.2 shows the features which Chessell Down [8] and Linton Heath 9 [9] possess, and separates them into those in common and different. As Figure 12.2 shows, these two brooches have 12 features in common, out of a total of (22 + 21 - 12 =) 31 possessed by one or the other or both. The similarity measure between them is therefore

$$\frac{12}{31} \times 100 = 39.$$

Figure 12.2 Features present, in common and different on Chessell Down [8] and Linton Heath 9 [9]



Three points about this procedure should be noted. First, some brooches have far more features than others. One consequence of this is that high similarity measures between complex brooches (those with many features) are rarer than high similarity measures between simpler brooches (those with few features). Crudely speaking, this means that complex brooches have to 'score' more features in common to be rated as very similar. However, this reflects the facts: two simple brooches may be very alike, just because the few features they have are shared; whereas two quite similar complex brooches may differ on just a few out of many features and therefore be rated as somewhat less similar than the two simple ones. Intuitive or subjective judgments of similarity would be influenced by this in just the same way as the objective measure described here.

Secondly, all the positive features possessed by the brooches were counted as equal; or, to put the same point in reverse terms, no features were weighted more highly than others. This was done because there are no grounds, in advance of carrying out the analysis, for judging which features should be ascribed more importance than others. One consequence of this, among others, was that the overriding significance that Leeds

attached to the presence or absence of the footplate median bar, and which also emerged so strongly in the analyses of Leigh and Hines, was not built in as an assumption.

Similarly, there was in this analysis no partitioning of characteristics into categories of unequal importance, such as Hines' trichotomy of 'equivalent', 'related' and 'common' features.

Thirdly, the procedure provided a similarity measure for every pairing of brooches, not just for selected pairings (as in Hines' tables of similarity coefficients).

12.2 Results

The complete set of 4465 similarity measures is given (twice) in Appendix 7.5: it will be noted that a high proportion of them are single digits, and a few (see especially Little Wilbraham 6 [26]) are zeroes.

Because that data set is so large, for convenience Appendix 7.6 presents, for each of the 95 brooches,

either a list of all the brooches with which it has a similarity measure greater than 50; **or**, if it has no similarity measure greater than 50, the similarity measure between it and the brooch(es) with which it has the highest similarity measure.

The similarity measures listed in Appendix 7.6 range from 100 (between each pair in the triad Market Overton [34], Londesbrough 4 [35], Kenninghall [36]) down to 27 (between Brighthampton [76] and East Shefford [123]). The measures of 100 between nos 34, 35 and 36 do not mean that the three brooches are actually identical, but that at the level of analysis being conducted here all their features are equivalent. Twenty-nine brooches had a highest similarity measure of 50 or less; 66 had at least one measure greater than 50.

Inspection of these data suggested that there were several groups bound together by high or relatively high measures; equally clearly there were many brooches with only loose connections with others. An attempt was therefore made to sort the brooches into groups

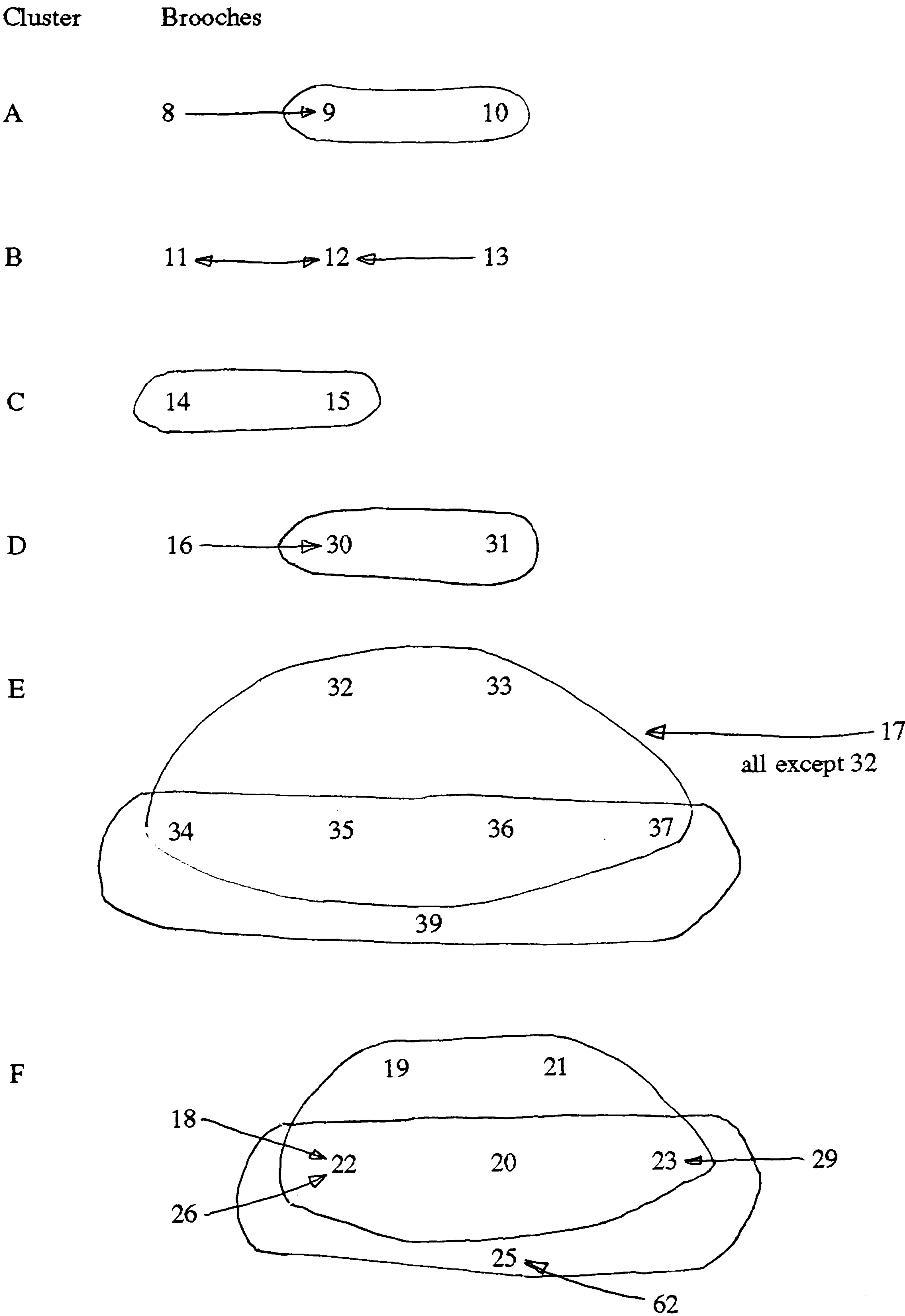
and 'hangers-on'. The procedure for doing this was as follows. All similarity measures greater than 50 were considered strong enough to make the brooches concerned members of the same group, and brooches whose highest measures were less than 51 were considered 'hangers-on'. Measures greater than 50 were therefore used to collect brooches into groups, and measures less than 51 were used to attach otherwise loose brooches to groups. A group plus any hangers-on was dubbed a 'cluster'. The results of this 'similarity clustering' procedure are shown in Figure 12.3.

In Figure 12.3 the clusters are shown in numerical order of the lowest-numbered brooch (whether central or hanger-on) in the cluster. Each single circle encloses brooches which have similarity measures of over 50 with each of the others in the circle. The double circle in cluster H encloses 11 brooches all of which have similarity measures of over 50 with at least four others in that set - the full set of single circles here would be too complicated to show. Brooches enclosed in a circle with no overlaps with others, or in at least one of a set of overlapping circles, constitute a group.

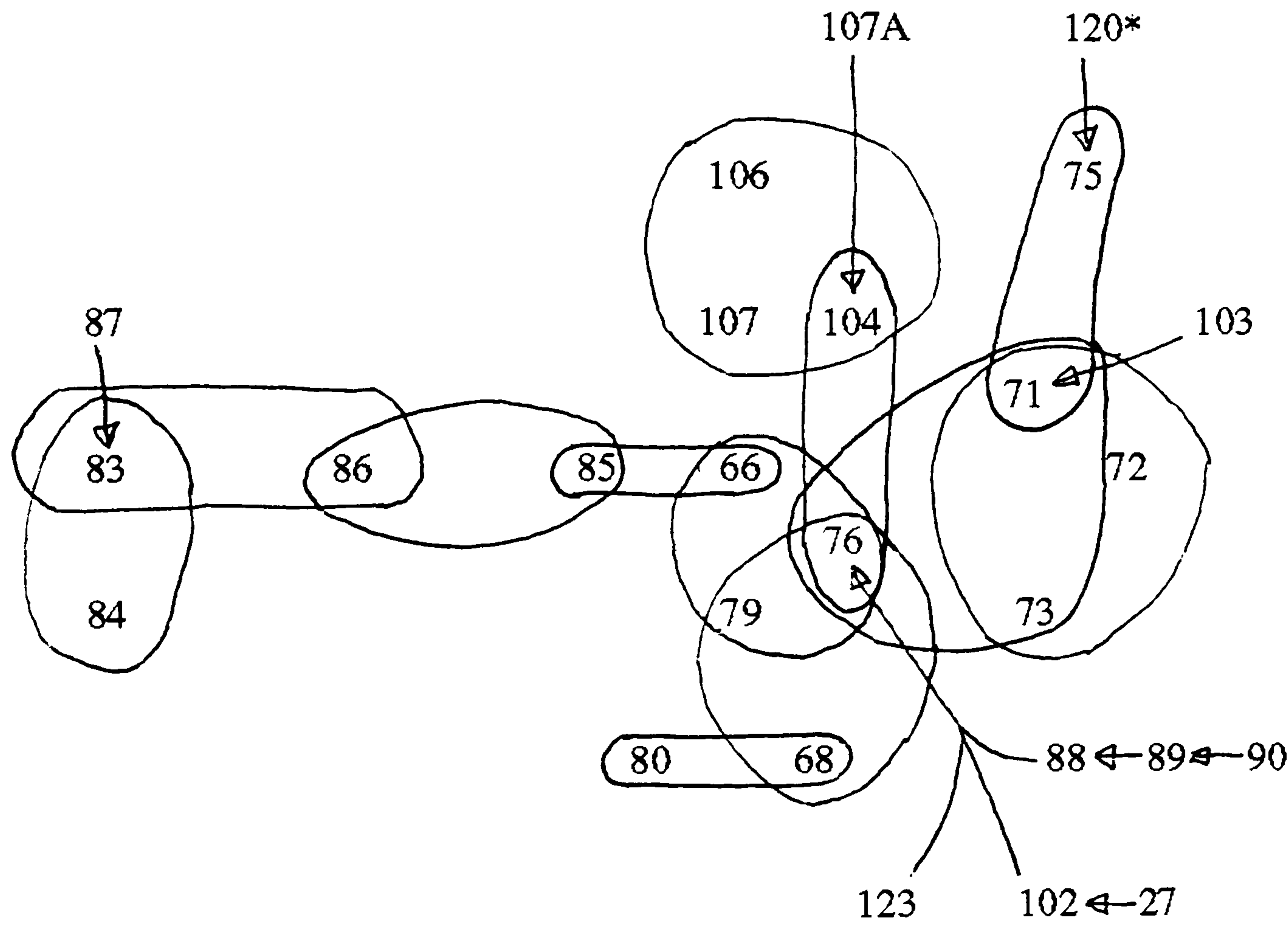
Even within groups, brooches not enclosed within the same circle have similarity measures with each other of less than 51. In a large group, therefore, members at opposite edges may have relatively few features in common, but are connected through a continuous chain of high or relatively high similarities.

Brooches whose highest similarity measures are under 51 have their strongest link indicated by an arrow. In most cases, this makes them hangers-on to a group. However, Holywell Row 11 [11] and Rothley Temple [12], with a similarity measure with each other of exactly 50, are shown as forming a small group of their own, with Suffolk 1 [13] as a hanger-on; the three together constitute cluster B. These three brooches would otherwise have nowhere obvious to go, since none of them has any similarity measure higher than 50.

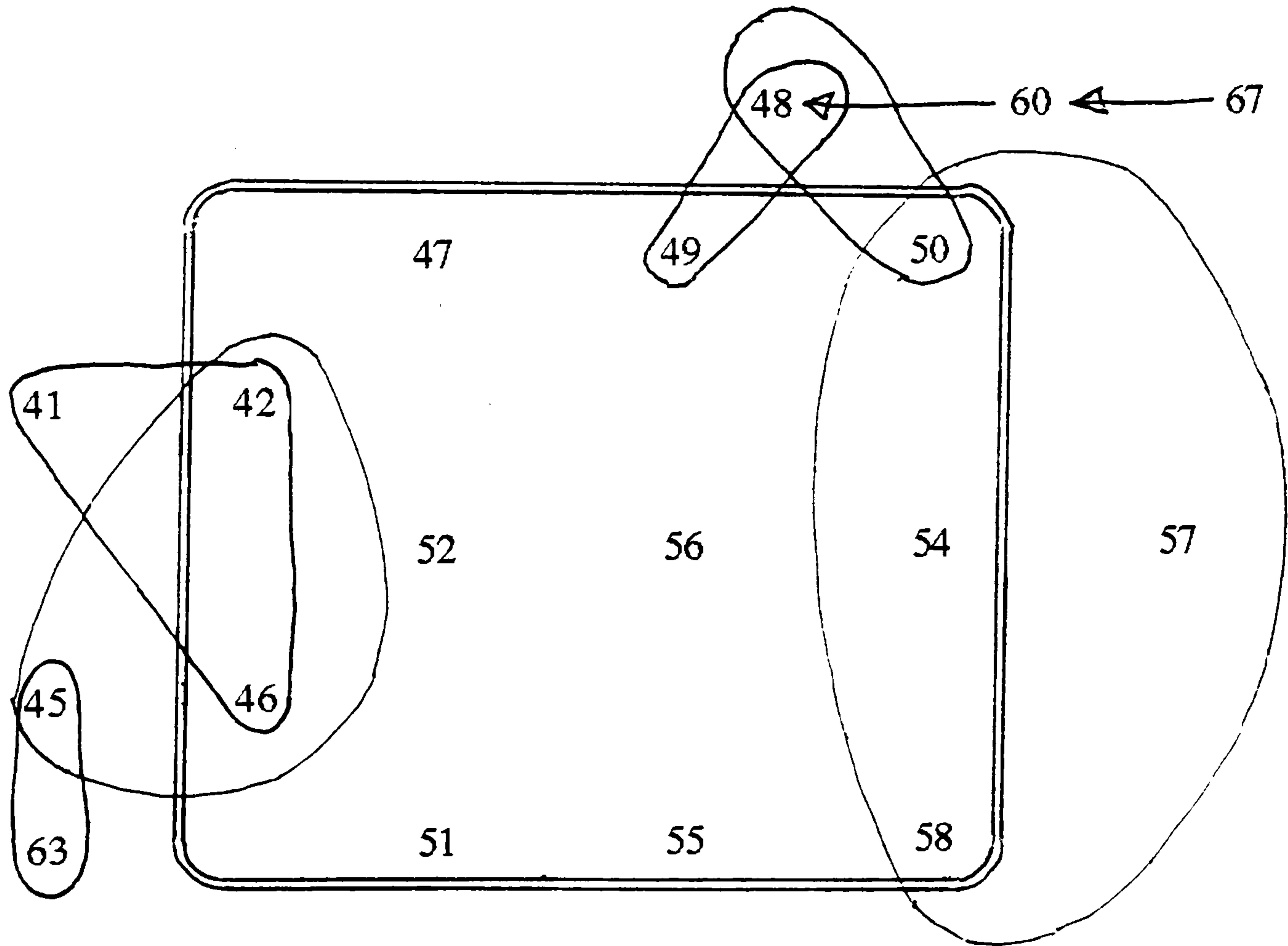
Figure 12.3 Results of similarity clustering procedure



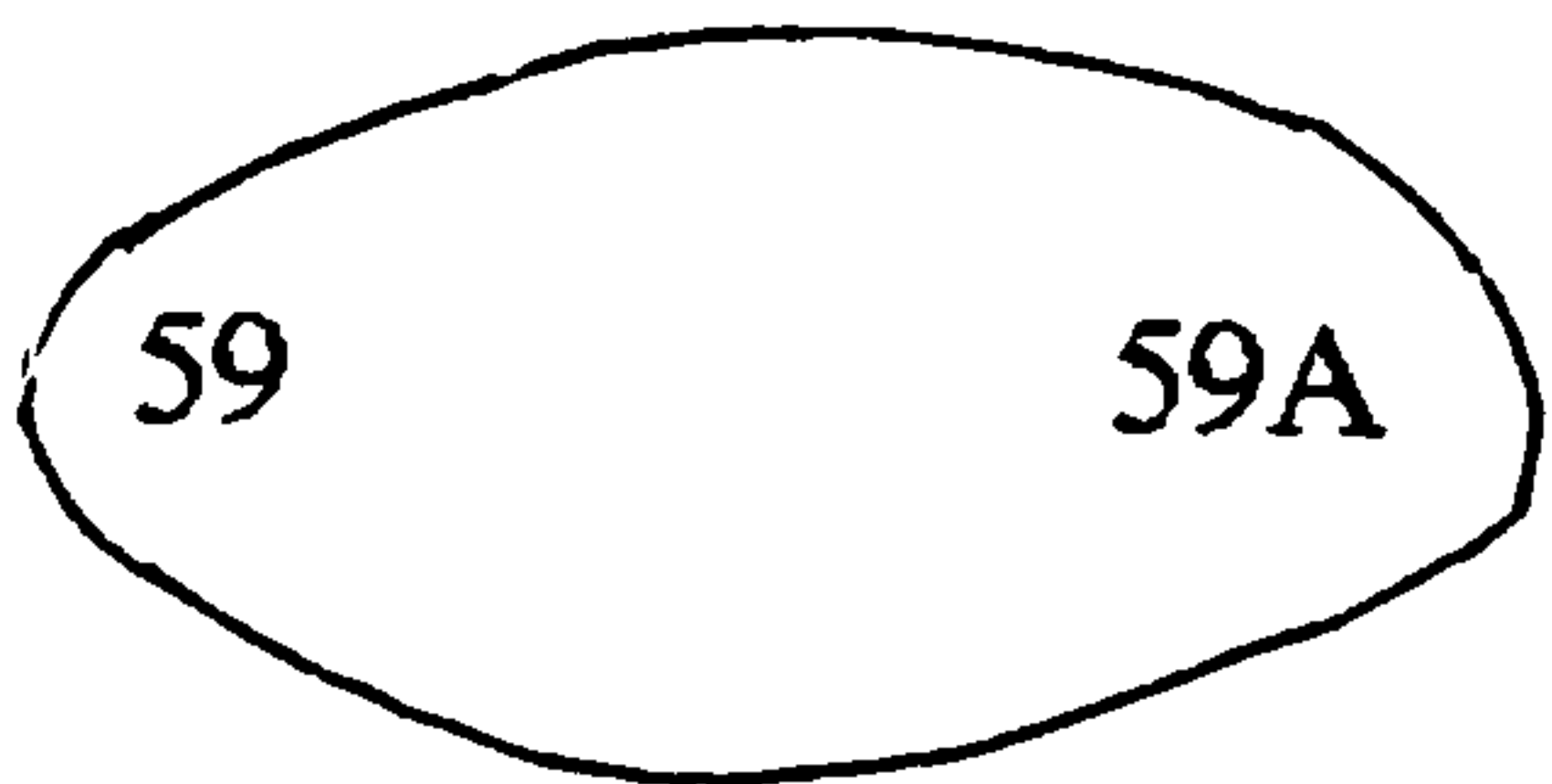
G



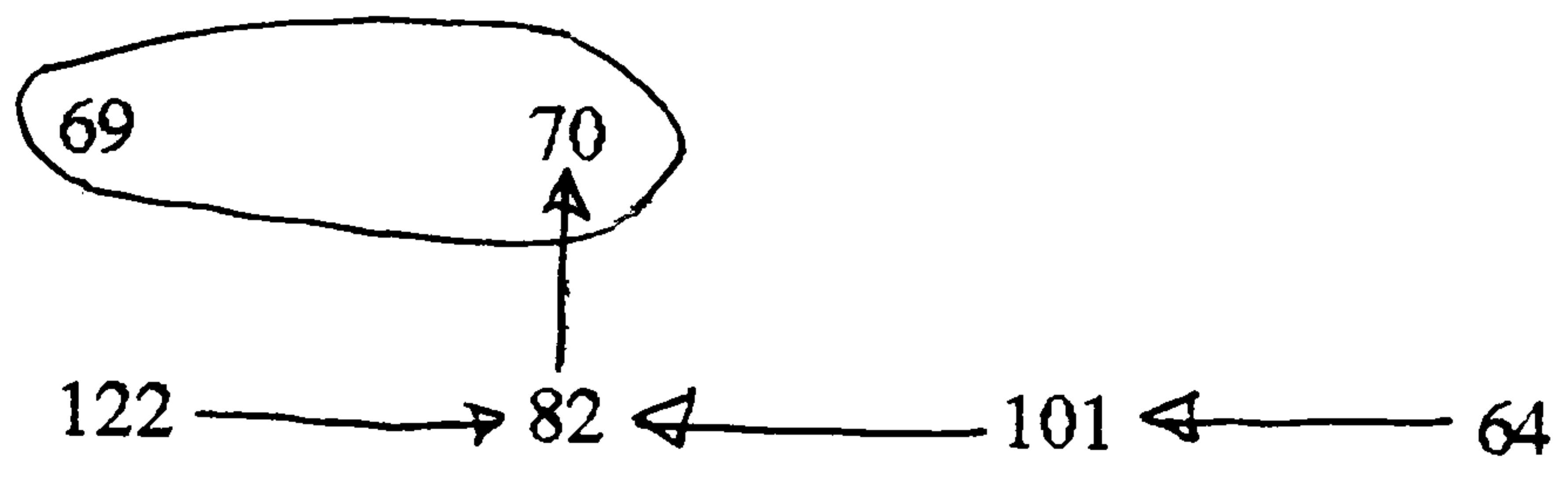
H



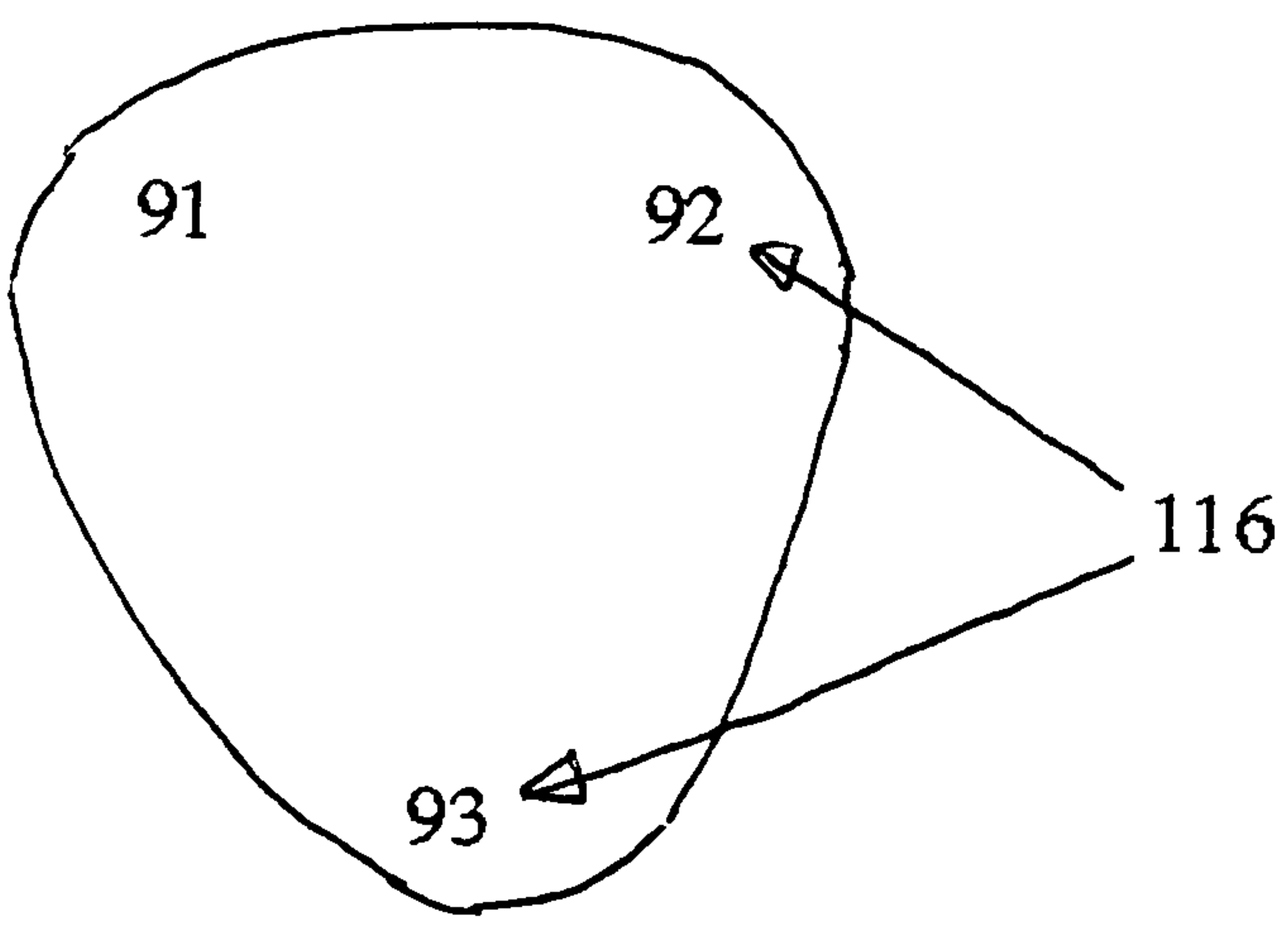
J



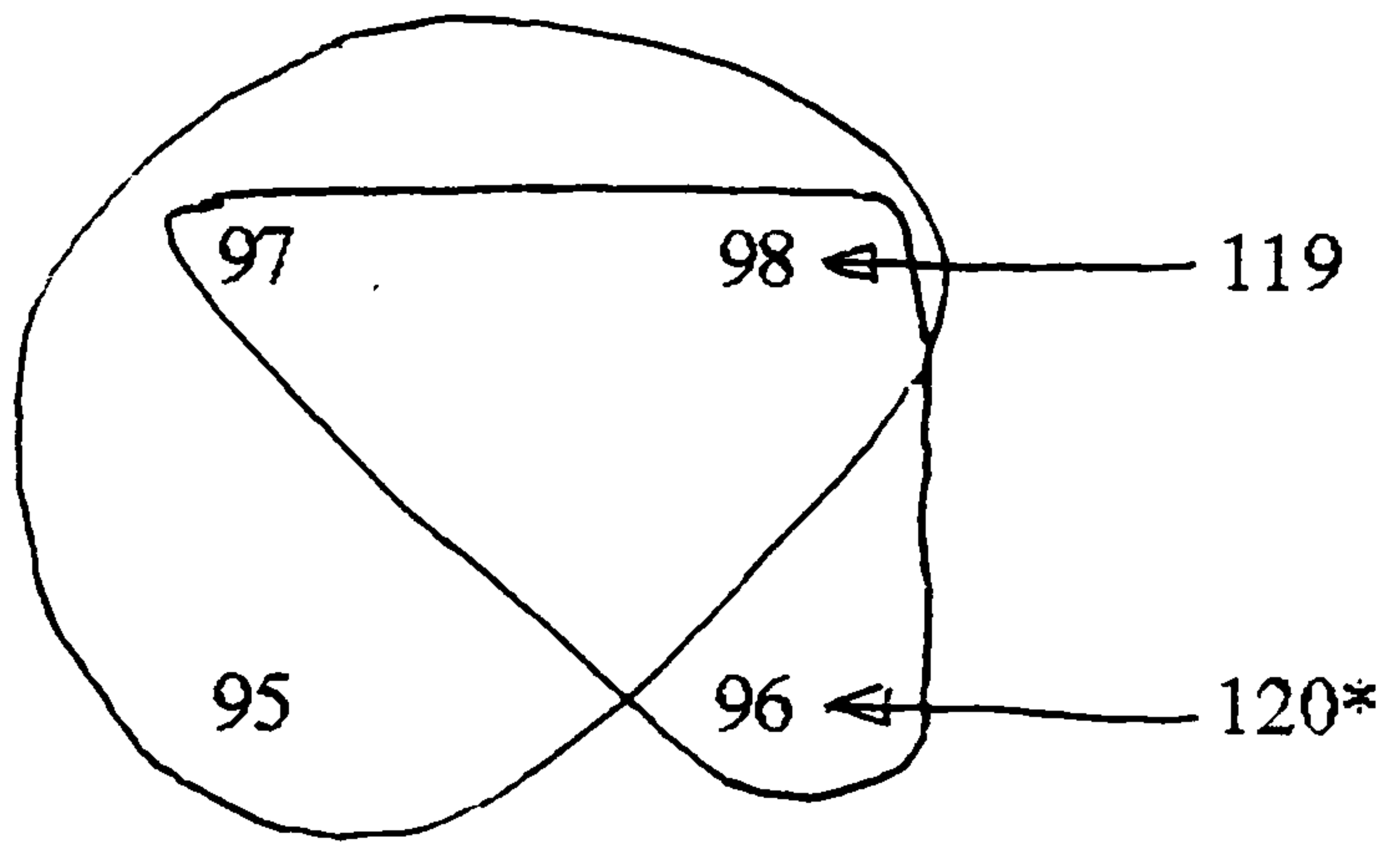
K



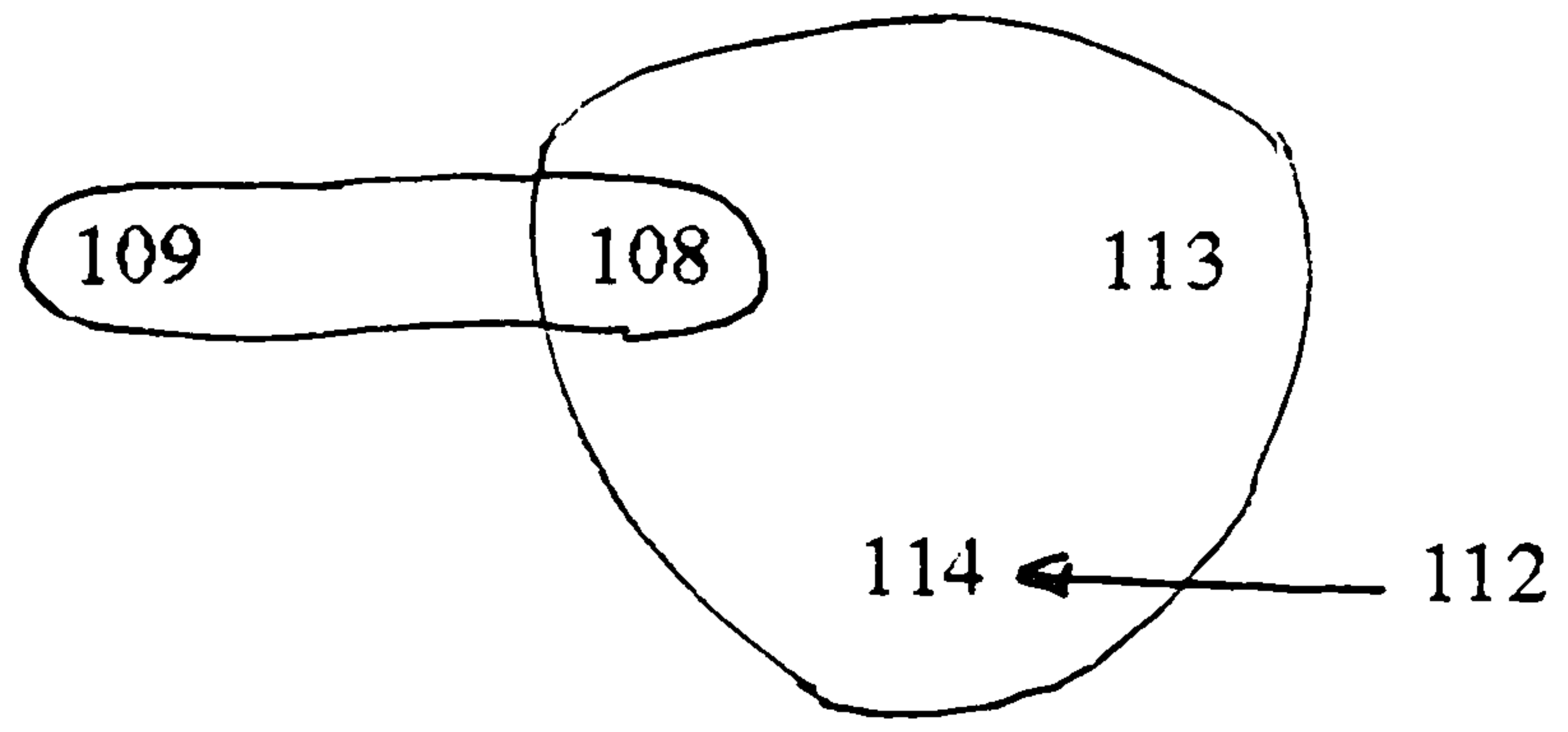
L



M



N



Apart from B, cluster K has the weakest similarities: only Alfriston 43 [69] and Guildown 46 [70] have a measure above 50 (60), and all the other links are relatively tenuous. This is therefore a ragbag cluster, or one that might have been better not formed.

Driffield [120] is shown twice, hanging on to Baginton [75] and Market Overton [96]. Since both links are weak (similarity measures both 32), this was not considered strong enough to link together clusters G and M.

The resulting clusters range from minimal (C and J, containing two brooches each) to large (18 brooches in H; 26 in G). Cluster G has a small 'nucleus' and several branches; only Bidford-on-Avon 88 [71] and Brighthampton [76] have similarity measures of over 50 with more than two others in the cluster. By contrast, cluster H has a very tightly-knit centre.

A strong feature of the analysis which led to these clusters is that no brooch has similarity measures of over 50 with brooches in more than one cluster. Even if measures of exactly 50 were taken into account, the effect would be marginal: of the 17 such measures (ignoring that between nos 11 and 12), 14 would merely reinforce the internal cohesion of clusters already established. The three exceptions (Unknown site [39] - Market Overton [56], Alfriston 43 [68] - Guildown 46 [70], Linton Heath 21 [86] - Market Overton [96]) would create only small links between clusters E and H, G and K, and G and M respectively.

12.3 Discussion and evaluation

The procedure described above is discussed and evaluated in this section, first in terms of the relevant criteria from among those set out in section 8.1, then in terms of the value of the results obtained. In the following section the results are further evaluated through a comparison with previous classifications.

The criteria taken from section 8.1 are that a new methodology should

- be fully and clearly explained
- be implemented consistently
- keep the devising of classifications methodologically distinct from the deriving of chronologies from them
- enable classifications of different artefact-types to be devised independently
- reduce the element of subjectivity to a minimum.

Explicitness and consistency

Of all the procedures described in this section (indeed, of almost all of those described in this thesis), this is the first about which it has been possible to be fully explicit: all the stages in the method, and all the states through which the data passed, are described in this chapter or its Appendices, and are open to inspection, cross-checking and replication. As far as is humanly possible, the procedures have also been carried out consistently.

Independence

No hint of chronological reasoning was used during the devising of the classification, and it could be used entirely separately for different artefact-types.

Objectivity

As far as the calculation of similarity measures from the matrix of brooch features is concerned, the aim of objectivity was achieved fully, since the method is purely arithmetical. Where other stages are concerned, however, the claim to objectivity must be moderated somewhat.

The partitioning of a typical GSHB into fields relied mainly on previous work of experts, and therefore assumed that a consensus between experts is reliable, but also incorporated two minor modifications which were introduced for the present analysis and were therefore more subjective. Once the fields had been defined, however, the analysis of which fields were present on each brooch was a largely objective matter. The description of the decoration on the fields, and enumeration of the variants, again relied on previous

expert analyses, but since Leeds' and Hines' descriptions largely agree the possibility of subjective error was somewhat reduced. The identification of which variants were present on each brooch was to an extent subjective, but probably not much more so than the identification of which fields were present on each brooch. So far, therefore, some subjectivity was present, but it is difficult to see how it could be reduced very far. There will continue to be room for debate about how many fields should be recognised on GSHBs, about what the various decorative variants are, and about which are present on each brooch, so that each scholar coming to the material may make some modifications, just as Hines modified the Helgö scheme of analysis of the B-elements.

As already mentioned, the calculation of similarity measures was fully objective. Then, given the similarity measures and the description of the clustering technique, no result other than that obtained should emerge from a re-application of the technique. However, the use of a similarity measure of 50 as the effective cut-off point in constructing the groups was a matter of judgment which needs justifying. Pragmatically, it might be said that it worked; the amount of overlap between groups (as distinct from hangers-on) was either small or nil, depending on whether or not similarity measures of exactly 50 were used. A more principled justification would be that it would be strange to create groups where any members had fewer than half of their features in common with at least one other member; this was, after all, one of the grounds on which Leeds was criticised in chapter 4.

Overall, therefore, it may be claimed that the amount of subjectivity in the method was low, and possibly also that it was lower than in any comparable previous method of classification.

Evaluation of results

The specially-devised method of calculating similarity measures appeared to prove its worth: it produced measures for every pair of brooches in the inner corpus, and did so without assumptions having to be made about the relative importance of particular features.

The result of the similarity clustering was apparently largely clear-cut. The qualification 'apparently' is needed because the preceding discussion has shown that this description properly applies only to the groups, and then only if similarity measures under 51 are ignored. Of the 13 clusters, 11 do have a central group formed from similarity measures over 50. However, these 11 central groups contain only 66 brooches (69%); the remaining 29 brooches are fitted in with links of 50 or less. This procedure reinforces the apparent external isolation of the clusters. But if all similarity measures down to 27 (the lowest used to attach a 'loose' brooch to a cluster) were taken into account, the clusters would not appear as distinct as Figure 12.3 suggests. Probably every cluster would have weak links of this sort with at least one other, more likely with several. This reinforces the spatial image reached at the end of the analysis by form in the previous chapter: some clusters might be fairly distinct (and have dense centre groups), but many would straggle towards each other in one or more dimensions.

What this analysis also suggests (again) is that it would be highly problematic to determine which dimension, if any, of this multi-dimensional artefact universe might correspond to time.

12.4 Comparison with Leeds' and Hines' classifications

The clusters shown in Figure 12.3 were formed by a largely objective procedure: how closely do they compare with the groups formed more subjectively by Leeds and Hines? The data for this comparison are given in Table 12.1, where hangers-on are indicated by asterisks.

In Table 12.1 the new clusters are listed in the same order as in Figure 12.3. Driffield [120] is shown only in cluster M, because of the better fit with Hines' group XXII. The groups to which Leeds and Hines allocated the brooches are indicated. Fourteen of the 95 brooches in this set were not allocated to groups by Hines: the more peripheral categories to which he allocated them are shown.

In his text (though not in his Plates) Leeds divided some of his groups into subgroups:

- A3 into subgroups (a), (b), (ci) and (cii)
- B1 into 'normals', and 'hybrids' 1, 2 and 3
- B8 into subgroups (i) and (ii).

All of these subgroups are shown in the Table .

Hines also divided some of his groups (I, II, III, IV, XXII) between his chronological phases. However, since the fit between the new clusters and Hines' groups was already very close, none of Hines' subgroups are shown in Table 12.1.

Also marked in the Table are cases where all or most of the brooches in a Leeds or Hines group or Leeds subgroup fell within one of the new clusters. (This is not indicated for Leeds' subgroups A3(b) and B1 hybrids 2 and 3 or for Hines' groups XII and XVIII, each of which consists, within the inner corpus, of only one brooch - it was considered that the amount of correspondence would be artificially increased by counting such mini-groups.)

Of the new clusters, only K showed no tendency to agree with any of Leeds' or Hines' groups, but as already pointed out, in the new classification this cluster is marginal.

In calculating the amount of correspondence between the new clusters and Leeds' groups, it was felt to be unreasonable to count the two complete brooches within his 'B unclassified' set: the effective total for this comparison was therefore 93. Of the relevant groups in Leeds' classification, only A2, A4, B4, B5 and B7, comprising 25 brooches (27%) fell completely within new clusters. However, subgroups A3(a), B1 normals and B8(i), comprising 19 brooches, also fell completely within new clusters: these raise the correspondence to 44 brooches (47%). Moreover, eight of the 11 members of subgroup A3(cii), and seven of the eight members of group B3, fell completely within new clusters: if these are included, the correspondence rises to 59 (63%).

Leeds' groups B2 and B6 and subgroups A3(ci), B1 hybrids 1 and B8(ii) showed little correspondence with the new clusters.

Table 12.1 Comparison of new clusters with Leeds' and Hines' groups

New cluster		Brooch no	Leeds' group	Hines' group
A	8 *	A2	III	
	9	A2	III	
	10	A2	III	
B	11	A3(a)	IV	
	12	A3(a)	IV	
	13 *	A3(b)	IV	
C	14	A3(ci)	IX	
	15	A3(ci)	IX	
D	16 *	A3(ci)		indiv.
	30	A3(cii)	XIX	
	31	A3(cii)	XIX	
E	17 *	A3(ci)		indiv.
	32	A4	XVII	
	33	A4	XVII	
	34	A4	XVII	
	35	A4	XVII	
	36	A4	XVII	
	37	A4	XVII	
	39	A4	XVII	
F	18 *	A3(ci)		indiv.
	19	A3(cii)	XV	
	20	A3(cii)	XV	
	21	A3(cii)	XV	
	22	A3(cii)	XV	
	23	A3(cii)	XV	
	25	A3(cii)	XV	
	26 *	A3(cii)		indiv.
	29 *	A3(cii)		indiv.
	62 *	B1 hybrid 1		indiv.
G	27 *	A3(cii)		small
	66	B2		I
	68	B2		I
	71	B3	VI	
	72	B3	VI	
	73	B3	VI	
	75	B3	VI	
	76	B3		I
	79	B3		I
	80	B3		I
	83	B4	II	
	84	B4	II	
	85	B4	II	
	86	B4		
	87 *	B4	II	
	88 *	B4		I
	89 *	B4	II	

	90 *	B4	XII		
	102 *	B6			small
	103 *	B6		I	
	104	B7	XIII		
	106	B7	XIII		
	107	B7	XIII		
	107A *	B7	XIII		
	123 *	B unclass.			miscell.
H	41	B1 normal	XVI		
	42	B1 normal	XVI		
	45	B1 normal	XVI		
	46	B1 normal	XVI		
	47	B1 normal	XVI		
	48	B1 normal	XVI		
	49	B1 normal	XVI		
	50	B1 normal	XVI		
	51	B1 normal	XVI		
	52	B1 normal	XVI		
	54	B1 normal	XVI		
	55	B1 normal	XVI		
	56	B1 normal	XVI		
	57	B1 normal	XVI		
	58	B1 normal	XVI		
	60 *	B1 hybrid 1			indiv.
	63	B1 hybrid 2	XVIII		
	67 *	B2		I	
J	59	B1 hybrid 1	XIV		
	59A	B1 hybrid 1	XIV		
K	64 *	B1 hybrid 3			indiv.
	69	B2		I	
	70	B2		I	
	82 *	B3			small
	101 *	B6			small
	122 *	B unclass.			indiv.
L	91	B5	XI		
	92	B5	XI		
	93	B5	XI		
	116 *	B8(ii)		I	
M	95	B6	VII		
	96	B6	VII		
	97	B6	VII		
	98	B6	VII		
	119 *	B8(ii)	XXII		
	120 *	B8(ii)	XXII		
N	108	B8(i)	V		
	109	B8(i)	V		
	112 *	B8(ii)	X		
	113	B8(ii)	X		
	114	B8(ii)	X		

One larger similarity between the new classification and Leeds' should also be noted, however. The division between clusters A-F and G-N corresponds almost exactly to that between Leeds' classes A and B: of the full inner corpus of 95 brooches, only Barrington A [27] and Market Overton [62] fall on the 'wrong' side. This therefore also corresponds almost exactly to Leeds' division between undivided and divided footplate.

(As noted in section 2.4, Leeds himself placed two brooches, Little Wilbraham 6 [26] and Barrington A [27], which both have divided footplate, on the 'wrong', undivided, side of his own line. In the new clusters, no. 27 is on the 'divided' side, but no. 62 has taken its place, so that there are still two brooches with divided footplate on the 'undivided' side.)

It was stated above that 'the overriding significance that Leeds attached to the presence or absence of the footplate median bar ... was not built in as an assumption' in this analysis. It is all the more significant, therefore, that this feature nevertheless came through very powerfully in the results, again as in those of Leigh and Hines. The reason appears to be that the presence of the median bar so constrains the decorative possibilities of the footplate that a constellation of other features correlates very highly with it (cf. Leigh, 1980: 44). Correspondingly, the absence of the median bar appears to permit the use of a largely different set of decorative features.

Doran and Hodson (1975: 281ff.), as cited by Leigh (1980: 44), raised an objection (in the context of seriation) to the use of correlated data. This objection might be considered relevant also to the use of correlated data in analyses of similarity, such as this. The objection was that the use of data that were already positively correlated would weight the analysis towards a particular conclusion. This objection seems to the present author misplaced: classification by decorative features, whether by manual or computer methods, inherently seeks positive correlations, and removal of apparently correlated features would make the discovery of them more difficult.

The amount of correspondence between the new clusters and Hines' groups is even higher than between the clusters and Leeds' groups. All the relevant brooches in Hines' groups

II, III, IV, V, VI, VII, IX, X, XI, XIII, XIV, XV, XVI, XVII, XIX and XXII fell completely within new clusters. These comprise 68 brooches, or 84% of the 81 brooches from the inner corpus which Hines allocated to his main groups. Also, of the 11 brooches in Hines' group I, seven fell within cluster G: if these are included the correspondence rises to 75 brooches (93%).

However, this high degree of agreement is boosted by the exclusion of the 14 brooches from the inner corpus which Hines did not classify: if these are counted in, then the amount of agreement falls to 72% excluding group I, or 79% including it. Yet it is noticeable in Table 12.1 that all 14 of Hines' peripheral brooches are also hangers-on in the new clusters, so that their problematic or marginal status actually reinforces the correspondence between this classification and Hines'. This suggests that Hines was right to place such a relatively high proportion of his corpus in peripheral categories, and that brooches which are difficult to place in a classification should be left outside it rather than forced in.

Since the analysis which resulted in this conclusion was largely based on Hines' analysis of the typical GSHB into fields, and of the decorative variants found on them, it might be argued that this close correspondence is unsurprising, and indeed artificial. However, the division into fields was neither unique to Hines - it is part of the general approach to GSHBs - nor copied slavishly from him. And the listing of decorative variants owed almost as much to Leeds as to Hines - see again the list of features compiled in Appendix 2 and used in section 4.1 in the analysis of Leeds' consistency in applying his own apparently principal method. The lower amount of correspondence between this classification and Leeds' than between this classification and Hines' should be seen as further evidence of the unsystematic nature of Leeds' approach, and the much greater systematicity and objectivity of Hines'. The method reported in this chapter should therefore also be seen as a formalisation of Hines' approach, largely justifying his classification on a more objective basis still.

12.5 Conclusions

From the results of the analysis presented in this chapter, and from the comparison of those results with previous work, it may be concluded that the form of similarity analysis used is a promising way of producing largely objectively-derived classifications, and much more promising than the procedures tried out in the two previous chapters. Where it is used on an artefact-type for which existing classifications exist, it may also serve as a check on their systematicity and objectivity, as in this case with Leeds' and Hines' results. From that check it seems legitimate to conclude, first, that Hines' identification of problematic brooches was impeccable; secondly that, so far as the members of his corpus which are also members of the inner corpus are concerned, virtually all of his groups were well constructed and homogeneous. The only significant exception was his group I, which he himself conceded was heterogeneous (Hines, 1984: 114).

However, it must be stressed that this validation of Hines' findings applies strictly and only to his classification, and not to the chronological inferences he drew from it. As stressed in chapter 9, it is actually more logical to treat the groups discovered in the classification of any one artefact-type as free-floating until classifications of several artefact-types have been rigorously established and can be compared. Therefore Hines' allocation of his groups to a two-dimensional matrix in which one dimension corresponded to time and could be divided into three (possibly three and a bit) phases, and the other dimension corresponded to contemporaneous variation, seems premature. Leigh's attempt to arrange his 98 brooches individually in a broad chronological sequence seems even more premature. It would seem more advisable at present to refrain from any sequencing or even phasing of SHBs at all, and to consider them as adrift in a 'brooch galaxy' of which the name is known - Style I - but the number of relevant dimensions is not. Within it, however, the members of similarity groups do at least drift together.

In fact, even this conclusion needs to be narrowed, in the light of the principle enunciated in section 9.2, namely that similarity implies contemporaneity. That principle was adopted as a necessary assumption for justifying the search for similarity groups within

one artefact-type as a stage in the larger search for find-horizons. But if artefacts within groups are to be considered so similar that they can be assumed to have been made at about the same time, and used as the basis of a search for horizons, how similar must they be? It seems logical to repeat what was said in section 9.2, namely that there must be a *high* degree of similarity. Within the procedure and results reported here, a high degree of similarity is defined as a similarity measure of over 50.

But what then of brooches whose highest similarity measure is less than 51? The logical conclusion is that they should not be used. That is, they should be neither firmly allocated to groups nor used in the further search (when it comes about) for horizons. They have to be left in limbo, waiting for new finds with which they can form groups.

In terms of the clusters presented in Figure 12.3 and Table 12.1, this means that

- the brooches shown as hangers-on to clusters are those in limbo, those which are not to be firmly considered contemporary with any others and which are not to be used in the search for horizons;
- the brooches shown as members of the central groups within clusters can be safely considered as contemporary and can be used in the search for horizons, for evidence which will at least link them to other groups adrift within Style I.

But this assumes that a search for horizons is feasible; the following chapter takes up both this problem and other aspects of how progress can continue to be made.

PART F: WHERE NEXT?

Chapter 13: The next steps can all be described, and some can be taken

13.1 Progress made, needed and possible

The progress made can be summarised as follows. The need to undertake a radical re-shaping of the theory and methodology of archaeological classification for the purpose of unsupported chronological determination has been demonstrated. A strategy for doing this has been proposed, and the first three stages of it exemplified for one class of metalwork. The classification of GSHBs which has emerged from this procedure appears convincing, both in its own right and through comparison with a previous classification, and in particular is untrammelled by the chronological preconceptions of typology. The revalidated groups of GSHBs could be used in the search for further progress.

The progress needed can also be concisely summarised. Stage 3 of the new approach, the classification-by-decoration procedure reported in chapter 12, should be fully scrutinised and evaluated by others, and if necessary applied even more systematically to the classification of GSHBs. It should also be applied to other artefact-types; the obvious next candidate would be the Kentish SHB corpus. Plans should be made for assembling reliable, objectively-achieved, non-typological classifications of enough artefact-types to establish a basis for stages 4 and 5 of the new strategy; as part of this planning, the artefact-types to be concentrated on should be chosen to maximise the set of reliable closed finds involved. All of this appears to be possible with the information and procedures available now.

Progress beyond that is likely to be much more difficult. In the revival and adaptation of Montelius' actual method sketched in chapter 9, it was envisaged that after sufficient artefact-types had been classified rigorously and independently it would be time to use the classifications in an attempt to produce either a seriation or a set of sequenced find-

horizons from an analysis of closed-grave assemblages. But only one such fresh classification has been done, and even when all that was suggested in the previous paragraph is done, the time may still not be right for moving on to the search for horizons, because of the shortage of closed finds. Nevertheless, some progress may be possible, not in moving on to that stage, but in analysing the difficulties and in sketching solutions.

In the next two sections, therefore, two related aspects of the problem of relying on closed finds to produce a relative early Anglo-Saxon chronology are discussed, namely the extent to which it can be assumed that objects found in the same grave were made at about the same time, and the scarcity of reliable closed finds from this period. Then in further sections possible alternative ways of establishing contemporaneity are discussed, involving workshop, artisans', toolmark and pottery groups and European parallels.

13.2 The contemporaneity of artefacts found in closed-grave assemblages

Can it be assumed that objects buried together were made at about the same time?

Attitudes to this problem range from the optimistic:

The ... presumption of practical contemporaneity ... is possible for most dress-accessories associated in individual graves
(Hines, 1984: 25)

to the ultra-cautious in estimating the gap between the separate manufacture of the objects found together and their burial:

You may fix your typological series without a flaw; you may fix the dates of manufacture of objects beyond a doubt; but you cannot tell within a generation when the things were buried in the ground.
(Lethbridge, 1956: 114)

This problem was analysed in an important book by Almgren (summarised by Wilson, 1959) which tackled the difficulties inherent in providing chronologies for archaeological periods which do not possess objective indicators of their historical progression. Almgren studied 450 bronze keys of post-Roman date found in Northern and Western Europe and came to some interesting conclusions. He pointed out that students of periods for which

there is no external chronology and who have to rely on grave-goods to set one up have to be very careful about assuming that goods which were buried together were in use contemporaneously. He demonstrated that an artefact could have been deposited in a grave at any time within a 50-year period (if one included time of manufacture and time of use):

An object could then be placed in a grave in the first year of manufacture or in the last year of a generation which bought it in the last year of manufacture - we have therefore a margin of uncertainty of at least half a century.
(Wilson, 1959: 113)

Then Almgren showed that another artefact found in association with it could, if there were no other dating criteria available, be as much as two generations earlier or two generations later than the original artefact. He argued from this that:

In a combination of two finds this margin of uncertainty must be even greater if we use the normal methods of dating type E by type A through the link $A+B=B+C=C+D=D+E$. In such a case the margin of uncertainty must grow with every link until exact dating statements are useless.
(Wilson, 1959: 113)

Finally and most importantly Almgren showed

the likelihood that a manufactured object of the kind used for dating by association makes its most frequent appearance in grave-finds at the end of the period of manufacture, presuming either an even or uneven annual production.
(Wilson, 1959: 113)

(A similar conclusion was reached by Leigh (1980: 17-18). The conclusion has profound and probably disastrous implications for Hines' belief (1984: 180) that he had detected individualistic production early in the history of GSHBs and mass production late: if Almgren's and Leigh's argument is valid, then the fact that fewer early representatives of a type survive may simply be an artefact of the mechanisms of survival.)

Almgren then went on to conclude that the deposition of any particular artefact could have taken place at any time within a period of a hundred years, if one allowed a generation for manufacture and a generation for use, or possibly longer if one allowed for the heirloom

factor. So two conclusions can be drawn from Almgren's work: dating the deposition of an artefact should be separate from speculation about its date of production; and artefacts that were buried together may have been manufactured at vastly different times.

Both of these caveats have been accepted and applied by most practising archaeologists. Differentiating between the dates of deposition and production forms part of the interpretation of most reports on Anglo-Saxon cemeteries (cf. especially Welch, 1983), and most archaeologists are aware that finding artefacts within the same grave-assemblage does not automatically mean that they were produced within the same narrow period. The only way to establish a greater likelihood of artefacts that are found together having been made at the same time is precisely Montelius' original insistence on not accepting single examples of co-occurrence, and placing ever greater reliance on associations the more often they occur.

Wilson (1959) argued that statistical methods need to be used to establish whether the co-occurrence of two artefact-types is significant or can be accounted for by chance: but this seems impractical for the material being discussed here, for two reasons. First, there is the purely pragmatic consideration that the amount of material may well not be large enough to support such statistical approaches. More rigorously, it can be argued that, even if the quantity of material were much larger, it would still not be a random or representative sample of the material originally produced; without this characteristic it is doubtful that it would be logically justifiable to apply statistical techniques to it at all.

It therefore seems justified to take Montelius' original line, without defining too precisely how often a co-occurrence needs to be repeated before coincidence is judged to have been excluded. A modern re-statement of the same principle is the following:

The most significant characteristic of the cemetery at Spong Hill is its size. Several thousand cremations are likely to be excavated... Size is important because the value of conclusions increases with the size of the sample on which they are based... Archaeological site distribution maps can never be complete, but at least if based on a large number of objects they may show a pattern rather than a random spread. Single examples of association between different types of objects may

represent the burial of an old object, an heirloom even, together with a new one, but recurrence of the same association increases the probability that the types were contemporary.
(Hills, 1977: 30-1)

13.3 The scarcity of, and alternatives to, closed Anglo-Saxon finds

However, the principle that has just been re-affirmed renders even more bothersome the scarcity of closed finds from the early Anglo-Saxon period. Leeds (1949: 108-10) could find only 19 associations with other metalwork among his 147 brooches, and one of those, Holdenby [143], was for a square-headed/cruciform hybrid, and another, Gilton 48 [4], was called into question by Leigh (1980: catalogue entry). Hines (1984: 180-1) did not set out to provide a list of associations, but mentioned that about 20 of his GSHBs had associations with saucer or applied brooches, and named 10 of them. Because one of these was already in Leeds' list, the total of reliable associations for GSHBs rises to 26.

Inspection of Leigh's (1980) catalogue revealed that, of his 99 definitely or possibly Kentish SHBs, only 31 have reliable grave associations, of which only 23 are other forms of classifiable metalwork, and two of those are also in Leeds' list. The full list of 47 brooches with associations is given in Table 13.1. Within the Table asterisks indicate the 15 brooches which belong to the groups which emerged reliably from the classification procedure described in chapter 12, and which are therefore firm candidates for inclusion in the search for horizons or sequences. Only four others in the Table and involved in that classification failed to emerge as members of groups (nos 116, 26, 101 and 103).

The picture is probably not much better for other artefact-types. In contrast, for the analysis of his 1300-year-long period, Montelius had information on 342 closed finds. Though the early Anglo-Saxon period is only about one-sixth as long (or about as long as each of Montelius' subperiods), this does not mean that a relative chronology of the early Anglo-Saxon period could be based on as few as (approximately) 60 closed finds. Not only would this certainly produce too few examples of most associations to be reliable, but both archaeologists and historians would want, ideally, a reliable subdivision of the

Table 13.1 SHBs with reliable associations (N=47)

Non-Kentish (N=26)	both (N=2)	Kentish (N=23)
Hines (1984)	Leeds (1949)	Leigh (1980)
Alveston Manor 5 [116]	Finglesham D3 [1]	
Berinsfield 102	Bifrons 41 [3]	
Beckford A11	Linton Heath21 [86] *	Sarre 4
Bidford-on Avon 88 [71] *	Little Wilbraham 6 [26]	Mucking 99
Barrington A11 [21] *	Lakenheath [14] *	Bekesbourne 30
Great Chesterford 2	Linton Heath 9 [9] *	Bifrons 42
Linton Heath 40 [23] *	Tuddenham [10] *	Bifrons 51
Morningthorpe 371	Guildown [70] *	Bifrons 63 [2]
Little Wilbraham 111	Holywell Row 11 [11] *	Bifrons 64
	Luton [95] *	Chessell Down 40
	Linton Heath 32 [91] *	Chessell Down 45
	Little Wilbraham 158 [104] *	Chatham Lines 2
	Little Wilbraham 3 [113] *	Chatham Lines 6
	Nassington 5 [107] *	Chatham Lines 18
	Hornton [101]	Dover 20-1
	Coleshill [103]	Finglesham E2
Little Wilbraham 40 [114] *		Finglesham 203
		High Down 2
		Lyminge 39
		Lyminge 44
		Lyminge 60
		Mersham 1
		Stodmarsh 1

period into several recognisably distinct subperiods. For the present, the number of available reliable closed finds has to be recognised as woefully inadequate to provide this.

Part of the solution to the shortage of reliable associations will undoubtedly have to be the discovery and careful excavation of new closed graves with assemblages of classifiable artefacts. For this process to provide enough evidence for horizoning or seriation, however, will certainly take a very long time.

Meanwhile, therefore, there has to be an intensive search for alternative methods of showing that certain artefacts were contemporary. In the light of all the criticism, earlier in this thesis, of subjective methods of deducing chronologies from perceived developments in styles of decoration, it is only logical to insist that such alternative methods must be based on objectively demonstrable data. There is therefore no question of proposing the resuscitation of art-historical speculation about chronology, whether applied to the sequence of individual brooches (Leigh) or of groups (Leeds and Hines).

Leigh did also, however, attempt to identify workshop groups and individual artisans' products, and these aspects merit consideration. As early as 1933 Röder made the claim that some metal objects ornamented with chip-carving might be identified as coming from an individual artisan or single workshop, but until Leigh's work very few technological analyses had been undertaken which might determine whether connections might be made between similarly chip-carved artefacts in Britain.

Workshop groups

Leigh's attempt to define workshop groups was, like most of his chronological speculation, based solely on artefact decoration. It has already been pointed out, however, that his enquiries, using the same method in both cases, produced the odd result of possibly 17 workshops outside Kent but only one in Kent. To the Kentish workshop he ascribed all 86 of his definitely Kentish brooches - but he also concluded that about 11 of those had been manufactured in southern Scandinavia and imported to Kent. If the Kentish workshop existed, it would also have had a long life, since the timespan of Kentish SHBs,

Leigh deduced, was about 80 years or, if only those manufactured in England are counted, still about 60 years. Also, at no point did Leigh define what he meant by a workshop, or whether the concept he had was compatible with the possibility that some artisans were itinerant. When the concept of a workshop is itself so ill-defined, the possibility of identifying workshop groups seems remote.

Artisans' groups

Leigh also attempted to uncover artisans' groups. His method was essentially the same as for deducing both artefact sequences and workshop groups; that is, it was based on particular features of artefact decoration, though of a type, or level of detail, which he considered was evidence of a much more individualistic style than the generality of decoration found on SHBs. He felt he was able to identify three artisans' hands.

The attraction of this procedure for those seeking chronological information is the possibility that it might yield links not only among artefacts of one type, but also between artefacts of different types, and thus begin to link groups within classifications of different artefact types into artefact-group-horizons. But it has to be said that the basis for the identification of such links is so far just as subjective as the basis for the identification of workshop groups and artefact sequences.

Moreover, attention has already been drawn (in section 4.3) to the confusion within Leigh's statements about how many artisans he could identify, and how many of the Kentish brooches they had each created. In addition, his chronological statements about them (1980: 498-9) seem confused. To the 'Kentish Master' Leigh attributed some of the Jutlandic pieces and some of the earliest pieces actually made in Kent; this implies the period between, say, c.480 and c.510. Leigh also thought that this artisan's activity did not overlap with that of the other two, both of whom he thought began work perhaps about 530. One he thought might have worked until c.560, the other until c.570. But to both men, Leigh ascribed brooches which on his own dating would be considerably earlier than 530; this is particularly true of the former of them, to whom he attributed items such as Sarre 4-1 - this he put earlier than Howletts 2 and Dover 1, which in turn he variously

dated as 'between 510 and 530' or 'about 530'. Given this degree of confusion, there seems little point in pursuing artisans' groups on the basis of speculation about brooch decoration.

13.4 Toolmark links

However, Leigh did discover another way of linking brooches. This involved the identification of marks produced on different brooches by the same tool. One such identification made by Leigh has already been mentioned, namely his finding of marks made by the same tool on the two Kentish SHBs, Chessell Down 12 and Stowting 1 (Leigh, 1980: 106, 269). This is clearly a much more objective approach than any based on decorative style. It allows the assignment of the two brooches concerned almost certainly to the same generation. Within the limits of the term as used in archaeology, these two brooches are therefore contemporary; they were manufactured in the same period, and quite possibly (though not certainly) in the same workshop. If the form of classification described in chapter 12 were applied to the Kentish corpus, and if, as seems likely from Leigh's estimate of the great difference (other than the toolmark) between them, these two brooches were to turn up in separate similarity groups, then those two groups would have been shown to be almost certainly contemporary.

Leigh has continued to investigate brooch-linking through tool-marks, but his

search among the Kentish square-headed brooches has so far revealed only one certain match between non-circular punches on different brooches [that already mentioned]...

Among the circular impressions, it has been possible to distinguish on the basis of size alone three possible groups of brooches consisting of two, five and four brooches respectively ... in which the members within each group share punching with what may perhaps have been the same circular-tipped tool...

Many brooches bear the impressions from more than one type of tool... There are thirty pairs of brooches ... which bear the marks of at least two types of tool. Among these ... there appear to be nine instances of the same two tools having been used on more than one brooch.

(Leigh, 1990: 111-4)

Although the number of brooches which have been found with similar distinctive marks is small so far, and does not yet bring the investigation near to providing definitive results, it is necessary to agree with Leigh that

we shall get a good deal closer once the whole collection of punch-decorated objects in Anglo-Saxon England has been carefully studied.
(Leigh, 1990: 114)

This form of identification of toolmark links would appear to be the only objective way to make progress in this field, and to complement the analysis of closed finds. More archaeologists need to be aware, therefore, of the possibility of identifying toolmark links, and to ensure that materials that might be suitable for this form of analysis are identified and retained.

On a point of terminology, it is suggested that this method of attributing groups to the same period should be called by the term used in this section, 'toolmark links'. This is to distinguish them from workshop and artisans' groups - those terms have become too identified with the form of subjective analysis mentioned in the previous section. Moreover, the term 'toolmark links' does name the form of evidence so described objectively; whereas to call them evidence of workshop groups is immediately to introduce a subjective interpretation.

13.5 Pottery groups

Pottery remains are much more plentiful than metalwork, and the identification of artisans' groups in pottery assemblages has been the subject of much enquiry for many years. Myres was the first to suggest that individual potters might be identified through their products. In 1937 he drew attention to four pots from Sancton cemetery which were connected through the use of five stamps and so were, he claimed, 'all certainly from the same hand' (1937: 293). Lethbridge followed the lead that Myres had given and in 1951 used stamps to identify three potters at Lackford, Suffolk. He was so confident of his identifications that he claimed: 'Stamps are the key to our Saxon pottery' (1951: 14). In 1969 Myres set out in his book *Anglo-Saxon Pottery and the Settlement of England* the products (connected by their use of stamps) which he felt illustrated the work of an

individual or a single workshop. Later this was followed by his *Corpus of Anglo-Saxon Pottery* (1977) in which he used an identical method to isolate the products of 56 potters. To some extent a re-analysis of the pottery in the East Anglian area by Green, Milligan and West (1981) led to the identification of two groups of pottery styles geographically located to the north and south of the region. As with Lethbridge these groups were identified through a study of pottery stamps and styles, but again like Lethbridge, no analysis was made of the ceramic fabric. All of these analyses were based on relatively small amounts of pottery, and led to Briscoe's (1981) warning that careful comparison is needed before pots can be assigned to a particular potter.

In contrast to the bases on which previous analyses had been based, the single cemetery at Spong Hill, Norfolk, produced several thousand cremations (Hills et al, 1987), each containing a cinerary urn. Some of the urns were decorated with stamp marks, and some of the stamp marks could be firmly identified on more than one urn. On this basis, approximately 14% of the urns could be assigned to groups, and the excavators identified 67 potters' groups, or many more artisans' groups than have ever been proposed for any type of metalwork. However, the groups could not be sequenced: they remain 'free-floating'. This is basically because the pots on which the marks are found are all, effectively, of one type. It might be that the pots could be analysed into groups on the basis of aspects of decoration other than the stamp marks, perhaps along the lines illustrated for GSHBs in chapter 12. If this could be done, then a form of seriation could be attempted, setting stamp mark groups along one axis and pot groups along the other. It remains to be seen whether this is feasible, since the pots might all be so similar that no sufficiently differentiated groups would emerge; but the possibility calls for investigation.

Meanwhile, however, it must be noted that no other Anglo-Saxon site has produced anywhere near the quantity of pottery needed for this form of analysis, and that this form of analysis has not been done, and may not be feasible, with the Spong Hill material. For the time being, therefore, the analysis of pottery, like the analysis of metalwork, is a possibility waiting to be explored.

13.6 European parallels

The last of the suggestions to be made for by-passing the scarcity of Anglo-Saxon closed finds is a speculation that may turn out to be a unfulfillable longing. It involves the European material, both continental and Scandinavian. It may be that the number of closed finds in Europe is substantially larger than in England, and that it provides a continuous series from c.350 to c.650. It is certainly the case, as was pointed out in the discussion of Böhme's and Haseloff's work in chapter 7, that a small number of Germanic coin-dated graves are available on the continent both early in the Migration Period and late in Style I and thereafter. If the classification method devised here were applied to appropriate categories of the European material, and such absolute dating evidence as is available were then used, a relative chronology for the whole period 400-600 and with pegged ends might emerge. Within this, the stylistic developments might be datable, or at least sequenceable, by objective means and without recourse to art-historical speculation. The sequence of European stylistic developments, more securely founded and more precise than the outline division into Nydam Style and Styles I to III, might then be usable for sequencing parallel stylistic developments in England. It would be a long detour, but one lives in hope.

13.7 Conclusions

This chapter has suggested that the objective of providing a fresh start in the classification of Dark Age metalwork for dating purposes has been achieved, and that progress can be made on this basis. The method of classification proposed could be further evaluated. The system of nominating a set of free-floating groups of each artefact-type as those for which firmer dating evidence is sought as a priority conforms to Montelius' original system. Progress can be made by collecting together the reliable closed finds available in England, by choosing from that collection the artefact-types most likely to be useful in future attempts at horizons, by renewing the classifications of those artefact-types along the non-typological lines sketched, and by intensifying the search for alternative ways of establishing contemporaneity.

Chapter 14: Overall conclusions and recommendations

14.1 General conclusions

The question that this thesis seeks to address is how to devise reliable classifications of Anglo-Saxon artefacts of the fifth and sixth centuries in order to provide an outline chronology for the period. By a reliable classification is meant one that is arrived at in such a way that any information that is derived from it reflects the situation as it was when the artefacts were made.'

That was the opening paragraph of chapter 1. How far has that aim been achieved?

It should be remembered that the aim was above all methodological. It was to devise and give theoretical justification for a method, and not necessarily to produce wholly valid results from that method. However, it can now be claimed not only that a method has been devised and justified, but also that it has produced its first tentative results. Those results take the form of a list of similarity groups of GSHBs whose members can with some confidence be considered contemporary with each other; confidence in the reliability of the groups was increased by their congruence with those of Hines (1984).

Along the way, two strong principles for archaeological classification emerged:

- (1) **Classification and chronology must be kept separate.** If classifications are to be reliable bases for chronologies, they must be devised without preconceptions about chronology. In particular, to use the same forms of evidence for creating classifications and for deducing chronologies appears to be a fundamental error.
- (2) **Classificatory methods must be as objective as possible.** If classifications are to be reliable bases for chronologies, they must be based as far as possible on replicable, public data, and not on the classifier's feel for the material. Reliance on subjective judgments, both art-historical and evolutionary, appears to be a second fundamental error.

Among the other conclusions reached were the following:

- that the two principles just stated apply not only to SHBs but to all forms of Dark Age metalwork
- that recent chronologies of metalwork decorated in Salin's Style I may be correct in overall timespan and in some details, but as a whole have not been proved correct beyond reasonable doubt
- that the interdependence of the chronologies of many of the forms of Anglo-Saxon metalwork disbars them from validating each other
- that continental chronologies should also not be relied upon for the time being
- that the principles of Montelius' actual original method of deriving chronologies from classifications via closed finds and find-horizons were sound, and, suitably adapted, offer a valid way forward
- that the methods of similarity measures and similarity clustering devised for this research and described and used in chapter 12 are good tools ready for use
- in particular, that the method of calculating similarity measures makes it possible to avoid weighting particular features and thereby building in biases
- that methods of clustering data which rely on computerised cluster analysis or on grouping by eye are unreliable.

14.2 Recommendations

Those involved in classifying early Anglo-Saxon artefacts, and even more so those involved in using classifications of early Anglo-Saxon artefacts for dating purposes,

should prepare for a period of retrenchment. The classifications currently in use are mostly in need of re-examination, and quite possibly substantial revision. Probably, attempts to attach even suggested dates to artefacts and their find contexts should also be suspended, or at least have stronger caveats attached than hitherto.

Among the tasks that need to be undertaken to allow re-emergence from this period of retrenchment are

- evaluation of the proposed new method of classification
- application of it to further artefact-types
- sifting closed finds ready for re-starting the search for subperiods within the Dark Ages
- making an urgent search for alternative indications of contemporaneity, especially toolmark links, and
- keeping all archaeological material that might possibly facilitate the search for such toolmarks, and re-examining as much already available material as possible as part of this search.

Meanwhile, it will be best to conceive of the fifth and sixth centuries in England, archaeologically, as composed of three phases of material:

- Phase 1, comprising all objects decorated in styles known or believed to be prior to Salin's Style I and floating before c.475
- Phase 2, comprising all objects decorated in Salin's Style I and floating between, say, c.475 and c.575
- Phase 3, comprising all objects decorated in styles known or believed to be later than Salin's Style I and floating after c.575.

Closer dating awaits completion of the programme of work just sketched.

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APPENDIX 1: Cross-referenced lists of SHBs in corpuses of Leeds (1949), Leigh (1980) and Hines (1984)

Appendix 1.1: List of brooches in Leeds' corpus

KEY: * = incomplete brooch
(*) = incomplete brooch that is nevertheless usable in analyses

§ = brooch also in Leigh's Kentish corpus - see Appendix 1.3

Where a cemetery name as given by Leigh or Hines differs materially from the form used by Leeds, the alternative name is shown in brackets.

Minor groupings in Hines' corpus: (e) = enigmatic
(i) = individualistic
(m) = miscellaneous
(s) = small
x = excluded

Status in present study: i = inner corpus
c = other members of common corpus
x = excluded

N.B. Where there is no entry in the 'status' column, the brooch is accepted as a GSHB but not included in the common corpus.

Leeds' group	Brooch no	Brooch name	Description of brooch if incomplete	Hines' group	Status in present corpus
A1	§1	Finglesham D3		x	
	*§2	Bifrons 63	lacks terminal lobe	x	
	§3	Bifrons 41-1		x	
	*§4	Gilton 48	lacks part of headplate and part of footplate	x	
	§5	Richborough (Leigh: Goldstone Cop Street)		x	
	§6	Chessell Down 6		(e)	
	7	Guildown 206		x	
A2	§8	Chessell Down 22		III	i
	9	Linton Heath 9		III	i
	10	Tuddenham		III	i

A3	11	Holywell Row 11		IV	i
	12	Rothley Temple		IV	i
	*12A	Lackford	consists of part of headplate only	(i)	c
	§13	Suffolk		IV	i
	14	Lakenheath		IX	i
	15	Haslingfield		IX	i
	*15A	Lackford 50/126	lacks most of footplate	IX	c
	16	Fordham		(i)	i
	17	Market Overton		(i)	i
	18	West Stow		(i)	i
	19	Lakenheath		XV	i
	20	Market Overton		XV	i
	21	Barrington A 11		XV	i
	22	St John's College		XV	i
	23	Linton Heath 40		XV	i
	*24	Girton	consists of part of footplate only	XV	c
	25	Tuddenham		XV	i
	26	Little Wilbraham 6		(i)	i
	27	Barrington A (Orwell)		(s)	i
	*28	Nassington	lacks whole of footplate	XV	c
	29	Welbourn		(i)	i
	30	West Stow		XIX	i
	31	Sleaford		XIX	i
A4	(*)32	Ipswich	lacks one side lobe	XVII	i
	33	Thornbrough		XVII	i
	34	Market Overton		XVII	i
	35	Londesborough 4		XVII	i
	36	Kenninghall		XVII	i
	37	Barrington A		XVII	i
	*38	Ipswich	lacks terminal lobe	XVII	c
	39	Unknown site (Hines: Suffolk)		XVII	i
	[39A Finningham N.B. This is a lost brooch, given this shadow number by Leeds (1949: 31, 125) in his gazetteer; included by Hines in his group XVII.]				
A5	*40	Newnham	lacks headplate and most of footplate	(m)	c
B1	41	Ipswich 29		XVI	i
	42	Ipswich 17 or 41		XVI	i
	*43	Ipswich 24, 52 or 59	lacks terminal lobe	XVI	c
	*44	Hunstanton	lacks terminal lobe and one side lobe	XVI	c

	45	Bury St Edmunds		XVI	i
	46	Holywell Row 14		XVI	i
	47	Holme Pierrepont		XVI	i
	48	Billesdon		XVI	i
	49	Kenninghall		XVI	i
	50	Kenninghall		XVI	i
	51	Ipswich 102		XVI	i
	52	Catton		XVI	i
	*53	Laceby	lacks terminal lobe	XVI	c
	54	Lakenheath		XVI	i
	(*)55	Faversham	lacks part of headplate	XVI	i
	56	Market Overton		XVI	i
	57	Ipswich 17 or 41		XVI	i
	58	Bridgham		XVI	i
	59	Londesborough 6		XIV	i
	59A	Unknown site (Hines: "Yorkshire")		XIV	i
	60	Kenninghall		(i)	i
	*61	Market Overton	lacks most of footplate	(i)	c
	(*)62	Market Overton	lacks part of headplate	(i)	i
	63	Mildenhall		XVIII	i
	64	Nassington 33		(i)	i
	*65	Brooke	lacks part of headplate and part of footplate	XVI	c
B2	66	Alfriston 28		I	i
	67	Mitcham 25		I	i
	68	Alfriston 43		I	i
	69	Alfriston		I	i
	70	Guildown 116		I	i
B3	71	Bidford-on-Avon 88		VI	i
	(*)72	Offchurch	lacks small parts of headplate and footplate	VI	c
	73	Cherbury Camp		VI	i
	*74	Baginton	lacks terminal lobe	VI	c
	75	Baginton		VI	i
	76	Brighthampton 51		I	i
	*77	St Andrew's Hospital	lacks terminal lobe (Hines: Northampton)	VIII	c
	*78	Stapleford	lacks terminal lobe (Hines: Saxby)	VIII	c
	79	Chessell Down		I	i
	80	Fairford		I	i
	*81	Hampnett	consists of two small parts of headplate only	I	c
	82	East Shefford		(s)	i

B4	§83	Herpes 2		II	i
	§84	Sarre 159		II	i
	85	Duston		II	i
	86	Linton Heath 21		II	i
	87	Badby		II	i
	88	Woodstone		I	i
	89	Tuxford		II	i
	90	Norton		XII	i
B5	91	Linton Heath 32		XI	i
	92	Quy		XI	i
	93	Ragley Park		XI	i
	*94	Girton	consists of side lobes and small part of headplate only	XI	c
B6	95	Luton		VII	i
	96	Market Overton		VII	i
	97	Fairford		VII	i
	98	Harlton		VII	i
		(Hines: Haslingfield)			
	*99	Abingdon	consists of part of bow and part of footplate only	VII	c
	*100	Mitcham 116	consists of part of headplate only	VII	c
	101	Hornton		(s)	i
	102	Marston St Lawrence		(s)	i
	103	Coleshill		I	i
B7	104	Little Wilbraham 158		XIII	i
	*105	Unknown site	lacks terminal lobe	XIII	c
	106	West Stow		XIII	i
	107	Nassington 5		XIII	i
	107A	Ruskington		XIII	i
B8	108	Barrington B9		V	i
	109	Myton		V	i
	*110	St Andrew's Hospital	lacks footplate	V	c
		(Hines: Northampton)			
	*111	Kempston	consists of bow and part of footplate only	I	c
	112	Little Wilbraham 28		X	i
	113	Little Wilbraham 3		X	i
	114	Little Wilbraham 40		X	i
	*115	Unknown site	lacks most of footplate	X	c
	116	Alveston Manor 5		I	i
	*117	Ingarsby	lacks terminal lobe	XXII	c
	*118	Barrington A	lacks terminal lobe	(m)	c

	119	Fridaythorpe		XXII	i
	120	Driffield C38		XXII	i
Bunc	*121	Alveston Manor 89	lacks part of footplate	X	c
	122	Thornbrough		(i)	i
	123	East Shefford		(m)	i
	*124	North Luffenham	lacks most of footplate	I	c
	*125	Barrington A	consists of one side lobe only	(m)	c
	*126	Barton Mills	consists of bow disk only x		c
C1	127	Sporle		x	x
	128	Kenninghall		x	x
	129	Kilham		x	x
C2	130	Kenninghall		x	x
	131	Staxton		x	x
	132	Hornsea		x	x
	133	Driffield		x	x
	*134	Darlington	lacks most of footplate	x	x
	135	Darlington		x	x
	136	Wigston Magna		x	x
	137	Whitehill Point		x	x
C3	138	Ipswich		x	x
	139	Haslingfield		x	x
	140	Rothley Temple		x	x
	141	Kempston		XXI	x
	*142	Little Wilbraham	consists of part of headplate and part of footplate only	XXI	x
	143	Holdenby		XXI	x

Appendix 1.2: List of non-Kentish GSHBs not in Leeds' corpus but discussed by Leigh

N.B. All these brooches are accepted in the present study as GSHBs, but not included in the common corpus.

KEY: Minor groupings in Hines' corpus: (e) = enigmatic
(i) = individualistic
(m) = miscellaneous
(s) = small

Brooch name	Assigned by Leigh to Leeds' group	Hines' group
Beckford A 11	B3	VI
Beckford B 74		(i)
Black Patch 21 (Hines: Pewsey 21)		VII
Broadway Hill 5		(s)
Cambridge region (M7372)	A3	
Coleshill (see Dickinson, 1976, Plate 44b)	B2	
Dartford		I
Dorchester VI (Berinsfield) 102		I
Dorchester VI (Berinsfield) 107		(m)
Empingham 1		(e)
Little Eriswell 27	A4	XVII
Mucking, cremation 942	B6	VII
Paglesham	A2	III
Rainham		(i)
Spong Hill 1012 ELN 24/5	B1	XVI
Unknown site (British Museum 65,3-15,2)	B2	

Appendix 1.3: List of brooches in Leigh's Kentish corpus

N.B. Following Leigh's practice, where a cemetery has yielded some brooches with known grave numbers and others without, the former are listed first.

KEY: - = considered not definitely Kentish by Leigh and not assigned by him to a Series

p = pair of brooches treated as one by Leigh
t = trio, set of three brooches treated as one by Leigh

Minor grouping in Hines' corpus: (e) = enigmatic

G = Great square-headed brooch (overall length 7.8 cm or more), therefore accepted as a GSHB, but not included in common corpus unless already in a Leeds group other than A1

Leigh's code	Brooch name	Leigh's Series	pair/ trio	Leeds' no. and group	Hines' group	Status in present study
Af.47	Alfriston 47	III	p			
Ba1	Barrington 1	-	p			
Ba2	Barrington 2	III				
Be.30	Bekesbourne 30	II	p			
Bi.41-1	Bifrons 41-1	I		3 A1		G
Bi.41-2	Bifrons 41-2	II	p			
Bi.42	Bifrons 42	I	p			
Bi.51	Bifrons 51	II	p			
Bi.63	Bifrons 63	I		2 A1		G
Bi.64	Bifrons 64	II	p			G
Bi1	Bifrons 1	III	p			
Bi2	Bifrons 2	-	p			
Bi3	Bifrons 3	III	p			
Bi4	Bifrons 4	III				
Ca1	Canterbury 1	I				G
Cd.22	Chessell Down 22	I		8 A2	III	G
Cd.40	Chessell Down 40	II	p			
Cd.45	Chessell Down 45	I	t			G
Cd.55	Chessell Down 55	II	p			
Cd3	Chessell Down 3	-				
Cd4	Chessell Down 4	II				
Cd5	Chessell Down 5	II	p			
Cd6	Chessell Down 6	-		6 A1	(e)	G
Cd7	Chessell Down 7	II				
Cd8	Chessell Down 8	III				
Cd9	Chessell Down 9	III				
Cd10	Chessell Down 10	II	p			

Cd11	Chessell Down 11	III				
Cd12	Chessell Down 12	II	t			
Co.1	Coombe 1	II				
Ct.2	Chatham Lines 2	III	p			
Ct.6	Chatham Lines 6	III	p			
Ct.18	Chatham Lines 18	II				
Ct1	Chatham Lines 1	-				
Do.20-1	Dover 20-1	II				
Do1	Dover 1	I				G
Dx1	Droxford 1	III				
Ea1	Eastry 1	II	p			
Fa1	Faversham 1	II				
Fa2	Faversham 2	III	p			
Fa3	Faversham 3	-				
Fa4	Faversham 4	II	p			
Fa5	Faversham 5	-	p			
Fi.2-1	Finglesham E2-1	I				G
Fi.2-2	Finglesham E2-2	II	p			
Fi.3	Finglesham D3	I		1 A1		G
Fi.203-2	Finglesham 203	II	p			
Gi.1	Gilton 1	I	p			
Gi.48	Gilton 48	-		4 A1		G
Gc1	Goldstone Cop Street 1 (Leeds: Richborough)	II		5 A1		G
Hd.2-1	High Down 2-1	III				
Hd.2-2	High Down 2-2	III	p			
Hd1	High Down 1	III	p			
He1	Herpes 1	II				G
He2	Herpes 2	I		83 B4	II	G
He3	Herpes 3	II				G
He4	Herpes 4	II	p			
He5	Herpes 5	II	p			
He6	Herpes 6	II	p			
He7	Herpes 7	III	p			
He8	Herpes 8	II				
He9	Herpes 9	II				
He10	Herpes 10	II				
Ho.1	Howletts grave 1	III				
Ho.7	Howletts 7	I	p			
Ho.12	Howletts 12	II	p			
Ho.17	Howletts 17	I				
Ho.18	Howletts 18	I	p			
Ho.21	Howletts 21	III				
Ho.23	Howletts 23	III				
Ho1	Howletts uncertain 1	I				
Ho2	Howletts 2	I				G
Ho3	Howletts 3	II				

Hy1	Hythe 1	I				
Ic1	Ickham 1	III				
Ku1	Kent unknown site 1	-				
Ku2	Kent unknown site 2	II				G
Ku3	Kent unknown site 3	II				
Ly.39	Lyminge 39	III	p			
Ly.44	Lyminge 44	I	p			G
Ly.60	Lyminge 60	III	p			
Me.1	Mersham 1	II				
Mi1	Milton-next-Sittingbourne 1	I	t			G
Mu.99	Mucking 99	III	p			
Mu.102	Mucking 102	-	p			
Mu.843	Mucking 843	II	p			
Pr.65	Preures 65	III				
Sa.4-1	Sarre 4-1	I				G
Sa.4-2	Sarre 4-2	I				
Sa.159	Sarre 159	I		84 B4	II	G
Sa1	Sarre 1	III				
Sa2	Sarre 2	III				
Sd.1-1	Stodmarsh 1-1	II				
Sd.1-2	Stodmarsh 1-2	-				
St.1	Stowting 1	III				G
St.2/9	Stowting 2/9	I	p			
St3	Stowting 3	-				
Su1	Suffolk unknown site 1	-		13 A3	IV	G
Un1	Unknown site 1	II				

Appendix 1.4: List of additional GSHBs in Hines' corpus

N.B. (1) For completeness, the 13 brooches additional to Leeds' corpus and discussed by Leigh (see Appendix 1.2) are listed here again.

N.B. (2) All these brooches are accepted in the present study as GSHBs, but not included in the common corpus.

KEY: * = incomplete brooch

(s) = small

(e) = enigmatic

(i) = individualistic

(m) = miscellaneous

Hines' group	Brooch name	description of brooch if incomplete
I	* Dartford Berinsfield 102	lacks part of headplate and most of footplate
II	* West Stow Geneva	consists of small fragment of footplate only
III	Paglesham	
VI	Beckford A 11	
VII	Compton Pewsey 21 (Leigh: Black Patch) Mucking urn 942	
X	* Lackford urn 50/178 Willoughby-on-the-Wolds 15	consists of part of footplate only
XII	* East Garston Warren	consists of bow and small parts of headplate and footplate only
XV	Wakerley 50 Wakerley 80	
XVI	Bury St Edmund's 27 Bergh Apton 64 Crimplesham Morningthorpe 214 Morningthorpe 288 Morningthorpe 359 Spong Hill 24	

	Great Chesterford 2	
	Ely	
	Willoughby-on-the-Wolds 46	
	Welbeck Hill 41	
XVII	Finningham 9 (N.B. = Leeds' 39A)	
	Little Eriswell 27	
	Bergh Apton 7	
	Burnham Norton	
	Great Bircham	
	Merton	
	Ruskington	
XVIII	Morningthorpe 371	
XIX	Lakenheath	
	Willoughby-on-the-Wolds.57	
XX	Spong Hill 18	
	Little Wilbraham 111(a)	
	Little Wilbraham 111(b)	
XXII	Sewerby 19	
	* Welbeck Hill 45	consists of part of footplate only
(s)	Little Eriswell 28	
(s)	Broadway 5	
(e)	Empingham I	
(i)	Rainham	
(i)	Beckford B 74	
(i)	Ruskington	
(m)	Berinsfield 107	
(m)	Toddington	
(m)	Baginton	
(m)	Laceby	

APPENDIX 2: Analysis of Leeds' groups for shared features

	Brooch no.				
Group A1	1	3	5	6	7
HEADPLATE					
egg & tongue border	1				
inner border: scroll design	1			6	
barred frame with 3 vertical lines	1				
zigzag border		3			
zoomorphic inner border		3			
panel: beaked animals		3			
wavy border				6	
masks					7
S motifs					7
BOW					
convex	1				
geometric ?	1				
disk		3	5		
representational		3			
rectangular panels					7
zoomorphic					7
FOOTPLATE					
undivided	1	3	5	6	7
rampant beasts	1			6	

Group A1, cont.	1	3	5	6	7
lower crouching animals	1			6	7
central cross motif	1	3			
lozenge frames	1				
semicircular side lobes filled with dots	1				
animal head at terminal lobe	1				
biting heads		3	5		7
downward marching animals		3		6	
zoomorphic inner panel		3			7
side lobes: discs with masks		3			
terminal lobe: human mask		3		6	7
lower footplate: couchant animals			5		

Group A2	8	9	10
HEADPLATE			
zoomorphic	8	9	10
divided panel	8	9	
free-standing masks		9	10
BOW			
plain	8		10
panelled	8		10
zoomorphic		9	
FOOTPLATE			
undivided	8	9	10
heads with curled beaks		9	10
biting heads	8		
side lobes: faces	8		10
side lobes: loops		9	
terminal lobes: geometric	8		
terminal lobes: masks		9	10
lower footplate: pair of animals	8		
jumbled zoomorphic ornament within lozenge	8	9	

Group A3	subgroup a		subgroup b	subgroup ci				
	11	12	13	14	15	16	17	18

HEADPLATE

inner panel:								
zoomorphic	11	12	13	14				
inner panel:								
geometric								
framed outer								
border	11			14				
excrecent ornament								
at corners, etc								18
punched geometric								
ornament at borders				14				
panel with								
scrollwork	11	12	13					
lentoid motifs					15			
panel with	11	12		14				
mask								

BOW

panelled	11	12	13				17	
grooved								
plain							17	
zoomorphic	11	12	13					

FOOTPLATE

undivided	11	12	13	14	15	16	17	18
divided								
mask at top	11	12						

Group A3	subgroup a		subgroup b	subgroup ci				
cont.	11	12	13	14	15	16	17	18
upper footplate: rampant beasts	11	12	13	14		16		
upper footplate: biting heads								
lower footplate: pair of animals	11	12	13					
side lobes: mask	11	12		14				
side lobes: plain or geometric			13				17	18
side lobes: excrescences				14				
terminal lobe: mask	11	12	13	14			17	
terminal lobe: plain/geometric			13				17	18
terminal lobe: excrescence							17	
centre: scrollwork	11							
centre: SS								
centre: diamond	11			14				
centre: 88	11							
centre: punched triangles		12						
centre: stud		12						

Group A3, cont.	subgroup cii										
	19	20	21	22	23	25	26	27	29	30	31

HEADPLATE

inner panel: zoomorphic	19	20				25	26		29		
inner panel: geometric	19										
framed outer border		20				25		27			
excrecent ornament at corners, etc						25		27	29		31
punched geometric ornament at borders											31
panel with scrollwork											
lentoid motifs											31
panel with mask								27			

BOW

panelled	19		21				26		29		
grooved			21					27			
plain											
zoomorphic							26				
stud/disc	19										31

FOOTPLATE

undivided	19	20	21	22	23	25			29	30	31
divided							26	27			
mask at top								27			

Group A3, cont.	subgroup cii		22	23	25	26	27	29	30	31
	19	20								
upper footplate: rampant beasts							27			
upper footplate: biting heads	19	20	21	22	23		27	29		31
lower footplate: pair of animals										
side lobes: mask			21	22	23	26				
side lobes: plain or geometric							27			
side lobes: excrescences										
terminal lobe: mask								29		
terminal lobe: plain/geometric										
terminal lobe: excrescence								29		31
centre: scrollwork										
centre: SS		20				26	27			
centre: diamond	19								30	
centre: 88								29		
centre: punched triangles										
centre: stud										

Group A4	32	33	34	35	36	37	39
HEADPLATE							
punched decoration between corners	32	33	34	35	36	37	39
zoomorphic		33	34	35	36	37	
BOW							
pyramidal		33	34			37	
grooved						37	
FOOTPLATE							
undivided	32	33	34	35	36	37	39
aquiline head	32	33	34	35	36	37	39

Group B1	Normals														
	41	42	45	46	47	48	49	50	51	52	54	55	56	57	58
HEADPLATE															
punched ornament on outer borders	41	42	45	46	47	48	49	50	51	52	54	55	56	57	58
lentoid corners															
angle plates at corners	41		45						51	52					
lozenges at corners	42				47									57	58
projecting lozenges at corners						48	49	50					56		
projecting lozenges at mid upper edge						48								57	58
scrollwork	41	42	45	46				50	51	52		55			
panel: geometric	41		45	46	47	48	49		51		54	55	56	57	
panel: zoomorphic	41	42	45	46		48	49	50	51		54	55	56	57	58
panel: mask															
BOW															
grooved		42	45	46	47	48	49	50	51	52	54	55	56	57	58
punched decoration on grooves			45						51				56		
triple median bar						48		50			54	55		57	
decorated ornamental disks	41														
stud/disk															

Group B1	Normals														
cont.	41	42	45	46	47	48	49	50	51	52	54	55	56	57	58
animal or human															
head at base	41	42	45	46		48	49	50	51		54	55	56	57	58
FOOTPLATE															
divided	41	42	45	46	47	48	49	50	51	52	54	55	56	57	58
biting/ beaked heads	41	42	45	46	47	48	49	50	51	52	54	55	56	57	58
head at top of bar															
all lobes plain	41	42	45	46	47	48	49	50	51	52	54	55	56	57	58
excrecent ornament	41	42	45	46	47	48	49	50	51	52	54	55	56	57	58
geometric design	41	42	45	46	47	48	49	50	51	52	54	55	56	57	
zoomorphic ornament	41	42	45	46	47	48	49	50			54			57	
openwork decoration	41			46	47		49	50	51	52			56		58
terminal lobe: head															
terminal lobe: frills															

Group B1	hybrids 1				hybrids 2	hybrids 3
cont.	59	59A	60	62	63	64

HEADPLATE

punched ornament on outer borders						
lentoid corners			60	62		
angle plates at corners					63	
lozenges at corners			60	62		
projecting lozenges at corners						64
projecting lozenges at mid upper edge						
scrollwork						64
panel: geometric					63	64
panel: zoomorphic	59		60			
panel: mask	59		60			64

BOW

grooved	59	59A	60	62		64
punched decoration on grooves						
triple median bar						
decorated ornamental disks					63	
stud/disk	59					
animal or human head at base			60			

FOOTPLATE

divided	59	59A	60	62	63	64
biting/beaked heads	59	59A	60	62	63	64
head at top of bar	59					

Group B1 cont.	hybrids 1				hybrids 2	hybrids 3
	59	59A	60	62	63	64
all lobes plain			60	62	63	
ex crescent ornament						64
geometric design					63	64
zoomorphic ornament				62	63	64
openwork decoration						
terminal lobe: head	59	59A				
terminal lobe: frills	59	59A				

Group B2	66	67	68	69	70
HEADPLATE					
inner panel: zoomorphic	66	67	68	69	70
human masks	66		68	69	70
BOW					
ridged	66				
grooved panels		67	68	69	70
plain panels		67			70
decorated panels	66		68	69	
FOOTPLATE					
divided	66	67	68	69	70
pair of animal heads at top	66	67			
side lobes: plain				69	70
human heads on side/terminal lobes	66		68		
studs on side/terminal lobes		67			
mask at each end of median bar	66		68	69	70
inner panel: zoomorphic	66	67	68	69	70

<i>Appendix 2</i>								
Group B3	71	72	73	75	76	79	80	82
HEADPLATE								
framed outer border	71	72		75	76	79		
zoomorphic ornament	71	72		75	76	79	80	
masks on border					76	79	80	
whirligigs	71	72		75				
SS in border				75				
inner panel: ÷					76			
inner panel: mask						79		
BOW								
3 ridges	71	72						
plain	71	72						
FOOTPLATE								
divided	71	72	73	75	76	79	80	82
biting heads	71	72			76	79		
zoomorphic	71	72		75		79		82
mask at each end of bar	71	72			76			
side lobes: mask	71					79		
terminal lobe: mask	71	72				79		
lobes: knobs								82
openwork	71							
inner panels: triangles							80	

Group B4	83	84	85	86	87	88	89	90
HEADPLATE								
garnet setting	83	84						
no garnet setting			85			88	89	
masks	83	84	85	86			89	90
ex crescent ornament				86				
zoomorphic ornament	83	84	85		87		89	
lower panel: beaded border			85	86				
frame							89	90
BOW								
strong midrib, lesser side ribs	83	84	85					90
plain	83	84						
decorated								90
disc							89	
FOOTPLATE								
divided	83	84	85	86	87	88	89	90
framed in loops	83	84	85	86	87	88	89	90
garnet settings	83	84		86				
no garnet settings			85		87		89	
zoomorphic ornament	83	84	85		87			90
head at end of bar	83		85					
biting heads	83	84	85		87			
lobes: heads			85					
triangular settings			85		87	88	89	90

Group B5	91	92	93
HEADPLATE			
inner panel: broad border	91	92	93
linear decoration	91	92	
plain			93
lentoid ornament	91	92	93
angled corner pieces	91	92	93
BOW			
panelled	91	92	93
FOOTPLATE			
undivided	91	92	93
zoomorphic ornament	91	92	93
panel bars to separate zoomorphic ornament	91	92	93
no decoration at head of foot			93
framed settings	91	92	93

Group B6	95	96	97	98	101	102	103
HEADPLATE							
border of masks	95	96	97	98	101	102	103
crenellated outer border	95		97	98	101	102	
panels enclosed by frames	95	96	97	98			
dividing line in border of mid panel			97				
head at top of bow	95	96	97	98			
zoomorphic ornament	95	96	97	98		102	
BOW							
plain		96					
ridged	95	96	97	98			
decorated with zoomorphic ornament	95		97				
geometric ornament				98			
FOOTPLATE							
divided	95	96	97	98	101	102	103
biting heads	95	96	97	98			
zoomorphic ornament	95	96	97	98		102	
head at side and terminal lobes	95	96	97			102	103
triangular panels		96		98			

<i>Appendix 2</i>				
Group B7	104	106	107	107A
HEADPLATE				
masks	104	106	107	
zoomorphic ornament	104	106	107	
perforations	104	106	107	107A
BOW				
(no features)				
FOOTPLATE				
divided	104	106	107	107A
triangular panels	104	106	107	107A
biting heads	104	106	107	107A
terminal lobe: undecorated panels				107A
side lobes: plain				107A
lobes: pear-shaped	104	106		

Group B8	subgroup i		subgroup ii		114	116	119	120
	108	109	112	113				
HEADPLATE								
incurving edges	108	109				116		
lentoid motifs	108	109					119	
zoomorphic ornament								120
masks	108	109	112	113	114	116	119	
settings						116		
BOW								
studs				113	114	116	119	
panelled	108	109		113	114	116	119	
zoomorphic ornament	108	109						
extension of mid-bow bar to headplate				113	114			
settings						116		
FOOTPLATE								
divided	108	109	112	113	114	116	119	120
biting heads	108	109						
zoomorphic decoration	108	109					119	
lobes: masks	108	109					119	120
lobes: framing			112					
lobes: pear-shaped						116		
body: lozenge-shaped						116		
settings for stones						116		
drooping heads						116		
quatrefoil rosettes								120
median bar: studs		109		113	114		119	120

APPENDIX 3: Materials for and data from experiment on obviousness

Appendix 3.1: Questionnaire

Place of study:

Subject of degree:

Year of course:

What experience did you have of archaeology (e.g. no. and duration of digs, courses etc) before you began your course? (Only for students not studying archaeology)

What were your 'A' level grades? Please set them out as A=5, B=4, C=3, D=2, E=1 (e.g. 3+2+1=6).

Briefly define what you mean by 'similarity'.

What principles did you use to classify the brooches? Please indicate if you have treated the attributes as if they were of equal importance or in a hierarchical order of importance.

If your classification has an aim please write it here (this is optional)

Set out in tabular form the completed classification. Please write the unifying characteristics for each group

What other information about the brooches might have assisted you in organising the material?

Time taken (in minutes)

Thank you very much.

Appendix 3.3: Instructions to subjects

(This is a standard script which must be kept to at all times)

Thank you all very much for giving up your time and coming here today.

This is an experiment which seeks to examine the concept of similarity which is the basis of all work on classification. In front of you, you will see some photographs of brooches and a questionnaire. In a few minutes I would like you to examine the brooches carefully and group them in any way which seems meaningful to you. While you are doing so I would like you to analyse consciously which attributes or parts of the brooch you are using in making up your groups. When you have completed the classification please would you fill in the questionnaire. The most important sections of it are where you set out the classification in tabular form and explain which criteria you used. For quickness you can use the numbers marked on the photos of the brooches to help you represent the classification. If you wish to show connections between the groups you can do so with a circle round the particular group or brooch joining it with a line to the connecting circled group or brooch. There is no right answer but the value of this for my research lies in your reasoning as much as in your groupings. You will have an hour to complete the task but if you finish earlier than that you are of course welcome to leave. When the experiment is complete and I (or Mrs Brooks) have analysed the data I (or she) hope(s) to be able to arrange a time to give a talk on the findings. Thank you very much.

Appendix 3.4: Criteria used by subjects in experiment on obviousness for grouping brooches

Subject no.	Principal criteria used
Group A	
16	form and decoration
27	form: headplate; footplate
28	form: footplate; then headplate
29	form
30	form then size (less importance)
31	form then decoration (less importance)
32	decoration: headplate; footplate
33	form: especially footplate
34	form: footplate then headplate; then size and decoration
35	form and decoration
36	form then decoration and finally size
Group B	
17	no information given
18	shape: headplate; footplate
19	shape: headplate; footplate
20	shape and decoration: headplate; footplate
21	shape: headplate; footplate
22	no useful information given
23	decoration: headplate; footplate
24	shape and size: headplate; footplate
25	shape and size
26	shape and decoration: headplate; footplate
37	shape and decoration
38	decoration and shape
39	shape and decoration: footplate
40	shape and decoration: headplate; footplate
41	shape and decoration
42	shape and decoration
43	decoration: headplate; footplate
44	shape: footplate
45	shape: footplate
46	shape: headplate; footplate
47	shape and decoration
48	not given
49	shape and decoration
50	shape and decoration: headplate; footplate
51	shape and decoration: footplate
52	no information given

53	shape and decoration: footplate
54	shape and size
55	shape and decoration
56	decoration
57	shape and size: headplate; footplate
58	no information given
59	shape and decoration
60	shape
61	shape: headplate; footplate
62	shape and decoration
63	decoration: headplate; footplate
64	shape
65	size and shape
66	size, decoration and shape
67	shape and size: headplate; footplate
68	shape: headplate; footplate
69	shape and decoration
70	shape: headplate; footplate
71	shape: headplate; footplate
72	shape and decoration: headplate; footplate
73	shape: footplate
74	no information given
75	no clear explanation given
76	shape and decoration: headplate; footplate
77	shape and decoration
78	shape
79	shape
80	shape, decoration and size
81	shape and decoration
82	shape and decoration

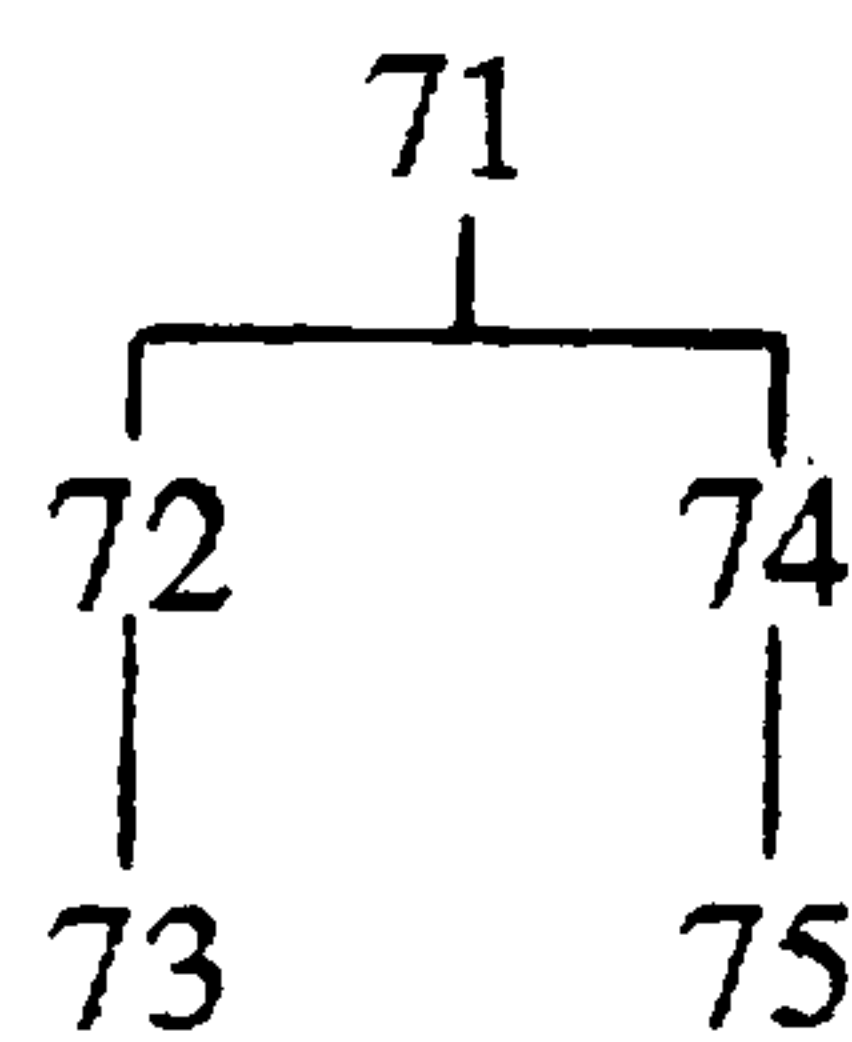
Group C

1	shape: headplate; footplate
2	no criteria given
3	shape: footplate
4	shape and decoration: headplate; footplate
5	shape: footplate
6	shape and decoration
7	no criteria given
8	by shading of the photocopies
9	shape and personal taste
10	shape
11	shape, decoration and size
12	shape and decoration
13	shape: headplate; footplate
14	shape: headplate; footplate
15	shape and decoration

APPENDIX 4: Chronological statements in Leeds (1949)

page	statement
1	'In eastern Kent it is doubtful whether [the GSHB's] life extends into the third quarter of the 6th century, and ... may not have appeared there before the beginning of that century, though individual pieces were certainly manufactured earlier. In the midlands it begins as early, but has a longer life. It is in the eastern counties that its history covers the longest period, from the early days of the settlement until the type disappears from our ken with the cessation of pagan burial.'
3	Implies that class C is late.
7	No.1 was 'found in an early 6th-century association... [T]here can be no doubt at all that [it] is an import from the Rhineland and had been made many years before the other brooches associated with it.'
10	Nos 1-5 'belong to the earlier cemeteries east of the Medway. This and stylistic considerations go far towards establishing an early date for this part of the group... Somewhat later is' no.6.
11	No.10 'was a poor copy of' no.9. Cf. pp.16 and 109.
17	No.11 has close relationship with no.2.
18	No.12 possibly influenced by group B1, and certainly by no.11; also close to A1 and possibly Kentish.
19	Subgroup A3b is second stage in group.
20	When subgroup A3c appears it 'at once ... divides into two streams.'
	Within A3ci no.14 is first.
22-23	Nos 17 and 18 influenced by B1.
24	No.19 parallel to no.83 and possibly influenced by B1; earlier than nos 20 and 23.
25	No.25 possibly influenced by B1 and B5.
27-28	Nos 27-29 all influenced by no.19.
28	No.29 possibly also by B1.

- 28 No.31 late.
- 31 A4 is later than B1.
- 38 B1 hybrids 1-3 parallel, but hybrids 1 go on longest and are influenced by A3 and B1 normals.
- 40 No.59A precedes B8.
- 41 No.60 parallel to early A3, especially no.14.
- 42 No.62 last of B1 hybrids 1.
- No.63 (B1 hybrids 2) slightly later than start of B1 hybrids 1.
- 43-44 Nos 64-65 (B1 hybrids 3) relatively late but no.64 is early in subgroup.
- 44 No.65 earlier than B4.
- 45 Group B1 'gives the impression of a comparatively short life for the group as a whole... It may be concluded that most, even of the hybrids, had been made by the middle of the 6th century or very shortly after. Their mutual relations are too close in time for much more than half a century to have elapsed between the first and the last.'
- 45 B2 influenced by A1 but (p.47) 'this group cannot be appreciably later than their Kentish models'.
- 47-48 No.71 'has a good claim to be regarded as moderately early', but later than B2.
- 49-50 Nos 72-75 are copies of no.71 but not quite contemporary, as in diagram on p.50:



- 53 No.80 (B3) 'is not an early member of the group' and influenced by B4. Whole of B3 influenced by B2; no.66 earlier than no.70; no.70 earlier than nos 79 and 80; whole group earlier than B6.
- 54 Presence of no.83 in France perhaps something to do with Clovis's campaign of 507.
- 55 No.84 copy of no.83, but 'in point of time there cannot be any great gap between' them.

- 57 No.87 is copy of nos 85 and 86.
- 59 No.89 is comparatively late.
- B1 brooches are older than B4.
- 60 No.139 (C3) is late echo of B4.
- 61 B5 'can hardly be much later - and indeed may be earlier - than' nos 85 and 86.
- No.92 is copy of no.91.
- 64 B6 influenced by B4, and later than B2 and B3.
- Nos 101-103 are 'all manifestly late'.
- 66 B7 related to B4 abd B5.
- 67 B8 related to A3 and B5.
- 69 No.109 is copy of no.108.
- 70 Nos 113-114 influenced by 'the late cruciform brooches of Åberg's group 4'.
- 71 'The pin-catch plate in the form of a fish [on no.116] may suggest connexion with Christian ideas... Although this would seem to imply a late date, possibly beyond that of most other brooches of this group [B8], the Alveston brooch [no.116] exhibits so many features in common with those of an unquestionably earlier stage as to leave its date a moot question.'
- 73 'All of [B unclassified] belong to the later history of this brooch type.'
- 74 No.121 parallel in time to no.108.
- 78 C1(a) 'may be no more than cheap copies of' ... 'the latest examples of the A3 group'.
- 79 No.129 related to late A3 and B1.
- 82 No.138 influenced by B1 or A3, and (p.83) early in group.
- 87 Nos 133 and 137 late within C2.
- 88 B1 at beginning of sequence, B8 at end.
- GSHBs have 'a period of 100 to 150 active years'.

- 88-89 'The system of classification which the material has called for does not in itself produce a picture of unbroken sequence of artistic development... At the same time the groups within the main classes have been arranged in what, so far as the initial appearance of each is concerned, seems to accord closely to their historical sequence.'
- 89 C3 perhaps later than B8 and C2.
- 101 A4 'must have been created within quite a short time after the Anglian invasion'.
- 102 'Group B1 tells a tale of early contacts; it is essentially an "invasion" type... If ... Salin's original thesis is carried to its logical conclusion B1 must be pre-500 and A4 can be but little later.'
- 'The C brooches ... have already been discussed [and] have been shown to be some of the latest products.'
- 103-104 B1 precedes A4, which precedes A3, which precedes C2.
- 104 'In fairly rapid succession, if not in part before the later stages of [A3], B4, 5 and 7 make their appearance.'
- 104-105 After B8, 'the Angles ... also broke away from the accepted [GSHB] form to incorporate their own personal tradition by combining the square head with the cruciform foot.'
- 104-105n The most advanced square-headed brooches of Kentish type ... are unlikely to be later than 525. The square-headed type must have fallen out of fashion in Kent by c. 550.'
- 108 A1 'must belong to the late 5th and early 6th centuries.'
- 109 No.13 parallel to no.3.
- No.70 is early.
- 110 B6 and C3 are late.
- 111 Puts several arguments 'in favour of retraction of the dating of several of the great square-headed brooches at least as far back as the early part of the 6th century and of accepting a fairly widespread production of these brooches based on Kentish models in Saxon areas by the middle of the century. The kinship of early members of [A3] with early Kentish models can be similarly demonstrated, but, as in [B4], the later offspring of [A3] shows definite signs of a long ancestry, so that some examples may reach the 7th century.'

- 117 Stands by main chronological lines of Leeds (1913: 106ff), except that places Chatham Lines cemetery close to 500 not 450.
- 120-121 'In conclusion I do not doubt that the history of the great square-headed brooch in England begins on the one hand before the close of the 5th century with actual imports from the Rhineland or with pieces produced immediately thereafter ..., and on the other in East Anglia certainly before the 6th century.'
- 121 A3 and B4 are early half of 6th century.
- 'To the 7th century may safely be assigned such pieces as [nos 117, 90, 119] together with [C2] and those with elaborate cruciform feet.'

APPENDIX 5: Data for analysis of GSHBs by size or proportion

Appendix 5.1: Raw data: seven measurements of brooches of inner corpus (mm)

Brooch no.	LENGTH				WIDTH		
	overall	headplate	bow	footplate	headplate (upper/lower)	bow	footplate
8	136	38	23	75	65	24	60
9	140	39	21	80	69	26	60
10	137	36	21	80	66	26	63
11	145	41	18	86	65	24	61
12	125	33	16	76	51	23	55
13	89	22	12	55	39	14	39
14	107	30	14	63	49/45	20	51
15	123	36	15	72	59/56	21	56
16* (31)	78	22	11	45	38	16	36
17* (68)	129	33	13	83	60/53	21	68
18* (103)	108	32	13	63	54/51	21	54
19	120	35	13	72	51/50	18	53
20	109	33	13	63	50/47	20	46
21	116	35	12	69	53/48	21	51
22	111	32	13	66	48/45	18	48
23	114	33	15	66	51/49	19	50
25	116	33	13	70	45/42	16	51
26* (13)	91	27	9	55	44/36	18	45
27* (15)	123	36	15	72	59	18	48
29* (68)	132	31	15	86	53/50	18	75
30	84	24	9	51	33/30	13	40
31	83	23	12	48	35	13	33
32* (33)	117	40	8	69	53/45	13	66
33	119	39	9	71	57	12	66
34	111	36	11	64	51/46	12	69
35	108	38	8	62	51	13	61
36	114	35	12	67	46/48	15	65
37	113	38	9	66	50/47	13	66
39* (34)	111	35	10	66	47/42	12	54
41	150	42	20	88	63/57	30	66
42	144	39	21	84	60/55	18	62
45	161	45	21	95	66/60	18	66
46	158	41	23	94	62/59	19	71
47	146	39	19	88	66/60	21	72
48	150	40	23	87	60/57	21	83
49* (59)	140	39	19	82	61/55	19	65

50	147	44	15	88	65/60	23	84
51	153	42	18	93	63/53	18	74
52	138	36	17	75	59/51	18	66
54	145	39	18	88	60/57	19	70
55	147	37	23	87	54/42	19	60
56	155	41	24	90	67/61	19	70
57	136	37	16	83	53/51	19	67
58	135	36	19	80	51/48	18	69
59	140	40	17	83	63/59	19	63
59A	140	36	23	81	60/55	19	60
60* (52)	138	36	18	84	61/55	21	70
62* (76)	141	44	19	78	77/71	19	62
63	135	39	19	76	59/56	21	61
64* (83)	125	36	20	69	61/58	21	60
66	132	37	18	77	57	23	64
67	93	27	14	52	42	20	46
68	129	36	20	73	54	18	74
69	108	33	15	60	51	18	60
70	120	33	14	73	51	18	60
71	140	39	20	81	65	23	66
72* (75)	137	36	21	80	60	22	66
73	134	36	22	76	60	24	66
75	137	36	20	81	60	23	60
76	140	39	20	81	69/63	20	60
79	140	41	15	84	68/65	24	66
80	144	39	20	85	71/68	26	68
82* (14)	101	30	17	54	42	13	48
83	124	39	18	67	60/55	23	60
84	127	40	17	70	57	23	59
85	147	43	17	77	64	20	69
86	144	43	17	74	70/66	21	83
87	150	39	15	96	65	22	73
88	129	38	22	69	60	18	68
89	158	53	15	90	78/66	33	75
90	173	60	17	96	83	32	84
91	177	56	21	100	77/71	26	83
92	165	51	18	96	72/63	26	71
93	168	54	18	96	75/70	26	83
95	174	53	21	100	80	27	84
96	186	60	18	108	87	27	89
97	161	48	21	91	75	24	75
98	174	52	23	99	75	27	83
101* (22)	110	38	17	55	50	18	48
102* (84)	128	41	15	72	65	21	54
103	108	35	12	61	51	20	54
104	126	41	15	70	57	20	65
106	135	42	15	78	61	20	68

107	134	41	15	78	60/57	21	68
107A	132	36	20	76	55/52	18	63
108* (47)	146	42	18	86	63/58	22	66
109	135	39	15	81	71/63	23	63
112	147	42	18	87	75/69	24	65
113	143	42	15	86	77/57	24	63
114	141	44	15	82	80/62	21	60
116	174	51	24	99	89/87	24	85
119	135	38	22	75	66	22	63
120* (80)	143	38	16	89	62/59	20	69
122* (92)	167	47	24	96	68/65	29	65
123* (67)	96	24	21	51	39	16	40

* Brooch removed from analysis as data set too large for computer to handle, followed (in brackets) by number of brooch with most similar measurements.

Under width of headplate, separate measurements for upper and lower edge are shown only where they differ.

Appendix 5.2: Cluster solutions arising from analysis by proportion

Cluster	features	brooches
1. Using upper headplate edge measurement		
a. 4 clusters		
1	narrow footplate	8 9 10 11 12 13 14 15 19 20 21 22 23 31 59 59A 63 66 67 70 71 73 76 80 84 87 95 98 107A (29) (+ 16 26 27 62 82 101 102 120 123)
2	wide footplate	33 34 35 36 37 48 68 (7) (+ 17 29 32 39 49)
3	narrow headplate, narrow footplate	25 30 41 42 45 46 47 50 51 52 54 55 56 57 58 75 85 (17) (+ 60 72 108)
4	long, wide headplate	69 79 83 86 88 89 90 91 92 93 96 97 103 104 106 107 109 112 113 114 116 119 (22) (+ 18 64 122)
b. 5 clusters		
1	wide headplate, narrow footplate	8 9 10 11 12 14 15 20 22 23 59 63 70 71 75 76 79 80 83 84 95 98 103 104 106 109 114 119 (28) (+ 18 27 49 62 64 72 82 101 102 120)
2	long headplate, wide footplate	31 33 34 35 36 47 67 68 87 (9) (+ 16 17 29 32 39 108 123)
3	narrow headplate, narrow footplate	19 21 25 30 37 41 42 45 46 48 50 51 52 54 55 56 58 59A 69 73 86 97 107 (23) (+ 60)
4	long, wide headplate	57 85 88 89 90 91 92 93 96 107A 112 113 116 (13) (+ 122)
5	short headplate	13 66 (2) (+ 26)

c. 6 clusters

1	wide headplate	8 9 10 11 12 14 15 20 22 23 59 63 70 71 75 76 79 80 83 84 95 98 103 104 106 109 114 119 (28) (+ 18 27 49 62 64 72 82 101 102 120)
2	long headplate, wide footplate	31 33 34 35 36 47 67 68 87 (9) (+ 16 17 29 32 39 108 123)
3	narrow headplate	19 21 25 30 37 42 45 46 48 50 51 52 54 55 56 58 59A 69 86 97 107 (21) (+ 60)
4	long, wide headplate, wide footplate	57 85 88 89 90 91 92 93 96 107A 112 113 116 (13) (+ 122)
5	short headplate	13 66 (2) (+ 26)
6	short headplate, narrow footplate	41 73 (2)

2. Using lower headplate edge measurement

a. 4 clusters

1	long bow, narrow footplate	8 9 10 11 12 13 14 15 19 20 21 22 23 66 67 70 71 73 76 79 80 83 84 87 95 96 98 103 104 106 107 107A 112 (33) (+ 18 26 27 62 64 82 101 102 120 123)
2 (12)	large headplate	86 89 90 91 92 93 97 109 113 114 116 119 (+ 122)
3	short bow, wide footplate	33 34 35 36 37 48 68 69 88 (9) (+ 17 29 32 39)
4	small headplate	25 30 31 41 42 45 46 47 50 51 52 54 55 56 57 58 59 59A 63 75 85 (21) (+ 16 49 60 72 108)

b. 5 clusters

1	long bow, narrow footplate	8 9 10 11 12 14 15 19 20 21 22 23 31 47 59 59A 63 66 70 71 73 76 80 84 87 95 98 107A (28) (+ 16 27 49 62 82 101 102 108 120)
2	large headplate	69 79 83 86 88 89 90 91 92 93 96 97 103 104 106 107 109 112 113 114 116 119 (22) (+ 18 64 122)
3	wide bow	13 67 (2) (+ 26 123)
4	short bow, wide footplate	33 34 35 36 37 48 68 (7) (+ 17 29 32 39)
5	small headplate	25 30 41 42 45 46 50 51 52 54 55 56 57 58 75 85 (16) (+ 60 72)

c. 6 clusters

1	smaller headplate, long bow, narrow footplate	8 9 10 11 12 15 19 20 21 22 23 31 47 59 59A 63 66 67 70 71 73 76 84 98 107A (25) (+ 16 27 49 62 101 102 108 123)
2	larger headplate, long bow, narrow footplate	14 69 79 80 83 86 88 95 96 103 104 106 107 112 116 (15) (+ 18 64 82 120)
3	large headplate	89 90 91 92 93 97 109 113 114 119 (10) (+ 122)
4	short bow, wide footplate	33 34 35 36 37 48 68 (7) (+ 17 29 32 39)
5	small headplate	25 30 41 42 45 46 50 51 52 54 55 56 57 58 75 85 (16) (+ 60 72)
6	wide bow	13 87 (2) (+ 26)

APPENDIX 6: Data for analysis of GSHBs by form

Appendix 6.1: Elements of the outlines of GSHBs

Brooch number:	Description of form element
A: HEADPLATE	
1:	sculptured or irregular top
2:	straight top
3:	crenellated top
4:	drooping to lower headplate
5:	zoomorphic ornament at upper headplate corners
6:	zoomorphic ornament at lower headplate corners
7:	non-zoomorphic additions to upper headplate corners
8:	non-zoomorphic additions to lower headplate corners
9:	trapezoid, wider at upper edge
10:	trapezoid, wider at lower edge
11:	protrusions to mid-top headplate
12:	curved line of top producing corners which sweep outwards and upwards
B: BOW	
13:	laterally convex
14:	disc
C: FOOTPLATE	
15:	circular terminal lobe
16:	rounded terminal lobe
17:	squared-off terminal lobe
18:	shovel-shaped terminal lobe
19:	cruciform-shaped terminal lobe
20:	mask-shaped terminal lobe
21:	circular side lobes
22:	rounded side lobes
23:	animal-shaped side lobes
24:	squared-off side lobes
25:	one pair of protrusions to lower footplate
26:	two pairs of protrusions to lower footplate
27:	three pairs of protrusions to lower footplate

Appendix 6.2: Form elements present on brooches of inner corpus

Brooch no:	Elements present on brooch	Duplicates
8:	2, 8, 13, 15, 21	
9:	3, 6, 13, 15, 21	
10:	3, 6, 13, 16, 21	
11:	2, 13, 20, 23	
12:	2, 9, 13, 20, 23	
13:	2, 7, 8, 13, 20, 24	
14:	2, 9, 13, 18, 24	
*15:	2, 9, 13, 18, 24	14
*16:	2, 9, 13, 18, 24	14
17:	1, 4, 9, 12, 13, 19, 21, 25	
18:	2, 7, 13, 16, 24	
19:	2, 5, 6, 11, 13, 18, 24	
20:	2, 5, 9, 13, 18, 24	
*21:	2, 5, 9, 13, 18, 24	20
*22:	2, 5, 9, 13, 18, 24	20
23:	2, 5, 8, 12, 18, 24	
25:	2, 4, 7, 9, 13, 16, 22	
26:	1, 4, 5, 8, 9, 11, 13, 18, 22, 25	
*27:	3, 6, 13, 15, 21	9
29:	2, 7, 8, 13, 15, 21, 25	
30:	2, 7, 13, 18, 24	
31:	2, 7, 9, 11, 13, 18, 24	
32:	2, 9, 13, 15, 21	
33:	2, 4, 7, 13, 15, 21	
34:	2, 4, 13, 15, 21	
*35:	2, 4, 13, 15, 21	34
*36:	2, 4, 13, 15, 21	34
37:	2, 13, 15, 21	
39:	2, 4, 13, 15, 22, 26	
41:	2, 9, 14, 15, 22, 26	
42:	2, 4, 13, 15, 21, 26	
45:	2, 4, 13, 15, 22, 25	
*46:	2, 4, 13, 15, 22, 26	39
47:	2, 4, 13, 15, 21, 27	
48:	2, 7, 8, 13, 16, 21, 27	
49:	2, 7, 11, 13, 15, 21, 27	

50:	2, 4, 7, 8, 13, 15, 21, 27	
51:	2, 4, 9, 13, 15, 21, 26	
*52:	2, 4, 9, 13, 15, 21, 26	51
54:	2, 4, 11, 13, 15, 21, 27	
55:	2, 4, 12, 14, 21, 25	
*56:	2, 4, 12, 14, 21, 25	55
57:	2, 5, 8, 14, 20, 24	
*58:	2, 5, 8, 14, 20, 24	57
59:	2, 9, 12, 15, 21	
59A:	2, 4, 9, 12, 15, 21	
*60:	2, 9, 13, 15, 21	32
*62:	2, 4, 13, 15, 21	34
63:	2, 4, 13, 14, 21, 24	
64:	2, 7, 8, 9, 11, 13, 15, 21, 25	
66:	2, 12, 15, 21	
67:	2, 12, 14, 20	
*68:	2, 12, 15, 21	66
69:	2, 12, 15, 20	
*70:	2, 12, 15, 20	69
71:	1, 12, 15, 20	
*72:	1, 12, 15, 20	71
*73:	1, 12, 15, 20	71
*75:	1, 12, 15, 20	71
*76:	2, 12, 15, 21	66
79:	2, 4, 12, 15, 21	
*80:	2, 4, 12, 15, 21	79
*82:	2, 13, 15, 21	37
83:	2, 7, 8, 12, 15, 21	
84:	1, 7, 8, 12, 15, 21	
85:	1, 12, 15, 21	
86:	2, 7, 9, 12, 15, 21	
*87:	2, 12, 15, 21	66
88:	2, 12, 15, 21, 27	
89:	2, 4, 13, 16, 22	
90:	2, 8, 12, 15, 21	
91:	2, 4, 7, 9, 12, 15, 21, 25	
92:	2, 4, 7, 12, 15, 21	
*93:	2, 7, 8, 12, 15, 21	83
95:	3, 13, 16, 21	
96:	2, 13, 16, 21	
*97:	3, 13, 16, 21	95
*98:	3, 13, 16, 21	95

*101:	3, 6, 13, 15, 21	10
*102:	3, 13, 16, 21	95
*103:	2, 13, 16, 21	96
104:	2, 13, 16, 22, 25	
*106:	2, 4, 13, 16, 22	104
*107:	2, 13, 16, 22, 25	
*107A:	2, 13, 16, 21	96
108:	2, 7, 8, 12, 13, 16, 23, 25	
109:	2, 12, 13, 16, 23, 25	
112:	2, 13, 16, 21, 25	
113:	1, 7, 8, 13, 20, 23	
114:	1, 7, 8, 12, 13, 16, 23, 25	
*116:	2, 4, 13, 16, 22	89
119:	2, 8, 13, 16, 21, 25	
*120:	2, 8, 13, 16, 21, 25	119
*122:	2, 4, 13, 15, 21	34
123:	3, 13, 20, 22	

* Duplicates removed from the database as full matrix too large for jaccard computer program to handle. Numbers in right-hand column are those of brooches with identical form elements which remained in the database.

Appendix 6.4: Groups arising from analysis by eye of scattergrams

Isolates: 17, 18, 26, 29, 64, 123

A. Groups found in scattergram 1 ("x"/"y" or "very indistinct to very distinct outline of terminal lobe"/"plain to elaborate outline of terminal lobe")

Group 1; 59, 66, 83, 84, 85, 86, 88, 90, 104
(+ 68, 76, 87, 93, 107)

Group 2: 25, 59A, 79, 89, 91, 92, 95
(+ 80, 97, 98, 102, 106, 116)

Group 3: 10, 108, 109, 114
(+ 101)

Group 4*: 11, 12, 13, 14, 19, 20, 23, 30, 31, 48, 67, 69, 71, 112, 113, 119
(+ 15, 16, 21, 22, 70, 72, 73, 75, 120)

Group 5*: 39, 41, 63, 96
(+ 45, 46, 103, 107A)

Group 6*: 8, 9, 32, 33, 34, 37, 42, 47, 49, 50, 51, 54, 55, 57
(+ 27, 35, 36, 52, 56, 58, 60, 62, 82, 122)

B. Groups found in scattergram 2 ("x"/"z" or "very indistinct to very distinct outline of terminal lobe"/"plain to elaborate outline of headplate")

Group 1: 25, 59, 59A, 66, 79, 83, 84, 85, 86, 88, 90, 92, 104
(+ 68, 76, 80, 87, 93, 107)

Group 2: 10, 89, 91, 108, 109, 114
(+ 101, 106, 116)

Group 3*: 48, 67, 69, 71, 95, 112, 119
(+ 70, 72, 73, 75, 97, 98, 102, 120)

Group 4: 11, 12, 13, 14, 19, 20, 23, 30, 31, 39, 41, 63, 96, 113
(+ 15, 16, 21, 22, 45, 6, 103, 107A)

Group 5*: 8, 9, 32, 33, 34, 37, 42, 47, 49, 50, 51, 54, 55, 57
(+ 27, 35, 36, 52, 56, 58, 60, 62, 82, 122)

C. Groups found in scattergram 3 ("y"/"z" or "plain to elaborate outline of terminal lobe"/"plain to elaborate outline of headplate")

Group 1:	25,33, 34, 39, 41, 42, 47, 51, 54, 59, 59A, 63, 66, 79, 86, 88, 89, 91, 92, 96, 104 (+ 35, 36, 45, 46, 52, 62, 68, 76, 80, 87, 103, 106, 107, 107A, 116, 122)
Group 2:	8, 9, 10, 32, 37, 49, 50, 57, 83, 85, 90 (+ 27, 58, 60, 82, 93, 101)
Group 3:	48, 55, 67, 69, 71, 84, 95, 109, 112, 119 (+ 56, 70, 72, 73, 75, 97, 98, 102, 129)
Group 4*:	108, 113, 114
Group 5*:	11, 12
Group 6*:	13, 14, 19, 20, 23, 30, 31 (+ 15, 16, 21, 22)

APPENDIX 7: Data for analysis of GSHBs by decoration

Appendix 7.1: Decorative fields present on brooches of common corpus

KEY: * = Incomplete brooch

Brooch no:	Fields present on brooch	
8:	a b d	h i j k l m n
9:	a b d	h i j k l m n
10:	a b d	h i j k l m n
11:	a b d	h i j k l m n
12:	a b d	h i j k l m n
*12A:	a b	
13:	a b c	h i j k l m n
14:	a b c e	h i j k l m n
15:	a b c e	h i j k l m n
*15A:	a b c e g h	
16:	a b	h i j k l m n
17:	a b c	h i j k l m n
18:	a b c	h i j k l m n
19:	a b c d e f	h i j k l m n
20:	a b c e	h i j k l m n
21:	a b c e	h i j k l m n
22:	a b c e	h i j k l m n
23:	a b c d e	h i j k l m n
*24:		i j
25:	a b c e	h i j k l m n
26:	a b c d e f	h i l m n o
27:	a b c e	h i l m n o
*28:	a b c d e	h
29:	a b c d e	h i j k l m n
30:	a b c	h i j k l m n
31:	a b c f	h i j k l m n
32:	a b	h i j k l m
33:	a b c d	h i j k l m n
34:	a b c d	h i j k l m n
35:	a b c d	h i j k l m n
36:	a b c d	h i j k l m n
37:	a b c d	h i j k l m n
*38:	a b c	h i j k l
39:	a b c d	h i j k l m n
*40:		h i j l

41:	abcd	hijklmno
42:	abcd	hijklmno
*43:	ab	hijkl no
*44:	abc	hijkl no
45:	ab e	hijklmno
46:	ab e	hijklmno
47:	abcde	hijklmno
48:	abcde	hijklmno
49:	abcdef	hijklmno
50:	abcde	hijklmno
51:	abc e	hijklmno
52:	abc e	hijklmno
*53:	abc e	hijkl no
54:	abcdef	hijklmno
55:	abcde	hijklmno
56:	abcd	hijklmno
57:	abcde	hijklmno
58:	abcde	hijklmno
59:	ab	hij lmno
59A:	ab	hij lmno
60:	abc e	hijklmno
*61:	abc e	hij
62:	abc e	hijklmno
63:	abcde	hijklmno
64:	abcdef	hijklmno
*65:	abc e	hij l no
66:	abc e	hij lmno
67:	ab e	hijklmno
68:	abc	hij lmno
69:	abc	hij lmno
70:	abc e	hij lmno
71:	abc e	hijklmno
72:	ab e	hijklmno
73:	ab e	hijklmno
*74:	abc e	hijkl no
75:	abc e	hijklmno
76:	abc e	hij lmno
*77:	abc e	hij l no
*78:	abc e	hij l no
79:	abc	hij lmno
80:	ab e	hij lmno
*81:	c	
82:	ab e	hij lmno
83:	abcde	hij lmno
84:	abcde	hij lmno
85:	abcde	hij lmno
86:	abcde	hij lmno

87:	abc e	hijklmno
88:	ab	hij lmno
89:	ab e	hijklmno
90:	ab de	ghijklmno
91:	abc e	hijklmno
92:	abcde	hij lmno
93:	abcde	hij lmno
*94:	abc	l
95:	ab e	hij lmno
96:	ab e	hijklmno
97:	ab e	hij lmno
98:	ab e	hij lmno
*99:		j o
*100:	ab e	
101:	abcde	hij lmno
102:	abc	hij lmno
103:	abc	hij lmno
104:	abc	hijklmno
*105:	abc	hij l no
106:	abc	hijklmno
107:	abc	hijklmno
107A:	abc	hijklmno
108:	abcd	hij lmno
109:	abcd	hij lmno
*110:	abc	h
*111:		h j o
112:	abc e	hijklmno
113:	abcd	hijklmno
114:	abcd	hijklmno
*115:	abcd	hi o
116:	abc	hij lmno
*117:	ab	hijkl no
*118:	abc	hij l no
119:	abcd	hijklmno
120:	abc e	hijklmno
*121:	abcd	h jklmno
122:	abc	hi lmno
123:	ab	hij lmno
*124:	ab e	hij no
*125:		l
*126:		h

Appendix 7.2: Description of the decorative fields of GSHBs, and outline description of their decorative variants

1. HEADPLATE

(a) outer field

It is made up of three separated quadrilateral areas that extend along and around the outermost part of the headplate, excluding the side that joins with the bow. The areas may be separated by the corners of the headplate. The outer field may be framed or unframed on its outermost edge but must be separated from the intermediate field by a frame. A difficulty can arise in deciding whether a thin outer border, decorated or plain, should be designated as a frame for the outer field (a) or as the outer field (a) itself. When this occurs, the problem can be resolved as follows: where the border is decorated and is not found again upon the headplate decoration (cf nos. 89, 90) or where it is plain but embellished with extra zoomorphic protrusions (cf nos. 19, 20), it is deemed to be the outer field (a); but where the decorated border is repeated elsewhere (cf no. 122) or the plain border is without embellishment (cf nos. 12, 15), it is deemed to be a frame for the outer field (a).

Variations

The decoration of the frame may continue uninterrupted around the three sides of the rectangular headplate not attached to the bow. Less often it continues round all four sides of the rectangular headplate. The outer edge of the border can be straight, crenellated, or designed in a looped pattern. If the flow of the design is interrupted at the upper corners by the motifs meeting at right angles then the design still counts as if the design were uninterrupted and should still be considered as part of the upper field (a). But if it is interrupted by either a geometric or zoomorphic motif placed at a diagonal to the upper corner and if this motif is unconnected with the decorative border, then this element of the brooch is to be considered to be field (c). The decoration can be anthropomorphic, zoomorphic or geometric

(b) intermediate field

The second area is uninterrupted and positioned within the outer field on the headplate. It is separated from the outer field and inner field (if any) by a frame. The frame may be thick or thin and the edge adjacent to the bow need not be framed. A difficulty can arise where there is a narrow, plain, quadrilateral field with a frame at either side. When this occurs, the thin border is to be designated as the intermediate field (b) because of the presence of the two frames at either side of it (cf nos. 69, 70, 82).

Variations

The intermediate field can be fully rectangular in shape (i.e. there is no inner field (e)).

Alternatively, it may surround an inner field (e) on only three sides, in which case it is generally shaped like the outline of an upside-down 'U' (i.e. \cap). The intermediate field is always framed on three sides though not always on the side attached to the bow. The intermediate field may be plain or decorated. If decorated, the decoration may be zoomorphic or geometric. Some intermediate fields may have a double line of decoration (as in the case of the two lines of masks on brooch 89). In this case the two lines of masks count as one border because no frame separates the two and there is only one width of masks to the left- and right-hand sides of the headplate.

(c) upper corners

The upper corners are two rectangular-shaped areas situated at either end of the top of the rectangular headplate. Where present, they interrupt field (a) and separate it into three areas. Upper corners as defined here are present only if certain additional conditions apply: if a motif unconnected with the design is placed at a diagonal in the upper corners; if reinforcements have been made to the corners to emphasise them; or if excrescences have been added to the upper corners that protrude beyond the outline of the headplate. There can be a difficulty in differentiating between those brooches where the decoration continues up to the upper corner (c) and abuts against decoration coming in at right-angles to it (cf nos. 72, 73). Only where a new motif is positively introduced need the upper corners (c) be commented upon (cf nos. 71, 74); otherwise this aspect of the brooch can be overlooked and treated as part of field (a).

Variations

Motifs on the upper corners may be geometric or zoomorphic, decorated or plain, extend beyond the rectangular shape of the headplate or stay within it, and/or continue the line of the frame or be placed at right-angles or a diagonal to the upper corner. There may also be embellishments or reinforcements to the corners.

(d) lower corners

These rectangular-shaped fields complement the upper corners (c) and are to be found at either end of the bottom of the rectangular headplate, adjacent to its attachment to the bow. They need be commented upon only if certain conditions apply: if the decoration on the frame hangs below the line of the headplate; if there is a change in motif unconnected with the rest of the design on the border; or if there are excrescences or embellishments added to the corner of the lower corner. Otherwise (like field (c)) this field is treated as if it is a continuous part of element (a). It can prove difficult to differentiate between a line of continuous decoration that is to be designated as the lower corners (d) and a line that forms part of the frame. Only where the line of decoration is not repeated elsewhere on the brooch can it be designated as lower corners (d) (cf nos. 85, 86); otherwise it must be considered as part of the frame (cf no. 122).

Variations

The decoration of the lower corners may be geometric or zoomorphic, decorated or plain,

extend beyond the rectangular shape of the headplate or stay within it, and/or continue the line of the frame or be placed at right-angles or a diagonal to the lower corners. They may also be embellished or reinforced.

(e) inner field

This is not present on all headplates of GSHBs. Where it does occur, it is surrounded by field (b) on three sides, though generally not on the side which attaches to the bow. It can be identified when any one of three possible conditions applies: it is entirely enclosed within the intermediate field (b); or surrounded on three sides by (b) and juxtaposed to the attached bow on the fourth side; or surrounded on three sides by the intermediate field but enclosing the innermost field (g). Each field including the inner field **must** be surrounded by a frame either on all four sides or on three sides where the side attached to the bow has been left unframed.

(f) top knob

This is a rare occurrence but easy to identify. It is a protrusion located at the centre of the upper side of the outer edge of the rectangular headplate.

Variations

The top knob may be large or small, decorated or plain.

(g) innermost field

Some rare cases have yet another inner field on the headplate. It is rectangular in shape and situated within the centre of the headplate. To be identified as the innermost field, it must be: placed within the inner panel (e); or surrounded on three sides by it and in juxtaposition to the attached bow on the fourth side. The inner field (e) then forms an upside-down U (i.e. \cap) or an enclosed box around the innermost field (g) and operates just as the intermediate field (b). All fields must be separated from each other by a frame.

2. BOW

(h) bow

This is common to all brooches. It joins the rectangular headplate to the footplate and is constructed in an arched shape.

Variations

The bow can be plain, ridged or panelled, plain or decorated and adorned with a disk or not.

3. FOOTPLATE

(i) upper borders

There are two upper borders situated at the top of the footplate just below the bow and above the side lobes (l). They are present on footplates of all GSHBs (whether from Leeds class A or B). In class A brooches they are separated by the lozenge- or kite-shaped frame (j) and in series B brooches by the bar (o).

Variations

The design of the upper borders of the footplate is almost invariably zoomorphic though in rare cases geometric ornament is present. In class A the zoomorphic ornamentation may represent an animal, though differentiation between the different manifestations may be difficult; this explains the category for general zoomorphic ornament. To be definitively identified as a "rampant beast" the animal must be standing up; to be categorised as open-mouthed the animal must have a clearly visible mouth and have its head facing downwards with the lozenge or diamond shape of the frame forming the sweep of the neck of the beast; and to be identified as "affronted" faces these must be clearly visible. There is a degree of subjectivity here.

(j) frame

This is present in class A brooches but is not to be found in class B. Class A brooches show two lozenge- or diamond-shaped decorative lines within the footplate which begin at the neck of the zoomorphic ornament on the upper borders (i), split into two and separate so that each connects with a side lobe before joining together at the terminal lobe, leaving the centre area free for further decoration. The frame is considered to surround the lobes where a similar thickness continues and where any pattern also follows. There is some subjectivity here: for example where the lobes are encircled by framing of a similar thickness to elsewhere on the frame (j), this is not considered as part of the frame (j) but as separate to the lobes (cf no. 64).

Variations

The footplate frame can be made of a single line or several lines, be plain or decorated, stop at the side lobes or extend round them and/or stop at the terminal lobe or extend round it. The mask at the top and/or bottom of the frame (j) is considered part of that element and not part of the terminal lobe (m) if there is no change in the outer form before the terminal lobe (cf nos. 17, 29)

(k) lower borders

On brooches on which they are present, the two lower borders are located on each side of the footplate and below the frame (j) on that section that runs between the side and terminal lobes. They are only found on GSHBs of class A. There may be some difficulty in identifying whether element (k) is present on any particular brooch or not. To identify

it accurately one must compare the composition of frame (j) above the side lobes: where there is no addition to the frame (j) below the side lobes in the way of extra lines or a decorative or plain flange, then the lower borders (k) are not present on that brooch; where extra lines or a flange do exist below the frame (j) then the lower borders (k) are present. The knobs **must** be above the line of the terminal lobe; otherwise they are not counted (cf no. 72)

Variations

The lower borders of the footplate may be plain, accentuated by lines, embellished by up to three excrescences, and/or decorated.

(l) side lobes

They are two in number and are positioned midway down the footplate, one to each side. Where frame (j) is present, the side lobes are joined by the lozenge- or diamond-shaped sweep of the frame (j) both to the bow and upper part of the footplate and to the terminal lobe.

Variations

The side lobes can be circular, semi-circular, rounded or bar-shaped, plain or decorated with masks, zoomorphic decoration or geometric patterns. It is particularly difficult to differentiate between circular, semi-circular and rounded lobes. Circular lobes must have a strongly circular shape with more than half their shape outlined beyond the footplate; semi-circular lobes must have a strong circular shape with approximately half their shape outlined beyond the lobe; while rounded lobes need only continue the same shape of the frame (j) or border (k) to a softly rounded shape. Side lobes can be plain, or decorated with masks, or zoomorphic or geometric ornament. Some are emphasised by extra lines or may have settings for stones.

(m) terminal lobe

This is an embellishment added to the base of the footplate of all GSHBs.

Variations

The terminal lobe can be circular, or rounded, an elongated bar, sub-triangular or scythe-shaped. The lobe may be plain, or decorated with masks, zoomorphic decoration or geometric patterns. Circular and semi-circular terminal lobes may be outlined by extra lines and/or settings for stones or studs.

(n) inner field

This is an area situated at the centre of the footplate and within the area delineated by the kite-shaped frame (j). It is uninterrupted on most class A brooches but is bisected by the bar (o) on all class B brooches.

Variations

The footplate inner field can contain zoomorphic or geometric decoration and sometimes settings for stones.

(o) bar

This is present on all class B brooches but on only two of class A (nos 26, 27). It generally bisects the footplate from the bow to the terminal lobe, sometimes accompanied at top and/or bottom by a mask. Rarely the vertical bar is cut by a horizontal one at right angles (cf nos. 26, 122).

Variations

The footplate bar can be decorated or plain.

Appendix 7.3: List of, and key to, decorative variants in the decorative fields of GSHBs

1. HEADPLATE

(a) outer field

- (1) crenellations
- (2) upstanding plain band
- (3) masks
- (4) geometric pattern
- (5) plain with an etched line
- (6) creeping animals
- (7) interlinked jumbled animals or masks
- (8) holes
- (9) plain
- (10) scalloped border

(b) intermediate field

- (11) geometric pattern
- (12) intertwined animals
- (13) creeping animals
- (14) mask-like faces
- (15) flowers with pronounced centres
- (16) squares or rectangular shapes
- (17) holes
- (18) division of panel
- (19) emphasised lines
- (20) circles
- (21) plain
- (22) mask
- (23) diamond shape
- (24) pattern within squares
- (25) setting for stones

(c) upper corners

- (26) plain and/or geometric shaped corners
- (27) elaborated corners in the shape of animals
- (28) reinforced corners
- (29) exaggerated corner in circle shape
- (30) exaggerated corner in kite shape
- (31) exaggerated corner in square shape
- (32) knobs set at the diagonal or in the corner

- (33) holes
- (34) plain addition to exaggerate corner
- (35) diagonal line/lentoid shape
- (36) decorated geometric or zoomorphic shape
- (37) mask decoration
- (38) settings for stones

(d) lower corners

- (39) drooping of corner below the line of the headplate panel in line with field (a)
- (40) not interrupting the design of the frame
- (41) plain, square or rectangular corners(
- (42) small embellishments to the side of the corners
- (43) holes
- (44) embellishments to the diagonal of the corners
- (45) reinforcement and more pronounced aspect of the corner
- (46) corner embellished with extended circle
- (47) decorated square corners
- (48) settings for stones
- (49) small continuous border below fields (b), (d) or (e)
- (50) geometric decoration

(e) inner field

- (51) one or more square or rectangular shapes
- (52) vertical or horizontal lines
- (53) within (b)
- (54) creeping animals
- (55) intertwined animals
- (56) two emphasised square shapes
- (57) two sub-triangular shapes
- (58) plain
- (59) geometric pattern
- (60) joined to bow
- (61) holes
- (62) mask
- (63) circles
- (64) divided area

(f) top knob

- (65) small with whirligig decoration
- (66) elongated knob with or without decoration
- (67) very pronounced tall knob with enlarged elongated head

(g) innermost field

- (68) separated with two raised knobs like eyes
- (69) a box or boxes decorated with geometric ornament
- (70) within (e)
- (71) attached to bow

2. BOW**(h) bow**

- (72) plain
- (73) ridged
- (74) inner area decorated with zoomorphic ornament
- (75) inner area decorated with geometric ornament or emphasising lines
- (76) with stud
- (77) panelled
- (78) etched
- (79) decorated on ridging/panelling or with lines emphasising ridging/panelling

3. FOOTPLATE**(i) upper borders**

- (80) openmouthed biting heads
- (81) rampant beasts
- (82) general zoomorphic ornament
- (83) holes
- (84) geometric decoration with horizontal and/or vertical lines
- (85) swirls
- (86) zoomorphic affronted masks
- (87) plain

(j) frame

- (88) lozenge- or diamond-shaped
- (89) with stamped or incised ornament
- (90) with chain-link decoration
- (91) all round side and terminal lobes
- (92) to side and terminal lobes
- (93) emphasised by inner extra lines sometimes with decoration
- (94) stopping at side lobes but round terminal lobe
- (95) beginning with mask at head below junction with the bow
- (96) with mask at foot above junction with terminal lobe
- (97) integral with (i)

(k) lower borders

- (98) with no excrescent knobs
- (99) with one excrescent knob
- (100) with two excrescent knobs
- (101) with three excrescent knobs
- (102) geometric decoration
- (103) plain
- (104) with lines emphasising frame
- (105) creeping animals
- (106) border all round footplate

(l) side lobes

- (107) circular (when enclosed in outline of circle shape)
- (108) rounded
- (109) square or bar-shaped
- (110) masks
- (111) semi-circular (when enclosed by outline or making semi-circular shape)
- (112) plain
- (113) zoomorphic decoration
- (114) pear-shaped within terminal
- (115) geometric decoration
- (116) emphasised by lines
- (117) setting for stones
- (118) flower-shaped decoration
- (119) with stud
- (120) not projecting beyond broad framework of brooch

(m) terminal lobe

- (121) circular (when enclosed in circle outline or protruding in a clearly circular shape)
- (122) rounded
- (123) extended elongated bar
- (124) stud
- (125) mask
- (126) non-zoomorphic or geometric decoration
- (127) sub-triangular
- (128) scythe-shaped or double scythe-shaped
- (129) pear-shaped within terminal
- (130) setting for stones
- (131) plain
- (132) emphasised by lines
- (133) jumbled zoomorphic decoration

(n) inner panel

- (134) mask
- (135) zoomorphic decoration
- (136) geometric or stamped decoration
- (137) diamonds
- (138) leaf-shaped
- (139) emphasised by lines
- (140) holes
- (141) triangles
- (142) circles
- (143) double 'S' shapes
- (144) plain
- (145) setting for stones

(o) bar

- (146) whole length from bow to terminal lobe
- (147) mask at top
- (148) mask at bottom
- (149) cruciform shape of bar from bow to terminal lobe and between side lobes
- (150) stud
- (151) decorated
- (152) bar placed within the lozenge shape
- (153) setting for stones at top
- (154) setting for stones at bottom
- (155) setting for stones on bar

Appendix 7.4: Decorative features present on GSHBs of inner corpus

Brooch no:	Features present on brooch
1. HEADPLATE	
8:	4 6 12 18 39 40
9:	1 3 12 18 39 40
10:	1 3 12 18 39 40
11:	4 13 59 62 63
12:	6 11 16 22
13:	6 11 20 34 40 42
14:	5 6 11 16 35 53 59 62 64
15:	4 6 11 18 35 53 59 62 64
16:	6 19 22
17:	5 19 22 26
18:	9 16 18 24 29
19:	9 13 27 40 42 51 53 59 64 65
20:	9 13 27 51 53 59 64
21:	4 13 27 53 59 64
22:	9 13 27 59 60
23:	9 13 27 40 42 51 53 59 64
25:	9 13 27 30 52 60
26:	9 13 27 40 44 52 60 66
27:	1 3 13 32 55 60
29:	9 13 29 40 44 46 51 53 59
30:	4 16 19 30
31:	4 16 35 37
32:	4 12 19
33:	5 12 19 30 41
34:	4 12 19 26 41
35:	4 12 19 26 41
36:	4 12 19 26 41
37:	9 12 19 26 41
39:	4 12 19 26 41
41:	4 11 16 18 24 28 40 45
42:	4 11 16 18 24 26 41
45:	4 11 28 40 45 51 53 58 64
46:	4 11 51 53 61 64
47:	9 11 16 17 26 41
48:	4 11 16 24 30 45
49:	4 11 16 24 30 41 67 71
50:	4 11 16 29 40 44 46
51:	4 11 19 28 51 52 53 59 61 64
52:	4 11 16 17 19 28
54:	4 11 19 26 44 46 52 53 66

55:	4 19 26 41 51 52 53 59 64
56:	4 11 16 17 19 26 41
57:	4 11 27 40 44 46 52 53
58:	4 19 27 40 44 46 51 52 53 64
59:	6 12
59A:	6 22
60:	4 6 11 35 51 60 63
62:	4 11 13 34 35 52 59 60
63:	4 13 17 28 45 51 52 53 64
64:	3 11 28 31 39 45 53 59 66
66:	3 13 35 59 60
67:	9 13 51 58 60
68:	3 12 19 28
69:	3 19 28 55 60 64
70:	3 19 28 55 60 64
71:	4 8 10 12 36 55 60 64
72:	8 10 12 55 60 62 64
73:	8 10 12 55 60 62 64
75:	4 10 12 36 55 60 62 64
76:	3 12 35 60 62 64
79:	3 12 35 37
80:	3 12 53 58
82:	3 19 55 60
83:	3 13 25 26 38 39 47 48
84:	3 12 25 36 38 39 47 48
85:	3 13 18 36 49 50 51 59 60 64
86:	3 13 18 30 49 50 51 52 53 64
87:	6 13 18 26 53 54
88:	4 19 53 62
89:	4 18 19 22 54 59 68 71
90:	4 11 18 22 39 55 59 60 69 70
91:	3 11 28 35 55 60 62
92:	3 11 28 35 55 60 62
93:	3 21 28 35 40 45 55 60 62
95:	1 3 13 18 52 53 59
96:	3 13 18 51 52 53 64
97:	1 3 13 18 51 52 53 59 64.
98:	1 3 13 18 51 52 53 59 64.
101:	1 3 21 26 33 39 43 53 55.
102:	1 3 12 18 33.
103:	3 8 12 36
104:	3 8 12 35
106:	3 8 12 35
107:	3 8 12 35
107A:	3 8 12 35
108:	3 12 30 35 40 44 60 62
109:	3 4 12 30 35 40 44 60 62

112:	7 12 30 35 52 53
113:	7 12 22 30 35 49
114:	7 12 22 30 35 49
116:	3 19 30 35 38 59 60 63 64
119:	3 15 18 32 39 40
120:	6 11 18 29 60
121:	3 12 16 18 24 35 40 49
122:	3 12
123:	1 9 12

B. BOW

8:	72 77
9:	74 77 79
10:	72 73
11:	74 76 77
12:	74 76 77
13:	74 76 77 79
14:	74 76 77 79
15:	72 77
16:	74 77
17:	72 77 79
18:	72 76 77
19:	75 76 77
20:	75 76 77
21:	75 76 77
22:	72 76 77
23:	75 77
25:	73 75 76
26:	74 77
27:	72 73
29:	73 75
30:	76
31:	76
32:	76
33:	76
34:	76
35:	76
36:	76
37:	76
39:	73 75
41:	75 76
42:	72 73
45:	72 73 76
46:	72 73
47:	72 73

48:	73 79
49:	73
50:	73 79
51:	73 75
52:	72 73
54:	73 79
55:	73 76 79
56:	73 75
57:	73 79
58:	72 73
59:	73 76 79
59A:	72 77
60:	73 79
62:	72 73
63:	75 76
64:	72 73
66:	72 77 79
67:	73 75
68:	73 74
69:	74 77
70:	72 73
71:	72 73
72:	72 73 79
73:	72 73
75:	72 73 79
76:	72 73
79:	72 73 79
80:	73 74
82:	72 73
83:	72 73 79
84:	73 79
85:	72 73
86:	72 73 79
87:	72 73
88:	72 73
89:	75 76
90:	73 74 79
91:	74 76 77 79
92:	74 76 77 79
93:	74 76 77
95:	74 77 79
96:	72 73 79
97:	73 74
98:	73 75
101:	72 73
102:	72 73 79
103:	74 77

104:	72 73 79
106:	72 73
107:	72 73
107A:	72 73
108:	74 77
109:	74 77
112:	75 76 77
113:	74 76 77
114:	74 76 77
116:	74 76 77
119:	72 73 76
120:	72 73 76
121:	74 76 77
122:	74 77 79
123:	72 73

C. FOOTPLATE

8:	81 88 89 91 93 95 98 105 107 110 121 126 134 135
9:	82 88 91 93 95 98 102 107 113 121 125 136
10:	82 88 91 93 98 104 108 110 121 125 132 136
11:	80 88 92 93 95 98 105 110 125 136 137
12:	80 88 92 95 98 105 110 125 136 142
13:	80 88 89 92 93 98 105 115 120 125 136 137
14:	80 88 89 92 93 95 98 102 109 110 123 125 137
15:	80 88 92 95 98 103 109 110 123 125 137
16:	82 88 92 98 103 109 113 123 133 137
17:	84 88 92 93 95 98 103 107 112 125 127 131 137
18:	80 88 92 98 104 109 113 121 131 137
19:	81 83 88 92 97 98 103 109 110 123 125 137
20:	81 88 92 97 98 103 109 110 123 125 137 143
21:	81 88 92 93 97 98 102 109 110 123 125 137 143
22:	81 88 92 97 98 103 109 110 123 125 137 143
23:	81 88 92 97 98 103 109 110 123 125 137 143
25:	81 88 92 97 98 103 1110 111 123 125 137 143
26:	81 110 123 125 149
27:	82 108 114 116 121 125 136 147 148
29:	82 88 92 96 97 98 103 107 112 128 131 133 137 143
30:	84 88 92 98 103 109 112 123 137 143
31:	84 88 92 98 103 109 115 123 126 136 137 143
32:	85 88 92 97 98 103 107 112 121 131
33:	85 88 92 97 98 103 107 112 121 131 135
34:	85 88 92 97 98 103 107 112 121 131 135
35:	85 88 92 97 98 103 107 112 121 131 135
36:	85 88 92 97 98 103 107 112 121 131 135
37:	85 88 92 97 98 103 107 112 121 131 135

39:	85 88 92 97 100 104 107 112 121 131 135
41:	81 88 90 92 97 100 103 111 112 121 131 140 141 146 151
42:	81 83 88 90 92 97 100 103 111 112 121 131 140 141 146 151
45:	81 88 90 92 97 99 103 111 112 121 131 139 141 144 146
46:	81 83 88 90 92 97 100 103 111 112 121 131 140 141 146 151
47:	81 83 88 90 92 97 101 112 121 131 140 141 146
48:	81 88 90 92 97 101 112 121 131 141 144 147 151
49:	81 83 88 90 92 97 101 107 112 121 131 140 141 147 151
50:	81 83 88 89 92 97 101 107 112 121 131 141 144 146 151
51:	81 83 88 92 96 100 107 112 121 131 140 141 146 151
52:	81 83 88 92 96 100 107 112 121 131 140 141 146
54:	81 83 88 89 92 97 101 107 112 121 131 141 144 146 151
55:	81 88 89 92 97 100 103 107 112 121 131 141 144 146
56:	81 83 88 92 97 100 107 112 121 131 140 141 144 146
57:	81 88 90 92 99 107 112 121 131 139 141 144 146 151
58:	81 83 88 92 97 99 107 112 121 131 140 141 144 146 151
59:	81 88 90 92 93 97 108 110 116 122 125 126 132 139 141 144 147 148
59A:	81 88 90 92 97 108 110 116 122 125 126 132 141 144 146
60:	82 88 92 95 98 102 107 112 121 131 141 144 147
62:	81 88 92 97 98 103 11 116 121 126 135 148
63:	81 88 89 92 97 99 111 112 121 131 141 144 146 151
64:	82 88 92 99 107 115 121 126 135 152
66:	82 88 89 91 97 108 110 122 125 126 135 147 148 152
67:	82 88 91 95 98 103 107 119 121 124 131 135 147 152
68:	82 88 91 97 108 110 116 122 126 135 147 148 152
69:	82 88 92 97 107 112 122 125 132 135 147 152
70:	82 88 94 97 107 112 122 126 135 147 148 152
71:	82 83 88 91 93 97 107 113 122 125 126 135 147 148 152
72:	81 83 88 91 93 97 98 103 107 113 118 122 125 126 135 147 148 152
73:	82 83 88 91 93 97 107 116 119 122 125 126 135 147 148 152
75:	82 88 89 92 97 107 113 122 132 135 147 152
76:	82 83 88 91 93 97 108 110 116 122 125 132 135 147 148 152
79:	82 88 89 91 93 97 108 110 116 122 126 132 135 148 152
80:	81 88 91 97 108 110 116 122 125 126 135 141 144 148 152
82:	82 88 91 97 107 116 119 121 124 126 135 141 146
83:	81 83 88 89 91 97 108 114 116 117 122 129 130 132 135 141 145 147 148 152
84:	82 88 91 97 108 114 116 117 122 129 130 132 135 141 145 151 152 153 154
85:	81 88 91 97 108 110 122 125 126 135 141 148 152
86:	81 88 91 97 108 114 116 117 122 126 129 130 132 135 139 141 145 152
87:	81 88 91 97 99 102 108 114 116 122 129 135 147 148 152
88:	82 88 91 97 108 114 116 122 131 132 135 141 145 148 152
89:	81 88 91 97 108 114 116 122 129 132 135 139 141 152

90:	81 88 91 97 107 115 116 122 126 132 135 139 141 146 151 153
91:	81 88 91 97 99 108 114 116 122 129 130 132 135 147 148 152
92:	81 88 91 97 108 114 116 122 129 132 135 152
93:	81 88 91 97 108 114 116 122 126 129 132 135 147 148 152
95:	81 83 88 89 91 97 107 113 116 122 125 132 135 147 148 151
96:	82 88 91 93 97 107 113 116 122 132 135 151 152
97:	81 83 88 91 93 97 107 113 116 122 125 126 132 135 147 148 151 152
98:	81 83 88 91 93 97 107 116 119 122 124 129 132 135 147 148 152
101:	82 88 91 97 107 116 118 121 126 136 147 152
102:	82 88 94 97 98 103 108 113 116 121 125 132 135 147 148 151 152
103:	82 88 91 93 97 107 113 116 122 125 132 135 139 141 144 147 148 152
104:	82 83 88 91 93 97 99 108 114 116 122 129 132 136 139 141 144 147 152
106:	81 83 88 91 97 98 103 108 114 116 122 129 132 136 140 141 151 152
107:	81 83 88 91 93 97 99 103 108 116 117 122 129 132 136 139 141 144 152
107A:	82 88 92 97 98 103 107 112 122 131 139 141 144 147 152
108:	86 88 92 93 95 96 110 122 125 126 132 135 147 148 152
109:	86 88 93 95 96 110 122 126 135 148 152
112:	86 88 91 93 97 99 107 119 122 125 132 135 147 148 152
113:	86 88 92 95 96 99 110 125 135 147 148 150 152
114:	86 88 92 95 96 110 122 125 135 147 148 150 152
116:	81 88 90 91 93 97 107 114 115 117 122 126 132 135 146 155
119:	81 88 91 93 97 99 107 116 119 122 132 133 136 147 148 150 152
120:	82 88 92 93 97 100 104 107 118 122 132 135 146 150
121:	88 92 97 100 109 110 123 125 135
122:	82 89 91 97 107 118 121 126 133 135 146 149 151
123:	83 84 92 93 97 120 125 135 150

Appendix 7.5: Similarity measures between the 95 GSHBs of the corpus

	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	25	26	27
8	-	39	35	24	22	22	20	26	12	20	18	15	13	19	17	15	10	12	5
9	39	-	52	25	23	26	24	16	20	24	18	12	10	16	11	13	8	13	19
10	35	52	-	18	16	17	12	17	9	14	19	13	11	14	14	13	14	9	32
11	24	25	18	-	50	41	45	41	21	26	23	29	32	41	34	27	25	17	9
12	22	23	16	50	-	44	43	34	28	23	25	20	22	22	23	18	19	14	6
13	22	26	17	41	44	-	41	26	23	24	21	24	19	22	20	22	16	12	5
14	20	24	12	45	43	41	-	60	28	28	26	34	37	45	31	32	21	14	2
15	26	16	17	41	34	26	60	-	32	27	29	38	42	42	40	41	23	12	5
16	12	20	9	21	28	23	28	32	-	30	27	25	28	23	30	27	20	11	3
17	20	24	14	26	23	24	28	27	30	-	23	18	20	20	25	19	17	6	6
18	18	18	19	23	25	21	26	29	27	23	-	23	25	21	31	21	18	6	6
19	15	12	13	29	20	24	34	38	25	18	23	-	81	62	61	85	48	29	5
20	13	10	11	32	22	19	37	42	28	20	25	81	-	76	75	88	59	28	5
21	19	16	14	41	22	22	45	42	23	20	21	62	76	-	62	67	48	23	5
22	17	11	14	34	23	20	31	40	30	25	31	61	75	62	-	65	64	35	12
23	15	13	13	27	18	22	32	41	27	19	21	85	88	67	65	-	52	31	5
25	10	8	14	25	19	16	21	23	20	17	18	48	59	48	64	52	-	33	12
26	12	13	9	17	14	12	14	12	11	6	6	29	28	23	35	31	33	-	10
27	5	19	32	9	6	5	2	5	3	6	6	5	5	5	12	5	12	10	-
29	9	12	13	16	8	12	13	18	21	22	19	35	38	27	29	41	31	11	8
30	9	6	6	21	19	16	24	28	36	30	27	25	32	32	35	27	33	3	0
31	11	9	9	24	21	22	26	30	28	19	25	24	30	30	32	25	27	3	3
32	20	17	13	18	15	13	11	16	21	31	23	18	20	20	21	16	21	0	3
33	18	15	12	13	13	11	13	11	19	32	21	17	18	15	19	14	23	0	3
34	22	15	12	16	13	11	10	15	19	32	21	17	18	18	19	14	19	0	3
35	22	15	12	16	13	11	10	15	19	32	21	17	18	18	19	14	19	0	3
36	22	15	12	16	13	11	10	15	19	32	21	17	18	18	19	14	19	0	3
37	18	15	12	13	13	11	10	11	19	32	25	20	22	15	23	18	23	3	3
39	21	11	15	9	6	8	7	8	10	22	16	10	11	14	8	11	14	0	6
41	15	10	10	10	14	12	11	15	8	13	23	19	18	18	15	17	21	5	2
42	15	7	13	7	11	7	9	18	8	18	23	14	12	12	15	12	18	3	8
45	14	7	12	10	10	11	13	20	8	15	15	24	23	20	18	22	20	5	7
46	12	5	10	8	8	7	11	21	8	16	14	23	21	18	16	21	18	3	8
47	13	8	11	5	11	7	9	10	6	20	21	15	13	10	17	13	16	6	8
48	13	10	8	8	11	10	12	10	6	17	18	9	10	13	11	10	16	3	8
49	12	7	7	8	11	7	9	10	5	13	17	11	10	12	10	9	15	3	8
50	18	13	10	8	11	15	14	10	5	16	17	14	10	12	10	12	13	8	5
51	12	7	7	10	8	7	13	17	8	15	10	24	23	23	12	23	18	5	5
52	16	8	11	8	12	8	9	13	9	21	18	10	8	10	11	7	11	3	9
54	14	9	7	7	8	12	13	12	8	21	10	13	12	14	10	11	15	11	5
55	14	9	7	13	8	12	18	17	11	24	13	24	26	23	18	23	21	5	5
56	13	7	8	8	11	7	9	10	9	19	14	14	13	15	10	12	16	3	5
57	15	13	10	8	8	12	11	12	5	16	11	14	12	15	10	15	15	15	5
58	17	9	12	7	5	7	8	14	8	18	13	24	20	20	15	22	17	14	7
59	18	13	23	17	18	18	20	13	9	13	8	17	18	22	19	15	22	9	18
59A	21	8	18	15	24	14	15	21	17	18	12	19	21	21	26	20	18	13	13
60	19	23	14	17	18	16	23	22	16	24	14	9	10	13	11	10	13	3	15
62	22	8	14	17	11	13	14	26	12	14	14	21	22	22	31	22	34	12	22
63	12	5	5	13	8	9	13	12	5	10	13	25	27	27	15	23	24	8	5
64	19	17	21	8	9	10	12	16	9	11	11	10	10	10	11	10	8	3	15
66	22	19	24	17	11	13	20	19	9	14	8	18	19	19	27	18	16	16	30
67	19	20	17	11	9	5	7	10	13	17	15	18	19	10	17	19	24	9	19
68	17	18	26	9	9	5	7	5	13	5	3	7	8	8	8	8	11	6	24
69	11	21	14	15	16	14	15	14	21	21	9	15	17	17	18	16	14	13	19
70	14	11	14	3	3	2	5	8	9	14	6	7	8	8	11	8	11	3	28
71	24	21	22	10	5	7	9	12	8	13	8	11	9	15	13	9	12	5	24
72	25	23	20	12	7	11	15	16	10	20	10	18	16	16	20	16	20	8	18
73	21	18	22	10	5	7	11	12	5	13	5	11	9	12	13	9	12	5	27
75	18	16	16	11	5	10	14	15	12	13	11	9	10	13	13	10	13	3	18
76	18	18	38	13	8	7	16	18	5	10	5	14	12	15	16	12	15	8	32
79	26	19	35	8	5	10	14	10	6	11	5	7	7	10	11	7	10	3	22
80	19	17	24	11	12	8	12	10	6	5	3	15	16	16	14	16	17	13	19
82	21	18	22	3	3	3	2	5	10	11	9	5	5	5	11	5	11	3	29
83	15	11	19	4	2	6	6	4	2	9	4	10	8	8	11	8	11	5	23
84	11	16	23	2	2	4	4	2	5	4	2	4	4	4	4	4	6	0	15
85	21	12	25	13	8	4	11	18	3	7	8	22	24	21	25	23	21	14	24
86	15	11	19	4	2	4	8	10	2	6	7	14	15	13	11	15	16	7	17
87	18	10	16	5	5	5	9	13	6	8	8	12	13	15	13	12	13	6	25
88	13	8	21	8	3	2	7	13	9	11	8	7	8	10	8	7	8	0	23
89	15	7	13	10	8	5	6	10	8	7	8	14	15	18	13	12	13	3	8
90	21	16	14	9	10	11	10	11	7	9	4	8	9	11	11	8	11	7	10
91	11	14	12	12	13	14	18	11	8	7	7	11	11	11	15	9	12	11	22
92	13	16	13	14	14	15	20	13	9	8	8	12	13	13	16	10	13	12	18
93	17	14	15	12	10	11	13	9	8	4	7	13	11	11	15	11	12	14	22
95	20	31	18	15	10	14	18	14	11	12	10	21	20	20	18	20	15	17	19
96	18	26	26	8	3	7	11	13	9	13	11	14	15	15	10	15	13	6	18
97	19	25	23	14	7	9	15	13	7	9	7	23	21	21	14	21	16	13	21
98	16	17	20	9	2	4	10	11	2	7	5	23	22	22	12	21	17	8	18
101	18	26	30	5	5	5	4	7	6	10	8	7	7	7	8	7	7	0	33
102	18	31	41	7	8	9	9	15	14	15	16	11	12	9	15	12	15	3	35
103	18	32	22	13	11	12	11	7	15	13	8	9	10	12	10	9	7	8	17
104	12	21	31	7	5	9	8	7	5	10	5	6	4	7	7	4	7	0	26
106	15	15	29	8	8	7	6	12	8	10	8	14	12	10	16	12	15	3	21
107	15	15	29	7	5	7	6	9	5	10	5	11	9	9	13	9	12	3	17
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76	63	42	-	64	45	30	38	33	44	31	34	45	23	20	42	38	42	32	42
79	42	36	64	-	48	32	39	38	38	36	32	43	24	24	36	36	36	30	45
80	35	19	45	48	-	29	33	32	48	37	38	40	29	28	33	33	37	34	29
82	42	27	30	32	29	-	22	23	29	25	20	33	19	33	21	24	24	18	31
83	27	26	38	39	33	22	-	62	33	51	46	41	31	25	41	35	35	36	32
84	23	27	33	38	32	23	62	-	26	43	27	39	29	29	33	33	27	22	33
85	35	26	44	38	48	29	33	26	-	51	37	31	29	29	27	26	30	31	37
86	24	23	31	36	37	25	51	43	51	-	42	41	38	30	35	35	32	33	50
87	30	21	34	32	38	20	46	27	37	42	-	42	38	21	39	31	35	32	35
88	35	33	45	43	40	33	41	39	31	41	42	-	41	25	33	33	33	24	38
89	17	18	23	24	29	19	31	29	29	38	38	41	-	36	34	38	34	25	24
90	26	27	20	24	28	33	25	29	29	30	21	25	36	-	30	33	27	34	30
91	30	28	42	36	33	21	41	33	27	35	39	33	34	30	-	85	74	36	25
92	26	28	38	36	33	24	35	33	26	35	31	33	38	33	85	-	72	32	28
93	33	25	42	36	37	24	35	27	30	32	35	33	34	27	74	72	-	33	22
95	28	26	32	30	34	18	36	22	31	33	32	24	25	34	36	32	33	-	48
96	37	39	42	45	29	31	32	33	37	50	35	38	24	30	25	28	22	48	-
97	42	27	43	34	43	23	33	23	46	43	37	28	26	35	30	27	33	72	63
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109	27	22	35	33	30	14	13	13	24	15	13	19</							

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47	13	14	18	12	10	14	21	18	26	4	2	7	5	5	14	14	22	11	20
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49	18	16	15	14	12	14	20	14	25	9	7	12	10	9	13	14	15	11	12
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51	28	29	14	11	9	11	19	13	21	4	4	14	4	4	17	11	20	13	11
52	11	11	13	10	7	12	18	15	24	7	8	5	8	7	11	12	23	8	13
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58	24	22	16	13	11	18	21	21	26	8	9	13	7	6	15	18	17	13	14
59	30	24	15	30	38	40	27	37	29	30	18	27	22	24	21	29	25	11	19
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62	28	25	18	27	12	14	24	21	23	18	19	15	13	13	19	17	22	11	16
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66	34	28	25	34	35	33	24	24	26	38	33	31	26	29	28	23	19	29	13
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68	37	31	31	38	43	36	30	29	29	33	32	26	24	27	24	29	17	28	14
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71	42	33	30	32	48	34	26	28	31	28	27	32	18	20	23	28	27	19	26
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73	42	39	33	32	44	38	29	32	31	32	27	36	18	20	23	34	27	19	26
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76	43	41	27	44	45	52	41	44	32	44	35	37	24	27	27	35	28	17	27
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82	23	27	40	26	26	25	23	22	25	13	14	16	5	5	27	25	28	32	14
83	33	37	26	30	28	43	41	40	21	17	13	20	10	13	23	33	15	14	13
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92	27	28	18	23	31	36	38	33	16	30	29	27	18	21	38	26	22	21	6
93	33	31	25	24	34	33	34	30	17	41	36	31	23	25	38	33	17	18	5
95	72	54	23	38	43	24	25	21	15	24	17	35	17	20	29	30	17	29	14
96	63	55	31	41	38	36	31	30	26	17	15	31	7	10	24	36	32	24	16
97	-	73	30	38	43	28	29	29	19	29	21	36	16	18	33	38	21	21	19
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103	43	33	24	36	-	47	30	40	41	36	28	41	24	27	27	32	21	27	15
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107	29	33	23	28	40	76	69	-	44	19	18	26	12	14	23	38	18	10	18
107A	19	20	26	31	41	47	41	44	-	21	16	22	16	19	14	24	23	15	17
108	29	20	12	22	36	21	17	19	21	-	81	40	52	55	29	21	18	16	15
109	21	16	10	15	28	17													

Appendix 7.6: Similarity Measures selected as basis of clustering

The table below lists, for each of the 95 brooches of the inner corpus with any similarity measure greater than 50, all the brooches with which it has a similarity measure greater than 50. For those brooches with no measures above this value, the brooch or brooches with which it has the highest similarity measure are given in brackets, with the measure following as a subscript.

Brooch no:	Related brooches:
8:	(9) ₃₉
9:	10
10:	9
11:	(12) ₅₀
12:	(11) ₅₀
13:	(12) ₄₄
14:	15
15:	14
16:	(30) ₃₆
17:	(33 34 35 36 37) ₃₂
18:	(22) ₃₁
19:	20 21 22 23
20:	19 21 22 23 25
21:	19 20 22 23
22:	19 20 21 23 25
23:	19 20 21 22 25
25:	20 22 23
26:	(22) ₃₅
27:	(102) ₃₅
29:	(23) ₄₁
30:	31
31:	30
32:	33 34 35 36 37 39
33:	32 34 35 36 37 39
34:	32 33 35 36 37 39
35:	32 33 34 36 37 39
36:	32 33 34 35 37 39
37:	32 33 34 35 36 39
39:	32 33 34 35 36 37 56
41:	42 45 46
42:	41 46 47 49 52 54 56
45:	41 46 57 58 63
46:	41 42 45 51 52 54 58
47:	42 49 52 56
48:	49 50
49:	42 47 48 50 56

50:	48 49 54 56 57 58
51:	46 52 54 55 56 58 63
52:	42 46 47 51 54 56
54:	42 46 50 51 52 55 56 57 58
55:	51 54 56 58 63
56:	39 42 47 49 50 51 52 54 55
57:	45 50 54 58
58:	45 46 50 51 54 55 57
59:	59A
59A:	59
60:	(48) ₄₂
62:	(25) ₃₄
63:	45 51 55
64:	(101) ₃₃
66:	76 79 85
67:	(60) ₃₄
68:	70 76 79 80
69:	70
70:	68 69 71 73
71:	70 72 73 75 76
72:	71 73 75
73:	70 71 72 75 76
75:	71 72 73
76:	66 68 71 73 79 104
79:	66 68 76 104
80:	68
82:	(70) ₄₄
83:	84 86
84:	83
85:	66 86
86:	83 85 96
87:	(83) ₄₆
88:	(76) ₄₅
89:	(88) ₄₁
90:	(89) ₃₆
91:	92 93
92:	91 93
93:	91 92
95:	97 98
96:	86 97 98
97:	95 96 98
98:	95 96 97
101:	(82) ₄₀
102:	(76) ₄₄
103:	(71) ₄₈
104:	76 79 106 107
106:	104 107

107:	104 106
107A:	(104) ₄₇
108:	109 113 114
109:	108
112:	(114) ₄₇
113:	108 114
114:	108 113
116:	(92 93) ₃₈
119:	(98) ₄₂
120:	(75 96) ₃₂
122:	(82) ₃₂
123:	(76) ₂₇

