

37 Gold bracteates and correspondence analysis

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The purpose of this paper is not to present anything really new, either in the way of new methods or of new results. I intend simply to give, as an example, an account of the use of correspondence analysis on an archaeological material, and to highlight some the problems which emerged during the work. These, in fact, throw some light on the practical utility of the method.

37.1 GOLD BRACTEATES

The aim of my work with multivariate methods is to establish a chronology for gold bracteates, a special type of pendant mostly found in southern Scandinavia and Norway (Figures 37.4, 37.7, 37.8; Mackeprang 1952; Malmer 1963:76–221; Hauck *et al.*). They belong to the Migration Period, which in Scandinavia comprises the 5th and the first half of the 6th centuries A.D., and their dating can possibly be confined to the later half of the fifth century exclusively (Lund Hansen 1992). They are embossed with quite complicated pictures, struck on matrix dies — this is a point of some importance in what follows. Many of them were also adorned with punched ornament after striking — another detail of importance (Axboe 1982, 1988). The motifs of the bracteates indicate that apart from their function as jewellery they had a definite religious significance (Hauck 1992; Axboe & Kromann 1992, with further references).

In southern Scandinavia virtually no bracteates have been found in graves: they are all single finds, or part of hoards with other bracteates and sometimes also with other precious objects (Hines 1989:197–199; Andrén 1991 fig. 3). This means that although we know of about 900 gold bracteates from more than 550 different dies, a chronology for their development cannot rely on combinations between bracteates and other artefact-types for more than a basic dating (Axboe

1992, with further references). For finer divisions we have to trust typological methods applied to the attributes of the bracteates themselves.

37.2 ANALYSING THE BRACTEATES

The first step in my investigation was to divide the bracteate-motifs into details — eyes, ears, human hair styles, animal heads, etc. — and to define a number of types of each of these. Some bracteates, however, show a human bust, others a human head placed over an animal, and a large group shows only a highly stylized animal. So to permit comparisons on an equal basis, I chose to concentrate on the details of the human heads, thus making it possible to compare the so-called A-, B- and C-bracteates, and to include about 500 bracteates from 345 different dies. The occurrence of 71 different detail-types was recorded, in more than 2500 incidences. This was all stored in a dBaseIII+ database.

After some futile essays with k-means clustering and nearest neighbour-dendrograms, I ended up using correspondence analysis together with sorted two-way matrixes of the bracteate-dies and their variables. For the latter method and for different statistics I have used The Bonn Seriation and Archaeological Statistics Package (Herzog & Scollar 1987) which also provided the clustering facilities. As correspondence analysis had not yet been included in this package, I had a program published by Richard Wright (Wright 1985) adapted for my purposes.

Correspondence analysis of a perfect seriation will result in a horse-shoe, or, better, a parabola (Madsen 1988 fig. 11). My first attempt with the details of the human faces in seen in Figure 37.1. It was not very encouraging, but at least there might be a nicer parabola hidden in this cloud. And, indeed, some types and dies that I would

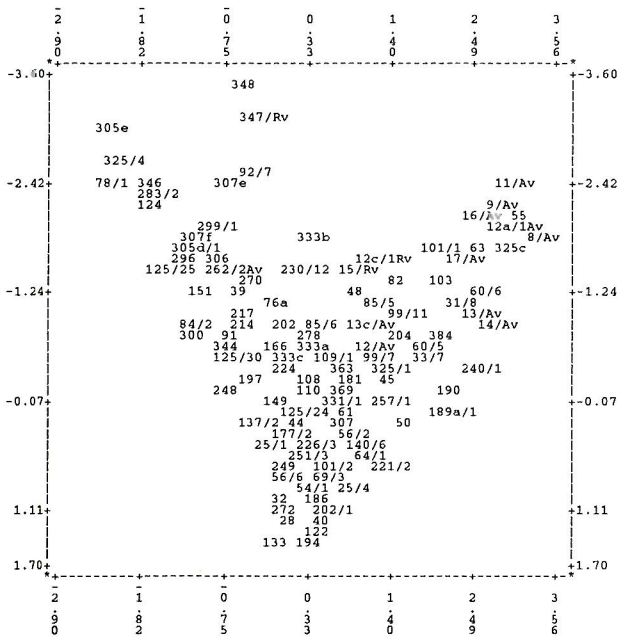


Figure 37.1: The first attempt to seriate the gold bracteates using correspondence analysis.

expect to be early were found at one edge of the diagram, while others that can be presumed late were at the other edge.

37.3 IMPROVING THE MATRIX

So I scrutinized my sorted matrix. Some details, such as human eyes shaped like dots or solid ovals, occurred from beginning to end. They are so simple that they may be "invented" again and again, and so they were eliminated as being without chronological significance. I had also started with a rather detailed typological classification, and found it reasonable to merge some of the types. For example, many of the human heads wear more or less elaborate diadems. Originally I had divided the most splendid type of diadem (Axboe in press, Appendix B) into two types, one with a dotted or linear contour (as in Figure 37.4 middle left), the other with no contour. These were merged into one type, as were other mutually related details, and less messy diagrams resulted.

Another important process was the re-assessment of problematic details. Bracteates are very small, with a picture field of only 2 or 3 cm across, and many details measure only 1 or 2 mm. Although I made my definitions of the motif-details as clear-cut as possible, the bracteate makers, of course, took no account of such definitions. No matter how unambiguous your definitions are, it may in practice be questionable whether a

particular eye should be classed as an oval or a pointed oval. The bracteate pictures are also highly compressed, and it may be difficult to decide whether a specific detail was intended to be a human ear, a part of the hair style, or both. Similar ambiguity can be found in other Germanic ornamented objects of the Migration Period (Leigh 1984).

I therefore scrutinized those incidences which appeared in the sorted matrixes as "outliers", much earlier or later than other incidences of the same type. Of course some of these had to be faced as uncomfortable facts, but quite a few appeared to be ambiguous and to fit as well — or perhaps even better — into other types. Also some detail-types profited by being redefined. In all cases, my measure of success was whether the changes resulted in a slimmer and more pronounced parabola in the correspondence analysis.

This may sound like unscientific manipulation of one's data. But it is not. Of course the objects are *a priori* to the investigation and should be respected as such. But the types of the variables and their definitions were established by me, and it would be an outrageous stroke of good fortune should I have hit exactly the chronologically significant ones at the first attempt. Recurrent selection and testing of types, objects and definitions are a basic and indispensable element of scientific work, but this may be forgotten in a false veneration of the supposed "objectivity" of computer methods. Even the best of programs can only process the data-input given, and, if the result is unsatisfactory, one may have to reconsider both the methods and the data used as well as one's choice and classification of variables (for a different, and unsuccessful, approach to the gold bracteates see Højlund Nielsen 1988:51; for conflicting views of identical find materials e.g. Ethelberg 1986, 1990:134f. vs. Ringtved 1986:121-129; Hines 1992 vs. Palm & Pind 1992). It is, however, essential that the definitions and the premisses of the conclusions are made explicit.

In the course of the investigation it is also essential to make the changes step by step, always preserving the preceding versions of the database, so that it is possible to go back and explore other possibilities.

37.4 SUCCESS!?

Having trimmed my database, as described, to 342 dies, 51 variables and 2445 incidences, I ended up with the curve shown in Figure 37.2, which like most of my working printouts shows

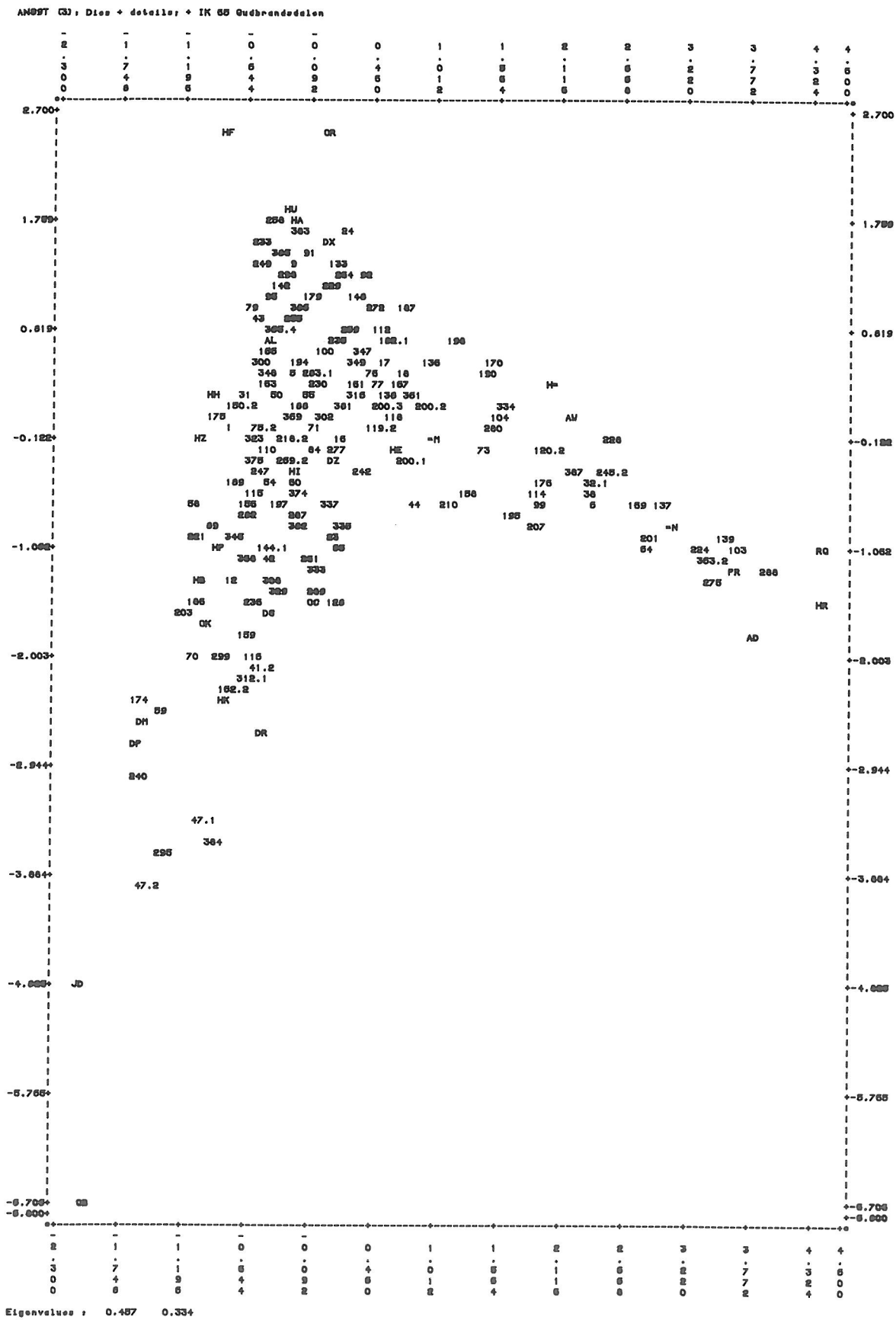


Figure 37.2: Correspondence analysis of human faces of all bracteates (both dies and details included).

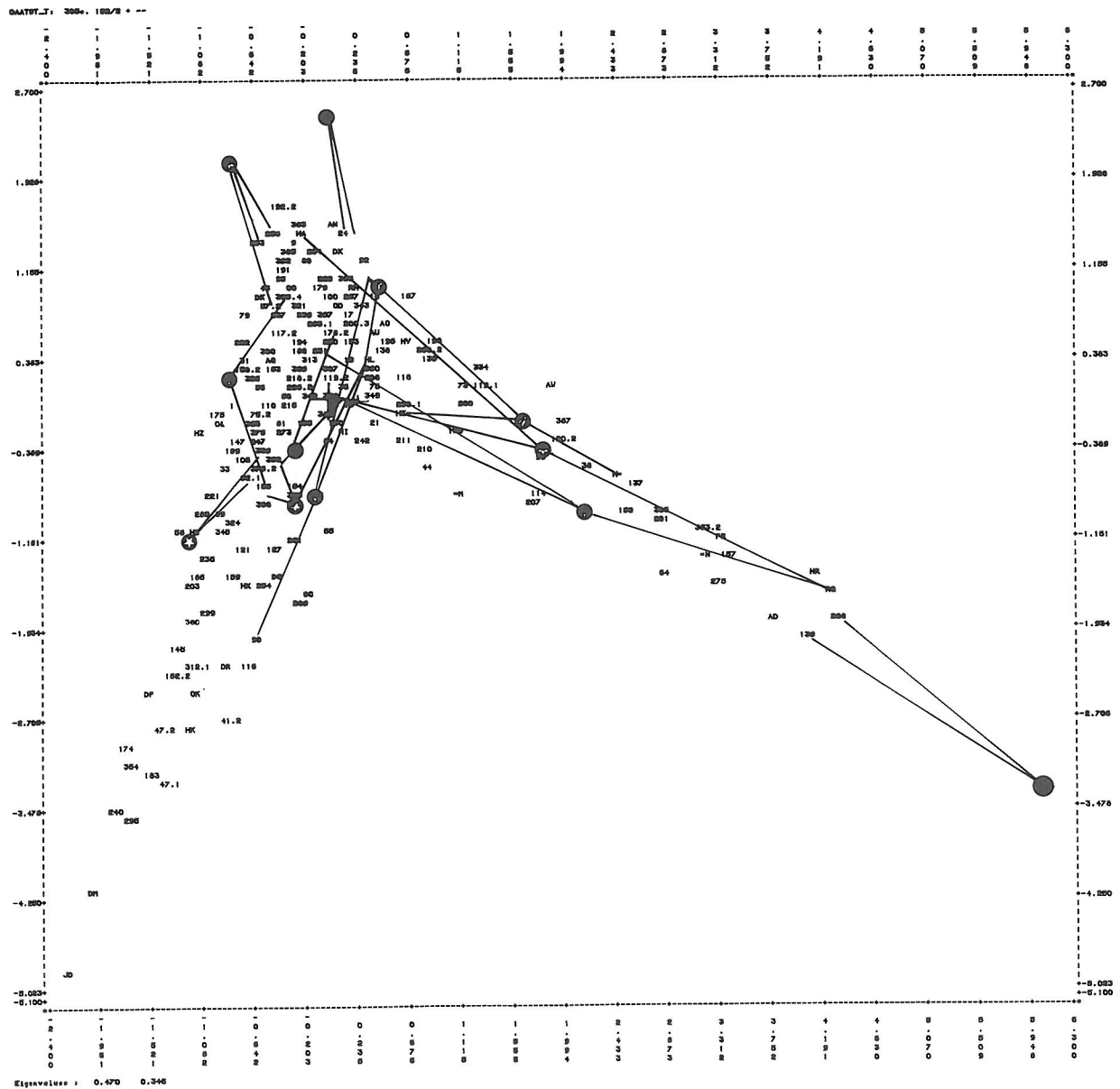
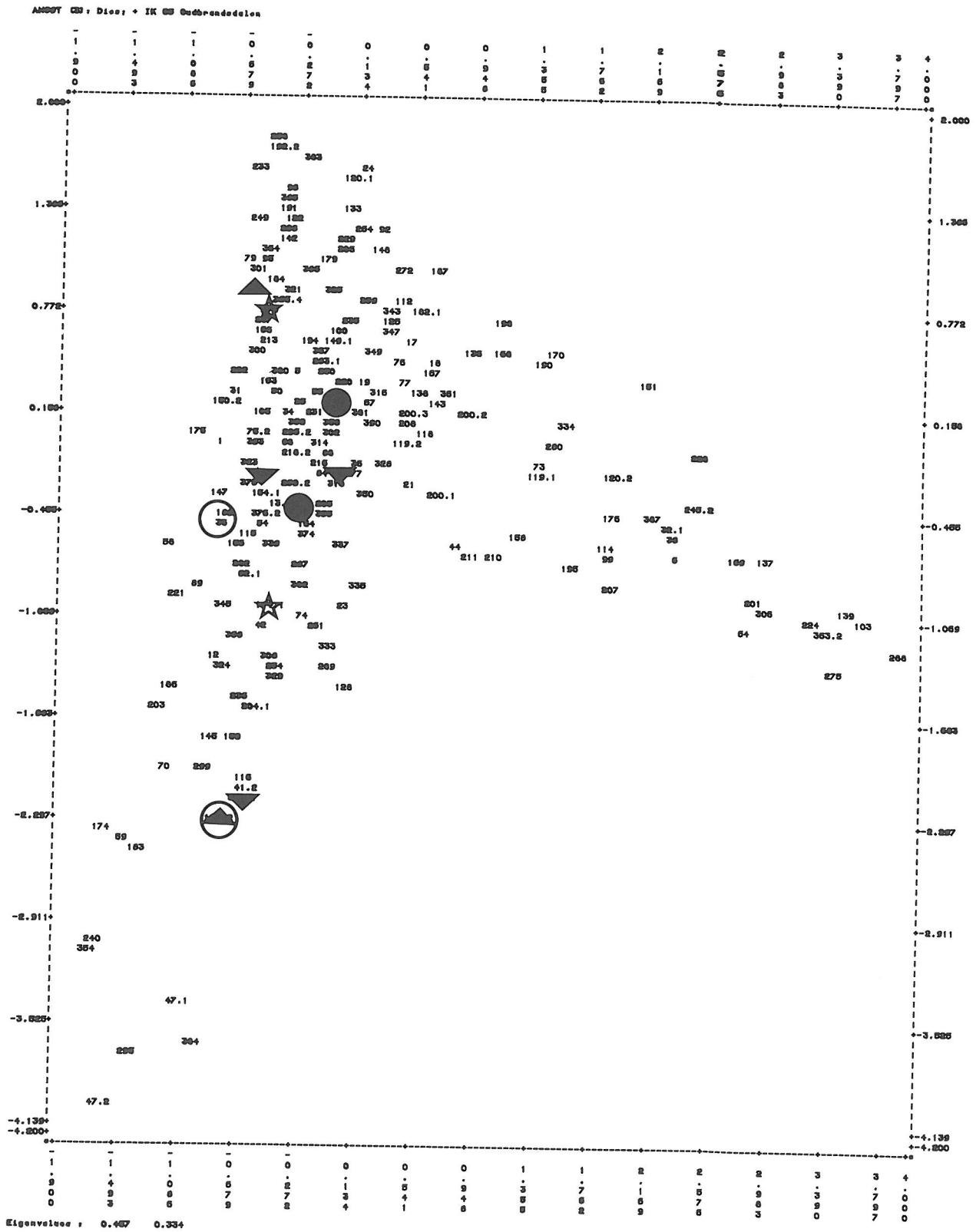


Figure 37.5: Analysis of human faces (details and dies, A- and C-bracteates only). The black dot marks a detail which was added to the two latest dies in the seriation. The stars indicate dies/details with 2-3 incidences, and they are connected to the details/dies where they occur.

care. It cannot, for example, be used to tell that «Bracteate A is a little earlier than bracteate B» even if the dies concerned may be so placed in the curve. The occurrence of a parabola indicates that the variables considered can be ordered according to a typological seriation with gradual change in respect of details. But the exact locations of dies and details in the curve are not determined solely by their place in typological development. They are also influenced by the number of their incidences.

This was demonstrated by some details, which find a place “flying” over the top of the curve (see also Høilund Nielsen 1992). These turned out to occur on only a few dies which were placed in the adjacent part of the curve, and which apparently were kept in place there by their other variables. If details with few incidences occur near one end of the curve, they may, correspondingly, be “shot out” to the tip of the curve.

To demonstrate this, in Figure 37.5 I have added a detail to the two latest dies in the dia-



- 1
- ☆ 2
- ▲ 3
- ▼ 4
- 5

Figure 37.6: Analysis of all human faces (dies only) with indication of dies linked through border punches or other specific details; see Appendix.

gram, and this detail (the solid black dot) has been placed far out, to form the right-hand end of the curve. I have also marked (with stars) the dies and details which have only two or three incidences each, and connected them with the respective details or dies. It appears that these are not simply placed between the dies or details involved; they are "pushed away" from the zero point of the diagram which is indicated by a cross. However one cannot simply assume that details at the tip of the curve have only a few incidences: the two types at the left-hand tip have 9 and 10 incidences respectively and can thus be presumed to be genuinely early types.

So even if correspondence analysis shows that seriation is possible, the chronological utilization of this seriation really must involve the sorted matrix. With this, one can see whether a type is frequent or not, and whether it is long- or short-lived, and thus estimate the chronological viability of objects and details.

37.5.2 Typology and reality

But another problem arose, which shows that the concept of typology itself must be used with some care, at least when one is working on material like the gold bracteates with high levels of individualistic features.



Figure 37.7: Two bracteates from Darum, Jutland, linked through the dot-and-circle border punch; see Appendix. After Hauck et al.



Figure 37.8: Two bracteates from Overhornbæk, Jutland (left and centre), and one from Lindkær, Jutland (right), with characteristic runic borders; see Appendix. After Hauck et al.

As I mentioned, many bracteates have a punched border decoration. In a few cases, the same border punch can be shown to occur on bracteates whose central designs were made with different dies. Now artisans tend to be very jealous of their personal tools and don't like lending them to others; also it is unlikely that a punch would survive unharmed to stay in use for several decades. So when two bracteates are punch-linked, it is likely that they were manufactured within a relatively short period and possibly by the same man, and one would expect them to be placed quite close in the diagrams. The same applies to the relatively few bracteates for which we have other strong reasons to suppose that they were made by the same master.

But in point of fact such bracteates may be very unlike each other, and they are placed accordingly, as shown by the diagram Figure 37.6, where each linked group has its own sign. Some couples, like the round dots, may be acceptable. I can also understand the placing of the open circles, which stand for a die that had been changed (Mackeprang 1952:30, 101; Axboe 1982:5f.): the man had a bird's head added at the nape, a feature apparently not found on the earliest bracteates.

Much more startling is the pair of bracteates in Figure 37.7, which are linked by their dot-and-circle punch (Axboe 1982:52ff.). In the diagram in Figure 37.6 they are marked with triangles pointing upwards. They come from the same hoard, but without the punch-link I cannot imagine that anybody would consider them to be manufactured by the same man or even contemporaneous.

The same applies to the group in Figure 37.8, which come from two neighbouring finds from the central part of Jutland. The diagnostic detail is the runic border with eagles' heads, which is unique to these three dies. It is natural to group the central motifs of the bracteates to the right and the left together, as they are merely reversed versions of the same picture. But the motif of the bracteate in the centre of Figure 37.8 has no similarity whatsoever to the two others apart from the distinctive border zone. As shown in the diagram by the triangles pointing downwards, these bracteates are also widely separated by the correspondence analysis, with the man's head as the early piece. But they must, so to speak, have known each other and were indeed very probably made by the same man.

These examples warn us to treat our analyses with some care. And it is not correspondence analysis as such which is to blame; the problematic pieces are also placed far apart in the sorted

matrixes. So it is the method of typology itself which has to be taken with a pinch of salt, at least when used on an artistic material like the gold bracteates.

I can suggest some explanations for this. For one thing, the development of the gold bracteates took place within a very short time archaeologically, perhaps no more than 2 generations. So the lifetime of a bracteate-maker may cover a considerable part of this period. As already mentioned, the prototypes for some of the bracteate designs were Roman coins with the Emperor's bust. These were available to Scandinavians throughout the period of the bracteates, and so it was always possible to return to the prototypes and make new, "classical" bracteates even at a mature stage of bracteate development.

Of course, I am happy that seriation proved possible at all, and I will go on, trying to extract both chronological and other information from my diagrams (cf. Axboe in prep.). But the lesson for me and for others must be that all seriations should be used with care and reflection, and not taken at face value.

Appendix

Bracteates with different dies linked by identical border punches or runic borders (Figure 37.6).

- | | |
|---|------------------------|
| 1) Espelund-C, M 15:12; IK 49
Furulid-C, M 15:26; IK 60 | } Volute-shaped punch |
| 2) Holmetorp-A, M 4:18; IK 279
Ravlunda-C, M = 11:3; IK 144,1 | } Volute-shaped punch |
| 3) Darum-A, M 3:12; IK 162,2
Darum-C, M 6:26; IK 43 | } Dot-and-circle punch |
| 4) Overhornbæk-A, M 3:13; IK 312,1
Overhornbæk-C, M 6:23; IK 140
Lindkær-C, A 86a; IK 110 | } Runic border |
| 5) Darum-A, M 3:12; IK 162,2
Skonager-A, M 3:13; IK 162,1 | } Bird's head added |

Abbreviations

A: Axboe 1982 (Catalogue-numbers)
IK: Hauck et al. (Catalogue-numbers)
M: Mackeprang 1952 (Plate-numbers)

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