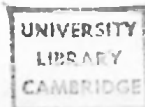


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BELL BEAKERS AND THEIR CONTEXT  
IN CENTRAL EUROPE:  
A NEW APPROACH



Dissertation submitted for examination for the degree  
of Doctor of Philosophy in the University of Cambridge

by

Stephen James Shennan,  
Fitzwilliam College.

1977

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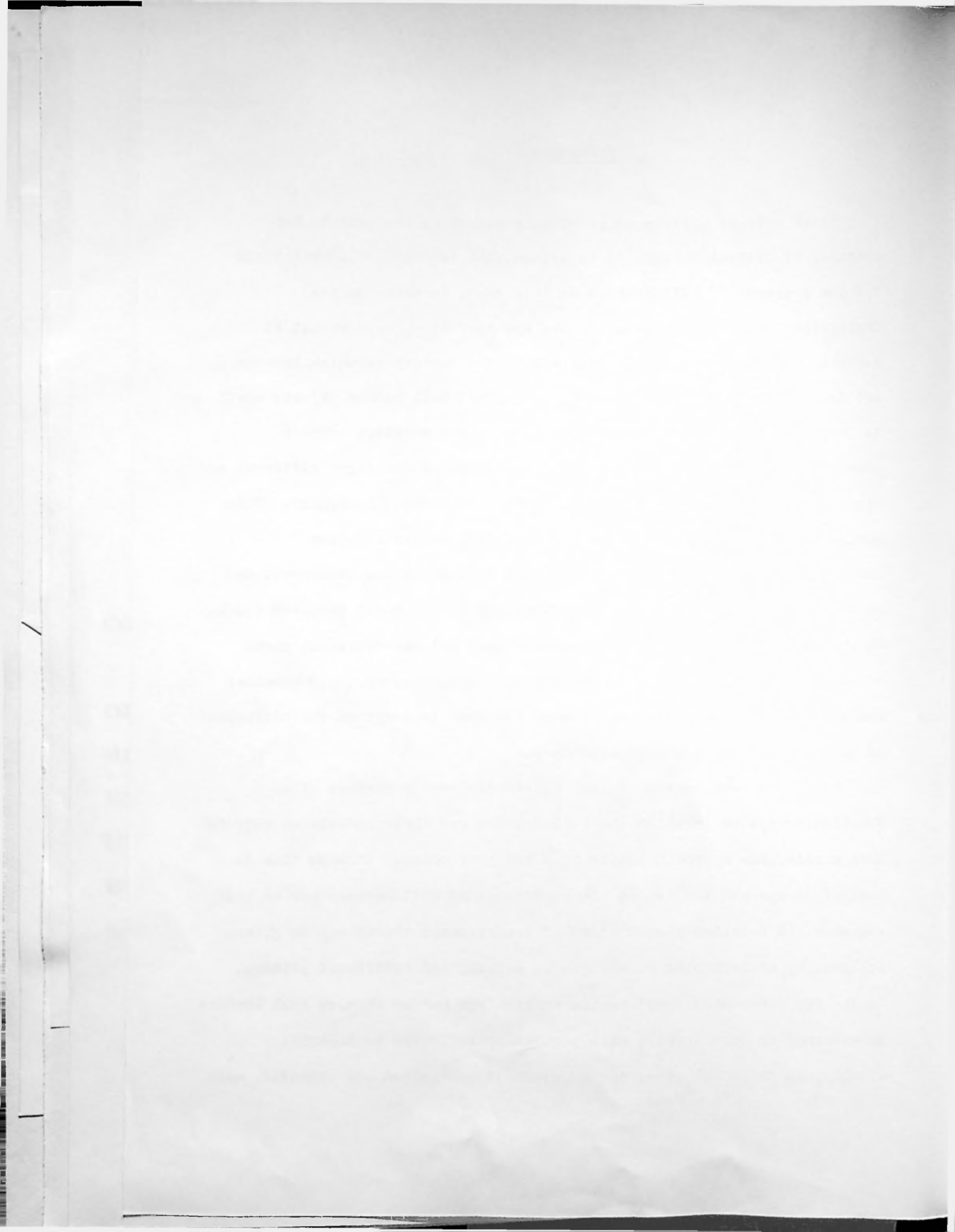
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## SUMMARY

After a brief history of previous research on the Bell Beaker cultures of Central Europe, it is argued that traditional explanations for the presence of Bell Beakers in this area, in terms of the immigration of a 'Beaker people', are unsatisfactory, and result at least in part from a lack of attention to the context in which Beakers are found; it is suggested that the widespread Bell Beaker objects are, in fact, prestige goods. In the following three chapters certain expectations derived from this argument are tested for three different regions of Central Europe: Bohemia, Moravia, and Central Germany. This analysis shows that the assumptions about Bell Beaker relative chronology on which earlier theories have been based are incorrect, and at the same time leads to some modifications of the model proposed above. In the light of these results the connections between different parts of Central Europe, and between Central and Western Europe, are examined and a hypothesis is offered to account for them in terms of the diffusion of innovations with prestige overtones.

After the development of this relatively static picture of a functioning system in which the Bell Beakers and their associated objects have a role, the approach shifts to a study of changes through time in Central Europe and the impact the appearance of Bell Beakers has on this sequence. A detailed presentation of the regional chronology is given, followed by a discussion of changes in economy and settlement pattern. In the two succeeding chapters the change from Corded Ware to Bell Beakers is examined in more detail, with particular reference to Bohemia. Finally, in the conclusion, the argument is summarised and extended, with



a discussion of the situation outside Central Europe and some suggestions as to why the Bell Beaker phenomenon may have occurred when it did.

The point is made, however, that the Bell Beaker 'problem' is far more complex than is usually acknowledged, and that before it is possible to embark on large-scale explanations it is necessary to establish for each area exactly what it is that has to be explained.

1. The first part of the paper is devoted to a general discussion of the problem.

2. In the second part, we consider the case of a single particle.

3. The third part is devoted to the case of a system of particles.

4. In the fourth part, we consider the case of a continuous medium.

5. The fifth part is devoted to the case of a system of continuous media.

6. In the sixth part, we consider the case of a system of continuous media.

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## PREFACE

When, during my third year as an undergraduate, I was thinking of a subject on which to do research, I had in mind two initial considerations: the area had to be Central Europe and the period had to be the later Neolithic and the beginning of the Bronze Age. This period in Central Europe seemed shrouded in virtually impenetrable gloom which examination of the literature did little to dissipate; yet it was clearly at this time that the foundations for the better known developments of the later Early Bronze Age were laid. In the middle of this little known period lay the Central European Bell Beaker culture, a subject also important to another set of problems, those connected with the origins and significance of the Bell Beaker 'culture group' as a whole: in the preceding few years several suggestions had appeared in the literature to the effect that Bell Beaker origins probably lay in Central Europe rather than Iberia. With all these points in mind, after seeking advice from a number of people, I decided to take the Bell Beakers of Central Europe as my dissertation topic.

I began research in October 1971 financed by a Major State Studentship, for which I am grateful to the Department of Education and Science. In 1972 and 1973 I made two visits to Central Europe, staying almost a year in all and visiting West Germany, Austria, Hungary, Czechoslovakia, East Germany and Poland. During this time I received help from many people which I am only too pleased to acknowledge.

In West Germany I am grateful to the authorities of the museums at Regensburg and Munich for allowing me to study objects in their care. I would also like to thank Dr U. Fischer of the Frankfurt City Museum, who gave me the benefit of his enormous knowledge of



the Late Neolithic in Central Germany, and particularly Dr E. Schubert, of the Römisch-Germanisch Kommission in Frankfurt. Dr Schubert was extremely kind and helpful and through his good offices I was able to use the Kommission's library, superbly equipped, cool, and made additionally pleasant by faint strains of music from the Palmengarten.

In Austria I was made very welcome at the Naturhistorisches Museum in Vienna by Dr W. Angeli and his colleagues in the Prehistory department, who kindly gave me access to everything I wanted to see.

By far my greatest debt in Hungary is to Mrs Rosza Schreiber-Kalicz, who allowed me to study and draw the unpublished material from her extremely important recent excavations of Bell Beaker settlements and cemeteries on the Csepel Island, south of Budapest. She and her husband Dr N. Kalicz, were also very hospitable and helped to make my two visits to Budapest particularly pleasant. I would also like to acknowledge the help of the staff of the Hungarian National Museum, who enabled me to study material in their care, and of Dr S. Bökönyi, who found time to discuss with me the faunal remains from the Csepel Bell Beaker sites.

The number of people to whom I owe thanks in Czechoslovakia is enormous, but I must begin with Dr E. Neustupný of the Archaeological Institute at Prague. On being informed rather than requested, by the Board of Graduate Studies in Cambridge, that he was to be my supervisor while I was in Prague he was amused rather than annoyed and gave unstintingly of his time and knowledge over a period of several weeks as well as helping with practical problems which arose. Similarly kind was Dr J. Ondráček of the Brno Archaeological Institute who gave me free access to the unpublished information on Bell Beaker finds from Moravia contained in the Institute's archives. It would have



been impossible to complete my thesis if this information had not been available to me. But Dr Ondráček's help did not end there. He enabled me to stay in the Institute's beautiful, if rather ghostly, guest house in the Moravian karst district, and interceded for me at a police station when I was having problems with my visa. Others who gave me considerable help include Drs M. Buchvaldek and L. Košnar of the Charles University, Prague, Dr J. Vládar of the Nitra Archaeological Institute, Dr E. Pleslová-Štiková of the Prague Archaeological Institute and Mrs M. Nenadalová, my Prague landlady. I would also like to thank the staff of the museums at Bílina, Kolín, Poděbrady, the Prague City Museum, the Moravian Museum, Brno, and especially Prof. J. Neustupný, Dr I. Hásek, and the rest of the staff of the archaeology department of the National Museum, Prague, who allowed me to study the objects in their care and were invariably more friendly, helpful and hospitable than I had any right to expect.

Finally, in East Germany, I must express my gratitude to Dr H. Behrens, director of the Landesmuseum für Vorgeschichte at Halle, who allowed me to study the material in his museum and gave me access to his own private card index of Bell Beaker finds in Central Germany as well as the then unpublished manuscript of his book on the Neolithic of the Elbe-Saale area, not to mention showing me much personal kindness.

Perhaps a last Central European debt should be recorded to a person I never met, Dr L. Hájek. He more than anyone has provided the information on which this thesis is based, through his published catalogue of the Bell Beaker finds from Bohemia and his compilation of virtually all the unpublished information on the Moravian Bell Beakers which I was allowed to see in Brno.

Turning nearer home, I would like to thank Dr J.D. Wilcock of



the North Staffordshire Polytechnic for carrying out some special computing for me with the PLUTARCH system he has developed at Keele University.

No words can express the debt I owe to my late supervisor, Dr David Clarke, who unfortunately never saw this dissertation completed. Always ready to find the time to help, the stimulus he provided by his brilliance, insight and imagination was a source of inspiration and he more than anyone has shaped my whole outlook on archaeology. I feel extremely privileged to have been supervised by him.

I also want to express my deep gratitude to Dr John Coles, who kindly agreed to be my supervisor after David's death. He has read the thesis and made numerous helpful comments upon it, as well as providing much friendly guidance and advice. Finally, I must thank my wife, without whose constant help and support this thesis would never have been completed, and whose criticisms helped to make my style clearer than it would have been otherwise.

As will be clear from my debts of gratitude, I have received help from many sources, but this dissertation is not the result of work done in collaboration with any other person apart from the computing carried out for me by Dr Wilcock using his special facilities at Keele University. This is acknowledged in the appropriate place in the text and a joint article with Dr Wilcock is bound into the back of this thesis; our individual contributions to this article are clearly distinguished. All other computing not so acknowledged was carried out by myself, using standard 'program packages' available on the Cambridge IBM 370/165 computer. Reference to these packages, and to all other sources of information used in this dissertation, is made in the text.

The dissertation conforms to Faculty of Archaeology and Anthropology



regulations concerning the maximum length of dissertations, being just under 80,000 words, including the bibliography. There are no appendices but four papers, three published and one in the press, are bound into the back of the thesis for consideration. The thesis itself consists of two volumes, one of text and another of tables and figures; the object of this arrangement is to make it easier for the reader to refer to the illustrations while reading the text.



## CHAPTER ONE: AN OUTLINE OF PREVIOUS RESEARCH

Bell Beakers attracted the interest of archaeologists as early as the mid nineteenth century; since then so much has been written about them that a detailed history of research would probably require a thesis in itself. Much of this earlier research has been concerned with the general problems of the Bell Beaker 'culture group' as a whole and is already well-known in English-speaking circles (Sangmeister's Reflux theory for example); it does not need extensive repetition here. The history of research on the West European Bell Beaker areas falls outside the scope of a dissertation concerned with Central Europe and is, in any event, quite familiar. The same cannot be said for the work which has been carried out by Central European prehistorians: knowledge of this has remained largely restricted to the German-speaking world. Even within this narrower field the amount of work which has been done is enormous and no attempt will be made to cover it in detail here: the aim is essentially to provide a perspective for the dissertation which follows. Three main aspects are therefore of interest: theories explaining the spread of the Bell Beakers, theories as to their origin, and work on the chronological sequence. Before examining these, however, it is necessary to begin at an earlier stage: the initial recognition of Bell Beakers and of the fact that similar vessels were to be found in many different areas.

In 1878 Voss drew attention to the Bell Beakers from Branowitz (now Vranovice) in Moravia and commented that vessels of similar type were known from Hungary, Saxony, the Rhine area, Holland, England and Brittany. Earlier in the same year Frhr. von Adrian, in a paper on the prehistoric antiquities of Sicily, had already pointed out the similarities between the Branowitz pottery and a vessel from the cave

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In 1878 Voss drew attention to the Hell Beakers from Brunnshausen (near Vöhringen) in Bavaria and commented that vessels of similar type were known from Hungary, Saxony, the Rhine area, Holland, England and Brittany. Earlier in the same year Herr. von Adriaen, in a paper on the prehistoric antiquities of Sicily, had already pointed out the similarities between the Brunnshausen pottery and a vessel from the cave

at Villafrati. The Bell Beakers from Tótközl, Hungary, were published by Hampel in 1877 while Schneider described some Bell Beakers from Polepy, Bohemia, in 1878. As we can see, the similarities were recognized more or less as soon as work began and the assumption was made that these similarities were more than simply fortuitous and suggested a connection. Seventeen years later further progress had been made and Voss (1895:123) could write:

'Diese Ihnen vorgezeigten Gefässe (Bell Beakers)...scheinen einer bestimmten Zeitperiode zu entstammen, welche sich wohl in manchen Gegenden mit der Steinzeit berührt, im Grossen und Ganzen jedoch schon der Metallzeit angehört. Ich wurde aber vorschlagen, sie nicht, wie es Tischler gethan hat, mit den schnurverzierten Bechern Ähnlicher, aber doch typisch verschiedener Form, zusammenzuwerfen unter dem Namen 'geschweifte Becher', sondern die früher von mir vorgeschlagene Bezeichnung als 'Branowitzer Typus'... beizubehalten....'

The distinction made between Corded Ware and Bell Beakers was an important advance and it was not forgotten, but perhaps too much weight should not be attached to the observation on chronological position, even though it was to prove correct. At the time it was one among a number of views: in 1900 Götze was to argue that the Corded Ware and Bell Beakers must stand at the beginning of the Neolithic development in Central Europe, a position based on detailed stratigraphic arguments which must have overtaxed the quality of the observations on which they were based.

Even while they lasted, however, the disputes about chronology did not affect the basic cultural connections which had been established and it was not long before explanations for these were suggested. In 1906



Schliz offered an account which in its essentials has remained established almost to the present day:

'Zerstreut über das ganze Gebiet unserer Karte finden wir Gräber und Einzelfunde der Glockenbecherbevölkerung, internationale schweifender Horden, halb Händler und halb bogenbewaffnete Nomaden, mit dem Ausgangspunkt in den Dolmen der Bretagne und festeren Sitzen bei Worms...und in Mähren.' (Schliz 1906:334)

The strength and longevity of this theory, with minor variations, are remarkable, since it was proposed at a time when very little material was known and has continued unaltered by the enormous accumulation of information almost to the present. Furthermore, the challenge which is now being offered to it depends not so much on new data but on a new way of looking at what has already been collected. There could not be a better exposure of the belief, still prevalent in Central European archaeology, that accumulation of information will eventually provide all the answers.

Needless to say, the early workers were also interested in the question of origins and initially a variety of views was held, as they had been on the matter of chronology. Schliz above suggests Brittany. Montelius believed that the Bell Beakers originated in the Orient, a view heavily criticised by Grössler (1909), who himself believed that the Thuringian Bell Beakers resulted from a mixture of Nordic-Megalithic pottery with the Central German Bandkeramik. Finally, in the same year as Grössler's paper appeared, H. Schmidt presented the view that the origin of the Bell Beaker was to be found in the Iberian peninsula, a hypothesis which was to remain virtually unchallenged for fifty years, similarly unaffected by the gradual accumulation of finds. It is thus not only possible to agree with Fischer (1975:4) that, 'Man kann sagen, dass mit der Jahrhundertwende das Bild der Glockenbecherkultur in den Hauptzügen



feststand', but to add that ten years later the theories to account for it had also been established.

East of the Rhine, as indeed elsewhere, the following fifty years were a period of detailed regional work mainly devoted to the improvement of chronologies and the presentation of the increasing amounts of material, much of it discovered as a result of the growing industrialisation of Central Europe.

Neumann published his corpus of the Bell Beaker assemblages from Central Germany in 1929 together with an analysis of the relationship between his area and those adjacent to it. The corpus was brought up to date in 1948 by Schlette, who also presented an unconvincing typological classification of the Beakers and pointed to indications of social stratification in the Bell Beaker graves from Central Germany. Since this time there has been no new catalogue but such a work is now less necessary owing to the excellent and speedy publication of new finds in such periodicals as the Jahresschrift für mitteldeutsche Vorgeschichte. In this post-war period there have been two main workers in East Germany: Behrens, who has concentrated on the detailed cultural and chronological connections of the late Neolithic, particularly the connections between Bell Beakers and Corded Ware; and Fischer, who has made two outstanding contributions with his important study of the Central German Corded Ware (1958) and his analysis of the burial practices of the Central German Neolithic (1956); the latter may be considered a forerunner of the modern approaches to funerary evidence developed by Binford and others.

In Hungary there is little to record. After the initial excavation of the T8k8l cemetery in the nineteenth century there was almost no work on the Bell Beakers until the examination of Hungarian Early Bronze Age chronology by Bóna (1963) and Kalicz (1968) in the 1960s. The extremely

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Hermann Gutschalk, in the case of the Bell Beaker assemblage from  
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chronology by Horn (1957) and Kallies (1965) in the 1960s. The extremely

important recent excavations of Schreiber, and the conclusions she has drawn from them, are described elsewhere (p. 163).

Bohemia and Moravia, in contrast, have a continuous history of interest in the problems posed by the Bell Beakers. As we have seen, some of the earliest finds came from here although the reports were often published by Germans and Austrians rather than Czechs. After the First World War this situation changed and nationalism began to play a part. Czechoslovakia, newly independent from the defunct Hapsburg empire, set up an archaeological institute to foster interest in the country's heritage. The amount of material available gradually increased. A measure of the change may be obtained by comparing Píč's Čechy předhistorické, published in 1899, with the first volume of Stocký's Pravek země české which appeared in 1926. This outline of the Bohemian Neolithic was probably the most important publication on Czech prehistory of the inter-war years. It contained an extensive photographic corpus of Bohemian Bell Beakers and a discussion of their significance and internal chronology which would be widely accepted today:

'Le groupe des vases caliciformes est un groupe culturel fermé, qui se distingue nettement des autres cultures ayant existé en Bohême. Il n'est pas issu d'éléments indigènes, mais son origine est étrangère; à son arrivée en Bohême il avait atteint son apogée et il marque l'invasion d'un peuple étranger, différent des tribus indigènes, même par son aspect physique. Son autonomie absolue se trahit non seulement par des formes de céramiques à ornement caractéristique, mais encore par le reste de son contenu culturel, comme armes, outils et parures.... Il y a eu un développement dans le groupe des vases caliciformes de Bohême; cependant il n'a pas atteint bien profondément les formes véritablement typiques,

important recent excavations of the site, and the conclusions the has  
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as an archaeologist, in 1957, the first interest in the country's  
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mais s'est borné surtout à la céramique d'accompagnement, contenant beaucoup d'éléments d'autres régions culturelles et il s'est terminé au commencement de la plus ancienne période de l'époque d'Unétice....' (Stocký 1926:138)

The Spanish origin was also accepted and Stocký's verdict was, 'si l'on discute encore, c'est sur la question de savoir par où elle est parvenue en Europe Centrale.' (Stocký 1926:150) Within this complacent framework of belief that virtually everything was already known about the Bell Beakers work continued. In Moravia the main researcher was Červinka who in 1938 completed a manuscript which was regrettably never published but remains available in the library of the Brno Archaeological Institute: it consisted of a corpus of drawings and descriptions of all the Bell Beaker finds from Moravia up to that date. The work of Palliardi too was important, particularly his excavations at Jevišovice-Stary Zámek which provided a foundation for the Eneolithic chronology of Moravia; unfortunately, this work too was not properly published at the time and the Moravian Eneolithic has remained until recently largely unknown outside Czechoslovakia.

From the 1930s until his recent retirement, however, the doyen of Bell Beaker studies in Czechoslovakia was Ladislav Hájek. He contributed numerous papers on various aspects of the Bell Beakers in Central Europe, but these were all very much in the established tradition and it is his collection of up-to-date information for Bohemia and Moravia which must be regarded as his main achievement: Kultura zvoncovitých pohárů v Čechách (Die Glockenbecherkultur in Böhmen), a catalogue of the Bell Beaker finds from Bohemia, was published in 1968. A similar catalogue compiled by Hájek for Moravia in 1950 has never been published but, like Červinka's manuscript, is available at the Archaeological Institute in Brno. These

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Bell's research work continued. In 1950 the main researcher was Gertrude

and in 1950 completed a monograph which was respectfully never published

but remains available in the library of the Prehistoric Institute:

it consisted of a survey of the monuments and descriptions of all the Bell

research finds from 1930 up to that date. The work of Bell's finds too was

important, particularly his excavations at Javinskaya-Stary which

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be regarded as his main achievement: Kultura eneolitická v Čechách

(The Neolithic Culture in Bohemia), a catalogue of the Bell's research finds

from Bohemia, was published in 1955. A similar catalogue compiled by

Stary for Moravia in 1950 has never been published but, like Gertrude's

manuscript, is available at the Prehistoric Institute in Brno. These

two catalogues provide the foundation for much of this dissertation and are indispensable to any reassessment of the Bell Beakers of Central Europe.

It has already been seen that the common factor uniting all the work just described is its acceptance, implicit or explicit, of hypotheses concerning the origin and spread of the Bell Beakers established near the beginning of this century. In the last fifteen years, however, new hypotheses have been proposed which do not fall in this tradition. E. Neustupný (1961, 1966) in particular has emphasised the Central European character of the Bell Beaker assemblage in that area and has argued that it may have originated in the Corded Ware or Vučedol groups. The idea of a Central European origin, whether from Corded Ware or Vučedol antecedents, has recently been more widely advocated, for example by Barfield (1971) and Schubert (1973), while most recently of all an origin in Holland has been proposed (Lanting et al. 1973).

But it is not simply on questions of origin that views have begun to change. As Fischer (1975) has pointed out, even as early as the 1940s there were suggestions that the Bell Beaker 'people' were not mobile traders, prospectors or pastoralists but mixed farmers, and this view has gained increasing support, aided by the independent evidence that the Corded Ware population too must have been largely agricultural, despite the lack of settlements (Neustupný 1969). Nevertheless, even advocates of this position have continued in the belief that the Bell Beaker assemblage was transmitted by means of an invading population, and the majority still believe in small mobile groups living side by side with the population of the later Corded Ware and quite possibly with certain other groups as well.

In the chapters which follow a more detailed account will be given

two categories provide the foundation for much of this discussion and are indispensable to any treatment of the Bell System of Central

Europe.

It has already been seen that the common factor within all the work

has been the same, namely, the study of the history of the Bell System

concerning the origin and growth of the Bell System within the last

beginning of this century. The last fifteen years, however, are

perhaps more important than any other in the history of the Bell System.

A. Bellamy, in his book, "The Bell System," has emphasized the central position

of the Bell System in the history of the Bell System and has argued that

it has been the central factor in the history of the Bell System. The idea of

a central factor in the history of the Bell System has been emphasized by

many writers, for example by Bellamy (1907) and

others (1907), who have pointed out that the Bell System has been

the central factor in the history of the Bell System.

But it is not only the central factor in the history of the Bell System

which has been pointed out, even as early as the 1900s.

There were suggestions that the Bell System "people" were not mobile

because of the central position of the Bell System, and this view has

been reinforced by the independent evidence that the

central factor in the history of the Bell System has been the Bell System

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In the chapter which follows a more detailed account will be given

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beginning of the 19th.

## CHAPTER TWO: A PRELIMINARY DESCRIPTIVE MODEL FOR THE BELL

### BEAKER ASSEMBLAGE IN CENTRAL EUROPE

The previous chapter has given an outline of research on the Bell Beaker 'culture', with particular regard to the Central European parts of its distribution. At the end of the 1960s there was a large measure of agreement on the mechanism by means of which the 'culture' had spread, but there remained some question about the place of origin. As we have seen, after a long period in which the Iberian peninsula had reigned supreme, it was increasingly suggested that Central Europe might well be a candidate. Ten years ago investigation of this latter question would have seemed an adequate goal for research, but the effect of recent upheavals in archaeological thought was to make it clear that a more basic reassessment was essential. In particular it had been shown by Binford (1965) and others that artifact differences cannot simply be considered as local variations in cultural tradition reflecting the history of human groups. At least as important are the behavioural variations in production, distribution and consumption/use of the objects, and this emphasis on behaviour has the effect of turning attention much more than before to the context of the artifact, since this provides one of the few avenues towards the reconstruction of that behaviour. It follows from this that an understanding of the historical significance of cultural phenomena requires a consideration of the behavioural realms to which they belong. Consequently, new work must proceed by making the relation between observations of archaeological remains and inferences to past events and conditions as explicit as possible. In the present case, therefore, it was necessary to make a detailed investigation of the sort of entity which the Bell Beakers and their accompanying objects represented, or even whether they could be

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THE HELL AND ITS ORIGIN

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and their accompanying objects represented, or even whether they could be

regarded as an entity at all. It may be added that this does not constitute a complete rejection of norms as relevant to human behaviour - indeed, it could be argued that it is only normative behaviour which is likely to survive in the archaeological record - it is, however, a timely reminder that archaeologists deal with the results of behaviour and not directly of thoughts; furthermore, it is a valid criticism of the simplistic normative views still widely prevalent in archaeological circles, which fail to consider precisely which groups of people share particular norms and why, a point to which anthropologists have given some attention (see e.g. Pelto and Pelto 1975).

If this is one of the main theoretical foundations for the present work, the other, which in many ways follows directly from it, is the rejection of the 'archaeological culture' as it has been used in European prehistory since near the beginning of this century. The reasons for this are not explored here but are presented in Shennan (1977, bound into back of thesis); reference may also be made to the discussion by Robson (1973) on the problems of defining meaningful objects of study.

Finally, the application of Caldwell's concept of the 'interaction sphere' to the Hopewell 'culture' of Middle Woodland North America by Struever and Houart (1972) represented a concrete example of how progress could be made simply by means of redescription with a problem similar in many ways to that of the Bell Beakers. It is, in fact, worth noting that Caldwell himself regarded the Corded Ware-Battle Axe group as an example of an 'interaction sphere' operating in European prehistory (Caldwell 1964), summarised in Struever and Houart 1972: 77).

It will readily be appreciated that acceptance of the implications of this work inevitably led not simply to a search for origins but to an attempt at the explication and ultimately the explanation of the structure of the Bell Beaker assemblage and its distribution in time



and space.

Before going any further, however, it is legitimate to ask whether the similarities which have been documented over the last hundred years really represent a unitary phenomenon, or whether they are not the result of parallel independent development, as argued, for instance, by Harrison (1974). The view taken here is that the former is the case, although not in the way which is usually accepted and which Harrison has rightly criticised. To some extent this view must be subjective in the absence of any theory to relate ceramic similarity to behavioural significance, or of any definite evidence for long-distance exchange of vessels, but cumulatively the arguments that the decorated Bell Beaker, as opposed to the total Bell Beaker assemblage, had a single origin seem overwhelming. The similarities are not just at a very general level, but include very specific details, such as cord-defined zones on otherwise comb-decorated vessels, and a remarkable identity of motifs. Furthermore, the demonstration by radiocarbon dating that the various regional groups of Bell Beakers are indeed contemporary provides an independent argument for the possibility of connections: it is no longer necessary to use the ceramic evidence as proof of both contemporaneity and contact.

Up to now our concern has been with goals. The next aspect to be considered is how these may be achieved, and here too theory is important. The first stage must be to develop a behavioural reconstruction which accounts for the archaeological remains, rather than merely assuming that they represent a cultural tradition. Previous work reconstructed this behaviour as migration without hesitation because of this invalid assumption. On the other hand, this does not exclude the possibility that migration was responsible, and as this was the in situ hypothesis it seemed most appropriate to start by investigating whether there were any anomalies

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Before going any further, however, it is legitimate to ask whether the statistics which have been documented over the last hundred years really represent a unitary phenomenon, or whether they are not the result of parallel independent development, as argued, for instance, by Barton (1958). The view taken here is that the former is the case, although not in the way which is usually accepted and which Barton has rightly criticized. It does seem that this view must be subjective in the absence of any theory to which certain statistical regularities could be ascribed, or which could provide evidence for long-distance exchange of vessels, but undoubtedly the hypothesis that the decorated Bell Beaker, as opposed to the total of other assemblages, had a single origin seems oversimplified. The statistics are not just at a very general level, but include very specific details, such as cord-defined zones or otherwise cord-decorated vessels, and a remarkable identity of motifs. Furthermore, the demonstration by radiocarbon dating that the various regional groups of Bell Beakers are indeed contemporary provides an independent argument for the possibility of connections: it is no longer necessary to use the ceramic evidence as proof of both contemporaneity and contact.

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in the data for which it failed to account. It should not be forgotten that migration hypotheses, as well as falling in with the cultural ideas of the day, also fitted the facts and provided an explanation for the most striking feature of the whole Bell Beaker phenomenon, the widespread similarity of assemblages. These have been largely from graves, but in the last few years increasing amounts of Bell Beaker settlement evidence have come to light and its most significant feature in the present context is the extent to which it varies from area to area. Although other authors have commented on this point (e.g. Schütle 1969), its importance has not been generally appreciated and its effect as something of a 'surprise' in terms of traditional explanatory models has not been acknowledged (cf. Binford 1972).

There is very little resemblance, for instance, between the contents of the East Anglian settlement sites in England, such as Fifty Farm or Chippenham (Leaf 1935, 1940) and the material from the settlements excavated by Schreiber in the environs of Budapest, Hungary (Schreiber 1967, 1973). In terms of pottery it is only Bell Beakers which the two areas have in common, and while these are numerically significant in England, in Hungary they are represented only by a few sherds in pits filled mostly with pottery of the local proto-Nagyrév culture. Moreover, these local wares seem to be merely an intermediate stage in an ongoing native tradition from the Makó group to the Nagyrév culture (Schreiber 1972, but see below for a detailed outline of the Hungarian evidence). A similar situation is seen in Jutland, where Bell Beakers occur as a minority element at the settlement of Myrhøj (Jensen 1973). At Cerro de la Virgen in south-east Spain (Schütle 1969), Bell Beakers are found in small numbers (never more than 5%) in the context of a local pottery typological development from Neolithic to Bronze Age. The main areas which may be an

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There is very little resemblance, for instance, between the contents of the local assemblages situated along the Rhine, such as Vix or Gengenot (last 1957, 1960) and the material from the settlements excavated by Schult in the environs of Budapest, Hungary (Schult 1967, 1973a, 1973b). In terms of pottery it is only Bell Beakers which the two areas have in common, and while there are numerically significant in Ireland, in Hungary they are represented only by a few shards in place. Mixed mostly with pottery of the local proto-Hungarian culture. Moreover, these local wares seem to be merely an intermediate stage in an ongoing native tradition from the Hango group to the Magyar culture (Schult 1972, but see below for a detailed outline of the Hungarian evidence). A similar situation is seen in Finland, where Bell Beakers occur as a minority element at the settlement of Tyrväskö (1972). As Catto is in Britain in north-east Spain (Schult 1969), Bell Beakers are found in small numbers (never more than 25) in the context of a local pottery typological development from Neolithic to Bronze Age. The main areas which may be an

exception to this pattern of a minority Beaker presence are Britain and the Lower Rhine area, where there is some suggestion of a true Bell Beaker domestic assemblage. In fact, if one looks at the Bell Beaker distribution area as a whole, on the basis of the settlement evidence, the one common link is the Bell Beaker vessel itself, in different regional forms. The grave material extends this inventory of widespread objects to include wrist-guards, tanged copper daggers, V-perforated buttons and arrowheads, together with some copper trinkets, all of which are very rare in settlement contexts.

If this evidence is examined in the light of the behavioural view of culture just discussed, one comes to the conclusion that the Bell Beaker assemblage is not a discrete entity with a sort of objective existence of its own. It is a restricted set of artifacts found in a variety of local contexts; moreover, it is restricted in an interesting way. The wide-ranging objects are not subsistence-producing tools or a basic assemblage of domestic pottery. They include a single ceramic type, the Bell Beaker (with the subsidiary presence of polypod bowls in some areas), which, in east Central Europe at least, is only found as a fine ware. This is associated with a number of other objects which are almost never found in settlements and are rare even in graves but which, by their nature and context, are most likely to be connected with the social persona of the deceased: fine stone wrist-guards, copper daggers and ornaments, etc. This does not mean that they were produced solely for the purpose of use in the burial rite but rather that they were on the whole relatively uncommon objects which were so highly regarded that they did not often find their way into normal domestic refuse.

Once again we have no theory which might enable us to relate this situation in a systematic way to the past behaviour which produced it.



Nevertheless, it is obvious that it does not constitute the wholesale transference of a material cultural assemblage from one area to another, the view implicit in the literature on which the migration hypotheses have been based. The local variations which have been noticed have always been assumed to be the result of later differentiation after the 'Beaker people' had settled down, a position which is untenable, at least for Central Europe, as will be shown below. The evidence fits in far better with an alternative model, but before outlining this it is necessary to consider some further arguments which may be advanced against the migration hypothesis.

Questions of subsistence economy will be dealt with in detail elsewhere; here, however, it is necessary to examine them briefly in so far as they have been used to support migration arguments, since one of the best known migration views regards the 'Bell Beaker people' as nomadic pastoralists. With regard to pastoralist hypotheses generally, Neustupný (1969) has presented several arguments against them in the context of late Eneolithic Central Europe. There are also several considerations which apply particularly to the Bell Beakers. First, the belief in a one-to-one correlation between a restricted material inventory and burial and a particular subsistence economy is naïve a priori, stemming as it does from the assumption that the economy is simply another cultural trait and relates, therefore, primarily to culture rather than to environment and population. This idea is especially naive in the present case since the area over which Bell Beakers are found is ecologically enormously diverse, stretching from North Africa to northern Scotland and from Ireland to Hungary. Secondly, at least in large parts of Central Europe the occupation associated with Bell Beakers continues to be concentrated in the same fertile arable areas as were occupied throughout the Neolithic by groups whose mixed farming

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as were occupied throughout the Neolithic by groups whose sites surviving

economy is attested on other grounds. If the same constraints were not operating it is unlikely that this would be the case. The arguments for metal-prospecting, coupled as they usually are with belief in an Iberian origin, are equally dubious. There is plenty of copper ore in the Iberian peninsula and every indication that it was being exploited in Beaker times (Harrison 1975); searching as far as Central Europe hardly seems necessary. Furthermore, on present evidence the most important ore sources in Central Europe at this period were those in Slovakia, where the presence of Bell Beakers is almost unknown, in contrast to their dense distribution elsewhere in Czechoslovakia and a concentration to the south in Hungary.

Outlining the disadvantages of earlier views is an important part of establishing a new hypothesis as worthy of consideration, and in the preceding paragraphs some of the disadvantages of the usual solutions to the Bell Beaker problem have been described; others will be considered as they arise in later chapters. Now, however, it is necessary to deal with what is often believed to be the main argument in favour of a migration solution, the evidence of physical anthropology, in order to show why it cannot be regarded as a decisive factor. The question has two aspects, one theoretical the other empirical. A good description of the theoretical arguments is provided by Trigger (1968:7):

'The idea that each tribe had its own well defined physical and cultural characteristics was based on the theory that people who interact freely with one another will tend to retain and develop traits in common, whereas those who are separated from each other will tend to develop along their own lines. The tendency to attribute all change to the differentiation of originally similar tribal units led prehistorians to believe that racial, cultural and linguistic

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differences all originated as a result of the same ethnic separations. As groups spread they tended to develop regional variations which, in turn, gave rise to new cultures.'

It was the work of Sapir (1921) and Boas (1940) which showed that the history of race, language and culture had to be treated as separate problems, and that racial, cultural and linguistic differences were not all the result of a single process of differentiation.

Other changes have come from within physical anthropology itself, which has replaced the old typological approach with one based on multivariate measurements of skulls; consequently, we no longer have simple contrasts between 'long heads' and 'round heads', but gradients of similarity between one population and another. Furthermore, it has been recognised that environmental influences can play a considerable role in determining head shape and it has been suggested that the secular brachycephalisation observable in the physical anthropological record may be associated with features which are selectively favoured in certain circumstances (e.g. Olivier and Almeida 1972).

Central European physical anthropologists (e.g. Gerhardt 1953) have been slow to give up the typological approach, but this is not universally true, as can be seen from the conclusions of Grimm in a recent survey which deals mainly but not entirely with Germany, the best researched area from this point of view:

'Zusammenfassend können wir sagen: Die nach früheren Forschungsergebnissen angenommene relative Einheitlichkeit des morphologischen Typus in vorgeschichtlichen Populationen mit einer bestimmten Kultur ist durch Vermehrung der Funde und deren intensivere Bearbeitung zweifelhaft geworden. Dies gilt allgemein für das Neolithikum und speziell für die hier betrachteten Becherkulturen.'

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It was the work of Huxley (1937) and Boas (1940) which showed that the history of race, language and culture had to be treated as separate problems, and that racial, cultural and linguistic differences were not all the result of a single process of differentiation.

These changes were made from the physical anthropology itself, which has rejected the old typological approach with its based on arbitrary assumptions of racial, linguistic, or cultural groups. It has since been replaced by a more realistic approach, based on the study of individual differences and their causes.

Contrasts between 'races' and 'cultural groups', but contrasts of ethnicity between the races and the cultures. Furthermore, it has been pointed out that individual differences can play a considerable role in the study of individual differences. It is now suggested that the modern

anthropological approach in the physical anthropology should be replaced with theories which are collectively founded in certain circumstances (e.g. Oliver and Alcock 1932).

Recent European physical anthropologists (e.g. Gollard 1933) have been able to give up the typological approach, but this is not universally true, as can be seen from the conclusions of Huxley in a recent survey with data mainly but not entirely with Germany. The best researches are

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gestellten Aussagen relative Ähnlichkeit der morphologischen  
Formen ist wissenschaftlichen Formationen mit einer bestimmten Kultur  
ist durch Veränderung der Form und durch intensive Bearbeitung  
realisiert worden. Diese Ähnlichkeit ist der Resultat und  
gibt die hier betrachteten Forschungen.'

'Die mitteldeutschen Schnurkeramiker können z.B. nicht mehr als vorwiegend hyperdolichokran angesehen werden. Die Glockenbecherleute enthalten auch andere Komponenten als 'planokzipitale Steilköpfe'. Trotzdem lassen sich Schnurkeramiker- und Glockenbechergruppen mit bestimmten Rechenverfahren voneinander und gegenüber anderen jungsteinzeitlichen Populationen abheben.

'Zur abtrennung eines Formenwandels als Umweltmodifikation durch Wechsel in Wirtschaftsform, Ernährungsweise usw. von Folgen der Einkreuzung anderer Gensätze ist künftig die Einbeziehung von als erblich bekannten nichtmetrischen Merkmalen notwendig. Erst dann werden Fortschritte in der Erklärung der auffälligen Formenunterschiede zwischen Individuen und Gruppen am Ende der Jungsteinzeit möglich sein (1969:203).'

Grimm's most recent comment, quoted in Behrens (1973), is as follows:

'Die bisherigen anthropologischen Befunde und Beurteilungen (bis Mitte 1971) lassen sich so zusammenfassen, dass nichts gegen eine Kontinuität der Bevölkerung spricht.'

Grimm is arguing that the distinctions between populations in terms of cranial measurements are not so clear-cut as had been previously imagined, and he goes on to suggest that even when these have been precisely defined it is still necessary to distinguish environmentally induced change from that brought about by the introduction of new genes if we are examining the development of a region's population over a period of time. That changes in the cranial index of the population of an area through time need not necessarily be the result of an influx of population from outside may be illustrated by an example from Coon (1939:560):



The following table shows the results of the survey conducted in 1950. The data is presented in two columns: 'Number of cases' and 'Percentage of total cases'. The first column lists the number of cases for each category, and the second column shows the corresponding percentage. The categories are listed in the first column, and the percentages are listed in the second column. The data is as follows:

Category	Number of cases	Percentage of total cases
Category 1	10	10.0%
Category 2	20	20.0%
Category 3	30	30.0%
Category 4	40	40.0%
Category 5	50	50.0%
Category 6	60	60.0%
Category 7	70	70.0%
Category 8	80	80.0%
Category 9	90	90.0%
Category 10	100	100.0%

The data shows that the number of cases increases from 10 to 100, and the percentage of total cases increases from 10.0% to 100.0%. The data is presented in a clear and concise manner, making it easy to understand the results of the survey.

'Very few centuries passed, however, before the racial character of the Christianised Bohemians began to undergo a radical change. Only in the sixth century A.D. was the Slavic settlement of Bohemia complete; by the ninth, the mean cranial index of the Czechs had risen from 75 or 76 to 77: by the eleventh or twelfth century, it had reached 78. In the early sixteenth century, it had reached only 80 or 81, but after the great plague of 1520, it began to climb rapidly, so that in the seventeenth century it had risen to 83.5 and in the eighteenth to 85. This complete alteration of head-form in Bohemia is one of the most marked and best documented phenomena of its kind in the racial history of the world. Most of it happened under the eyes of writers and historians, but it remained virtually, if not entirely, unknown until the Central European craniologists, well within the last fifty years, brought it to light. As in southern Germany the change involved not merely the shape of the cranial vault, but facial and nasal measurements as well.'

It should be added that there is no correlation between the changes in the cephalic index and historical episodes which might have resulted in the introduction of new genetic elements. On the contrary, if the correlation noted by Olivier and Almeida (1972) between brachycephaly and resistance to infectious disease is a valid one, it may be that the plague to which Coon refers had the effect of changing the balance of genes in the population and increasing the tendency to brachycephalisation.

This is clearly not the last word on the relation between physical anthropologists' conclusions and other historical events; no doubt considerable advances will be made in the future. Nevertheless, the account presented here gives sufficient reason for not attaching an overriding importance to the findings of physical anthropology in what are

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riding importance to the findings of physical anthropology in what are

essentially archaeological arguments.

It is now possible to state the hypothesis which is being offered as an alternative to the migrations. This is intended to apply mainly to Central Europe but obviously must have some relevance to other areas as well. The Bell Beakers and the other widespread objects associated with them represent neither a 'culture' nor a 'culture group' but, if we are dealing in these terms, a widespread prestige 'subculture'. They have a widely recognised social, and doubtless ritual, significance and are differentiated from objects of more local occurrence not simply on the basis of their different distribution but also because of their different nature. Such a model clearly has similarities to the 'interaction sphere' idea already mentioned, and in order to specify it in more detail it may be useful to compare the Bell Beaker situation with the Hopewell Interaction Sphere as described by Struever and Houart (1972).

Historically, the two have a considerable amount in common. Early scholars devoted their attention to such relatively obvious and instantly appealing phenomena as burials and, as we have already seen in the Bell Beaker case, soon noted that very similar artifacts occurred in widely scattered areas. Similarly again, although certain regional differences were acknowledged, both were regarded as single cultures and research focussed on their origins. In some ways it might be argued that the similarities noted here reflect parallels in the development of archaeological thought in Europe and America rather than substantive features in common, but this is clearly not the whole truth - in fact, we are dealing with similar reactions to similar phenomena. More recently, however, in both Hopewell and Bell Beaker studies, attention has turned to settlements and it has become apparent, as we saw above for the Beaker example, that the domestic pottery belongs to a number of local regional traditions, while

essentially archaeological arguments.

It is now possible to state the hypothesis which is being offered as an alternative to the traditional. This is intended to apply mainly to Central Europe but obviously must have some relevance to other areas as well. The Bell Beaker and the other widespread objects associated with them represent neither a 'culture' nor a 'civilization' but, if we are to follow in these terms, a widespread 'super-culture'. They have a widely recognized model, and sometimes ritual, significance and are differentiated from objects of more local occurrence not simply on the basis of their different distribution but also because of their different nature. It is a social clearly and unambiguously to the 'interaction sphere' idea already mentioned, and it must be specified in more detail it may be useful to compare the Bell Beaker situation with the Hopewell interaction sphere as described by Barrow and Hoopes (1975).

Historically, we now have a considerable amount in common. Early studies devoted their attention to such relatively obvious and instantly appreciable phenomena as burials and, as we have already seen in the Bell Beaker case, soon noted that very similar artifacts occurred in widely scattered areas. Similarly again, although certain regional differences were acknowledged, both were regarded as single cultures and research focussed on their origins. In some ways it might be argued that the similarities noted have reflected parallels in the development of archaeological thought in Europe and America rather than substantive features in human, but this is clearly not the whole truth - in fact, we are dealing with similar reactions to similar phenomena. More recently, however, in both Hopewell and Bell Beaker studies, attention has turned to settlements and it has become apparent, as we saw above for the Beaker example, that the domestic pottery belongs to a number of local regional traditions, while

the Americans have also recognised a series of local ecological adaptations in the various areas where Hopewell artifacts are found. Such work has not yet been carried out in Europe but it can reasonably be argued that the situation is similar, given the ecological diversity of the Bell Beaker area, to which reference has been made above.

In the Hopewell case the items which the various Middle Woodland groups had in common included,

'copper earspools, celts, and breast-plates; chipped obsidian artifacts, marine shell containers, worked bear teeth; cut mica sheets and silhouettes; plain and effigy platform pipes; human figurines, and a special class of pottery described as 'Hopewell ware'. It was hypothesised that selected local Middle Woodland groups in eastern North America obtained these items by participation in a series of transactional systems for which the term Hopewell Interaction Sphere was coined' (Struever and Houart 1972, 48.)

Obviously the particular types concerned are completely different, but, if this list is compared with the widespread Bell Beaker/<sup>inventory</sup>already discussed, it is also clear that the former is far more extensive. Here then is an area where the specifically Hopewell analogy does not fit so well although that does not in itself exclude the possibility of regarding the Bell Beaker phenomenon as an 'interaction sphere'. Struever and Houart abstract a number of characteristic features of this entity from Caldwell's discussion:

'Contact between contemporary regional cultures involved movement of small quantities of scarce raw materials, including minerals, native or smelted metals, marine products, etc. These appear archaeologically most often in burial association as prestige goods. These artifacts

the Indians have also recognized a series of local ecological adaptations in the various areas where Hopewell artifacts are found. Such work has not yet been carried out in large part, but it can reasonably be argued that the situation is similar, where the ecological diversity of the Bell Beaker area, in which reference has been made above.

In the Hopewell area the local groups of the various Middle Woodland groups are in common occurrence.

'copper ear ornaments, celts, and ground-stones; chipped celts, celts, knives, and arrowheads, worked bone tools; cut stone axes and arrowheads; and other things; human figurines, and a special class of objects described as 'Hopewell ware'. It was hypothesized that a certain level of the Woodland groups in eastern North America obtained their raw materials in a series of transactions system for which the term original Intermediate System was coined.

(Grismer and Robert 1971, 45).

Obviously the particular types concerned are completely different, but, it is clear that the widespread Bell Beaker already discussed, it is also clear that the former is far more extensive. There is an area where the specifically Hopewell analogy does not fit so well although that does not in itself exclude the possibility of regarding the Bell Beaker phenomenon as an 'interaction sphere'. (Grismer and Robert 1971, 45).

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Grismer's discussion:

'Contact between contemporary regional cultures involved movement of small quantities of scarce raw materials, including minerals, native or smelted metals, marine products, etc. These appear archaeologically most often in burial association as prestige goods. These artifacts

appear to have functioned in the social system largely as symbols of status. The participant societies appear in all cases to be characterised by sedentary communities with supracommunity integration reflected in special ceremonial settlements, or ritual precincts in the larger communities. Movement of interaction sphere artifacts and raw materials among local and regional units is recognisable on at least three levels: a) among villages within a region; b) among nearby regional cultures; and c) among cultures scattered over a broad geographic area' (Struever and Howart 1972: 77-78.)

This description moves us away from specific comparisons with the Hopewell to a more general level and has the effect of drawing our attention to aspects of the Bell Beaker phenomenon which are unknown, in Central Europe at least, but which are susceptible to investigation. Our initial hypothesis, that the Bell Beaker package has a widespread prestige significance is a necessary attribute of the model. Its fit with the evidence from the graves and, more important, from the settlements certainly seems better than its predecessors, since the vast differences in the domestic material now become in no way surprising. As it stands, however, the hypothesis does not have anything to say about the means of interaction and how these relate to the social organisation. The interaction sphere model postulates transaction centres and the British class II henges or the fortified sites of the Portuguese Eneolithic, in both of which Bell Beakers are found, might certainly be seen in this light; it is natural to ask whether anything comparable exists in Central Europe.

Our aim consists in testing and extending the initial model and in reconstructing a number of systems, particularly regional social systems, together with the role of the objects in those systems and the nature of the links between them. Insofar as the same objects will be used as

appear to have functioned in the social system largely as systems of status. The pertinent societies appear in all cases to be characterized by secondary communities with substantially identical relations in a special, extraneous relationship, or ritual practices in the larger community. However, in the case of the latter, the relations are not identical among local and regional units or communities on at least three levels: (a) among villages within a region; (b) among nearby regional centers; and (c) among distant centers over a broad geographic area. (However, the same is not true.)

This description covers the way that social comparisons with the system to a more general level and the effect of drawing out attention to aspects of the social system which are unknown, in Central Europe at least, but which are susceptible to investigation. The initial hypothesis, that the local center system has a widespread practice of social comparison, is a necessary attribute of the model. It is with the distance from the center and, more important, from the settlements certainly more distant than the predecessors, since the vast differences in the social system now become in no way surprising. As it stands, however, the hypothesis does not have anything to say about the nature of interaction and how these relate to the social organization. The interaction sphere and postulate transaction center and the British class II center or the fortified sites of the Portuguese settlements, in both of which all centers are found, might certainly be seen in this light; it is meant to ask whether anything comparable exists in Central Europe. The aim consists in testing and extending the initial model and in constructing a number of systems, particularly regional social systems, together with the role of the objects in those systems and the nature of the interaction. Insofar as the same objects will be used as

evidence in all these tasks it is clearly important to be aware of the dangers of circularity. Such reconstruction does not constitute a final explanation since it does not give an account of how and why the situation arose in the first place; it is, however, an essential part of any such explanation, as this must relate to a particular situation which is believed to exist. This scheme of aims inevitably dictates a particular sequence of work which will now be outlined briefly.

The idea that the Bell Beakers and associated objects might be high status goods was based on a priori assumptions about the nature of the goods and general impressions from their distribution. It must, of course, be tested in a particular situation and this is carried out by means of a detailed analysis of the Bell Beaker graves from Bohemia and Moravia which occupies three chapters. These, however, are two extremely similar areas and the question naturally arises whether the social organisation inferred for those areas extends more widely or not, and whether the objects play similar roles elsewhere. This is explored by an investigation of the Bell Beaker graves from Central Germany. A further chapter covers the linkages and similarities between these regions as well as taking into account other areas for which the data available is less satisfactory; it also contains some conclusions as to the nature and organisation of the inter-regional system which the objects represent in Central Europe.

The work described thus provides one of the essential prerequisites for an explanation. This remains impossible, however, so long as the model is static. Further progress involves the study of change and this is attempted in the succeeding chapters although it is hampered to some extent by lack of adequate data.

Archaeologists have been aware of change ever since Thomsen first

evidence in all these cases is the directly important to be aware of the  
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 situation arose in the first place; it is, however, an essential part of  
 any such explanation, as this must refer to a particular situation which  
 is believed to exist. This nature of the individuality of the  
 particular response of each individual will now be outlined briefly.  
 The idea that the individual and associated objects might be like  
 atoms which are free to move about independently of the nature of the  
 world and persons is not only a very old one, but it is still, of  
 course, the basis of the theory of action and this is carried out by  
 means of a detailed analysis of the individual's response from the nature and  
 events which are associated with it. These, however, are the extremely  
 shallow areas and are not really a study of whether the social  
 organization influences the response or whether the response influences the  
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 Archaeologists have been aware of change ever since the first

defined his Three Age system. Unfortunately, they have usually been content to describe a sequence and then finish, in the belief that their duty has been discharged. Little attention has been given to the processes operating through time. Even the sequences which have been developed, although they may have been useful when archaeological material was first being recognised and classified, are in fact inimical to the study of change, as Plog (1974) has demonstrated:

'When an archaeologist is asked to describe the pattern of change over time for the site or region he is studying, his basic response will be to create a chronology - to define a series of phases, stages or periods in short time blocks. To conceptualise time in this fashion is to treat it categorically. But, time is not a series of categories: it is a continuum.... Clarke (1968) has discussed this point extensively and used terms such as 'time trace' and 'trajectory' in describing the continuous pattern of change over time in some variable' (1974:44.)

Plog illustrates his point with a figure, reproduced here as fig. 2.1, and goes on,

'While no pattern of variation for a single artifact fits the overall pattern precisely, and some artifacts confound it entirely, there is less variability within, than between, categories.

'But to arrange data in this fashion has a deleterious effect on an investigator's ability to understand change: the two episodes of change, from Phase I to II, and from Phase II to III, are obscured. The changes fall half in one period and half in another. They are represented by the lines between the categories' (1974:45.)

These arguments clearly have a lot of force and relevance and can

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 was first being produced and used, are in fact related to the  
 study of change, as the following observations show:

'When an archaeologist is asked to describe the pattern of change  
 over time for a site or region he is studying, his basic response  
 will be to create a model - he defines a series of phases, stages  
 or periods in short time periods. He conceptualizes time in this  
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 categories: it is a continuum.... Clarke (1968) has discussed this  
 point extensively and used terms such as 'time trace' and 'trajectory'  
 to describe the continuous pattern of change over time in some

Wheeler (1970:14).

He illustrates his point with a figure, reproduced here as

Fig. 2.1, and goes on,

'While no pattern of variation for a single artifact with the  
 overall pattern precisely, and some artifacts conform it entirely,  
 there is less variability within, than between, categories.  
 Not to arrange data in this fashion has a deleterious effect on  
 an investigator's ability to understand change: the two episodes of  
 change, from Phase I to II, and from Phase II to III, are obscured.  
 The changes fall half in one period and half in another. They are  
 represented by the lines between the categories' (1970:15).

These arguments clearly have a lot of force and relevance and can

easily be seen as the working out of the chronological implications of the Binfordian critique already described.

Although Plog's framework is essentially correct, it presents a number of practical problems, the main one being that in the past all the data has been collected and presented in terms of a phase framework, as a result of which it is very difficult to look at it in any other way. The compromise answer which will be adopted here is first to give a traditional outline chronological sequence for Central Europe in order to place the Bell Beakers in a widely recognised temporal framework; then, given this basic ordering, to look at the changes in different aspects of activity which took place in a more limited period and area, and attempt to relate them to one another along the lines Plog has suggested. A more detailed discussion of the problems which this involves will be given in the relevant chapters but some comments are appropriate here.

First, Plog himself would no doubt reject the type of synchronic analysis which has been advocated earlier in this chapter. But this is at least sometimes necessary. For instance, the graves which will be used in the succeeding investigations of social organisation were no doubt deposited successively. However, if they were considered one at a time, supposing one knew the order, little would emerge. With care for the chronological aspect treating the graves en bloc can and does work.

Secondly, explaining change requires the consideration of variables not relevant to the synchronic part of the study. This involved the reconstruction of social organisation and exchange systems and an investigation of the role of various objects in them. If we want to know how and why the situation reconstructed arose it is necessary to look further than these aspects themselves. The changes observed may well be related to other changes in the sphere of subsistence economy, technology



or population, and all these must therefore be considered; even if they do not prove to be significant factors this too is relevant to understanding the nature of the change.

This short discussion of change completes the presentation of the sequence of work which follows and the reasons for it; now it is possible to go on to the first task, testing the initial model on data from Bohemia and Moravia.

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various of work which follows and the reasons for it; now it is possible

to go on to the first part, dealing with the initial model on data from

Sweden and Norway.

### CHAPTER THREE: ANALYSIS OF THE BELL BEAKER GRAVE

#### ASSOCIATIONS FROM BOHEMIA AND MORAVIA

The large number of closed grave finds constitutes one of the main bodies of material available for a study of the Bell Beaker assemblages of Central Europe. In this respect the area is much better off than, for example, the Rhone valley, where such closed finds are virtually non-existent (Bill 1973). Although these associations have been considered piecemeal by a number of authors (e.g. Sangmeister 1964, Hájek 1966b), they have never been systematically examined.

The work to be described is based on a largely complete list of the Bell Beaker graves in Bohemia and Moravia. For Bohemia the source is the catalogue by Hájek (1968), which is complete up to that year. Unfortunately Moravia does not have such a convenient list: the material is mostly either unpublished or available only in obscure local periodicals. After an initial search through the literature it was therefore necessary to study the complete Bell Beaker archives of the Moravian Archaeological Institute, Brno, and this was done in October 1972 and June and July 1973. Dr J. Ondráček of the Brno Institute estimates that these contain at least 85% of all the graves known in Moravia.

The main purpose of the analysis was to investigate the patterns of association of the different grave goods; for this reason other aspects of the graves, such as the orientation or the position of the goods in the grave, were not considered here. Of particular interest were the relations between the widespread Bell Beaker artifacts and those of more local occurrence. It has already been suggested that a sharp distinction should be drawn between these, on the basis both of their different



distributions and of the different types of artifact concerned (see p. 19). It was pointed out that the widespread objects are rare in settlements in this area and are mostly found in graves, a situation clearly connected with the nature of the artifacts concerned: a variety of fine pottery and certain items of personal equipment, sometimes of metal. The nature and context of these artifacts suggested the possibility that they might have a special social significance, and that if this were the case it might be reflected in the grave associations. Graves have a considerable advantage over other types of archaeological feature in that their content is, broadly speaking, a direct result of people's intentions and thus anything found in a grave may be considered as having some sort of significance. If it were found that the widespread objects were not randomly mixed with other types, but tended to be segregated, or if it appeared that graves containing these artifacts had a greater quantity or variety of goods than graves which did not, it would certainly tend to confirm the hypothesis that they had some special significance. It is important to remember, however, that in the case of segregation other explanations apart from social differentiation, such as separation in time, would have to be ruled out.

Although the investigation of this problem was the specific goal of analysis, there was also the possibility that it might reveal hitherto unsuspected patterns which could then be further explored.

Unfortunately, not all the data available was of sufficiently high quality to be used. For any given grave it was essential to be as sure as possible that all the objects originally in the grave had been found, and that they had not been mixed with objects from other graves, in order to obtain a true picture of the associations. Many were excavated early in this century and insufficiently reported; others were already damaged

distributions and of the different types of artifacts concerned (see p. 10).

It was pointed out that the widespread objects are rare in settlements in this area and are mostly found in graves, a situation clearly connected

with the nature of the artifacts concerned: a variety of fine pottery and certain items of personal equipment, accessories of metal. The nature and context of these artifacts suggested the possibility that they might

have a special social significance, and that if this were the case it would be reflected in the grave assemblages. Graves have a considerable advantage over other types of archaeological features in that their content

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order to obtain a true picture of the assemblage. Many were excavated early

in this century and insufficiently reported; others were already damaged

when the excavators arrived. In the light of this only those graves were selected which had sufficient circumstantial detail in their description to suggest that they had been adequately recorded. In practice 'sufficient circumstantial detail' was generally defined as the recording of the position of the artifacts in relation to the body, thus errors both of inclusion and of exclusion may have been made but it is hoped that the former have been reduced to a minimum. In Bohemia 207 graves were of the required standard out of more than 860 listed by Hájek i.e. less than 24% ; in Moravia 220 graves were used out of more than 803 i.e. less than 27% (Both these figures include sites for which there exists only a list of vessels and a note saying 'from graves'.) It is, therefore, obvious that size of sample has had to be sacrificed to accuracy of recording.

Because of this problem an attempt was made to see how the sample used in the analysis related to the whole material available, in the belief that individual inaccuracies in this material might well be evened out on the larger scale. The method used was to compare the proportions of particular objects in the sample with their proportions in the total number of graves. This is not entirely satisfactory since even if the numbers are the same, the associations between the objects may be different, while the converse could also be true.  $\chi^2$  measures of association, however, are unsatisfactory, as the following example shows.

Table 3.I below represents the association between decorated Bell Beakers and undecorated jugs in those Moravian graves not used in the analysis. The figures in brackets, of course, represent the expected frequencies.



Table 3.I	Jug	No Jug	
Decorated	35	43	78
Bell Beaker	(41.3)	(36.7)	
No Decorated	172	75	247
Bell Beaker	(165.7)	(81.3)	
	207	118	325

$$X^2 = \frac{N(ad-bc)^2}{(a+b)(c+d)(a+c)(b+d)} = 15.8 \text{ with 1 d.f.}$$

This figure is significant at more than the 0.001 level, but its value takes into account the d cell of the table: the number of graves with neither a decorated Bell Beaker nor a jug. This has nothing to do with the association of decorated Bell Beakers and jugs, and might easily take any value from one to several hundred without in the least affecting the number of associations between the two; depending on what it is  $X^2$  will vary from very significant to not at all. To say in this case that you would expect 81 graves with neither, instead of 75, is meaningless. Certain other related measures are even less satisfactory, for example Yule's Q:

$$Q = \frac{ad - bc}{ad + bc}$$

Again this uses the d cell, and for the figures in the 2 x 2 table  $Q = -0.47$ , indicating a reasonably strong inverse relationship. But if we use Q on the expected frequencies in the table - the values you would expect to get if the variables were independent given the marginal totals,  $Q = -0.28$ ; there is still a negative relationship because of the large number in the c cell. For these reasons then such tests were not used

Table 2.1	Observed	Expected
Decorated	32	45
Not decorated	147.5	136.5
Total	179.5	181.5
Decorated	32	45
Not decorated	147.5	136.5
Total	179.5	181.5

$$\chi^2 = \frac{(32 - 45)^2}{45} + \frac{(147.5 - 136.5)^2}{136.5} = 12.8 \text{ with } 1 \text{ d.f.}$$

This figure is significant at the 0.001 level, but the value taken into account the 1 d.f. of the test: the number of degrees of freedom is 1. This has nothing to do with the association of decorated and not decorated, and might easily take any value from one to several hundred without in the least affecting the number of associations between the two; depending on what it is  $\chi^2$  will vary from very significant to not at all. To say in this case that you would expect 84 graves with neither, instead of 75, is meaningless. Certain other related measures are even less satisfactory, for example Fisher's  $\phi$ .

$$\phi = \frac{ad - bc}{ad + bc}$$

again this uses the 4 cells, and for the 1 d.f. in the 2 x 2 table  $\phi = 0.47$ , indicating a reasonably strong inverse relationship. But if we use  $\phi$  on the expected frequencies in the table - the values you would expect to get if the variables were independent given the marginal totals,  $\phi = 0.38$ ; there is still a negative relationship because of the large number in the c cell. For these reasons then such tests were not used.

and only difference of proportions tests were carried out.

Using a knowledge of the mean of the sample and of the population, the aim here is to find out whether the sample is a random one - that is, how likely would the particular sample mean be with the given population mean. If it appears very unlikely we cannot extend our results - any significance they have is restricted to the data on which they were evaluated.

The following description is based on Blalock (1972). Given a dichotomised nominal scale (here the presence or absence of a pottery type), the arbitrary scores may be treated as an interval scale since there are only two of them. The scores form a bimodal distribution consisting of ones and noughts, but if  $N$  is large enough the sampling distribution of sample means will be approximately Normal  $(\mu, \sigma^2/N)$ , regardless of the form of the population.

Let  $p_u$  = the number of ones

and  $q_u$  = the number of noughts

(where  $u$  indicates that we are dealing with the entire universe)

The mean is obtained by adding the values and dividing by the total number of cases. But regardless of the number of noughts their contribution to the sum will be nought. Therefore, the population mean is:

$$\mu = \frac{Mp_u}{M} = p_u$$

where  $M$  is the size of the population.

By the same argument  $\bar{X} = p_s$ , where  $p_s$  is the proportion of ones in the sample.

It can be shown that  $\sigma = \sqrt{p_u q_u}$

Using the central-limit theorem gives



$$\sigma_{\bar{X}} = \sigma_{p_s} = \frac{\sigma}{\sqrt{N}} = \sqrt{\frac{p_u q_u}{N}}$$

where  $p_s$  indicates that we are dealing with the standard error of sample proportions.

We now substitute these terms into the formula for the statistic Z which is normally distributed with a mean of 0 and a standard deviation of 1. The resulting score gives us the difference between the population mean and the sample mean in terms of standard errors, which can then be looked up in the Normal table.

$$Z = \frac{\bar{X} - \mu}{\sigma_{\bar{X}}} = \frac{p_s - p_u}{\sqrt{p_u q_u / N}}$$

This test was applied to the proportions of graves with decorated Bell Beakers, undecorated jugs and undecorated bowls, as representing the most numerous objects. Bohemia and Moravia were considered separately; the sample was large in both cases (199 and 201 individuals). The population in each case was defined as the total number of definite graves available and the sample was the sample from each area actually used in the cluster analyses (see below). The figures are given in Tables 3.II-III below.

Table 3.II

	Moravia		
	Sample	Total	Z score
Decorated Bell Beakers	62/201	168/582	0.59
Undecorated jugs	152/201	391/582	2.54
Undecorated bowls	111/201	284/582	1.83

$$I = \frac{1}{2} \left( \frac{1}{n} + \frac{1}{m} \right)$$

where  $I$  indicates that we are dealing with the standard error of sample proportions. We now substitute these values into the formula for the statistic  $Z$  which is normally distributed with a mean of 0 and a standard deviation of 1. The resulting value gives us the difference between the population mean and the sample mean in terms of standard errors, which can then be looked up in the normal table.

$$Z = \frac{\bar{p} - p}{\sqrt{p(1-p)}} = \frac{0.52 - 0.50}{\sqrt{0.50(1-0.50)}} = 0.79$$

This test was applied to the proportions of graves which decorated Bell Beakers, unadorned Bell Beakers, and unadorned bowls, as representing the same unknown objects. Bohemia and Moravia were considered separately; the sample was large in both cases (199 and 201 individuals). The population in each case was defined as the total number of definite graves available and the sample was the sample from each area actually used in the cluster analysis (see below). The figures are given in Tables 3.11-11.1 below.

Table 3.11		Moravia	
	Sample	Total	Score
Decorated Bell Beakers	62/201	166/585	0.32
Unadorned Bell Beakers	132/201	391/585	2.34
Unadorned bowls	177/201	504/585	1.83

Table 3.III

Bohemia

	Sample	Total	Z score
Decorated Bell Beakers	36/199	89/583	1.19
Undecorated jugs	115/199	320/583	0.57
Undecorated bowls	92/199	223/583	2.33

Before discussing the meaning of these results one important point should be made. Supposing there were a statistically significant difference between the sample and the population, our null hypothesis that the sample is random might be incorrect for a trivial reason: because our initial assumption that individual inaccuracies will be evened out on the larger scale is wrong, and not because the sample really is biased. If all the poorly reported graves had in fact been accurately recorded the result might have been different. Clearly, therefore, too much weight cannot be placed on the results of these tests and significance levels should be conservatively chosen. The sample proportions were invariably larger than the population proportions and on the basis of this a one-tailed test was chosen since the direction was predicted; the significance level was set at 0.01 i.e. a Z of more than 2.32 is significant.

it is immediately seen that for Moravia the proportion of undecorated jugs is significantly larger than expected, while for Bohemia undecorated bowls are on the borderline and make clear the difficulties of making simple decisions on the basis of such significance tests. The others: decorated Bell Beakers and undecorated bowls in Moravia, decorated Bell Beakers and undecorated jugs in Bohemia are well within the limits and may therefore be considered as possible random samples of the population

Table 2.111			Tobacco	
	Decorated	Undecorated	Total	n
Decorated	36,795	80,563	117,358	1.75
Undecorated	172,700	120,563	293,263	0.97
Total	209,495	201,126	410,621	2.72

Before discussing the results of these results one important point should be made. The results were statistically significant. The difference between the two groups was significant. The results of the sample in which the difference was not significant for a typical reason: because our initial assumption that individual differences will be evened out on the larger scale is not, and not because the sample really is biased. If all the poorly reported groups had in fact been accurately reported the results might have been different. Clearly, therefore, too much weight cannot be placed on the results of these tests and significance levels should be conservatively chosen. The sample proportions were invariably lower than the population proportions and on the basis of this a one-tailed test was chosen since the direction was predicted; the significance level was set at 0.01 i.e. a 3 of more than 2.32 is significant. It is immediately seen that for Norway the proportion of undecorated was significantly larger than expected, while for tobacco undecorated was on the borderline and not clear the significance of making single decisions on the basis of such significance tests. The other decorated Bell Beaker and undecorated bowls in Norway, decorated Bell Beaker and undecorated jars in Bohemia are well within the limits and are therefore be considered as possible random members of the population.

represented by all the available graves in each of the two areas. This does not mean, of course, that they represent a random sample of the once existing population.

Examination of the data soon provides a reason for the over-representation of undecorated jugs in the Moravian sample. Of the 201 graves 76 come from three sites, and of these 67 contain jugs. Inter-site differences exist, naturally, and are considered elsewhere; here we see that a few large sites of a particular type may bias the whole at least as far as numbers are concerned, but this is different from biasing our picture of which object is associated with which, a feature not totally dependent on the numbers and difficult to test because of the generally small cemetery size. The fact that we can see a definite reason for this large number of jugs has the further effect of confirming that the sample is non-random in this case. On the other hand there is no such obvious explanation for the high number of graves with undecorated bowls in the Bohemian sample: none of the sites here is particularly large and of those that have 10 graves or more only one has a lot of undecorated bowls (Brandýsek, 13 graves, of which 9 contained bowls); since the Z score was only 0.01 above the top end of the critical region it should not perhaps be taken too seriously.

The above discussion of the problem raised by the samples used in the following analyses has perforce produced only limited conclusions. The relations between the available population and the samples for most of the cases do not seem to be markedly biased although this is not so for the Moravian jugs. The focus of interest, however, is the pattern of associations, and there is no reason for this to be altered by the excessively large number of jugs. Nevertheless, the dangers of over-interpretation are clear and should be borne in mind throughout the

represented by all the available graves in each of the two areas. This does not mean, of course, that they represent a random sample of the entire existing population.

Examination of the data again provides a reason for the over-representation of undecorated graves in the Norwegian sample. Of the 101 graves 76 come from the two areas, and of these 67 contain jugs. Later this difference exists, and is not contained elsewhere; here we see that a few graves which are particularly large may bias the whole at least as far as number is concerned, but this is different from biasing the picture of a lot of graves associated with which, a feature not totally dependent on the number and different for each because of the generally well-assorted size. The fact that we can use a definite reason for this large number of jugs is the further effect of confirming that the sample is representative in this case. On the other hand there is no such obvious explanation for the high number of graves with undecorated bowls in the Norwegian sample: none of the sites here is particularly large and of those that have 10 graves or more only one has a lot of undecorated bowls (Lundby, 15 graves, of which 9 contained bowls); since the 5 score was only 0.01 above the top end of the critical region it should not perhaps be taken too seriously.

The above discussion of the problem raised by the samples used in the following analysis has produced only limited conclusions. The relation between the available population and the samples for most of the cases do not seem to be seriously biased although this is not so for the Norwegian jugs. The focus of interest, however, is the pattern of associations, and there is no reason for this to be altered by the successively larger number of jugs. Nevertheless, the danger of over-interpretation are clear and should be borne in mind throughout the

following account.

The main method used to investigate the grave associations was cluster analysis. This was chosen for several reasons: first, because only a multivariate method such as this could cope with the complexity of the data; second, because other multivariate methods, such as factor analysis, were inappropriate for this particular data, which was binary and involved widely differing attribute frequencies (cf. Manjone and Sanday 1971). For the clustering the package of computer programs known as CLUSTAN IB (Wishart 1970) available on the Cambridge IBM 370/165 was used. Several of the available clustering techniques were tried in order to find out how similar their results were, but they all involved the same basic data preparation.

The aim was to cluster not the graves themselves but rather the objects found in them, to discover which of these objects tended to be associated. The programs used had two slight disadvantages. First, they consider only presence/absence of objects, not their quantity: thus, two Beakers and one jug in a grave are reduced to Beaker and jug. For Bell Beaker graves this is not very important as graves with more than one of any given object are not very common. Moreover, presence/absence removes problems of evaluating quantities: for instance, if 30 beads are found in a grave with a Beaker, is this a stronger association than if there is only a single bead? Logically presence/absence is more satisfactory. The other disadvantage is that the programs could only cope with 400 graves. If there had been considerably more than this it would have been worth splitting them up into two different samples; as there were only 427, 27 of these were randomly eliminated.

All objects which occurred in more than three graves were considered, 32 in all (see table 3.IV).

following account.

The main method used to investigate the grave associations was cluster analysis. This was chosen for several reasons: first, because only a multivariate method such as this could cope with the complexity of the data; second, because other multivariate methods, such as factor analysis, were inappropriate for this particular data, which was binary and involved widely differing absolute frequencies (cf. Marjono and Baskin 1977). For the clustering the package of computer programs known as CLUSTAL 1B (Nightingale 1977) available on the Cambridge IBM 370/165 was used. Several of the available clustering techniques were tried in order to find out how similar their results were, but they all involved the same basic data preparation.

The aim was to cluster not the graves themselves but rather the objects found in them, to discover which of these objects tended to be associated. The program used had two slight disadvantages. First, they consider only presence/absence of objects, not their quantity: thus, two baskets and one jug in a grave are reduced to basket and jug. For Bell's test graves this is not very important as graves with more than one of any given object are not very common. Moreover, presence/absence removes problems of evaluating quantities: for instance, if 30 beads are found in a grave with a basket, is this a stronger association than if there is only a single bead? Logically presence/absence is more satisfactory. The other disadvantage is that the program could only cope with 400 graves. If there had been considerably more than this it would have been worth splitting them up into two different samples; as there were only 407, 37 of these were randomly eliminated. All objects which occurred in more than three graves were considered. It is all (see table 3.IV).

All the objects are well-known traditionally defined categories and are mostly functional. To some extent their use was inevitable as the level of object description in Hájek (1968) was no more detailed than this, but equally they seem not unreasonable categories at this level of generality. The only real source of argument is the pottery types. It might be felt that such features as decorated/undecorated, handled/unhandled etc. should either have been left out or incorporated in some form of hierarchical description (cf. Whallon 1971); but the second option was not a practical possibility in the context of the programs used, while the first would have resulted in a loss of information. The categories were therefore left as they were, and their relative behaviour in the ensuing analyses observed.

Table 3.IV makes clear the widely differing frequencies of the objects concerned and this had important repercussions for the type of association index chosen. 10 of these objects occurred 10 or less times in 400 graves, while on the other hand undecorated jugs appeared in 267 and undecorated bowls in 203 graves. This meant first that mutual lack of association could not be considered significant, and second that certain relationships of inclusion were likely to be underestimated by most indices; for example, even if all four whetstones were associated with undecorated jugs, this would not appear at all significant if the number of joint occurrences were divided only by the number of jugs. For this reason the coefficient of Kulczynski (1927, quoted in Sokal and Sneath 1963:130) was used, with negative matches excluded:

$$S = \frac{1}{2} (n_{JK}/n_J) + (n_{JK}/n_K)$$

where  $S$  = similarity

$n_J$  = total number of occurrences of J

$n_K$  = " " " " " K

$n_{JK}$  = number of joint occurrences of J and K.

All the objects are well-known traditionally defined categories and are mostly functional. To some extent their use is inevitable as the level of object description in (1957) was no more detailed than this, but actually they mean not unambiguous categories at this level of generality. The only real source of argument in the present paper is the fact that some features are associated with certain objects, e.g. shape, etc. should be left out or incorporated in some way of hierarchical description (cf. Gellman 1971); but the second option was not a primary possibility in the context of the program and, while the first option was in a sense of information. The categories were not only left out but were, and their relative behavior is the same as in (1957).

Table 2.1 shows that the highly differing frequencies of the objects concerned and which are important representations for the type of association index chosen. 10 of these objects occurred 10 or less times in 100 groups, while on the other hand undecorated items appeared in 100 and undecorated bowls in 100 groups. This meant that that actual lack of association could not be considered significant, and hence that certain relationships of inclusion were likely to be underestimated by most indices; for example, even if all four whistles were associated with undecorated items, this would not appear as all significant if the number of joint occurrences were divided only by the number of items. For this reason the coefficient of Kulczynski (1957, quoted in Gellman and Soutar

(1957:170) was used, with negative matches excluded:

$$K = \frac{1}{2} (n_{JK} \sqrt{n_J} + n_{JK} \sqrt{n_K})$$

where  $n_J$  = similarity  $n_J$  = total number of occurrences of J

$n_K$  = total number of occurrences of K

$n_{JK}$  = number of joint occurrences of J and K.

This gives weight to the total occurrences of both objects, not just the larger of the two.

Using this coefficient the program worked out a similarity matrix (table 3.V), on which the subsequent clustering operations were carried out.

#### i) Program DNDRIT

The description of this method, and of the other clustering techniques, is taken from the CLUSTAN IB manual (Wishart 1970:59-60), where full details can be found.

DNDRIT starts with the minimum spanning tree - this is the graph of  $(N - 1)$  edges which connects all points (i.e. objects to be clustered), has the least overall length and no circuits. The idea is that the optimum solution for  $K$  clusters may be obtained by the removal of  $(K - 1)$  edges from the shortest dendrite. All possible groupings are considered and the best one selected.

Fig. 3.2 shows the minimum spanning tree for the Beaker objects; numbering corresponds to the list already given. This single cluster contains the total sum of all the similarities in the similarity matrix. The first clustering cycle removes the edge joining 1 and 5 (see fig. 3.2), giving two clusters. The total similarity may now be divided into two components: within-group similarity i.e. the total sum of similarities between all pairs of objects in a given cluster added to the total sum of similarities within all other clusters; and between-group similarity i.e. the total between-group sum of similarities.

The results for the Beaker case may be seen in Table 3.VI. Only four cycles were carried out as the program was already taking large amounts of computer time, but this was enough to establish the outline of the clustering.

This gives weight to the local occurrences of both objects, not just the larger of the two.

Using this coefficient the program worked out a similarity matrix (Table 3.V), on which the subsequent clustering operations were carried out.

4) Program HENKEL

The description of this method, and of the other clustering methods, is taken from the *Journal of the Royal Statistical Society* (1970:28-32), where full details can be found.

Table 3.V shows the minimum spanning tree - this is the graph of  $n-1$  edges which connects all points (i.e. objects to be clustered), but the least overall length is achieved. The idea is that the optimum solution for a cluster may be obtained by the removal of  $(n-1)$  edges from the shortest distance. If possible groupings are considered and the best one selected.

Fig. 3.4 shows the minimum spanning tree for the Henkel objects; connecting corresponds to the first already given. This single cluster contains the total sum of all the similarities in the similarity matrix. The first clustering cycle removes the edge joining 1 and 2 (see Fig. 3.5), leaving two clusters. The total similarity may now be divided into two segments: within-group similarity i.e. the total sum of similarities between all pairs of objects in a given cluster added to the total sum of similarities within all other clusters; and between-group similarity i.e. the total between-group sum of similarities.

The results for the Henkel case may be seen in Table 3.VI. Only two cycles were carried out as the program was already taking large amounts of computer time, but this was enough to establish the outline of the clustering.

On the first cycle the within-group similarities are quite high, then they drop considerably with steps two and three before levelling out at step four. It is clear that although this may be the optimum division of the dendrite, the grouping is not very satisfactory since after cycle one it results in a large increase in the between-group similarity which is being disregarded. It is probable that within-group similarity would increase again as the groups became smaller, but for the reason already mentioned this could not be investigated. Such smaller groups are considered in the results of program HIERAR (see below). On the whole it seems best to look no further than the first cycle and the two broad groups which it produces, since only here is the sum of within-group similarities significantly more than 50% of the total.

The members of the two clusters are listed in table 3.VII.

It is immediately obvious that Cluster I contains only one pottery type, the decorated Bell Beaker, (and sherds), together with some of the most characteristic widespread Bell Beaker objects, including wrist-guards and daggers. Cluster II contains virtually all the other pottery, including the local jugs, bowls and 'Töpfe', and only V-perforated buttons and bone pendants of the 'classic' Beaker objects. These results will be discussed in detail below together with the results of the other clustering methods.

## ii) Program MODE

The description of the method is again taken from Wishart (1970:31-34).

'Given a density estimator  $K$ , we compute the average  $A(I)$  of the  $2K$  smallest distance coefficients for each individual ( $I$ ). This value provides a measure of the density of the space in the immediate vicinity of each individual - small  $A(I)$  are associated with points that lie

On the first cycle the within-group similarities were quite high, but they drop considerably with steps two and three before leveling out at step four. It is clear that although this may be the optimum situation of the technique, the grouping is not very satisfactory since after cycle one it tends to be a large increase in the between-group similarity which is rather unexpected. It is probable that within-group similarity would increase more as the groups became smaller, but for the reasons already mentioned this could not be investigated. Each smaller group was considered as a separate unit of program analysis (see below). On the whole it seems that the technique does the first cycle and the two second groups which it produces, almost equally well in the sum of within-group similarities and in the sum of between-group similarities.

The numbers of objects assigned to clusters are listed in Table 3. VII.

It is immediately obvious that Cluster I contains only one poetry

type, the decorative (alliteration, (and words), together with some of the most characteristic widespread alliteration objects, including words, words and objects. Cluster II contains virtually all the other poetry, including the local type, 'loose', and only a few scattered patterns and some patterns of the 'classical' type. These results will be discussed in detail below together with the results of the other clustering methods.

clustering methods.

III Program 1952

The description of the method is again taken from Table 3. VII (21-25).

'Given a density estimator  $\hat{f}$ , we compute the average  $A(i)$  of the  $K$  nearest distance coefficients for each individual  $i$ . This value provides a measure of the density of the space in the immediate vicinity of each individual - small  $A(i)$  are associated with points that are

in regions of high density....

'Next, the individuals are ordered according to their  $A(I)$  values. This ordering determines the sequence in which the individuals are 'introduced' to the cluster nuclei, or become 'dense'. At the start of the hierarchic clustering process that individual with the least  $A(I)$  value is 'introduced' and initiates the first cluster nucleus. During each subsequent cycle of the algorithm, the 'coefficient threshold'  $R$  is increased to the next smallest  $A(I)$  value and the associated individual becomes 'dense'. Four actions are possible.

- 1) The new point is separated from all other 'dense points' by a distance which exceeds  $R$ . When this happens the point initiates a new cluster nucleus and the number of clusters is increased by one.
- 2) The new point is within distance  $R$  of one or more 'dense' points which belong to only one cluster nucleus. In this case the new point joins that cluster.
- 3) The new point is within distance  $R$  of 'dense' points belonging to two or more clusters. If this happens the clusters concerned are combined.
- 4) At each 'introduction' cycle the smallest distance  $D$  between dense points belonging to different clusters is found. If at some cycle the next smallest  $A(I)$  threshold value exceeds  $D$ , then we combine those two clusters separated by distance  $D$ .

'...We define the cluster nuclei as the groupings of 'dense' points at coefficient  $R$  together with those 'nondense' points which happen to be within a distance  $R$  of any dense point. All other 'nondense' points...are deemed sufficiently remote to be unclassified.

'It is usually desirable that every individual should be classified

is regions of high density....

'Next, the individuals are ordered according to their  $A(1)$  values.

This ordering determines the sequence in which the individuals are 'introduced' to the cluster nuclei, or hence 'dense'. At the start of the hierarchical clustering process that individuals with the least  $A(1)$  value are 'introduced' and initiated as first cluster nucleus.

During each subsequent step of the algorithm, the coefficient threshold  $A(1)$  is increased as the next smallest  $A(1)$  value and the associated individual are 'dense'. Some actions are possible.

1) The new point is separated from all other 'dense points' by a distance which exceeds  $B$ . Then this happens the point initiates a new cluster nucleus. The number of clusters is increased by one.

2) The new point is within distance  $B$  of one or more 'dense' points which belong to only one cluster nucleus. In this case the new point joins that cluster.

3) The new point is within distance  $B$  of 'dense' points belonging to two or more clusters. In this happens the clusters concerned are coalesced.

4) At each 'introduction' cycle the smallest distance  $B$  between dense points belonging to different clusters is found. If at some cycle the next smallest  $A(1)$  threshold value exceeds  $B$ , then we continue those two clusters separated by distance  $B$ .

....we define the cluster nuclei as the groupings of 'dense' points as coefficient  $B$  together with those 'non-dense' points which happen to be within a distance  $B$  of any dense point. All other 'non-dense' points....are deemed sufficiently remote to be unclassified.

It is usually desirable that every individual should be classified

on a best-fit basis. For this purpose, the 'complete' classifications are obtained by grouping each 'nondense' point which is unclassified at the nuclei level, with the cluster that contains its nearest dense point.

'...An interesting feature of the method is that there is always precisely one cluster at both the start and end of the analysis. Sometimes no more than one cluster is ever resolved, but usually the number of cluster nuclei increases until a maximum is reached prior to the first fusion. It has been suggested that this maximum number of clusters corresponds to the lowest 'natural' level of classification which is possible.'

The above description applies specifically to distance coefficients, but it works in exactly the same way on similarity coefficients such as the one used here.

The results of program MODE are shown in table 3.VIII. Only two clusters are formed before fusion, at coefficient 0.381. As the print-out shows (table 3.VIII), these are given twice, as 'MODE NUCLEI GROUP' and 'MODE COMPLETE GROUP'. In the nuclei groups are the 'dense' points and those 'nondense' points within similarity R (here 0.381) of any 'dense' point. All the 'nondense' points beyond this are unclassified. Here members of cluster 1 are marked 1, members of cluster 5 as 5, and unclassified objects 0, in order from 1 to 32. In the complete group classification these unclassified objects have been assigned to the nearest of the two clusters on a best fit basis. The members of the two 'nuclei' clusters are given in table 3.IX.

When the other objects are added on a best-fit basis, the two clusters correspond exactly to those produced by DNDRIT (see above). A measure of the extent to which objects have been assigned in the complete

on a best-fit basis. For this purpose, the 'complete' classification are obtained by grouping each 'condensed' point which is unclassified at the model level, with the cluster that contains the nearest data point.

...An interesting feature of the method is that there is always precisely one cluster at each end of the analysis. Sometimes no more than one cluster is ever received, but usually the number of clusters varied between one and a maximum is reached prior to the first split. It was found, however, that this maximum number of clusters corresponds to the lowest 'internal' level of classification which is possible.

The above description of the method is necessarily too distant and abstract, but it works in exactly the same way as similarity coefficients such as the one used here.

The results of the analysis are shown in Table 2.11. Only two clusters are formed before fusion, at coefficient 0.507, as the first-out class (Table 2.11), these are given twice, as 'LOW MOLECULAR WEIGHT' and 'HIGH MOLECULAR WEIGHT'. In the model groups are the 'dense' points and those 'condensed' points within similarity 2 (here 0.507) of any 'dense' point. All the 'condensed' points beyond this are unclassified. Here members of cluster 1 are marked 1, members of cluster 2 as 2, and unclassified objects 0, in order from 1 to 35. In the complete group classification these unclassified objects have been assigned to the nearest of the two clusters on a best fit basis. The members of the two 'model' clusters are given in Table 2.12.

When the other objects are added on a best-fit basis, the two clusters correspond exactly to those produced by WARD (see above). A measure of the extent to which objects have been assigned in the complete

classification is given by the Enclosure Ratio.

$$\text{Enc. Ratio} = \frac{\text{Number of individuals classified at the nuclei level}}{\text{Number of individuals}}$$

$$\text{In this case Enc. Ratio} = \frac{20}{32} = 0.63 \quad (\text{see table 3.VIII})$$

Cluster II increases from 10 to 19 members on the Complete Classification and in any consideration of its meaning, it is clearly necessary to differentiate its two components, for it contains the two most common objects (undecorated jugs and bowls), with which any artifact without other strong associations would tend to be connected, even on a purely random basis. (See below for a discussion of this point.)

As we have already pointed out, the results of MODE are very similar to those of DNDRIT, but MODE's 'nuclei group' classification provides better cluster definition. MODE, moreover, has the further advantage of providing details of which graves contain the objects in the clusters, information important at the next stage of analysis - interpretation and explanation of the clusters. Before we come to this, however, there is one more clustering method to be described.

### iii) Program HIERAR

The final CLUSTAN program used is a method to produce hierarchic groupings. This provides more information than the previous programs; its interpretation is consequently more complex, although to some extent this is counter-balanced by the dendrogram form in which the results are produced.

All the individuals start off separate and in a series of steps those individuals or clusters which are most similar are combined and a dendrogram of the relationships produced. Several linkage procedures are available with HIERAR, of which three were suitable for the similarity coefficient chosen:

classification is given by the following ratio.

$$\text{Inc. Ratio} = \frac{\text{Number of individuals classified at the next level}}{\text{Number of individuals}}$$

In this case Inc. Ratio =  $\frac{1}{2} = 0.5$  (see Table 3. VII)

Cluster II therefore has 10 members on the complete classification and in the classification of the members, it is clearly necessary to distinguish between the two components, for it contains the two most common objects, which are not related, with which any object without other objects is not connected, even on a purely random basis. (The basis for a division of this point.)

As we have shown, the members of II are very similar to those of III, but the method of classification provides better cluster definition. However, the further advantage of providing details of which, there are in the objects in the clusters, information is that at the next stage of the classification - interpretation and explanation of the clusters. Before we come to this, however, there is one more interesting method to be described.

#### (iii) Program Hierarchy

The final program used is a method to produce hierarchical programs. This provides more information than the previous programs; its interpretation is consequently more complex, although to some extent this is counter-balanced by the advantages for which the results are produced.

All the individuals start off separate and in a series of steps these individuals or clusters which are most similar are combined and a dendrogram of the relationships produced. Several linkage procedures are available with which, of which three were suitable for the similarity coefficient

- 1) Single linkage
- 2) Complete linkage
- 3) Average linkage

These are well-known but nevertheless their behaviour is worth briefly summarising. With Single-linkage similarity is defined as the highest similarity coefficient between two individuals, one from each cluster. It produces straggling clusters and tends to degenerate to chaining. Complete-linkage is based on the smallest single similarity coefficient between two individuals, one from each cluster. As Wishart (1970:39) says, it is liable to produce irregular results because the similarity criterion is only determined for two individuals and has no regard for group structure. Average-linkage, on the other hand, uses the average of all the similarity coefficients for pairs of individuals, one from each cluster, and tends to find spherical clusters.

Dendrograms were produced by all three methods for the Beaker data and one of the main points which they make clear is that the levels of association between objects are generally low. The one high value connection is that between jugs and bowls (Nos. 5 and 7), long recognised as a standard combination and, moreover, the two most frequent objects. Any groupings which exist are certainly not sharply separate from other objects outside the group.

If one examines the dendrograms (figs. 3.3-3.5) in turn, double-linkage (fig. 3.3) appears the least satisfactory and does not produce any obvious groups which are not at least as well represented by the other two methods. Single-linkage on the whole produces the expected chaining, but one very obvious cluster stands out in contrast (see fig. 3.4):

- 1) Simple linkage
- 2) Complete linkage
- 3) Average linkage

These are well-known but nevertheless their behavior in worth analysis is interesting. With single-linkage similarity is defined as the highest similarity coefficient between two individuals, one from each cluster. It produces a dendrogram which tends to degenerate to chains. Complete-linkage is defined as the smallest single similarity coefficient between two individuals, one from each cluster. As a matter of fact, it is liable to produce a dendrogram which tends to degenerate to chains because the similarity criterion is only satisfied for two individuals and has no reason for propagation. As a result, on the other hand, when the average of all the similarity coefficients for pairs of individuals, one from each cluster, and tends to form spherical clusters.

Dendrograms were produced by all three methods for the beaker data and one of the main points which they make clear is that the levels of association between objects are generally low. The one high value is that between jugs and bowls (Nos. 5 and 7), long recognised as a standard connection and, moreover, the two most frequent objects. Any grouping which exists are certainly not sharply separate from other objects outside the group.

If one examines the dendrogram (figs. 2.5-2.7) in turn, double-linkage (fig. 2.5) appears the least satisfactory and does not produce any obvious groups which are not at least as well represented by the other two methods. Single-linkage on the whole produces the expected chains, but one very obvious cluster stands out in contrast (see fig. 2.6):

- |                          |                   |
|--------------------------|-------------------|
| 1. Decorated Bell Beaker | 19. Wrist-guard   |
| 13. Arrowhead            | 23. Ear-ring      |
| 14. Stone Axe            | 29. Flint Scraper |
| 15. Flint Flake          | 30. Boar's Tusk   |
| 18. Copper Dagger        | 32. Whetstone     |

This is the same as 'nuclear' cluster 1 produced by MODE and includes, as already remarked, some of the most characteristic widespread Bell Beaker artifacts. It is complete at a similarity threshold of c.0.400. If we examine the remainder to see which objects are associated at or above this level, we find the following group:

- |                     |                         |
|---------------------|-------------------------|
| 5. Undecorated Jug  | 10. 'Topf'              |
| 7. Undecorated Bowl | 20. V-perforated Button |
| 9. Polypod Bowl     | 22. Animal Bones        |
| 21. Bone Awl        | 27. Flint Blade         |
| 24. Copper Sheet    | 31. Urn                 |

These are identical to the members of 'nuclear' cluster 2 of MODE. They include the characteristic Central European combination of jug and bowl already mentioned, together with three other types of pottery, one of which, the polypod bowl, is certainly not just restricted to Central Europe. It is also noteworthy that the V-perforated buttons belong in this cluster and are not merely assigned to the remainder of 'chained' objects. These buttons are one of the most widely distributed of the 'Bell Beaker artifacts' and here they are associated with the local jugs and bowls, so it is clear that the difference between clusters 1 and 2 is not just the distinction between widespread objects and those of more restricted distribution; this point will be discussed further below.

1. Decorated Bell Beaker	19. White-glass
2. Arrowhead	20. Jar-ring
3. Stone axe	21. Flint dagger
4. Flint flake	22. Bone's tree
5. Copper dagger	23. Whetstone

This is the same as 'nuclear' cluster 1 produced by HMM and includes, as already mentioned, some of the most characteristic widespread Bell Beaker artifacts. It is complete at a similarity threshold of 0.800. If we examine the remainder to see which objects are associated at or above this level, we find the following group:

1. Undecorated bowl	14. 'Roggi'
2. Undecorated bowl	15. V-perforated button
3. Polyped bowl	16. Animal bones
4. Bone awl	17. Flint blade
5. Copper sheet	18. Pin

These are identical to the members of 'nuclear' cluster 2 of HMM. They include the characteristic Central European combination of jug and bowl already mentioned, together with three other types of pottery, one of which, the polyped bowl, is certainly not just restricted to Central Europe. It is also noteworthy that the V-perforated buttons belong in this cluster and are not merely assigned to the remainder of 'chained' objects. These buttons are one of the most widely distributed of the 'Bell Beaker artifacts' and here they are associated with the local jugs and bowls, so it is clear that the difference between clusters 1 and 2 is not just the distinction between widespread objects and those of more restricted distribution; this point will be discussed further below.

Little can be said about those objects which do not belong to either of the two clusters and are thus not very strongly associated with anything. They consist mainly of other varieties of pottery and include, interestingly enough, the types closely related to the decorated Bell Beaker: decorated handled Bell Beakers, undecorated Bell Beakers and undecorated handled Bell Beakers, which all join the dendrogram at virtually the bottom of the scale. One reason for their lack of associations may be that they are alternatives to the decorated Bell Beaker and therefore tend to be complementary to it - in the complete classification of MODE they were assigned to cluster 2 - but, like the decorated Bell Beakers, they do not associate with the jugs and bowls.

The average-link dendrogram (fig. 3.5) shows a rather more indefinite picture, although the basic features are the same. The 'Beaker cluster' (Cluster 1) isolated by Single-link and MODE is still present as a cluster (Nos. 1, 23, 18, 19, 14, 32, 13, 29, 15, 30 on the dendrogram). The similarity level at which it joins up, c.0.200, has fallen compared with Single-link, as indeed have many of the values at the lower end of the scale, an inevitable result of the method used, while there are greater differences in the levels at which different members of the cluster join up, and changes in the detail of their relationships within the cluster; nearest neighbour pairs, of course, remain together.

Those objects which are not members of this group are again chained and there are no markedly discernible clusters. Undecorated jugs and undecorated bowls, as a nearest neighbour pair, maintain their very high association and, still at a fairly high level (0.450), are joined by the 'Töpfe' (10). If one takes the cluster 1 threshold of c.0.200 one finds a group of eight objects connected:

little can be said about those objects which do not belong to either of the two clusters and are thus not very strongly associated with anything. They consist mainly of other varieties of pottery and include, interestingly enough, the types closely related to the decorated bell beakers: decorated beaded bell beakers, undecorated bell beakers and undecorated beaded bell beakers, which all join the cluster as virtually the bottom of the scale. One reason for their lack of association may be that they are alternatives to the decorated bell beakers and therefore tend to be complementary to it - in a complete classification of 1981 they were assigned to cluster 1 - but, like the decorated bell beakers, they do not associate with the form of beaker.

The average-link method (Ward 1963) shows a rather more indefinite picture, although the basic results are the same. The 'beaker cluster' (cluster 7) isolated by Ward-link and Ward is still present as a cluster (nos. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000).

These objects which are not members of this group are again checked and there are no markedly characteristic clusters. Undecorated jars and undecorated bowls, as a nearest neighbour pair, maintain their very high association and, still at a fairly high level (0.950), are joined by the 'beaker' (70). It can take the cluster 1 threshold of 0.850 and thus a group of eight objects connected:

- |                     |                         |
|---------------------|-------------------------|
| 5. Undecorated Jug  | 20. V-perforated Button |
| 7. Undecorated Bowl | 22. Animal Bones        |
| 10. 'Topf'          | 24. Copper Sheet        |
| 17. Copper Awl      | 25. Amber Button        |

All these objects, however, are clearly chained. As with the other methods it is only the objects of Cluster 1 which stand out as a definite group.

The groupings visible in the HIERAR dendrograms do seem to make reasonable sense archaeologically, and are indeed what one might have hoped to find. This only makes it all the more necessary to ask, are they valid? Although no statistical tests have yet been developed for cluster analyses, to some extent it is possible to get round this difficulty. One of the main problems of clustering is to what extent it produces distortion of the original similarity matrix; this can be investigated by examining the matrix of cophenetic values (Davis 1973:461). This is the matrix of apparent correlations contained within the dendrogram and is obtained by looking at the dendrogram for the similarity levels at which the different objects are linked together. Thus, in the Average-link dendrogram (fig. 3.5), 1 appears to join with 14 and 32 at c.0.241, and with 13, 29, 15 and 30 at c.0.204. An idea of the distortion is given by plotting elements in the cophenetic matrix against the equivalent values in the original similarity matrix: in this example they are 0.425, 0.521, 0.304, 0.354, 0.308 and 0.307 respectively. If the two matrices were identical, the plot would form a straight line. This was done for the 'Bell Beaker cluster' defined by Single-link and Average-link and the results are shown in figs. 3.6, 3.7. A numerical measure of the similarity between the matrices is given by the correlation between equivalent elements:



Average-link       $r = 0.57$

Single-link         $r = 0.35$

It is clear from the plots and the coefficients that Average-link gives much less distortion than Single-link but that, even so, it is not very good. One reason for this is clearly the relative rarity of most of the objects in the cluster; this means that on the whole they have low coefficients with each other and high ones virtually only with the decorated Bell Beaker, which is the most common object. The dendrograms reflect the relations of other objects to the decorated Bell Beakers quite well, especially Single-link. Just using the links of the decorated Bell Beaker to the others, we have:

Average-link       $r = 0.67$

Single-link         $r = 0.91$

This last result is satisfactory, but the distortion in the dendrogram for this group as a whole, and, in fact, the generally low level of similarity of all the groups and individuals in the dendrogram, suggest doubts about the clusters obtained even though these have been consistent from method to method. We might infer, for instance, that the groups obtained are only a function of the frequency with which the different objects occur, and are therefore essentially random. In order to test this an experiment was carried out.

Using the actual frequencies of the variables (objects), a set of random data was generated for input to CLUSTAN. The results are shown in Figs. 3.8-3.10. Most illuminating once again are Single-link and Average-link. No clusters appear at all and the chaining is complete. The main determinant of association is frequency of occurrence, thus jugs and bowls again show the highest similarity threshold, followed by Bell Beakers. It

average-link  $r = 0.57$   
single-link  $r = 0.52$

It is clear from the plots and the coefficients that average-link gives much less distortion than single-link but that, even so, it is not very good. The reason for this is clearly the relative rarity of most of the objects in the cluster; while we are told on the whole they have low coefficients with each other and with those virtually only with the decorated half beaker, which is the most common object. The dendrogram reflects the relative frequency of objects related to the decorated half beaker quite well, especially at the top, where the link of the decorated half

beaker to the other is  $r = 0.57$   
average-link  $r = 0.57$   
single-link  $r = 0.52$

This last result is satisfactory, but the distortion in the dendrogram for this group as a whole, and, in fact, the generally low level of similarity of all the groups and individuals in the dendrogram, suggest doubts about the clusters obtained even though these have been considered from another method. We might infer, for instance, that the groups defined are only a function of the frequency with which the different objects occur, and are therefore essentially random. In order to test this an experiment was carried out.

Using the actual frequencies of the variables (objects), a set of random data was generated for input to CLUSTAN. The results are shown in Figs. 2.2-2.4. Most illuminating once again are single-link and average-link. No clusters appear at all and the clustering is complete. The main determinant of association in frequency of occurrence, that is, the objects again show the highest similarity threshold, followed by half beaker. It

is clear that the clustering of the real data deviates markedly from randomness even though it is not possible to attach a statistic to this difference. The absolute frequency of occurrence of the different objects, of course, is certainly not random, but their mutual associations might have been, at least theoretically; this now seems not to be the case.

The results as described so far are not much more than pattern recognition, the job for which the computer programs were designed. It is now necessary to suggest explanations of these patterns and as a start we can turn to the questions asked at the beginning of this chapter. The most characteristic artifacts of the 'Bell Beaker culture' are very widespread and contrast in this respect with the material of the local milieu in which they are found. Is this difference between local and widespread objects paralleled within Central Europe itself in any way? Those objects which most successfully overcome distance friction tend to be the most valuable (given a diffusion process), while the very nature of the 'typical' Bell Beaker artifacts themselves suggests that they have some special significance. Is there any evidence of this in the grave associations studied? The one definite cluster of objects to emerge was the following:

- |                          |                   |
|--------------------------|-------------------|
| 1. Decorated Bell Beaker | 19. Wrist-guard   |
| 13. Arrowhead            | 23. Ear-ring      |
| 14. Stone Axe            | 29. Flint Scraper |
| 15. Flint Flake          | 30. Boar's Tusk   |
| 18. Copper Dagger        | 32. Whetstone     |

This appeared with MODE and HIERAR, Single-link and Average-link, while similar results were produced by DNDRIT. It must therefore play the major part in interpretation. Here, however, it is necessary to make an important proviso. The members of one cluster are by definition mutually exclusive to members of another cluster (at least with the methods used

is clear that the clustering of the real data deviates markedly from randomness even though it is not possible to attach a statistic to this difference. The absolute frequency of occurrence of the different objects, of course, is certainly not random, but their mutual associations might have been, at least theoretically; this now seems not to be the case.

The results as described so far are not much more than preliminary observation, the job for which the computer program was designed. It is not necessary to suggest explanation of these patterns and as a start we can turn to the questions asked at the beginning of this chapter. The most characteristic features of the 'Bell' pattern clusters are very widespread and contrast in this respect with the material of the local cluster in which they are found. In this difference between local and widespread objects provided within Central Avenue itself is any way? Those objects which most successfully overcome distance friction tend to be the most valuable given a diffusion process, while the very nature of the 'typical' Bell pattern attacks themselves suggests that they have some special

significance. Is there any evidence of this in the grave associations stated? The one definite cluster of objects to emerge was the following:

1. Decorated Bell Pattern	19. White-glass
2. Arrowhead	21. Iron-rod
3. Stone axe	22. Flint dagger
4. Flint flake	23. Bone's Turk
5. Copper dagger	24. Pottery

This appeared with WIT and HIRSH, single-link and average-link, while similar results were produced by UNLINK. It must therefore play the major part in interpretation. Here, however, it is necessary to make an important proviso. The members of one cluster are by definition mutually exclusive to members of another cluster (at least with the methods used

here), and a group once defined appears to have a real identity of its own; this can be deceptive. Although Bell Beakers, arrowheads, etc. belong in a different group from jugs, bowls etc., in any given grave objects from both groups may well be found together. Of the 400 graves considered, 151 contain objects of cluster 1 (the Bell Beaker cluster), while 370 have objects belonging to cluster 2 (the rest); of these latter 340 have objects from the more closely defined group:

- |                         |                  |
|-------------------------|------------------|
| 5. Undecorated Jug      | 21. Bone Awl     |
| 7. Undecorated Bowl     | 22. Animal Bones |
| 9. Polypod Bowl         | 24. Copper Sheet |
| 10. 'Topf'              | 27. Flint Blade  |
| 20. V-perforated Button | 31. Urn          |

This appears with HIERAR Single-link and as nuclear cluster 2 of MODE. There is thus a considerable degree of overlap in terms of the number of graves which have objects of both groups - only 27 of the graves containing cluster 1 goods do not contain goods of cluster 2 as well.

Bearing all this in mind, we can still see that cluster 1 includes five of the widespread objects: decorated Bell Beakers, arrowheads, copper daggers, wrist-guards and ear-rings, together with a number of not very characteristic objects which also tend to be widely distributed, both within the Bell Beaker 'culture' and outside it. It does not contain the polypod bowl or the V-perforated buttons - indeed, the latter are quite strongly associated with the local jugs and bowls. It appears then that as usual we do not have a simple situation: most of the widespread objects are in cluster 1, but two are not. Nevertheless, there are grounds for saying that the group including most of the widespread objects is neither randomly distributed over the graves, nor, except for V-perforated buttons, clustered

and, and a group once defined appears to have a real identity of its  
 own; this can be deceptive. Although Bell Beaker, arrowheads, etc. belong  
 in a different group from jars, bowls etc., in any given grave objects  
 from both groups may well be found together. Of the 400 graves considered,  
 151 contain objects of bronze (100 Bell Beaker clusters), while 249  
 have objects belonging to the Iron Age. The results of these latter 249 have  
 objects from the same class as the first group.

- |               |                |
|---------------|----------------|
| 1. Unadorned  | 2. Unadorned   |
| 3. Unadorned  | 4. Unadorned   |
| 5. Unadorned  | 6. Unadorned   |
| 7. Unadorned  | 8. Unadorned   |
| 9. Unadorned  | 10. Unadorned  |
| 11. Unadorned | 12. Unadorned  |
| 13. Unadorned | 14. Unadorned  |
| 15. Unadorned | 16. Unadorned  |
| 17. Unadorned | 18. Unadorned  |
| 19. Unadorned | 20. Unadorned  |
| 21. Unadorned | 22. Unadorned  |
| 23. Unadorned | 24. Unadorned  |
| 25. Unadorned | 26. Unadorned  |
| 27. Unadorned | 28. Unadorned  |
| 29. Unadorned | 30. Unadorned  |
| 31. Unadorned | 32. Unadorned  |
| 33. Unadorned | 34. Unadorned  |
| 35. Unadorned | 36. Unadorned  |
| 37. Unadorned | 38. Unadorned  |
| 39. Unadorned | 40. Unadorned  |
| 41. Unadorned | 42. Unadorned  |
| 43. Unadorned | 44. Unadorned  |
| 45. Unadorned | 46. Unadorned  |
| 47. Unadorned | 48. Unadorned  |
| 49. Unadorned | 50. Unadorned  |
| 51. Unadorned | 52. Unadorned  |
| 53. Unadorned | 54. Unadorned  |
| 55. Unadorned | 56. Unadorned  |
| 57. Unadorned | 58. Unadorned  |
| 59. Unadorned | 60. Unadorned  |
| 61. Unadorned | 62. Unadorned  |
| 63. Unadorned | 64. Unadorned  |
| 65. Unadorned | 66. Unadorned  |
| 67. Unadorned | 68. Unadorned  |
| 69. Unadorned | 70. Unadorned  |
| 71. Unadorned | 72. Unadorned  |
| 73. Unadorned | 74. Unadorned  |
| 75. Unadorned | 76. Unadorned  |
| 77. Unadorned | 78. Unadorned  |
| 79. Unadorned | 80. Unadorned  |
| 81. Unadorned | 82. Unadorned  |
| 83. Unadorned | 84. Unadorned  |
| 85. Unadorned | 86. Unadorned  |
| 87. Unadorned | 88. Unadorned  |
| 89. Unadorned | 90. Unadorned  |
| 91. Unadorned | 92. Unadorned  |
| 93. Unadorned | 94. Unadorned  |
| 95. Unadorned | 96. Unadorned  |
| 97. Unadorned | 98. Unadorned  |
| 99. Unadorned | 100. Unadorned |

This report is a summary of the results of the excavations at the site of the  
 there is thus a considerable number of objects in terms of the number of  
 grave which have objects of the group - only 17 of the graves containing  
 cluster 1 objects do not contain objects of cluster 2 as well.  
 Starting off this in mind, we can still see that cluster 1 includes  
 five of the widespread objects: decorated Bell Beakers, arrowheads, copper  
 daggers, wire-guards and ear-rings, together with a number of the very  
 characteristic objects which also tend to be widely distributed, both within  
 the Bell Beaker 'culture' and outside it. It does not contain the polygonal  
 bowl or the V-perforated buttons - indeed, the latter are quite strongly  
 associated with the local jars and bowls. It appears then that as usual we  
 do not have a simple situation: most of the widespread objects are in  
 cluster 1, but two are not. Nevertheless, there are grounds for saying that  
 the group including most of the widespread objects is rather randomly  
 distributed over the graves, not, except for V-perforated buttons, clustered

with what have already been characterised as 'local' objects. They tend to associate with one another, and this despite the 'pull' inevitably exercised by the large numbers of jugs and bowls. But, having said that the 'widespread' objects do tend to segregate, it is necessary to ask why this should be the case.

Here it is very important to remember that the clusters are indirect abstractions from the graves, a point which has already been made but cannot be overemphasised. The basic reason why cluster 1 is separate from the rest must be that the artifacts in it tend to be found together in different graves from the others. However, a glance at fig. 3.11 immediately shows that cluster 1 objects are found with objects of cluster 2 very much more often than not; apart from graves containing only a single good, which must, of course, belong to one cluster or the other, there are only 12 graves with cluster 1 goods alone to put the case for the separate identity of this cluster. On the other hand, there is a large number of graves without cluster 1 goods, so it must presumably be the absence of the cluster 1 goods from these graves which makes the difference. We can then go on to ask what other differences these graves show which might be related to their lack of cluster 1 goods - spatial, chronological etc. - as the first stage in an explanation. Before doing this, however, it is necessary to deal with some objections.

The first of these argues that since cluster 1 objects are not in any case very numerous, there is bound to be a number of graves which do not have them, even if they are distributed randomly. We have already seen the results of a random distribution of the goods, however, (see above p.45, figs.3.8-3.10) and how markedly it differs from the clustered pattern actually obtained, so this point may be dismissed. Another argument might be that you could take any set of the objects and show that not all



graves have it, and then go on to try and find out why. This is true, of course, but the CLUSTAN results have given us one particular set on the basis of the evidence and it is this which we must investigate. The final criticism is that arguing from object associations to graves is not a very satisfactory procedure, since the approach advocated depends on the argument that it is largely the absence of cluster 1 goods from certain graves which is the main reason for the clustering observed in the dendrogram, and this may not be the case. It will appear below, however, that this is an important factor and gives a very useful preliminary approximation in defining cluster 1; moreover it is not our sole recourse (see below p.52). With this in mind we can look first at the possibility of spatial differences.

The distribution of sites with graves used in the analysis is seen in fig. 3.12. Several things are immediately clear: first, there are virtually no sites having only goods of cluster 1; second, there is a considerable number with goods of both clusters; finally, there are sites in both Bohemia and Moravia which have only cluster 2 objects, but more of these are found in Bohemia (34 out of 69 sites) than in Moravia (17 out of 58 sites). In the light of the case made out above, it is necessary to try and find out if the sites without cluster 1 goods really are spatially different from the others in any sort of interesting way.

It is clear that these sites are mixed in with the others - there is no local segregation. Nevertheless, one could argue that there might well be differing patterns of social relations between neighbouring communities which could lead to such a picture as that observed. Moreover, there is a definite difference between the two regions - more sites without cluster 1 in Bohemia - so perhaps the clusters have a regional significance, at least to some extent.



When the evidence is examined in detail, however, the difference between sites without cluster 1 goods and the others is mostly trivial, one of the main factors on which it is dependent being the size of the cemeteries concerned. In Bohemia there are 35 sites represented by only a single grave, compared with 22 in Moravia (the reasons for this will be taken up elsewhere). If a site has only one grave, that grave can contain objects of both groups or of cluster 2 alone (excluding the two cases of cluster 1 only). In both areas considerably more than half the graves do not have goods of cluster 1, the second option (cluster 2 only) is therefore more likely and, of 57 1-grave sites, 31 are sites without cluster 1 objects, compared with 23 having both groups. When the single grave sites are excluded the number of sites without cluster 1 goods drops from 51 to 20. The greater number of cluster 2 sites in Bohemia than in Moravia may similarly be partly explained in this way. The former has 35 1-grave sites to the latter's 22. But the distinction between the two regions is emphasised by another factor: in Bohemia 133 out of 199 graves do not have cluster 1 objects, while in Moravia the proportion is only 116 out of 201. A summary of the results for the two areas is shown in table 3.X.

Although the spatial distinctions between sites without cluster 1 goods and the others do not seem to be of any significance in explaining the differences, this difference of proportions between the two areas is more important. It has already been argued that it is the graves without cluster 1 goods which are the main factor in defining the clusters, and if there are significantly more of these in one area than the other it suggests that regional considerations are at least partly responsible for the clusters observed. For this reason a difference of proportions test (Blalock 1972:228) was carried out to see if the observed difference was greater than would be expected if the proportions were in fact equal.



As the numbers in the samples of graves are quite large (199 and 201), the sampling distribution of the difference between proportions will be approximately normal with mean  $p_{u_1} - p_{u_2} = 0$ , and standard deviation of

$$\sigma_{p_{s_1} - p_{s_2}} = \sqrt{\frac{\sigma_1^2}{N_1} + \frac{\sigma_2^2}{N_2}} = \sqrt{\frac{p_{u_1} q_{u_1}}{N_1} + \frac{p_{u_2} q_{u_2}}{N_2}}$$

Since the direction of difference is predicted, a 1-tailed test is used. On the hypothesis  $p_{u_1} = p_{u_2}$  it follows that  $\sigma_1 = \sigma_2 = \sigma$ , and the following formula can therefore be used.

$$\sigma_{p_{s_1} - p_{s_2}} = \sigma \sqrt{\frac{N_1 + N_2}{N_1 N_2}}$$

$$\hat{\sigma} = \sqrt{\hat{p}_u \hat{q}_u}$$

$$\text{Thus } \hat{\sigma}_{p_{s_1} - p_{s_2}} = \hat{\sigma} \sqrt{\frac{N_1 + N_2}{N_1 N_2}} = \sqrt{\hat{p}_u \hat{q}_u} \sqrt{\frac{N_1 + N_2}{N_1 N_2}}$$

$$p_u = \frac{N_1 p_{s_1} + N_2 p_{s_2}}{N_1 + N_2}$$

In the present example  $N_1 = 199$  (the Bohemian graves)

$N_2 = 201$  (the Moravian graves)

$p_{s_1} = \frac{133}{199} = 0.66$  (the proportion of Bohemian graves without cluster 1 goods)

$p_{s_2} = \frac{116}{201} = 0.58$  (the proportion of Moravian graves without cluster 1 goods)

as the number in the number of groups are 100 and 200, the sampling distribution of the difference between proportions will be approximately normal with mean  $\mu = 0$ , and the standard deviation

$$\sigma = \sqrt{\frac{p_1(1-p_1)}{n_1} + \frac{p_2(1-p_2)}{n_2}}$$

Since the observed difference is  $\hat{p}_1 - \hat{p}_2 = 0.05$ , we have a  $z$ -test. The  $z$ -test is  $z = \frac{\hat{p}_1 - \hat{p}_2}{\sigma} = \frac{0.05}{\sqrt{\frac{0.5(1-0.5)}{100} + \frac{0.5(1-0.5)}{200}}} = 1.58$ , and the following table gives the probability of a type I error.

$$\begin{aligned} \frac{\hat{p}_1 - \hat{p}_2}{\sigma} &= \frac{0.05}{\sqrt{\frac{0.5(1-0.5)}{100} + \frac{0.5(1-0.5)}{200}}} = 1.58 \\ &= \frac{0.05}{\sqrt{0.005 + 0.0025}} = \frac{0.05}{\sqrt{0.0075}} = \frac{0.05}{0.0866} = 0.5774 \end{aligned}$$

In the present example  $\hat{p}_1 = 0.05$  (the observed proportion) and  $\hat{p}_2 = 0.05$  (the observed proportion). The proportion of positive results without cluster 1 is  $\hat{p}_1 = 0.05$  (the proportion of positive results without cluster 1 is  $\hat{p}_1 = 0.05$ ).

$$\hat{p}_u = \frac{199(0.66) + 201(0.58)}{199 + 201} = 0.62$$

$$\hat{q}_u = 1 - p_u = 0.38$$

$$p_{s_1} - p_{s_2} = (0.62)(0.38) \frac{199 + 201}{(199)(201)} = 0.0485$$

$$Z = \frac{(p_{s_1} - p_{s_2}) - 0}{p_{s_1} - p_{s_2}} = \frac{0.66 - 0.58}{0.0485} = 1.64$$

On a 1-tailed test this is not quite significant at the 0.05 level i.e. a result this extreme in this direction could happen slightly more often than one time in twenty even if the proportions were in fact equal. This result shows the unsatisfactory nature of the usual null hypothesis significance testing (cf. Rozeboom 1960), since if a 0.05 significance level had been set prior to the result, it would have been necessary to accept the null hypothesis, but if the result had been only 0.02 greater it would have been rejected. It seems best to regard this result as inconclusive to see if there are any other ways of tackling the problem which might give a more definite answer.

It was mentioned earlier that there existed an alternative, or rather a supplement, to arguing from the objects to the graves and then investigating these. In some circumstances the objects themselves may be used directly. Here we may put forward the hypothesis that if regional considerations are not in any way responsible for the object clusters observed then these same clusters should still be apparent in each of the two areas taken separately. This was tested by applying the cluster analysis techniques already outlined to the material of Bohemia and Moravia in turn.

$$p_u = \frac{199(0.50 + 50)(0.50)}{199 + 50} = 0.50$$

$$p_u = 1 - p_u = 0.50$$

$$p_u = \frac{199 + 50}{199 + 50} = 0.50$$

$$p_u = \frac{199 + 50}{199 + 50} = 0.50$$

For a  $t$ -test with this is not quite significant at the 0.05 level. A result this extreme in the direction of the null hypothesis is not one time in twenty even if the proportions were in fact equal. This result shows the unusual character of the usual null hypothesis significance testing (cf. Lehmann, 1959), since at a 0.05 significance level had been set prior to the result, it would have been necessary to reject the null hypothesis, but if the result had been only 0.05 greater it would have been rejected. It seems best to regard this result as inconclusive to see if there are any other ways of tackling the problem which might give a more definite answer.

It was mentioned earlier that there existed an alternative, or rather a supplement, to arguing from the objects to the process and then investigating these. In some circumstances the objects themselves may be used directly. Here we say the hypothesis that if rational considerations are not in any way responsible for the object clusters observed then these clusters should still be apparent in each of the two areas taken separately. This was tested by applying the cluster analysis techniques already outlined to the material of Bohemia and Norway in turn.

Program HIERAR was used with the Single-link and Average-link options, together with program MODE.

Turning first to MODE, the results for the two areas are markedly different (see tables 3.XI-XII). Analysis of the Moravian graves shows groupings very similar to those produced in the material as a whole (see above, tables 3.VIII-IX). No more than two clusters are produced and the members of these at the 'nuclei' level are given in table 3.XIII. The other objects, of course, are unclassified.

Cluster 1 now has two more members than when all the graves were used: the copper awl and sherds, both of which were assigned to it in the MODE complete classification for all the graves (see above). Cluster 2 is also basically the same, but here there are four changes. Flint blade and copper sheet are no longer included, and new members are: decorated handled Bell Beaker, decorated jug, handled 'Topf' and amphora. If we look at the MODE complete classification (table 3.XI), there are some further differences from the grouping of all the material. Amber buttons (25) are no longer assigned to Cluster 1 which does, however, gain the following: pot (12), bone pendant (16), and copper sheet (24). It seems unreasonable to make a great deal of these slight differences, which could be a result of many different factors (see below for a discussion of this point). The basic similarity between the pattern for Moravia and the pattern for the two areas taken together is undeniable.

The contrast with Bohemia is very striking (see table 3.XII). Here no more than one cluster is ever resolved, to which the successive 'dense' points are added in turn. Even allowing for the fact that MODE tends to produce spherical clusters (Everitt 1974:33) and thus would not detect a different sort of pattern, the results produced are still very different from Moravia when analysed by the same means, and this is the point which

Program 1000, was used with the single-link and average-link criterion.

together with program 1000.

During first to third, the results for the two areas are markedly different (see table 3.11-12). Analysis of the Norwegian graves shows a pattern very similar to those produced in the material as a whole (see above, table 3.11-12). In fact, the two clusters are produced and the members of each are the 'same' level are given in table 3.11.12. The

other objects, of course, are included.

Cluster 1 now has two more members than when all the graves were used: the copper, silver, and gold, which were assigned to it in the first complete analysis. For all the graves (see above, Cluster 2 is also basically the same, but there are four changes. First, the silver and copper are no longer included, and new members are: decorated wooden ball pendants, decorated 'L' handled 'loft' and 'scepter'. If we look at the 1000 complete analysis (table 3.11), there are some further differences from the grouping of all the material. Cluster 1 (2) are no longer assigned to Cluster 1 which does, however, gain the following: pot (10), some pendants (11), and copper sheet (12). It seems unreasonable to take a great deal of these slight differences, which could be a result of any different factors (see below for a discussion of this point).

The basic similarity between the pattern for Norway and the pattern for the two areas taken together is undeniable.

The contrast with Bohemia is very striking (see table 3.11.13). Here no more than one cluster is ever resolved, to which the successive 'dances' points are added in turn. Even allowing for the fact that 1000 tends to produce spherical clusters (see table 3.11.13) and thus would not detect a different sort of pattern, the results produced are still very different from Norway when analysed by the same means, and this is the point which

matters here.

The HIERAR dendrograms show a similar difference (see figs. 3.13-3.16). The Average-link dendrograms are reproduced (figs. 3.13-14), but are not particularly useful, since all the similarities are extremely low and are a result of the rarity of many of the objects. The numbers of several of these were already low when all the material was considered together; splitting it in two increases this problem still further as rare objects obviously have very low similarities with most of the others, and, consequently, produce extremely low averages. Attention is therefore concentrated on the Single-link results. The Moravian pattern (fig. 3.15) is again very similar to the total (fig. 3.4) although there is more sign of chaining in the 'Bell Beaker group'. The members of this group also correspond very closely. The ten objects brought together in this cluster of the total material are again associated:

- |                          |                   |
|--------------------------|-------------------|
| 1. Decorated Bell Beaker | 19. Wrist-guard   |
| 13. Arrowhead            | 23. Ear-ring      |
| 14. Stone Axe            | 29. Flint Scraper |
| 15. Flint Flake          | 30. Boar's Tusk   |
| 18. Copper Dagger        | 32. Whetstone     |

In this case, however, they are only the closest members of a larger group further including: sherds (28), copper awl (17) and amber buttons (25). Moreover, the last of these join this cluster at only a very short way below the point at which it joins with the rest of the objects. In the total material, by contrast, there was a sharp drop in the similarity level between completion of the cluster and its joining on to the rest (see again fig. 3.4). On the other hand, belief in the reality of the grouping is strengthened by the fact that it is identical to 'nuclei'

entire here.

The HIRSH descriptions show a similar difference (see fig. 3.12-3.13). The average-link dendrograms are reproduced (figs. 3.12-3.13), but are not particularly useful, since all the similarities are extremely low and are a result of the paucity of data of the objects. The numbers of several of these were changed but when all the material was considered together, splitting it in two groups, this problem still further was rare objects eventually have very low similarities with most of the others, and, consequently, produce errors in the dendrograms. Attention is therefore concentrated on the 10 objects (fig. 3.12) which are more alike in again very similar to one of the 10 objects (fig. 3.13) whereas there is more alike of clustering in the 'left' group. The numbers of this group also correspond very closely. The ten objects brought together in this cluster of the total material are again associated:

- |                          |                   |
|--------------------------|-------------------|
| 1. Decorated half basket | 19. White-guard   |
| 2. Arrowhead             | 23. Bar-ring      |
| 3. Stone axe             | 29. Flint scraper |
| 7. Flint flake           | 30. Bone's Tusk   |
| 8. Copper hammer         | 35. Whetstone     |

In this case, however, they are only the closest members of a larger group further including: whetstone (35), copper axe (19) and amber buttons (23). Moreover, the fact of these join this cluster at only a very short way below the point at which it joins with the rest of the objects. In the total material, by contrast, there was a sharp drop in the similarity level between completion of the cluster and its joining on to the rest (see again fig. 3.13). On the other hand, below in the reality of the grouping is strengthened by the fact that it is identical to 'united'.

cluster 1 produced by MODE on the Moravian material, with the exception of the amber buttons.

The Bohemian Single-link dendrogram (fig. 3.16) is markedly different. It is very 'chained', with little sign of a grouping at all: possibly one may be defined from the rest by the large drop in similarity visible between the linking of objects 29 and 10. Some of the objects joined by quite a high similarity are those of our well-known cluster 1 (items 1, 23, 19, 15, 30, 13, 14, 31(=32)), but the undecorated jugs and bowls (5 and 7) are also closely linked to them, a very noticeable difference from the patterns observed both in Moravia and in the two groups as a whole. Again our belief in the validity of this very distinct pattern in the dendrogram is strengthened by the fact that MODE too pointed in a similar direction.

The results of these analyses may be summarised as follows: first, it is clear that the groups apparent in the analysis of the total material do not just represent the two main areas put together, one being the Moravian associations and the other the Bohemian - this confirms the situation suggested by our earlier look at the graves i.e. that clusters 1 and 2 are mixed together spatially. On the other hand, it appears that there are considerable interregional differences, that the groupings produced by the material as a whole largely reflect the Moravian pattern, in which that of Bohemia was submerged. As a result of this, these initial groupings cannot be considered valid for Bohemia, which must therefore be reassessed on its own terms and investigated separately from Moravia. It follows from this that factors producing the patterns must be intraregional, and whether they prove to be chronological, social, or whatever, the inference of such different patterning in two adjacent areas which are strongly linked points to previously unsuspected complexities in the relations between the two regions which do not emerge from studies concerned

cluster 1 produced by MDS on the Norwegian material, with the exception

of the under buttons.

The Bohemian single-linguistic cluster (11, 5, 10) is markedly different.

It is very 'compact', with little variation of a grouping at all: possibly

one may be defined that the two of the large group in similarly visible

between the links of objects is not 10. Some of the objects joined by

quite a high similarity are those of our well-known cluster 1 (items 1, 2, 3,

10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100).

are also closely linked. In fact, a very noticeable difference from the

patterns observed in the other two groups as a whole. Again,

our belief in the validity of the very distinct pattern in the Norwegian

is strengthened by the fact that the two points in a similar direction.

The results of the analysis may be summarized as follows: first,

it is clear that the two groups in the analysis of the total material

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there are considerable intercorrelational differences, that the groupings produced

by the material as a whole largely reflect the Norwegian pattern, in which

that of Bohemia was submerged. As a result of this, these initial groupings

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on its own terms and investigated separately from Norway. It follows

from this that factors producing the patterns must be intercorrelational, and

whether they prove to be chronological, social, or whatever, the

inference of such different patterning in two adjacent areas which are

strongly linked points to previously unsuspected complexities in the

relations between the two regions which do not emerge from studies concerned

only with superficial differences in material content.

Before accepting these differences too readily, however, it is necessary to examine them closely, in order to find out whether they reflect solely different patterns of association, or if there are further complicating factors, particularly the absolute frequencies with which things occur. Table 3.XIV shows that there are some considerable differences in, for instance, undecorated handled Bell Beakers (4), decorated bowls (8) and 'Töpfe' (10) between the two areas. Interestingly enough, however, these do not seem to greatly alter the positions of these objects in any of the dendrograms: they are each in more or less the same place in all of them, but urns (31) are completely absent in Bohemia, clearly reflecting the low incidence of cremation here. Another point to bear in mind is that there are more goods in Moravian graves: cluster 1 goods occur 159 times compared with 108 in Bohemia; cluster 2 goods occur 458 times against 384 in Bohemia. The question arises of whether there is a difference in the proportions of these goods in the two areas which might at least partly account for the different patterns; this possibility was investigated using a difference of proportions test. The procedure for this has already been described (see above p.30). Again a 1-tailed test is used as the direction of difference is predicted.

$$p_{s_1} = 0.33 \quad p_{s_2} = 0.28 \quad \hat{\sigma}_{p_{s_1} - p_{s_2}} = 0.03194$$

$$Z = \frac{0.33 - 0.28 - 0}{0.03194} = 1.56$$

This result is not significant at the 0.05 significance level on a 1-tailed test i.e. a result this extreme in this direction could happen slightly more often than one time in twenty if the proportions were equal.

only with superficial differences in material content.  
Before accepting these differences too readily, however, it is  
necessary to examine them closely, in order to find out whether they  
reflect solely different relations of association, or if there are further  
constitutive factors, particularly the specific frequency with which  
these occur. Table 2.2 shows that there are some considerable  
differences in, for example, the number of different well-known (4), decor-  
ated bowls (5) and 'other' (17) between the two areas. Interestingly  
enough, however, there is no way to directly relate the positions of these  
objects in any of the inventories; they are seen in more or less the same  
place in all of them, but even (17) is completely absent in Bohemia.  
Clearly reflecting the low incidence of certain items, another point to  
bear in mind is that there are more bowls in Bohemian groups than in  
Silesian ones. This comparison with the Bohemian; cluster 2 goods occur  
455 times against 14 in Silesia. The question arises of whether there is  
a difference in the proportions of these goods in the two areas which  
might at least partly account for the different patterns; this possibility  
was investigated using a difference of proportions test. The procedure  
for this has already been described (see above p. 11). Again a 2-tailed  
test is used as the direction of difference is predicted.

$$Z = \frac{0.55 - 0.25}{\sqrt{0.0094}} = 1.56$$

$$P_{A1} = 0.55 \quad P_{A2} = 0.25 \quad P_{A1} - P_{A2} = 0.30$$

This result is not significant at the 0.05 significance level on a  
2-tailed test i.e. a result this extreme in this direction could happen  
slightly more often than one time in twenty if the proportions were equal.

We can, therefore, at least be sceptical of such a difference in proportions being responsible for the difference between the two regions.

A final point to be borne in mind is that the problem mentioned at the beginning, of certain objects being rare, is even more acute with the sample split in half, and volatility in these rare objects may be having some effect. This cannot be specifically assessed, but a general idea of the significance of the difference between the two regions may be obtained by randomly dividing the sample into two and comparing the results with the regional division. As we have seen already such a comparison has to be largely visual and intuitive, but it may not be any the less valuable for that. If the regional pattern differences do prove genuine it will then be worthwhile to characterise them in detail by looking at which associations are the same in both regions and which ones are different.

The graves were first randomly divided into two halves. The 32 variables (objects) were then coded on each set of graves in turn and analysed using MODE and HIERAR with Single-linkage. The Single-link dendrograms are shown in figs. 3.17-18. It is immediately apparent that there is very little sign of clustering. Both are largely chained and in neither of them do we find the objects of the 'Bell Beaker cluster' together - some of them are, but others are scattered across the dendrogram. Single-linkage, of course, defines straggling clusters and it is therefore interesting to compare its results with those of MODE, which produces more spherical groups. For the same material as in fig. 3.17, the more chained of the two dendrograms, MODE too produces no groupings (see table 3.XV. On the other, however, which shows a slight tendency to cluster in the dendrogram, MODE does produce a grouping (see table 3.XVI) (nuclear cluster, not all objects assigned).

is not, therefore, at least the neglect of such a difference in proportions being responsible for the difference between the two regions. A final point to be borne in mind is that the problem mentioned at the beginning, of certain objects being rare, is even more acute with the sample split in half, and velocity in these rare objects may be having some effect. This cannot be experimentally assessed, but a general idea of the significance of the difference between the two regions may be obtained by randomly dividing the sample into two and comparing the results with the regional divisions. The results are already such a comparison has to be largely visual at that time, but it may not be any the less valuable for that. If the results of the comparison are more revealing it will then be worthwhile to compare the two in detail by looking at which conclusions are the more in each region and which ones are different. The previous results have been divided into two halves. The 35 variables (objects) were then coded on each set of values in turn and analysed using MDS and a 1-2 with triple-linkage. The triple-linkage dendrograms are shown in figs. 3.47-50. It is immediately apparent that there is very little sign of clustering. Both are largely chaotic and in neither of them do we find the objects of the 'Redi Becker cluster' together - some of them are, but others are scattered across the dendrogram. Triple-linkage, of course, defines straight-line clusters and it is therefore interesting to compare the results with those of MDS, which produces more symmetrical groups. For the same material as in figs 3.47, the more chaotic of the two dendrograms, MDS too produces no structure (see table 3.48). On the other, however, which shows a slight tendency to cluster in the dendrogram, MDS does produce a grouping (see table 3.49) (another cluster, not all objects assigned).

This has some features in common with the dendrogram (fig. 3.18), but not a great deal. It is reasonable to ask why the results of such a random division do not bear more resemblance to those of the whole. Does this cast doubt on the groupings obtained on the total? There are two main reasons why this is probably not the case. Table 3.XVII shows the frequencies of the objects in the two random samples. The very low numbers of many of them mean that any sort of overall pattern can be obscured by violent oscillations - if you toss a coin four times you may well not get two heads and two tails.

The second point is probably more important. When the grave sample was broken down into the two regions, the group pattern of the whole was only found in Moravia, as we have seen. Random division of the graves, however, meant that the Moravian graves were split in two and mixed with the others; this would tend to submerge the pattern.

If this explanation is accepted, we can now recall the original aim of carrying out such a test, which was to get an idea of how the size of the difference between the two regions compares with that between two randomly divided samples. The Bohemian material behaves very like the two random samples, especially group 1 (fig. 3.17), if the dendrograms are compared, and it also shares with random group 1 the failure to produce more than a single cluster with MODE. While random group 2 shows a slight tendency to form distinct groups on HIERAR, it can in no way compare with the Moravian pattern (cf. figs. 3.15, 3.18), and it seems safe to suggest that the two areas really do differ markedly in their associations. It is important to realise, however, that it is in the structure of these relations that they differ. A given grave association may be found anywhere from north-west Bohemia to south-east Moravia. The difference

This has some features in common with the dendrogram (fig. 3.15), but not a great deal. It is reasonable to ask why the results of such a random division do not bear more resemblance to those of the whole. Does this mean that the dendrogram is not a good representation of the whole? There are two main reasons why this is probably not the case. While 3.15 shows the frequencies of the objects in the two main samples, the very low numbers of many of them make it difficult to see any pattern can be discerned by visual inspection. If you look at each class you may well not get the picture and so on.

The second point is that the dendrogram is not a good representation of the whole and is broken down into two main groups, the group division of the whole was only found in one of the samples. Random division of the groups, however, meant that the two main groups were split in two and mixed with the others; this would tend to obscure the pattern.

It is this explanation is accepted, we can now recall the original aim of carrying out such a test, which was to get an idea of how the size of the difference between the two regions compares with that between two randomly divided samples. The dendrogram material behaves very like the two random samples, especially group 1 (fig. 3.17), if the dendrogram are compared, and it also shares with random group 1 the failure to produce any more than a single cluster with 100%. While random group 2 shows a slight tendency to form distinct groups on HIERARCHY, it can do so very compared with the dendrogram pattern (cf. figs. 3.12, 3.13), and it seems safe to suggest that the two areas really do differ markedly in their associations. It is important to realize, however, that it is in the structure of these relations that they differ. A given grave association may be found separately from north-west Bohemia to south-east Moravia. The difference

basically lies in the presence of a distinct 'Bell Beaker cluster' in Moravia; in Bohemia these goods mingle more with the others, or at least are less strongly associated with one another.

As a further check, to confirm this picture and to find the effect on the groupings produced by rare objects, the cluster analyses were also run with objects occurring less than four times excluded. The HIERAR Single-link dendrograms are seen in figs. 3.19-20. For Moravia exactly the same grouping is produced as above, with the exception of the rare objects of course, and is, if anything, even more definite - the lack of chaining in the 'Bell Beaker cluster' contrasts strikingly with that in the rest of the dendrogram. For Bohemia the pattern does change and there is now some evidence for a small group consisting of decorated Bell Beakers (1), stone axes (14), copper daggers (18), wrist-guards (19) and ear-rings (23). This is confirmed by MODE analysis of the Bohemian material, which produces the final 'nuclei' grouping seen in table 3.XVIII.

The low enclosure ratio, however, makes clear that there are a lot of individuals which do not fit into this clustering and which have to be assigned on a best-fit basis. This contrasts with Moravia. Here the groupings are identical to HIERAR and we have an enclosure ratio of 0.86 which suggests that the division into clusters is very good.

It will be recalled that the reason for these spatial investigations was to try and find correlates for the initial division of goods into cluster 1, cluster 2 and the rest. It has now been shown that this division is only regionally valid. This will naturally affect further stages in its explanation: if the division is social in some way, it reflects only a local organisation of society/burial; if it is chronological



(i.e. a result of change), these changes only occurred in one particular area. The Bohemian pattern must be investigated separately and will likewise be a result of local conditions. A detailed comparison of the two regions is made elsewhere. In this chapter the subject is the grave associations and now that we have some idea of the spatial and regional aspects of this, it is necessary to turn to other potential sources of variability, the most prominent of which is Time.

11. a result of change, there should only occur in the particular  
 are. The historical picture must be investigated separately and will  
 limited by a result of local conditions. A detailed comparison of the  
 the region in each instance. It will consider the impact of the  
 more recent times and will be more than of the general and  
 regional aspects of life, in the way of the other historical  
 sources of variability, and will be limited to the in time.

# CHAPTER FOUR: CHRONOLOGY OF THE BELL BEAKER GRAVE

## ASSOCIATIONS IN BOHEMIA AND MORAVIA

Chronology has always been the favourite means of explaining differences in the Bell Beaker grave associations of Central Europe (cf. Sangmeister 1964, Hájek 1966<sup>b</sup>); indeed, other explanations have hardly been contemplated. Hájek's views in particular have dominated Central European discussions of the Bell Beakers and have been accepted by almost all the local prehistorians. It therefore seems appropriate, before presenting a new examination of the evidence, to make a detailed investigation of Hájek's arguments, based on his important article of 1966, 'Die Älteste Phase der Glockenbeckerkultur in Böhmen und Mähren'.

He begins, most appropriately, by defining his assumptions as to what an early Bell Beaker phase should look like in Central Europe:

'Bei unseren Überlegungen gehen wir von der Voraussetzung aus, dass die Älteste Phase durch jene Keramikformen, Verzierungsmuster und weitere Gegenstände gekennzeichnet wird, die schon in der Urheimat dieser Kultur und in den Gebieten, über die sie vordrang, zu finden sind .... Gleichzeitig jedoch müssen wir eine gewisse Weiterentwicklung in Erwägung ziehen, die die Glockenbecherkultur auf ihrem Wege zu uns sicher durchzumachen hatte.' (1966b: 211)

It is this basic assumption, at least in the sense in which it is intended by Hájek, which must be called into question. The one ceramic type which spreads over very extensive areas is, as we have seen, the Bell Beaker. Wide-ranging schemes of typological development can therefore only be applied to this particular vessel type, if to any at all. Hájek, however, goes further than this and argues that those



objects, specifically the Begleitkeramik (jugs, bowls etc.), which are not found over large areas like the Bell Beaker vessel must, therefore, be later. He maintains this despite the fact that the domestic ware associated with the fine Bell Beakers is very different in different parts of Europe and that he would thus have to subscribe to the view that initially only fine and not domestic pottery was universally manufactured. This basic assumption of Hájek's must therefore be modified: a wide view may give us an indication of which forms of decorated Bell Beaker are earlier than others but it does not say anything about their relations to the other components of the local assemblage in Central Europe.

He then goes on to outline a series of what he believes to be the earliest Bell Beaker finds in the area. These are regarded by Hájek as early for a variety of different reasons, some because of the Beaker typology, some because of the presence of 'western' tanged arrowheads, and others owing to the presence of ring ditches (and therefore perhaps barrows) round the grave. This is another supposed western, and therefore 'early' feature, despite the fact that a ring ditch also surrounded Šlapanice site 2, grave 6 (Archive AÚ ČSAV Brno, report 1020/50), which contained a bowl and a jug, types which Hájek would regard as late. His main arguments, however, depend on the typology of the Bell Beakers themselves and it is these which deserve the most attention. Even so, it is essential to realise that any conclusions concerning chronology refer only to the decorated Bell Beakers themselves and not to their relations with the jugs and bowls; these are independently investigated below.

The most important evidence is the presence of cord decoration on certain Czech Bell Beakers. Now that it has been definitely established,

objects, especially the *Beckwith* (Jugs, bowls etc.), which are not found over large areas like the Bell Beaker vessel must, therefore, be later. He maintains this despite the fact that the domestic ware associated with the fine Bell Beakers is very different in different parts of Europe and that he would thus have to subscribe to the view that initially only the most domestic pottery was universally manufactured. This is a condition of which's most therefore be modified: a wide view may give us an indication of which forms of decorated Bell Beakers are earlier than others and it does not say anything about their relations to the other contents of the local assemblage in Central Europe.

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The most important evidence is the presence of cord decoration on certain decorated Bell Beakers. Now that it has been definitely established,

through the Dutch sequence, that the All-Over-Corded Beakers are the earliest and are not hybrids of maritime Bell Beakers and Corded Ware in the Rhine area (Lanting et al. 1973), this element has even more significance. Another early feature appears to be decoration inside the rim, which may be in cord or comb. Hájek therefore correctly isolates a group of Beakers which show one or more of these features:

1. Praha-Bubeneč, Bohemia (National Museum, Prague, Inv.No.37.025) which has cord decoration inside the rim and cord defined decorated zones.
2. Hrdly, Bohemia (Roudnice-on-Elbe Museum Inv.No.78) with cord defined zones (associated with another decorated Bell Beaker without this feature).
3. Ohaře, Bohemia (Kolín Museum Inv.No.6351) with cord decoration inside the rim and cord defined zones.
4. Praha-Krč, Bohemia (National Museum, Prague, Inv.No.19641) with comb lines inside the rim.
5. Předměstí, Moravia (Přerov Museum), part of a Beaker with cord defined zones.

Also to be added here is a vessel not included by Hájek:

6. Vranovice, Moravia (Moravian Museum, Brno, Inv.No.93.238) with cord defined zones.

These vessels have certain other features in common. The decoration is usually made up of oblique comb fill, diagonal lattice motifs and very little else, while calculation of the rim diameter/height ratio shows that they are concentrated at the slim end of their region's distribution. Other vessels include these characteristics but

through the hatch openings, that the All-Ivory-Corded baskets are the  
earliest and are not hybrids of various Half Basket and Corded Ware  
in the same area (Lanning et al. 1973), this element has even more  
significance. Another early feature appears to be decoration inside  
the rim, which may be in cord or comb. Half baskets correctly  
indicates a group of baskets which show one or more of these features:

1. Trape-shoulder, Bohemia (National Museum, Prague, Inv.No. 97.627)  
which has cord decoration inside the rim and cord defined  
decorated zones.

2. Early, Bohemia (National Museum, Prague, Inv.No. 97.627) with cord  
defined zones (associated with another decorated Half Basket  
without rim features).

3. Chate, Bohemia (National Museum, Prague, Inv.No. 6397) with cord decoration  
inside the rim and cord defined zones.

4. Trape-arc, Bohemia (National Museum, Prague, Inv.No. 19647)  
with comb lines inside the rim.

5. Prokopsk, Moravia (Petrov Museum), part of a basket with cord  
defined zones.

Also to be added here is a vessel not included by Hajek:  
6. Vranovice, Moravia (Moravian Museum, Brno, Inv.No. 95.233) with  
cord defined zones.

These vessels have certain other features in common. The deco-  
ration is usually made up of oblique comb fill, diagonal lattice motifs  
and very little else, with calculation of the rim diameter/height  
ratio shows that they are concentrated at the rim and of their  
rim's distribution. Other vessels include these characteristics but

without the cord defined zones or inside rim decoration:

1. Borkovany, Moravia (Mikulov Museum, Inv.No.80/1 - 1/59) .
2. Praha-Strešovice, Bohemia (Dept. of Archaeology, Charles University, Prague, Inv.No.333).
3. Radotín, Bohemia (National Museum, Prague, Inv.No.36.969); not included by Hájek.
4. Trboušany, Moravia (Moravian Museum Brno, Inv.No.Pa 12.594/40); not included by Hájek.

The problem which has to be faced, however, is that early decorative motifs and styles may well continue alongside late ones even though they began earlier. This point may be examined by looking at associations of more than one decorated Bell Beaker in the same grave. There are several of these among the finds isolated by Hájek, including three of those listed above:

1. Hrdly. The associated Bell Beaker did not show any use of cord technique. Its filled zones were not executed with an oblique comb, but in a dense horizontal fashion characteristic of very large numbers of Central European Bell Beakers. The other decoration consisted of zones filled with a series of vertical strokes (see fig. 4.1).
2. Předmostí, Pit 2 (not definitely a closed find). This contained sherds of several vessels with a variety of types of ornament, including the decoration of groups of several adjacent zones, a feature characteristic of Moravia, as well as the use of a running negative lozenge motif in a zone otherwise filled with comb.

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3. Borkovany. The associated vessel included only solid filled zones of decoration; these, however, were not obliquely but horizontally filled in the characteristic Central European fashion.

These associated finds, therefore, already extend the range in the hypothetically early group even if Předmostí is excluded. This does not necessarily invalidate it but warns against the assumption of rigid typological successions. When the remainder of the finds assigned to it by Hájek are included in this 'early' group, the range of motifs rapidly become very wide indeed. One particular supposedly early feature, a topmost zone containing motifs and not simply solid fill, is admitted even by Hájek to appear in his following phase as well.

The well-known find of Ludeřov, Moravia (Hájek 1966b:214), contains Beakers which Hájek also assigns to his 'early' group on the basis that they have much in common with the group already outlined, including lattice motifs, short vertical strokes between the filled zones and a generally slim shape. However, these are associated with a variety of other motifs, such as multiple zig-zags, running lozenges and chequer patterns, as well as with an extremely wide shape in one case. The one feature these Beakers do not possess is metopic decoration, the presence of which is probably the most important single attribute defining Hájek's second phase. A similar situation is found at the site of Smolín, Moravia (Novotný 1958), which Hájek believes to be the latest of his 'early' group. Here part of a Beaker apparently with only horizontal comb-fill decoration was associated with another decorated with zones of running multiple zig-zags and combined horizontal and oblique fill of a characteristically Moravian type. Again no metopes are found, but otherwise the range of motifs which falls in Hájek's



'early' phase is so wide that virtually every vessel decorated simply with continuous running designs ought to be included in it, whereas Hájek himself, in the 1966 paper, makes only an arbitrary selection of 'early' vessels from those without metopic designs. A simple chronological interpretation of the presence or absence of metopes is likewise mistaken. We find that vessels without metopes make up 112 out of 128 decorated Bell Beakers in the Moravian Museum, a sample where there is no reason to believe that any chronological selection is operating. This may be contrasted with Bohemia, where the corresponding figure is 48 out of 71 decorated Bell Beakers in the National Museum, Prague. The presence of metopes may still have a chronological significance in Bohemia and Moravia but the spatial aspect of their occurrence should not be forgotten.

This discussion has centred on the definition of a supposed early phase, which was Hájek's main concern. There is, however, a number of associated finds containing more than one decorated Bell Beaker which did not fall within Hájek's province but are worth describing for the light they throw on potential pitfalls in the use of Bell Beaker typology as a chronological argument. The finds are particularly interesting in view of the foregoing discussion, since several of them document the co-occurrence of vessels with, and others without, metopic decoration: if there is a basic chronological distinction between these it is by no means absolute. The associations are illustrated in figs. 4.1-4.4. Perhaps the most striking is Řež, grave 3. Here a relatively slim Beaker with alternating oblique comb fill was associated with another decorated with similar fill as well as with zones of multiple running zig-zags; the grave also contained a third decorated Bell Beaker with elaborate zones of metopic decoration. Hájek's early, late

'early' phase in no wide that virtually every vessel decorated early with continuous running designs ought to be included in it, whereas later himself, in the 1955 paper, takes only an arbitrary selection of 'early' vessels from those without netopic designs. A sample chronological interpretation of the presence or absence of netopes is likewise mistaken. We find that vessels without netopes make up 12% out of 128 decorated vessels in the Norwegian Museum, a sample where there is no reason to believe that any chronological selection is operative. This can be demonstrated with objects, where the corresponding figure is 1 out of 13 decorated Bell Beaker in the National Museum, Trondheim. The presence of netopes may still have a chronological significance in Bohemia and Norway but the spatial aspect of their occurrence would not be forgotten.

This discussion has centered on the definition of a supposed early phase, which was Neolithic's main concern. There is, however, a number of associated finds containing more than one decorated Bell Beaker which did not fall within Neolithic's province but are worth describing for the light they throw on potential pitfalls in the use of Bell Beaker typology as a chronological argument. The finds are particularly interesting in view of the foregoing discussion, since several of them document the co-occurrence of vessels with, and others without, netopic decoration: if there is a basic chronological distinction between these it is by no means absolute. The associations are illustrated in fig. 1-3. Perhaps the most striking is B&B, Grave 3. Here a relatively late beaker with alternating oblique comb fill was associated with another decorated with similar fill as well as with zones of multiple running zig-zags; the grave also contained a third decorated Bell Beaker with elaborate zones of netopic decoration. Neolithic's early, late

and intermediate types are thus present in a single grave (fig. 4.2). Neratovice grave 4 contains a metope decorated vessel and another with solid horizontal comb fill, while a rather similar association comes from Bylany, grave 5 (fig. 4.3-4).

In concluding this analysis of Hájek's views on Bell Beaker typology and its chronological significance several points which have emerged may be summarised. The 'early' phase he defined seems fairly arbitrary, taking in as it does certain vessels with particular types of decoration and not others which are very similar. On his own criteria almost all decorated Bell Beakers with continuous zones and no metopes ought to be included in the 'early' phase, rather than the arbitrary selection he picks out. This would leave only those vessels with metopic ornament as late, but the associations just described show that this distinction is by no means absolute. Furthermore, the difference between Bohemia and Moravia in the number of metope decorated vessels suggests that they have a previously unrecognised spatial significance. If an early phase can be separated out, it must certainly be much smaller than that defined by Hájek, with far more restricted typological criteria. The members of the group listed at the beginning of this chapter (pp. 64-5), with their cord defined zones and inside rim ornamentation, are far more homogeneous as well as resembling more closely the early Dutch Beakers which there is now strong reason to believe stand at the head of the Bell Beaker sequence.

Before finally turning away from Hájek it is necessary to consider the validity of his arguments on the association of Beakers of particular types with the Begleitkeramik. The question of whether there is an altogether post-decorated Bell Beaker phase with Begleitkeramik, a view held by Sangmeister (1964) as well as Hájek, is

and intermediate types are then present in a single grave (fig. 4.4).  
Nevskoye grave 4 contains a vase decorated with a single band and another with  
solid horizontal comb lines, while a rather similar association occurs  
from Vilyuy, grave 2 (fig. 4.5-6).  
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considered in detail below; here only the question of whether or not particular types of decorated Beaker are associated with jugs and bowls is under investigation.

If the Beakers are divided up into those with metopes and those without, with the latter presumed to be earlier, it is clear that there is no basis for saying that the non-metope Beakers are earlier than the jugs and bowls since there are numerous examples of their joint occurrence. The figures are given in table 4.I. If only the very restricted group of vessels defined above is regarded as representing an early phase, the situation appears somewhat different as none of these was associated with a jug or bowl. Nevertheless, the number of Beakers in the group is extremely small and the whole question only brings us back to the initial point with which we began: why are there decorated Bell Beakers in some graves and not in others? Simply because these vessels may represent an early stage in the development of the Central European decorated Bell Beakers, it does not necessarily have to be assumed that they are earlier than the Begleitkeramik.

The cluster analyses described in the previous chapter brought out the distinction between decorated Bell Beakers and Begleitkeramik, as well as a number of others not previously noticed. As we have already seen, this difference has been interpreted chronologically by Central European prehistorians, who believe that the Bell Beaker Begleitkeramik outlived the decorated Bell Beakers. The aim now must be to test this interpretation. Before this can be done, however, it is necessary to divide up the material into its separate regions, Bohemia and Moravia. This was not done by Hajek but its importance has clearly emerged from the preceding chapter. The first area to be examined will be Moravia since here two clear groups of graves and artifacts were defined, closely

considered in detail below; here only the question of whether or not particular types of decorated baskets are associated with Jiggs and bowls is under investigation.

If the baskets are divided up into those with earpots and those without, with the latter presumed to be earlier, it is clear that there is no basis for saying that the ear-pot baskets are earlier than the

Jiggs and bowls since there are numerous examples of their joint occurrence. The figures are given in Table 4.3. It only the very restricted area of vessels defined above is regarded as representative an early phase, the distinction appears somewhat different in some of these was associated with a type of bowl. Nevertheless, the number of baskets in the group is extremely small and the whole question only returns us back to the 1-1-1 point which we began with: why are there decorated Jiggs and bowls in some graves and not in others? Simply because these vessels may represent an early stage in the development of the Central European decorated bell baskets, it does not necessarily have to be assumed that they are earlier than the bell baskets.

The character analysis described in the previous chapter brought out the distinction between decorated bell baskets and bell baskets, as well as a number of others not previously noticed. As we have already seen, this difference has been interpreted chronologically by Central European prehistorians, who believe that the bell basket bell baskets outlined the decorated bell baskets. The aim now must be to test this interpretation. Before this can be done, however, it is necessary to divide up the material into its separate regions, Bohemia and Moravia. This was not done by Kjaer but the importance has clearly emerged from the preceding chapter. The first area to be examined will be Moravia since here two clear groups of graves and artifacts were defined, chiefly

related to the decorated Bell Beaker - Begleitkeramik distinction.

Testing whether or not this distinction is chronological involves using a number of lines of evidence, none of which is satisfactory in itself.

First of all, it should be noted that of ninety graves with 'cluster 1' goods (the decorated Bell Beaker and its associations, see previous chapter), only thirteen do not contain goods of the other group; six of these are graves with only a single object. The evidence for an early phase, represented solely by the decorated Bell Beakers, is therefore relatively slight. The number of graves without any 'cluster 1' objects is considerable - 110 out of 200 - so to that extent the evidence for a later phase without 'cluster 1' goods, including decorated Bell Beakers, is more convincing. But the significance of this division is what we are trying to establish, it certainly cannot be used as evidence. It is necessary to consider more direct approaches to the chronology.

Unfortunately, the best of these, definite grave stratigraphies, is almost completely lacking. The only example is from the site of Šlapanice, where an inhumation containing a small jug, a handled 'Topf', and a small amphora, was found beneath an urned cremation associated with a two-hole wrist-guard and a decorated Bell Beaker; it is unclear from the report whether or not they were deposited simultaneously. Another possible source of information is horizontal stratigraphy visible in the graves of large cemeteries growing in a particular direction. The use of this approach, however, depends on the availability of cemetery plans and, unfortunately, they are only available for a single large site, again Šlapanice. Here decorated Bell Beakers appear scattered over the whole of the area of the cemetery (see fig. 4.5).

The other direct line of chronological evidence is settlement

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 'cluster' objects is considerable - 176 out of 265 - so to that extent  
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 Alnham, where an inhumation containing a small jug, a handled 'bowl',  
 and a small earthenware, was found beneath an urned cremation associated  
 with a two-hole wrist-guard and a decorated Bell Beaker; it is unclear  
 from the report whether or not they were deposited simultaneously.  
 Another possible source of information is horizontal stratigraphy visible  
 in the graves of large cemeteries growing in a particular direction.  
 The use of this approach, however, depends on the availability of  
 cemetery plans and, unfortunately, they are only available for a single  
 large site, again Alnham. Here decorated Bell Beakers appear  
 scattered over the whole of the area of the cemetery (see fig. 4.7).  
 The other direct line of chronological evidence is settlement

contexts. Here such artifacts as wrist-guards and copper daggers are largely lacking, so it is necessary to concentrate on the relations between decorated Bell Beakers and the other pottery. Are these always found on the same sites, and, if so, are they in separate pits or intermixed?

Table 4.II shows details of the Bell Beaker settlements known from Moravia. Only those finds which are both reasonably adequately reported and clearly represent settlement debris are included. A number of sites which have been regarded as settlement pits are probably destroyed graves. The general pattern clearly indicates contemporaneity of the decorated Bell Beakers and the various jugs, bowls and 'Töpfe'. They are found together in 19 pits out of 24, representing 20 sites. Of the remaining five pits, four contain very few sherds at all. Moreover, at all the sites for which we know the numbers of sherds, except Čechůvky, the decorated Bell Beakers are in a minority. There is no suggestion of a 'pure' Bell Beaker culture gradually being 'infiltrated' by local elements, as the traditional view would have it. Two sites, however, deserve comment: Rajhrad and Brno-Obrany. The second of these has only a single decorated Bell Beaker sherd in 500-600, while Rajhrad has none among its 47 sherds. It might be argued that the latter points to there being a period when decorated Bell Beakers had gone out of use, whereas Obrany indicates a time when they were already very rare. The fact that decorated Bell Beakers did go out of use at some time is undeniable, but these sites are not necessarily evidence of this. If decorated Beakers were quite rare generally, as they seem to have been, it might be that none were broken at the time the rubbish was deposited: it is extremely unlikely that a given pit will contain a representative cross-section of the

contexts. Here such artifacts as wrist-knives and copper daggers are largely lacking, so it is necessary to concentrate on the relations between decorated Bell Beakers and the other pottery. Are these always found on the same sites, and, if so, are they in separate pits or intermixed?

Table 4.11 shows details of the Bell Beaker settlements known from Norway. Only those sites which are both reasonably adequately reported and clearly represent settlement habitation are included. A number of sites which were reported as settlement sites are probably destroyed graves. The general pattern clearly indicates contemporaneity of the decorated Bell Beakers and the various jugs, bowls and 'pots'. They are found together in 10 pits out of 14, representing 50 sites. Of the remaining five sites, four contain very few sherds at all. Moreover, at all the sites for which we know the numbers of sherds, except (obviously) the decorated Bell Beakers are in a minority. There is no suggestion of a 'pure' Bell Beaker culture gradually being 'diluted' by local elements, as the traditional view would have it. Two sites, however, deserve comment: Rørdal and Bruc-Gutun. The second of these has only a single decorated Bell Beaker sherd in 300-500, while Rørdal has none among its 47 sherds. It might be argued that the latter points to there being a period when decorated Bell Beakers had gone out of use, whereas Gutun indicates a time when they were already very rare. The fact that decorated Bell Beakers did go out of use at some time is undeniable, but these sites are not necessarily evidence of this. If decorated Beakers were quite rare generally, as they seem to have been, it might be that none were broken at the time the rubbish was deposited: it is extremely unlikely that a given pit will contain a representative cross-section of the

available cultural material. Even if we accept that these sites have chronological implications, the fact that there are so few of them may mean that any phase without decorated Beakers was not very long, or that the rate of settlement deposition had decreased, but the small size of the available sample of settlements makes this sort of argument very dubious. Although the settlements constitute the most direct form of evidence for the chronology, the results are inconclusive. It is now necessary to turn to a more indirect method involving more assumptions, the use of typology.

Any sort of typological approach tends to be the object of considerable criticism today, no doubt justifiably in some cases. Despite this, however, the information available in artifact morphology has hardly begun to be tapped, especially in the context of specific hypothesis testing. The basis for employing the approach in this case is that certain objects are found in virtually all graves, both those containing 'cluster 1 goods (decorated Bell Beakers etc.) and those without. Since this is so, it is possible to put forward the hypothesis that if morphological differences exist between objects of a given type (e.g. jugs) found in graves with 'cluster 1' goods, and objects of the same type (i.e. other jugs in this case) found without such decorated Beaker associations, the difference between these two groups of graves is likely to be chronological.

This argument, of course, contains a number of complications. First of all, even if there was a change in what was put in the graves, there need not have been any concomitant change in the forms of the pottery being manufactured. They are separate spheres of activity, albeit ultimately related in a systemic fashion. In this context it is important to appreciate that changes in pottery style and changes in



burial are likely to be different sorts of event. Certain aspects of pottery, such as style, can change, at least within limits, more or less autonomously and stochastically, although here, too, more deep-seated alterations are sometimes reflected (cf. Deetz 1965). But unless one assumes that grave goods were more or less randomly distributed across the deceased population, this is not the case with burial. Changes in burial are unlikely to be trivial unless they are merely the result of changes in artifact fashions. They may reflect the appearance or disappearance of particular social roles (cf. Binford 1971), alterations in their significance, or the introduction of new beliefs concerning the disposal of the dead which may have had considerable repercussions in life activities as well. An obvious example is the change in Anglo-Saxon cemeteries which followed the conversion to Christianity.

On the other hand, we have to be certain that any differences we detect are due to change through time, and are not, for example, spatial. It has already been shown (Chapter 3 above) that within Moravia the differences between the two groups of graves (those with Bell Beaker associations and the others) are not spatial, but this aspect has to be checked because it is possible that difficulties might arise if the graves with 'cluster 1' objects were by chance selected from one part of Moravia, and the graves without from another.

There is a variety of objects common to graves with and without 'cluster 1' goods (Bell Beaker associations), but for testing the hypothesis put forward, the best are the jugs. These are the most numerous objects, as well as the most varied in form. They provide an excellent opportunity of finding out if there is any systematic pattern in the morphological variation, which follows the division between

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 the appearance or disappearance of particular social roles (cf.  
 Boser 1965), alterations in their significance, or the introduction  
 of new beliefs concerning the disposal of the dead which may have had  
 considerable repercussions in life activities as well. An obvious  
 example is the change in high-knob containers which followed the  
 conversion to Christianity.

On the other hand, we have to be certain that any differences we  
 detect are due to change through time, and are not, for example,  
 spatial. It has already been shown (Chapter 3 above) that within  
 Norway the difference between the two groups of graves (those with  
 bell beaker associations and the others) are not spatial, but that  
 respect has to be checked because it is possible that differences  
 might arise if the graves with 'cluster 1' objects were by chance  
 reflected from one part of Norway, and the graves without from another.

There is a variety of objects common to graves with and without  
 'cluster 1' goods (bell beaker associations), but for testing the  
 hypothesis put forward, the best are the jugs. These are the most  
 numerous objects, as well as the most varied in form. They provide an  
 excellent opportunity of finding out if there is any systematic pattern  
 in the morphological variation, which follows the division between

graves with 'cluster 1' goods (decorated Bell Beakers etc.), and those without. The spatial problems can be controlled by using as far as possible graves from the same site, or at least from the same small area, for comparison. Failing this, it is necessary to make sure that the graves with and without 'cluster 1' are spatially intermixed, and to map the results of any groupings in the jugs.

A further difficulty is that it is shape which is under consideration here and it may well not vary systematically over space as a function of human interaction, in a way that decoration is perhaps more likely to do. A vessel's shape will first of all be determined by its function, but given that we are concerned, as in this case, with a single functional type, it will relate to a variety of factors, including the quality and moisture of the clay, and variations in the technique of manufacture. These may be specific to a single site rather than a region, so it is obviously important to take this detailed level of variation into account.

Given these objectives, it was clear that mere examination and grouping of drawings of vessels was not satisfactory, especially as the variations in the jugs studied were relatively slight. It was necessary to use some sort of objective measure which would define precisely, given its assumptions, the relationships of each vessel to every other, and which would then allow the use of statistical techniques to search for structure within this data matrix.

Illustrations of 33 jugs from Moravian graves used in the original cluster analysis were available. To these were added 5 jugs from the site of Senice. Although the description of this find meant that it was not suitable for use in the cluster analysis, it was clear that there were no 'cluster 1' goods present. A list of all these jugs is

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graves with 'cluster' goods (decorated Bell Beaker etc.), and those without. The spatial problems can be controlled by using as far as possible graves from the same site, or at least from the same small area, for comparison. Taking this, it is necessary to make sure that the graves with and without 'cluster' are spatially intermixed, and to map the location of all graves in the area.

A further difficulty is that it is a range which is under consideration here, and it is not well and very systematically over space as a function of time. In other words, in a way that decoration is perhaps more likely to be. The range of all the decorated graves, but given some of the constraints, in this case, with a single function, it will relate to a variety of factors, including the quality and texture of the clay, and variations in the technique of manufacture. These may be specific to a single site rather than a region, so it is obviously important to take this detailed level of variation into account.

Given these objectives, it was clear that more examination and recording of drawings of vessels was not satisfactory, especially as the variations in the data studied were relatively slight. It was necessary to use some sort of objective measure which would define precisely, given the assumptions, the relationships of each vessel to every other, and which would allow the use of statistical techniques to search for structure within this data matrix.

Illustrations of 25 graves from Norwegian graves used in the original cluster analysis were available. To these were added 5 graves from the site of Jante. Although the description of this find meant that it was not suitable for use in the cluster analysis, it was clear that there were no 'cluster' goods present. A list of all these graves is

given in table 4.III. Ten measurements were taken at equal intervals from the top to the bottom of the jug. The measurements were taken from, and at right angles to, the centre line of the vessel drawing to the nearest point on the exterior surface of the pot; an example is shown in fig. 4.6. These measurements were then standardised for vessel size by dividing by the vessel height. It was considered that these ratios would be sufficient to give an adequate description of the vessel.

The resulting information was then analysed by the discriminant function analysis program BMD04M, from the package of Biomedical computer programs (Dixon 1968). Given a series of measurements on a number of variables, the aim of discriminant analysis is to find the linear combination of these variables which produces the maximum difference between two previously defined groups. The two groups in this case, of course, were those jugs found with 'cluster 1' goods (14 vessels), and those without (24 vessels). The program computes the discriminant function coefficients, Mahalanobis  $D^2$  (a generalised distance measure), and an F value, which cannot be used as a test of significance in this analysis because the required assumptions are not met. A list is then printed of the individuals in each group, ranked with respect to the discriminant function, and it is this which contains the information of interest; the list for the Moravian jugs is reproduced in table 4.IV. This shows a distinct separation into two groups and might therefore be taken as proof that there is a distinction between those jugs found with 'cluster 1' goods (decorated Beakers etc.) and the others, and, therefore, that a chronological difference exists between the two sets of graves. This, however, is not the case, for two reasons.



The first depends on the fact that the significance test cannot be used. Consequently it is not possible to say that the division into groups along the lines predicted means that the two samples come from different populations. It might be that two samples from the same population would show an equally large difference. The second point is that even if the difference were significant, it might be so as a result of variable which has not been considered: in this example because the vessels are from different sites. Even though these sites are spatially intermixed, (see fig. 4.7) it is possible that unsystematic variation from site to site may be important and must therefore be investigated. In fact, if there are large differences between samples from the same population, this is likely to be the reason. Both these problems were explored, using the program BMD O7M (Dixon 1968). This is designed to discriminate between several groups, and to carry out the closely related method of canonical variate analysis. From the discriminant functions weighted combinations of the original variables are produced, with the aim of optimising the separation between sample groups; these are known as canonical variates. They may be considered as axes of a multi-dimensional space, and the groups of units located in relation to them. The importance of each variate can be seen from the proportion of the total dispersion for which it accounts.

Two approaches were adopted. For the first analysis the jugs from graves without 'cluster 1' goods (decorated Beakers etc.) were randomly divided into two equal sized samples; these were then input to the canonical analysis program, together with the group of 'cluster 1' jugs. It was assumed that if the 'cluster 1' jugs were different, they would separate from the other two groups on the canonical variate scattergram more than either of these would from the other. Fig. 4.8



shows the three groups in relation to canonical variates one and two, which between them account for virtually all the dispersion. Group A (the 'cluster 1' jugs) predominates in the right hand part of the diagram, but group Y (sample 2 of the other jugs) also tends to be separate from group X (sample 1 of the other jugs). Given the assumption stated above, there is only the slightest evidence that the 'cluster 1' jugs are different from the others. A further measure of the separation between groups is given by the classification matrix which discriminant analysis produces (table 4.V). Grebinger and Adam (1974) have lucidly described how to interpret such a classification matrix:

'This has the same number of rows and columns as there are groups. Each row corresponds to one of the original vessel groups and each column represents the group to which the individual vessels are assigned by the discriminant analysis. A completely effective classification will display only zeros off the principal diagonal of the classification matrix; each vessel is then assigned to the group from which it came.'

In this case, three of the 'cluster 1' jugs (group A) are misclassified, four of group X and six of group Y, three of which were classified as A and three as X. This too suggests only a very slight degree of separation, if there is any at all.

But, as we have seen, even if there is such a difference, it is necessary to find out what it means, not merely to assume that it is chronological. To test this, the jugs were divided into 15 groups, both by site and association (see table 4.VI). Although the covariance matrices were not tested for equality, and all the groups were very small, it was still considered worthwhile to carry out the canonical

shows the three groups in relation to essential variables one and two, which between them account for virtually all the variation. Group A (the 'cluster 1' group) predominates in the right hand part of the diagram, but group Y (sample 1 of the other group) also tends to be separated from group X (sample 2 of the other group). Given the assumption stated above, there is only one slight evidence that the 'cluster 1' group are different from the others. A further measure of the variation between groups is given by the classification matrix which discriminant analysis (see table 4.11) produced and this (1959) have actually shown that the interest in such a classification

matrix

'This has a low number of rows and columns as there are groups. Each row corresponds to one of the original variables and each column represents the group to which the individual vessels are assigned by the discriminant analysis. A completely effective classification will display only zeros off the principal diagonal of the classification matrix; each vessel is then assigned to the group from which it came.'

In this case, three of the 'cluster 1' group (group A) are misclassified, four of group X and six of group Y, three of which were classified as A and three as Y. This too suggests only a very slight degree of separation, if there is any at all. But, as we have seen, even if there is such a difference, it is necessary to find out what it means, not merely to assume that it is chronological. In fact this, the data were divided into 12 groups, both by size and seasonality (see table 4.11). Although the covariance matrices were not tested for equality, and all the groups were very small, it was still considered worthwhile to carry out the canonical

analysis since there was no intention of using significance tests on the results, and the main aim was to obtain an impression of the relationships in the scattergram; moreover, it has been shown quite convincingly by Grebinger and Adam (1974) that the method still works even when assumptions are violated. It was assumed that if chronology was the important factor in distinguishing 'cluster 1' jugs from the others, rather than the mere fact of their coming from different sites, the 'cluster 1' groups would segregate together and separate from the other groups, in a way similar to that illustrated by Brothwell and Krzanowski (1974). Their canonical analysis of early Neolithic and Early Bronze Age cranial series not only differentiated the different samples in each of these groups but showed a marked separation between the two series themselves.

The scatter diagram of the groups against the first two canonical variates, which account for 65% of the total dispersion, is shown in fig. 4.9. The 'cluster 1' groups are labelled A to G, the others S to Z. Examination of the groupings shows that segregation by site is, of course, the predominant feature, and is, in fact, quite good. Interestingly enough, the group with the largest dispersion is that labelled Z, which is a remnant and does not belong to any single site. If one now looks for any evidence that groups A to G, the 'cluster 1' jugs, are separate from the others, this is not apparent - they do not seem to be in any way different from the remainder. Taken together with the preceding analysis, this seems to show that the differences between 'cluster 1' associated and other jugs are no greater than would occur if only inter-site differences and random variation were responsible - it does not seem necessary to invoke any chronological distinction.

Unfortunately, only a relatively small number of jugs could be



used in the analysis just described, as there were no more drawings available. A limited number of measurements had, however, been recorded in the reports for a much larger quantity of vessels and it seemed that these should be used, if possible, in order to increase the size of the sample on which the conclusions were based. To find out if this could be done, a Principal Components Analysis was carried out on the detailed information from the original 38 drawings, with the aim of establishing the main axes of variation in the jugs and then finding out whether such measurements were available for the larger sample.

'Principal Components analysis consists of a linear transformation of  $m$  original variables to  $m$  new variables, where each new variable is a linear combination of the old. The process is carried out in such a way that each new variable accounts for, successively, as much of the total variances as possible. When  $m$  new variables have been computed, all the original variance will be accounted for.' (Davis 1973:500)

The results of the analysis are shown in table 4.VII. It can be seen that component 1 accounts for easily the greater part of the variance: 82.34%; the second and third components account for 8.40% and 6.30% respectively, and the remainder are of negligible importance. The next section of Table 4.VII 'Eigenvectors by rows' shows the loadings of each of the original variables on the new components. All the variables are virtually identically weighted on the first component. The one common factor in these measures is their relation to vessel height, and, in fact, this component is a measure of vessel 'squatness', or the height/width ratio. The variables with the highest loading on the second component are the first, rim diameter, with quite a high

used in the analysis just described, as there were no more drawings available. A limited number of measurements had, however, been recorded in the reports for a much larger quantity of vessels and it seemed that these should be used, if possible, in order to increase the size of the sample on which the conclusions were based. To find out if this could be done, a Principal Component analysis was carried out on the detailed information from the original 35 drawings, with the aim of establishing the main axes of variation in the data and then finding out whether such measurements were available for the larger sample.

'Principal Component analysis consists of a linear transformation of a original variables to a new variables, where each new variable is a linear combination of the old. The process is carried out in such a way that each new variable accounts for, successively, as much of the total variance as possible. When a new variable has been computed, all the original variance will be accounted for.' (Davis 1973:300)

The results of the analysis are shown in Table 4.VII. It can be seen that component 1 accounts for nearly the greater part of the variance: 82.3%; the second and third components account for 8.4% and 6.3% respectively, and the remainder are of negligible importance. The next section of Table 4.VII 'loadings' shows the loadings of each of the original variables on the new components. All the variables are virtually identically weighted on the first component. The one common factor in these measures is their relation to vessel height, and, in fact, this component is a measure of vessel 'uprightness' or the height/width ratio. The variables with the highest loading on the second component are the first, rim diameter, with quite a high

negative loading, and at the other end, the area of maximum body width, with medium positive loadings; it is a measure of the rim diameter/maximum body width ratio. The third component clearly represents the relation of the base diameter to the maximum width, with a high positive loading on the final measurement and a slight negative weighting on the maximum body width area.

Measurements of height, maximum body width, rim diameter, and base diameter were available for a further 193 jugs, so ratios were calculated for these vessels corresponding to the first three components produced by Principal Components analysis on the small subset of jug data:

maximum body width/height

rim diameter/maximum body width

base diameter/maximum body width

57 of these vessels were associated with 'cluster 1' goods and 136 were not. This information was then analysed in a similar manner to that already described for the smaller, but more detailed, set of data. The larger group was randomly divided into three samples, which were analysed by the multi-group discriminant analysis program BMD 07M, together with the group of 57 jugs with 'cluster 1' associations. As before, it was assumed that if the 'cluster 1' jugs were different from the others they would separate from the other three groups on the canonical variate scattergram more than any of these would from each other.

The scattergram is illustrated in fig. 4.10; 'cluster 1' jugs (associated with decorated Beakers etc.) are labelled A, the three other samples of jugs X to Z; the first variate accounts for virtually all the dispersion. There is again very little to suggest that group A



is different from the other three: its mean is only slightly further away and all the dispersions overlap considerably. This picture is confirmed by the classification matrix (Table 4.VIII), from which it can be seen that more members of groups X and Z are misclassified as A than are put in the correct group. It might be argued that reduction to only three defining ratios is very coarse, and that differences would have appeared in the larger sample if more ratios had been available. This seems not to be the case. As will be seen below, several Bohemian samples were analysed first using these three ratios and then using twelve: both analyses produced the same result, although, of course, the configurations of the individual points were slightly different.

In the light of the work that has been described, it is necessary to ask whether we are justified in regarding all the graves containing these jugs, whether associated with 'cluster 1' goods or not, as 'contemporary'. It has already been stated that lack of typological change does not necessarily mean that there was no change in what was put in the graves. A related problem is that for reasons outlined elsewhere, vessel shape might well not change directionally through time, the end effect of which is an appearance of no change. This is certainly one possible implication of the results of the canonical analyses which might be preferred to the conclusion that the graves are 'contemporary'. Obviously it is not realistic anyway to consider all these graves as 'contemporary', and to mark them off from another 'phase' in which things are likewise regarded as 'contemporary', since the graves were deposited in a consecutive order. What we are trying to establish is whether or not the relation of the 'cluster 1' graves to the others is random with respect to time. If it were random we would not be able to predict which graves contained 'cluster 1' goods and which did not, even if we knew the exact order in which the graves had been deposited.



In the present case, when the evidence from the settlements and that from the jug morphology are taken together, it seems reasonable to consider the relationship between the two sets of graves as essentially random with respect to time in the sense just defined above. First, the settlement contexts show little sign of chronological differentiation between the decorated Bell Beakers and the other pottery, and the contents of these pits, although certainly not representing a random sample of settlement debris, are not subject to the same cultural constraints affecting the grave goods. Secondly, the assumption involved in the discriminant analyses, that there might be a morphological trend in the jugs through time, and that this might be a reasonable test of whether the two sets of graves were chronologically consecutive, seems reasonably valid, since if one takes a rather longer time span than the duration of the specifically Bell Beaker assemblage, this is exactly what happens. Jugs of slightly different, and indeed directionally changing, types continue to be placed in graves of the Unetice culture in both Bohemia and Moravia (cf. Moucha 1963, Ondráček 1967). The contents of these graves, moreover, differ from those of the Bell Beaker 'culture' and also differ between early and late Unetice. The fact that the jugs of the Bell Beaker assemblage cannot be put into a typological sequence, at least with respect to the hypothesis being tested, means that there is no evidence here for suggesting that the difference between the two groups of graves is chronological.

If these arguments are accepted, it means that the differences between the graves with and those without 'cluster 1' goods remain to be explained; in fact, the whole spectrum of variation in the graves must be accounted for, and not just a chronologically differentiated subset. An attempt will be made to do this in the following chapter,

In the present case, when the evidence from the north-west and south-east is taken together, it seems reasonable to consider the relationship between the two sets of graves as essentially random with respect to time in the sense just defined above. Thus, the settlement contains about 1500 graves of chronological differentiation between the decorated Bell Beaker and the other pottery, and the contents of these graves, although certainly not representing a random sample of settlement debris, are not subject to the same cultural constraints as the grave goods. Recently, the investigation involved in the identification analysis, that there might be a typological trend in the grave goods, and that this might be a reasonable test of whether the two sets of graves were chronologically consecutive, seems reasonable, since if one takes a rather longer time span than the duration of the specifically Bell Beaker assemblage, this is exactly what happens. Types of slightly different, and indeed directionally changing, types continue to be placed in graves of the Bell Beaker culture in both Bohemia and Moravia (cf. Hecner 1963, 1965, 1967). The contents of these graves, moreover, differ from those of the Bell Beaker 'culture' and also differ between early and late phases. The fact that the type of the Bell Beaker assemblage cannot be put into a typological sequence, at least with respect to the hypothesis being tested, means that there is no evidence here for suggesting that the difference between the two groups of graves is chronological. If these arguments are accepted, it means that the differences between the graves with and those without 'cinerary' goods remain to be explained; in fact, the whole spectrum of variation in the graves that be accounted for, and not just a chronologically differentiated subset. An attempt will be made to do this in the following chapter.

where the role of social variables will be considered, but before that it is necessary to examine the chronological evidence from Bohemia.

When we turn to Bohemia, the problem is similar, but not identical to Moravia. It has already been shown that there is no such well defined cluster of decorated Bell Beakers and other artifacts associated with them. On the other hand, a small group did emerge from the Bohemian data when rare objects were removed (see again fig. 3.20) and it is clearly important to establish whether or not it is a result of chronological factors, as we did for Moravia. The members of the cluster concerned are:

- 1. Decorated Bell Beaker
- 14. Stone Axe
- 18. Copper Dagger
- 19. Wrist-guard
- 23. Ear-ring

Apart from the fact that we are dealing with a much smaller cluster of objects, the argument then follows the pattern for Moravia. Again a considerable number of graves (144 out of 206) is without goods of the decorated Bell Beaker cluster. As before, our aim is to find out whether the division is one into two separate phases, or something else. But we are not just dealing with a division in the graves: there are also differences between the sites. Table 4.IX shows a list of those sites with five or more graves, whether these were used in the cluster analysis or not; some of these are not very well reported, but since we are concerned here with aggregates this is less important than it was for the cluster analysis.

It is immediately clear that some sites have decorated Bell Beakers

...the role of social variables will be considered, but before that  
it is necessary to examine the sociological evidence from before.

...then we have to consider, the problem is similar, but not identical  
to that. It has already been shown that there is no such well  
defined cluster of behavior as that of the other two clusters associated  
with them. On the other hand, the other two clusters from the  
behavior data when taken together show a very different picture. It is  
it is clearly shown that there is a cluster of behavior which is  
sociological in nature, and it is this cluster which is the  
cluster concerned.

1. ...
2. ...
3. ...
4. ...
5. ...

...from the fact that we are dealing with a much smaller cluster  
of objects, the argument then follows the pattern for behavior. Again  
a considerable number of groups (100 out of 200) in different kinds of  
the associated self behavior cluster. As before, our aim is to find out  
whether the division is one into two separate groups, or something else.  
But we are not just dealing with a division in the groups; there are  
also differences between the groups. Table 4.11 shows a list of these  
differences with five or more groups, whether these were used in the  
cluster analysis or not; some of these are not very well reported, but  
since we are concerned here with a comparison this is less important  
than it was for the cluster analysis.

It is immediately clear that some of these have been associated with behavior

and others do not, even when the number of graves is quite large. This did not occur in Moravia to nearly the same extent; there most of the large sites had at least one grave with a decorated Bell Beaker although, of course, the proportions varied. These large Bohemian sites are especially important since sampling is less likely to be the reason why decorated Beakers are absent than if the numbers of graves were small. A test was carried out to discover whether the distributions of those sites with decorated Beakers and those without were spatially segregated. The distributions are shown in fig. 4.1<sup>1</sup>. Following Pielou (1969), a 2 x 2 table was compiled of the nearest neighbour of each site, the sites being divided into two classes, those with decorated Bell Beakers and those without (see table 4.X).

A test for a difference between the AA, BB and AB, BA relationships was then carried out, using Fisher's exact test as the numbers were small. This test is very easy to use since tables are available which make calculations unnecessary (Finney et al. 1963). The result was not significant at the 0.05 level. This suggests that spatial differences between the two classes of site are not the reason for this division. A chronological difference is a possible explanation of the phenomenon, but this is not necessarily so, and other possible hypotheses will be considered in the next chapter. Independent evidence concerning the chronology must be found if it is available.

Once again grave stratigraphies are lacking, so it is necessary to turn directly to settlement contexts for information on the relationships between decorated Bell Beakers and undecorated jugs and bowls; the other objects of the Bell Beaker cluster are virtually never found in domestic situations. Unfortunately, the settlement evidence from Bohemia is even worse than that from Moravia; the material is

and others do not, even when the number of graves is quite large. This did not occur in the case of the grave which was found at the large site but at least one grave with a decorated bell marker although, of course, the proportions varied. These large bell markers also are especially important since sampling is less likely to be the reason why decorated markers are absent than if the number of graves were small. In the case of the grave which was found at the large site, the proportion of decorated markers and plain markers was 11.1% and 88.9% respectively. This proportion was found in 11.1% of the graves. Following Table 1, the data are compiled of the number of graves at each site, the proportion of decorated markers, and the proportion of graves with decorated markers (see Table 1.1). A test for a difference between the AA, BB and CC relations which was then carried out, using Fisher's exact test as the markers were small. This test is very easy to use since tables are available which make calculations unnecessary (Finney et al. 1963). The results were not significant at the 0.05 level. This suggests that spatial differences between the two classes of sites are not the reason for this division. A chronological difference is a possible explanation of the phenomenon, but this is not necessarily so, and other possible hypotheses will be considered in the next chapter. Independent evidence concerning the chronology may be found if it is available. Once again grave stratigraphy are lacking, so it is necessary to turn directly to settlement contacts for information on the relationships between decorated bell markers and undecorated jars and bowls; the other objects of the Bell Beaker cluster are virtually never found in domestic situations. Unfortunately, the settlement evidence from Bonhata is even worse than that from Hovvata; the material is

summarised in Table 4.XI. Three of the 14 sites recorded here, as well as some of the pits from sites with decorated Beakers, do not contain decorated Beaker sherds, and as the descriptions of these are reasonably adequate and decorated Beaker sherds are invariably recorded when found, it is fairly certain that such sherds were not present. The remainder of the sites contain decorated Beaker sherds, although the proportions are rarely given. The evidence of these settlements then is not very conclusive. There is some suggestion that there might be a phase without decorated Bell Beakers, but since these are rare anyway and were quite possibly exchanged (i.e. not made on every site), the absence of the Beaker sherds need not be interpreted chronologically. On the other hand, there is once again no evidence whatsoever for a phase consisting solely of Bell Beakers, and the dilemma of those who believe in such a thing is well brought out by Zápotocky (1960:26) in the following unconvincing rationalisation of the situation at the site of Kozly:

'But if the settlement at Kozly already belongs to a developed stage of the Bell Beaker culture, then the appearance of decorated pottery, which is typical of the beginning of this culture, is somewhat surprising. In the first place, however, the number of forms still decorated in the style of the first phase, which outlived this initial period, was perhaps only limited (at Kozly itself, of 164 sherds only 11 were comb and line decorated i.e. 6.7%); secondly, this phenomenon could be a feature restricted to this particular locality.'

No consideration is given to the obvious possibility that decorated Bell Beakers might be a special fine pottery style produced only in limited numbers throughout the Bell Beaker period.

remained in Table A.II. Three of the 14 sites recorded here, as well as some of the sites from sites with decorated vessels, do not contain decorated vessels either, and as the descriptions of these are necessarily abbreviated and decorated vessels appear are invariably recorded when found, it is fairly certain that such sites were not present. The remainder of the sites contain decorated vessels, although the proportion was small. The evidence of these relationships then is not very definite. There is some suggestion that there might be a phase which occurs in the early period, but since these are very many and the sites are widely scattered (i.e. not made on every site), a number of the sites cannot be included in the chronological sequence. There is some suggestion as evidence of a phase which occurs in the early period, and the evidence of those who believe in such a phase is well brought out by the study (1952:12) in a following unconvincing demonstration of the situation at the site of Kari.

But if the settlement at Kari already belongs to a developed stage of the Bell Beaker culture, then the appearance of decorated pottery, which is typical of the beginning of this culture, is somewhat surprising. In the first place, however, the number of forms still decorated in the early of the first phase, which out-lived this initial period, was perhaps only limited (at Kari itself, of the series only 17 were found and the decorated 1.5. 5.7); secondly, this phenomenon could be a feature restricted to this particular locality.

As consideration is given to the obvious possibility that decorated Bell Beakers might be a special type pottery style produced only in limited numbers throughout the Bell Beaker period.

Since the settlements do not provide a totally convincing answer as to whether the presence of decorated Bell Beakers is chronologically significant, it is necessary to look further, in order to find any evidence which, taken together with the settlements, might allow us to reach a more definite conclusion. The sequence of argument, of course, is that already outlined in the section on Moravia and leads on to typology. The reasons for the relevance of this approach have been given above and need not be repeated here. Briefly, it involves examining individual objects which are found both with the cluster of Bell Beaker goods and without, to see if there are any systematic morphological differences between them. The assumptions required in drawing conclusions from this are also discussed above. As with Moravia, the class of objects chosen was the jugs, since these are the most numerous objects found in both contexts.

Illustrations of 65 jugs from Bohemian graves were available, 16 with 'cluster 1' associations (decorated Bell Beakers etc.) and 49 others; a list is given in table 4.XII. The measurements taken were the same as for Moravia, but two more were added to see if they would make any difference: height of the maximum body width and height of the neck; all were standardised by dividing by the height of the vessel. The data were prepared, as before, with a view to finding out whether jugs associated with 'cluster 1' goods were morphologically different from those without such associations, and the same set of analyses was carried out as on the Moravian material, except for the simple two group discriminant analysis; this has been shown to give misleading results and was therefore omitted. Instead, the 49 jugs without Beaker cluster associations were randomly divided into three samples, two of 16 and one of 17 individuals, which were analysed, together with the

Since the specimens do not provide a totally convincing answer as to whether the presence of decorated Bell Beakers is chronologically significant, it is necessary to look further, in order to find any evidence which, taken together with the specimens, might allow us to reach a more definite conclusion. The sequence of argument, of course, is that already outlined in the section on Norway and leads on to typology. The reasons for the relevance of this approach have been given above and need not be repeated here. Briefly, it involves examining individual objects which are found both with the cluster of Bell Beaker goods and without, so as to see if there are any systematic morphological differences between them. The assumptions required in drawing conclusions from this are also discussed above. As with Norway, the aim of object choice was the same, since there are the most numerous objects found in both contexts.

Illustrations of 15 Jura from Bohemian graves were available, 10 with 'cluster 1' associations (decorated Bell Beakers etc.) and 5 others; a list is given in Table 8.11. The measurements taken were the same as for Norway, but two more were added to see if they would show any difference: height of the maximum body width and height of the neck; all were standardized by dividing by the height of the vessel. The data were prepared, as before, with a view to finding out whether items associated with 'cluster 1' goods were morphologically different from those without such associations, and the same set of analyses was carried out as on the Norwegian material, except for the simple two group discriminant analysis; this has been shown to give misleading results and was therefore omitted. Instead, the 15 Jura without Beaker cluster associations were randomly divided into three groups, two of 15 and one of 17 individuals, which were analysed, together with the

sixteen Beaker cluster jugs, by discriminant function and canonical analysis. The reasons for doing this have already been described, and, as before, it was assumed that if the Beaker cluster jugs were different from the other three groups, they would separate from them on the canonical variate scattergram more than any of these would from the other.

Fig. 4.12 shows the four groups in relation to canonical variates 1 and 2, which together account for 82% of the dispersion; the Beaker cluster jugs are group A, the others X to Z. It is apparent that group A is no more different than any of the others; in fact, from the positions of the means group Z seems to be the most extreme sample. The classification matrix (table 4.XIII) confirms this impression since a considerable number of individuals is mis-classified. As already mentioned in the section on Moravia, this analysis was re-run using only three ratios and produced an identical result (fig. 4.13).

Finally the jugs were divided by site and association into 16 groups (see table 4.XIV) and once more put into the canonical analysis program in order to obtain an impression of the relationships in the scattergram. It was assumed again that if chronology was the important factor in distinguishing graves with Beaker goods from the others, the groups of 'Beaker associated' jugs would segregate from these others (given, of course, that there had been a morphological change in the jugs). The scattergram of the groups against the first two canonical variates, which account for 58% of the total dispersion, is shown in fig. 4.14. The 'cluster 1' (associated with decorated Beakers etc.) groups are labelled A to G, the other groups S to Z. It is clear that there is no such segregation as that anticipated. Separation is essentially by site and there is no evidence of any clustering of

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groups A to G in any particular part of the scattergram. Thus, if this analysis is considered in combination with the preceding one, the conclusion to be drawn is the same as for Moravia: the differences between those jugs associated with the Beaker cluster and the others are no greater than would be expected if they were a result of random variation and/or inter-site differences.

As in Moravia, the two lines of evidence examined both point in the same direction; on balance it seems best to go into the next phase of the analysis assuming that the whole range of variation in the Bohemian (and Moravian) graves still remains to be explained, and that no chronological division can safely be made between the two sets of graves (and artifacts) we are considering.

group 4 to 6 in any particular part of the distribution. Thus, if this analysis is considered in connection with the preceding one, the conclusion to be drawn is the same as for the other two distances between those two associated with the cluster and the others are no greater than would be expected if they were a result of random variation under identical conditions.

As in Figure 4, the two lines of evidence remained both solid in the same direction; on Figure 4, however, the lines in the same place at the analysis showed that the same result of variation in the between and within group will remain to be explained, and that no chronological division can be made between the two sets of groups and within the same conditions.

CHAPTER FIVE: A SOCIAL INTERPRETATION OF THE VARIATION IN  
THE BELL BEAKER GRAVES OF BOHEMIA AND MORAVIA

In an earlier chapter it was suggested on a priori grounds that the widespread Bell Beaker artifacts might well have some special social significance which could account for the extent of their distribution. Several expectations were drawn from this suggestion, of which the main one was the hypothesis that the widespread objects would not be randomly intermixed with other types in a given area, but would tend to be segregated. The occurrence of this situation in Bohemia and Moravia has been documented in the chapter on cluster analysis of the grave goods. Two of the most obvious potential reasons for this - spatial differences and chronology - have been considered and rejected, thus the differences between graves with 'cluster 1' goods and those without remain to be explained.

It is now necessary to consider whether there is any independent evidence for the view that social differences are responsible for the observed segregation in the grave goods, and here we may recall an expectation which was mentioned in Chapter three. If the widespread objects were prestige goods, graves containing them might well have more than the average number of goods.

As in previous analyses the two regions, Moravia and Bohemia, were considered separately. For each area bar graphs were produced of the number of graves containing different quantities of goods. Quantity was defined on two different criteria, the number of different types of goods present and the total quantity of goods, produced by summing the numbers of all items. In the bar graphs those graves were

# CHAPTER THREE: A REVIEW OF THE LITERATURE

## THE TWO MAIN TYPES OF RESEARCH

In an earlier chapter, I have suggested that a typical study in the field of abnormal psychology will have one of two main types of research design. The first is the experimental design, in which the researcher manipulates one or more independent variables and measures the effect on one or more dependent variables. The second is the correlational design, in which the researcher measures two or more variables and examines the relationship between them. Both types of research have their strengths and weaknesses, and the choice between them will depend on the nature of the research question. In this chapter, I will review the literature on the two main types of research design, and discuss the implications for the study of abnormal psychology.

It is now necessary to consider whether there is any independent evidence for the view that experimental and correlational research are complementary. In the experimental design, the researcher manipulates one or more independent variables and measures the effect on one or more dependent variables. In the correlational design, the researcher measures two or more variables and examines the relationship between them. Both types of research have their strengths and weaknesses, and the choice between them will depend on the nature of the research question. In this chapter, I will review the literature on the two main types of research design, and discuss the implications for the study of abnormal psychology.

As in previous chapters, the two research designs, experimental and correlational, are considered separately. For each type, the strengths and weaknesses are discussed, and the implications for the study of abnormal psychology are considered. The chapter concludes with a summary of the main points, and a discussion of the implications for the study of abnormal psychology.

The first type of research design is the experimental design. In this design, the researcher manipulates one or more independent variables and measures the effect on one or more dependent variables. The second type of research design is the correlational design. In this design, the researcher measures two or more variables and examines the relationship between them. Both types of research have their strengths and weaknesses, and the choice between them will depend on the nature of the research question. In this chapter, I will review the literature on the two main types of research design, and discuss the implications for the study of abnormal psychology.

dis<sup>tin</sup>guished which contained that area's 'cluster 1' goods (see figs. 5.1, 5.2). A further set of graphs was also produced for each area, in which only those graves containing decorated Bell Beakers were marked off (see figs. 5.3, 5.4). These were considered separately, in order to find out whether the decorated Bell Beaker alone was an accurate predictor of goods quantity, rather than the more obviously prestigious copper daggers and wrist-guards associated with it. Statistical tests were then carried out to find whether the mean number of goods in graves with decorated Bell Beakers or 'cluster 1' goods was higher than in those without.

The bar graphs for Moravia are shown in figs. 5.1, 5.3. It seems immediately clear that the frequency distributions of those graves with 'cluster 1' goods and those with decorated Bell Beakers are different from those without these objects, both in variety and quantity of goods. This impression is confirmed by the results of tests on the significance of the difference between the means, which show that the mean number of types/goods in those graves with these objects is greater (see table 5.1). The results for Bohemia are similar but the difference is less marked (see figs. 5.2, 5.4, and table 5.II). On this basis, the hypothesis that graves with the widespread Bell Beaker objects also possess, on average, a larger number of goods than those without seems to be supported and we may take this as further evidence that the graves containing them belong to high-status individuals, and that the widespread goods had a prestige value. Against this it might be argued that in graves with a greater number of goods any rare good will have a greater probability of occurrence purely by chance, and it is necessary to ask whether this is compatible with a view of the situation as meaningful in human behavioural terms.



An affirmative answer must be given to this question for several reasons. On a priori grounds it is unlikely that the deposition of goods in a grave is random, a point confirmed below when the association of grave goods with age and sex categories is investigated. Although this establishes a basic principle, it still leaves the problem of whether goods-quantity (or variety) may be used as independent evidence for the high status of graves with particular goods. The solution to this part of the problem seems to be as follows. First, it is important to note that there are very few graves with solely 'cluster 1' goods, most have other objects as well. 'Cluster 1' goods can, therefore, be regarded as additional: more or less everybody had a basic set of mainly ceramic goods, but certain people had various extra items, presumably an indicator of their different (higher) status. This situation has as its inevitable corollary the fact that graves with these items have more goods than the rest.

The final point in favour of the view that graves containing 'cluster 1' objects belong to individuals of higher status stems, of course, from the nature of the objects themselves and, indeed, provides the reason for their use as prestige goods. 'Cluster 1', in both Bohemia and Moravia, contains most of those artifacts which can be considered most valuable in terms of labour input, probable distance travelled and availability of raw materials; this category includes the decorated Bell Beaker itself, which would have required a large amount of careful work for its ornamentation.

In the light of the evidence just discussed, and that already outlined in previous chapters, it seems that the initial hypothesis has survived testing well and has not been falsified: the widespread Bell Beaker artifacts are most probably prestige goods, and have a social



rather than a chronological significance. On the other hand, this is not to say that these goods are everywhere associated with a particular form of social organisation - such a view would clearly be as naive as believing in a correlation with a Beaker people. The objects are status symbols but the nature of the status hierarchy in which they function is local, and may well vary from area to area even within Central Europe. How much it actually varies is investigated below in a consideration of the evidence from Central Germany. So far, however, we have only looked at the significance of the artifacts; it is now necessary to examine in more detail the social system in which they functioned in Bohemia and Moravia.

The previous discussion must be taken as showing that certain graves were wealthier than others and, on the basis of Saxe's work (1970), it may be argued that this paralleled a distinction present in life and is strong evidence for a non-egalitarian society. These conclusions, however, are only the beginning of an investigation of the social differentiation present and of the way in which artifacts were used to symbolise them. In particular, it is important to be more specific about the degree to which the society was 'non-egalitarian'. The local communities of the Hopewell Interaction Sphere discussed in chapter two were characterised by a markedly hierarchical form of supralocal integration visible in the ceremonial centres and richly equipped burial mound groups at certain sites. If the Bell Beaker situation in Central Europe does not match up to this degree of complexity the relevance of the Hopewell analogy must be seriously questioned even though the hypothesis that the widespread artifacts are prestige goods has received support. As a first step in a more detailed study of this question it is necessary to control those



dimensions of variation for which independent evidence is available, especially that associated with the age and sex of the individual buried (see S.E. Shennan 1975).

Statistical tests were carried out to find whether certain goods were equally likely to be found with men or women, and with adults or children. A simple binomial test was used.

$$P(r) = \frac{N!}{r!(N-r)!} p^r q^{N-r}$$

where N = number of sexed/aged graves

r = number of times a good occurs with a specified category

e.g. male or child.

p = the probability that a good will occur with a given category

e.g. male or child.

q = 1-p

P = probability of r successes

p is set at 0.5 since the null hypothesis is that the good(s) will be equally distributed between men and women or adults and children.

The distribution of objects between adults and children will be considered first. Figures are given in table 5.III. In both Bohemia and Moravia jugs were more or less equally found with adults and children; the numbers in this case were reasonably large, which suggests that this equality may be genuine. In neither region was there a significant difference between adults and children with regard to the presence of that region's 'cluster 1' goods, but here the numbers were very small; a similar situation occurred when the decorated Bell Beakers were considered alone since they themselves are rare in graves of known age. To increase the numbers, the decorated Bell Beaker



figures for Bohemia and Moravia were combined; this time the result was significant at the 0.03 level and indicated that children were less likely than adults to have a decorated Bell Beaker deposited in their grave. Next all non-ceramic grave goods i.e. weapons, ornaments, chipped stone, were grouped together and their distribution in relation to age was tested in the same way as before. Both areas showed a significant difference between adults and children, in Moravia at the 0.01 level, in Bohemia at the 0.002 level; again children were less likely to have the goods. Finally, a test was carried out to find whether children and adults were equally distributed among those graves which contained more than three types of goods. Again the result was significant, in Moravia at the 0.03 level and in Bohemia at the 0.01 level, showing that there were less children among graves with more than three types of goods.

The very fact that these differences in grave goods correspond with categories (adults and children) recognised by independent criteria confirms the significance of variation in the grave goods, but is only the first conclusion which may be drawn from these results. Within the children there do not seem to be any great differences; on the whole there are only pots and animal bones in their graves, and the maximum range of objects is about four types, not so wide as that found among the adults. This suggests that children have a different status from at least some adults, having few or no ornaments or weapons and few decorated Bell Beakers, and that differences in wealth increase with age. If wealth were hereditary, one would expect some children to be richer than others in the same way as some adults are, but there is little evidence of this. It is worth emphasising, however, that this is not a simple dichotomy between adults and children; only a



minority of adults actually have these goods which are not found with children. It appears that as far as grave goods are concerned some dead adults have not changed status since they were children, but that it was only on arrival at adulthood that individuals had the possibility of changing status and achieving further distinctions; this fits in with the point already mentioned that such objects as the 'cluster 1' goods may be regarded in a sense as additional to the others.

Exactly which adults had the opportunity of achieving further status distinctions is the next subject of investigation, particularly the question of differences between men and women. Unfortunately, the number of sexed skeletons in both Bohemia and Moravia was too small to obtain any significant results in tests such as those carried out on adults and children. It has often been claimed, however, that those buried on their left-hand side are men, and those on their right-hand side are women. Table 5.IV shows those graves of known sex tabulated against the side on which the individuals were lying, for Bohemia and Moravia. In Moravia the male graves are more or less equally divided between left and right hand sides, while the females are only on the right. In Bohemia the quite large numbers of males are almost exclusively on the left hand side, while the number of females is too small to say. For neither area are the results conclusive, but the total lack of women in the left-hand-side position in Moravia and the marked predominance of men in the left-hand-side position in Bohemia made it seem worthwhile to see if there was any connection between the side on which the skeleton was lying and the presence of certain objects. The results are shown in table 5.V; those for Moravia will be considered first.

Decorated Bell Beakers, it is immediately clear, are roughly



equally distributed between the two sides and in the same proportion of each. The Moravian 'cluster 1' goods, including decorated Bell Beakers, show a different sort of pattern, with a clear suggestion that they are more often associated with the left-hand-side group. This association has two aspects. The first relates to the question: are equal numbers of 'cluster 1' goods found with skeletons on either side? The second investigates whether the proportion of left-hand-side graves with 'cluster 1' goods is different from the proportion of right-hand-side graves with these goods. For example, there might be five occurrences of 'cluster 1' goods in right-hand-side and five in left-hand-side graves i.e. equal numbers on each side. If, however, there are only five graves in our right-hand-side sample and fifty in our left-hand-side sample, we see a different aspect of the relationship. Both these aspects were tested statistically. For the first the null hypothesis was:

$$P(\text{'Cluster 1' goods with left-hand-side graves}) = P(\text{'Cluster 1' goods with right-hand-side graves}) = 0.5$$

The actual proportions were different from this at the 0.03 level of significance i.e. it is not likely that equal numbers of these goods occur with the two groups of graves - more are with the left-hand-side group.

For the second question a chi-square test was carried out to establish whether different proportions of left-hand-side and right-hand-side graves contained 'cluster 1' goods. A greater proportion of left-hand-side graves contained these objects and the difference proved significant at the 0.02 level.

In view of the fact that none of the Moravian female skeletons was on its left-hand-side, it seems reasonable to suggest that this is evidence of a tendency for the 'cluster 1' goods, except perhaps the



decorated Bell Beaker, to be associated with males, half of whom possess one or other of these goods. In this light it is interesting to look at the association of the V-perforated button with the left-hand-side and right-hand-side positions; the figures are given in table 5.V. It may be seen immediately that the 'cluster 1' situation is reversed, with a strong correlation between right-hand-side and the presence of these buttons, although even here they are in a minority of the graves. It is not possible to associate these buttons definitely with females given that males also occur on their right-hand-side, but the contrast with the 'cluster 1' goods is marked and must explain the fact that V-perforated buttons were the only one of the widespread Bell Beaker goods not to be a member of 'cluster 1'. In the local pottery too there is evidence of right-hand-side associations in Moravia: Töpfe are more frequently found in graves with individuals on their right-hand-side; a chi-square test on the result showed it to be significant at the 0.001 level.

In Bohemia the situation is entirely different, not least because there are twice as many left-hand-side graves, in contrast to Moravia, where the proportions are equal. This indicates that the rules concerning the side on which individuals were buried were different in the two areas, since there is no reason in terms of sampling why more left-hand-side than right-hand-side graves should have been found in one area rather than the other. In Bohemia, in fact, some cemeteries seem to have been almost completely made up of left-hand-side graves while there are no such right-hand-side cemeteries. The reality of the difference is confirmed if one looks at the figures in table 5.V for the relation of 'cluster 1' goods to side-lying: there is no significant association with the left-hand-side as there is in Moravia.



The preponderance of left-hand-side burials might be taken as evidence that more men than women were buried in an archaeologically detectable way in Bohemia; this, however, does not explain the fact that 'cluster 1' goods seem to be proportionally equally distributed between left-hand-side and right-hand-side. The one feature which both areas have in common is an association between V-perforated buttons and burial on the right-hand-side, but even this must probably have a different meaning in the two regions.

Although the analyses just described of the age-sex associations of the grave goods are incomplete as a result of the lack of data, they still have a number of important implications for an interpretation of the rank system which involved the use of Bell Beakers and their associated goods. It has already been shown that children did not on the whole have access to any other grave goods than pottery and animal bones. These other goods, however, are certainly not present in all adult graves, and it has been argued that this is evidence for a non-egalitarian situation in which rank was achieved. For Moravia the association of 'cluster 1' objects with the left-hand-side position of the skeleton strongly suggests that such achievement was restricted to males, a point confirmed in the few cases where the sex of the individual has been anthropologically determined. Half the left-hand-side skeletons from Moravia have one or other of the 'cluster 1' goods. If one allows that some of these left-hand-side skeletons are children, it is clear that at least half, most probably more, adult males have some 'cluster 1' goods. Within this group there is, of course, some internal subdivision: although some of the graves contain several 'cluster 1' goods, most have only one, and some of these, like the copper dagger, were probably more valuable than others, such as chipped stone flakes.



It is less easy to say anything about the females since right-hand-side skeletons seem to include both men and women. Nevertheless, in view of the contrast with the 'cluster 1' associations, it seems clear that V-perforated Buttons and Töpfe could represent some form of female differentiation, while decorated Bell Beakers seem to be more or less equally associated with either side, but are in a minority of graves, unlike the jugs and bowls. Again, if one allows that some of these graves will represent children, decorated Bell Beakers might appear in perhaps half the adult graves, equally with both sexes. All these high proportions suggest that within the groups that were eligible for them possession of one or other of these goods was by no means exclusive, apart, perhaps, from such absolutely rare items as copper daggers. On the other hand, possession or lack of these goods does seem to be a valid dichotomy, as we saw in the comparison of children and adults. To obtain an adequate picture, however, it is necessary to look at all the distinctions in the grave associations and not just those discussed above; this will be done after a consideration of the evidence available for Bohemia.

In Bohemia too, as we have seen, there was probably a system in which rank was achieved, but the material basis on which to build a more detailed outline is less satisfactory since the relation between sex and side-lying is unknown (except in so far as it is different from Moravia), thus no great significance can be attached to associations between objects and the side on which a skeleton is lying. The main point which does emerge from the evidence is that a smaller fraction of the population than in Moravia have any of the distinguishing objects, a point confirmed by the low proportion of anthropologically determined adult skeletons in Bohemia buried with decorated Bell Beakers (see table 5.III). The number of individuals of a particular



sex with any of these goods must remain unknown until more skeletons are examined by anthropologists.

But although this source of information is lacking, it is not necessary to give up any hope of achieving some insight into the complexity which obviously exists. One of the main points put forward by Saxe (1970) is that each combination of grave attributes will represent the social identity of the individual buried; this will be some sort of composite of his various statuses and the result may or may not be unique. Although, in an archaeological context, this may be affected by such problems as preservation factors, the basic idea is intuitively acceptable and is documented by Saxe with ethnographic data. In the present case only goods were used as other attributes are considered elsewhere. The relations of the various grave good combinations to one another may be usefully expressed by means of a dendrogram based on an inter-grave similarity coefficient and a hierarchic fusion clustering method. In examining the dendograms account may be taken of the fact that some individuals will only differ from one another in minor respects and thus groups of similar but not identical graves may be defined. It should not be forgotten too that it is much easier for two graves to be exactly identical when there is one good in each than when there are five or six.

Dendrograms of the relations between the graves on which the original object cluster analyses were based are shown in figs. 5.5, 5.6. The dendrograms were produced by means of the average-link cluster analysis option in the program HIERAR from the CLUSTAN IB package (Wishart 1970); the inter-grave similarity measure was the Jaccard coefficient, which does not take negative matches into account (Sokal and Sneath 1963:133). The graves from Bohemia and those from Moravia

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were analysed separately. In each of these areas there were approximately 120 different combinations of grave goods in 200 graves. These combinations reduced to about 20 more or less coherent clusters, to which one must be added for empty graves. The number could, of course, be increased or decreased to some extent by taking different levels of similarity, but the validity of the clusters may easily be checked merely by looking at the contents of the graves in each particular group, and those selected here seem reasonably homogeneous. Before describing the results of these analyses, however, it may be as well to comment on the validity of using an aggregate of graves from a whole region when individual sites are not available. Given this situation, a number of points may be made in favour of the approach. On a least effort basis the level of contact within a settlement region is likely to be higher than with other areas. It has already been shown in an earlier chapter that there do not seem to be any important differences between different parts of the individual regions. Furthermore, if there were some sort of segregation of the population into different cemeteries, a more adequate overall picture would emerge from combining a number of them. Finally, as we will see below, in the case of the Bohemian Corded Ware, where it was possible to compare the analysis of a single site with that of an aggregate region, the results were essentially the same with regard to age/sex associations and the distribution of numbers and types of grave goods.

The main feature of the Moravian graves which may be appreciated from the dendrogram presentation is the complexity of the situation being investigated, from which our previous dichotomies have been derived. If the clusters are considered in relation to the 'wealth' of the graves (see list of grave contents associated with the dendrogram



fig. 5.5), about six or seven groups appear to have more than the average number of goods, most of them towards the right hand side of the dendrogram and culminating in cluster 17 at the extreme right. These nine graves may be considered the richest in the analysis, but they are not markedly richer than some of the other graves and the main impression is clearly that of a continuum; this corresponds to the situation visible in the bar graphs of variety and quantity of goods for the Moravian graves (fig. 5.1). The distinctions between richer and poorer are not marked by any sharp breaks although they are real enough, as we saw in the earlier comparison of adults and children with respect to certain goods. Study of the clusters enables one to see the evidence on which the associations of objects with the side on which the skeleton was lying, are based. Some of the groups, including those with the most 'cluster 1' goods, are exclusively left-hand-side, e.g. clusters 17, 18. Others, notably those with Töpfe or V-perforated buttons are right-hand-side, while others again are mixed, although it is interesting to note that some of these are children's graves. The converse of this is that there are several clusters of left-hand-side and several of right-hand-side graves, a fact which shows the differentiation within these two categories.

The Bohemian dendrogram is similar to that for Moravia in its general structure and in the number of clusters isolated, but there are several important differences. The number of clusters of 'richer' graves which can be distinguished is smaller (four or five compared with six or seven) and there is a tendency for those graves with larger than average quantities of goods to be more scattered through the dendrogram, and not to form such coherent groups as they do in Moravia. This is presumably the result of greater heterogeneity in the contents



of these graves and is perhaps an indication that differences in wealth and status in Bohemia were less sharply defined. Another, related, feature is that there is not a very marked degree of clustering of graves characterised by Bohemian 'Cluster 1' goods: decorated Bell Beakers, wrist-guards, copper daggers and ear-rings. This, of course, parallels the much lower level of structured clustering which the artifacts from Bohemia showed in the earlier object cluster analysis (see chapter 3). A further respect in which the pattern for this area is less clearly structured than Moravia is the association of particular clusters with the side on which the skeleton was lying. This is, perhaps, not surprising in view of the very marked majority of left-hand-side over right-hand-side graves, already discussed, as a result of which left-hand-side graves tend to predominate in any cluster. On the other hand, any expectation that the smaller right-hand-side group might be seen to correlate with a limited range of grave associations is not fulfilled. Right-hand-side, like left-hand-side skeletons are found with all varieties of grave good combinations, whether these are rich or poor and whether they consist of what might a priori be considered male or female goods.

Despite the structural differences between Bohemia and Moravia which have been demonstrated above, it seems unreasonable to claim that the two areas were at completely different levels of organisation in terms of their degree of ranking. In both the evidence seems to point to a non-egalitarian system of achieved rank, but with the distinctions more clearly marked in Moravia. This applies even to those distinctions between male and female which are found in any society and, indeed, perhaps raises the question of whether we are not dealing with a less structured use of symbols rather than a less structured society.

of these graves and in perhaps an indication that differences in water  
 status in Bohemia were more strongly related. Another related  
 feature is that there is not a very marked degree of clustering of  
 graves characterized by Bohemian 'finger' bones: decorated bell  
 pates, wrist-bands, conical pates and ear-rings. This, of course,  
 reflects the much lower level of archaeological knowledge which the  
 evidence from Bohemia allows. It is also a fact that clusters of  
 graves (see chapter 3). In the case of the Bohemian graves, this  
 fact is less clearly marked than in the case of the graves of  
 particular clusters which have been noted. The evidence is, in fact,  
 in, perhaps, not marked in the case of the very marked degree of  
 inter-relationship over a wide area, which, although, as a  
 result of which, it is not possible to postulate in any  
 cluster. In the case of the Bohemian graves, the evidence is that the  
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 side, the evidence is found that all varieties of grave good combinations,  
 whether these are rich or poor and whether they consist of one or two  
 items, can be considered as one or two items.

Despite the structural differences between Bohemian and British  
 graves, which have been described above, it seems reasonable to think that  
 the two groups were at completely different levels of organization in  
 terms of their degree of wealth. In both the evidence seems to point  
 to a non-egalitarian system of achievement, but with the distinction  
 not clearly marked in Bohemia. This applies even to those clusters  
 that between male and female which are found in the same site,  
 indeed, perhaps raises the question of whether we are not dealing with  
 a less structured use of symbols rather than a less structured society.

The difference between the richest and poorest burials is also wider in Moravia, although in neither area can it be considered very great; unfortunately, because of the lack of any ethnographically backed theory relating the scale of distance between rich and poor to the complexity and stratification of the society, it is difficult to draw any strong conclusions from this. If it is taken in conjunction with the evidence presented above, however, it seems to point to a not very marked degree of hierarchical complexity, certainly not comparable to that apparent in the Hopewell situation.

In order to test these inferences an investigation was made of the spatial evidence for social differentiation. Perhaps the main assumption required here is that developed social hierarchy is reflected in spatial hierarchy, a view whose basis in fact is well documented by Soja (1971) and others. There is a notable lack of settlement remains of any kind belonging to this period in both Bohemia and Moravia, and there is no evidence for anything which could be described as a centre. This contrasts with the situation in the preceding *Řivnáč* and *Jevišovice B* cultures, where such settlement differentiation is clearly to be found (see below chapter 9). On the other hand, if the hill-tops occupied by these two cultures were no longer preferred, and if construction techniques had changed, it is possible to imagine that such centres would not be found even if they existed. For this reason attention was devoted to the size differentiation apparent within the cemeteries. The dead in a cemetery may reasonably be regarded as the output of a given community over time: larger cemeteries may represent a larger community or a longer occupation, and in the case of the Bell Beaker presence in these two areas it is not possible to distinguish between these two as such. If



a site is larger than others, however, this may merely be the result of exceptionally favourable settlement conditions, or, more significantly, of the fact that the site is structurally differentiated from the others (i.e. higher than them in the settlement hierarchy). Given our earlier assumption that developed social hierarchy is reflected in settlement hierarchy, we may expect to find differences between the cemetery from such a site and others, either in the overall content of the cemetery (generally 'richer' graves) or in the degree of differentiation between richer and poorer. If such features were to be found, it would be considerable evidence that a settlement hierarchy existed, despite the lack of actual settlement evidence. This would indicate a complexity in the social organisation not suggested by the results described above.

A possibility which is the complete antithesis of this is that large sites might be poorer, with higher status individuals being buried separately from the others in more or less isolated graves. This would not in itself either support or refute the presence of a settlement hierarchy but would tend to emphasise the separation of the richer individuals from the remainder of the population and point to a rigidity in the divisions revealed by the cluster analysis. Clearly, if there were no trends in grave contents with cemetery size, it would to a certain extent, like any null hypothesis, leave the various options open, but it would also be the result most in keeping with the results of the age/sex distributions of the goods, and of the cluster analyses, not to mention the lack of settlement material.

As already mentioned, two aspects were of interest: were the graves in cemeteries of certain sizes richer on average than the others, and to what extent did the degree of differentiation between



richer and poorer graves vary with cemetery size? The first of these was measured in two different ways: the mean number of objects/grave, and the percentage of graves in cemeteries of different sizes which contained goods already established as probably representing high status or wealth. The degree of differentiation was rather more difficult since on a one-grave site it is obviously meaningless and it is not much better when only two or three graves are present. Finally, the three maximum differences (in terms of number of objects/grave) at each cemetery size were taken. The cemetery sizes were then divided into five grave intervals (cemeteries with 1-5, 6-10, 11-15, 16-20 graves etc.) and the maximum differences within each interval were averaged out. As a further measure, the mean number of objects in the richest 20% of graves was used; the 20% figure was taken from those Moravian graves with more than four varieties of goods and was adopted because of a break in the slope of the bar graph (see fig. 5.1). These statistics were plotted against cemetery size measured in number of graves, with the sizes grouped into five grave intervals as above.

Before describing the results, it is necessary to consider some possible distorting factors. At the lower end of the size scale, especially with the one-grave sites, it is likely that in some cases more graves were present than were actually found, since discovery often occurred under rescue conditions. Secondly, as many graves as possible were included in order to improve the sample size and some of these were not very well recorded. Here again one-grave sites are likely to be over-represented, since they were often recovered in poor conditions which might have resulted in a failure to observe or record



all the artifacts in the grave. It is also perhaps worth emphasising that the aim of this study is to detect trends. Obviously, the content of a given cemetery will depend on the status of the particular individuals buried there, and such factors, which are random in terms of looking for a trend, will not entirely disappear even when cemeteries and graves are grouped and averaged in the calculation of the various indices. The intention here is to find out whether there are any significant tendencies which show through the random variation, or if all the statistics appear to be invariant with cemetery size.

As usual the two areas are considered separately, with Moravia first. The results are presented in figs. 5.7-5.10. Figure 5.7, of cemetery size against the percentage of graves with decorated Bell Beakers and 'cluster 1' items shows some marked fluctuations but no sign of any trend. Figure 5.8, of the mean number of goods/grave is similar in indicating an entirely invariant relation with cemetery size, although the fluctuations are less marked. There is thus no evidence at all that the graves are overall richer in either larger or smaller cemeteries. Figures 5.9 and 5.10, of the range from richest to poorest and the mean number of objects/grave in the richest 20% of the graves, are slightly different from the first two and more similar to one another. There is perhaps just a slight indication of a downward trend as cemetery size increases, i.e. the range from richest to poorest seems to decrease slightly, as does the mean number of objects in the richest 20% of the graves, so there is a suggestion that some of the richest graves are in the smallest cemeteries. On the other hand, the trend is slight compared with the fluctuations from point to point, and it should not be forgotten that the sample



of small cemeteries is much bigger than that of larger ones and would, therefore, be likely to include a greater range of variation. None of the bar graphs provides conclusive evidence for a change of any kind in grave goods with cemetery size.

Bohemia has a rather different distribution of population in relation to cemetery size; there are even more graves at the lower end of the size scale and no cemeteries as large as some of those in Moravia - the mean number of graves per site is 2.23, compared with 3.40 for Moravia. The results of analyses identical to those described above are shown in figs. 5.11-5.14. There are some definite differences, in that the fluctuations are smaller and the statistics are generally lower in their absolute values, but the picture is essentially the same as for Moravia, with no obvious sign of any change in goods with cemetery size - in fact, there is not even the slight suggestion, which existed in Moravia, that some of the richest graves are in the smallest cemeteries.

On present evidence it seems best to accept the null hypothesis of no change in grave combinations with cemetery size in Bohemia, but to allow the possibility that in Moravia richer individuals might have been buried in smaller isolated groups on occasion, even if the main determinant of cemetery size was merely length of occupation and/or the presence of a larger community as a result of locally favourable conditions. The comparison of the two areas is particularly useful because it enables the results from one to be checked against those from the other. Although a basic similarity exists between the two areas, there have also been consistent differences indicating more marked differentiation of all kinds in Moravia. The suggestion of some slight spatial differentiation in this area and not in Bohemia



is only in keeping with this general trend.

In conclusion, it is necessary to assess the extent to which the analyses described in this chapter provide support for an interpretation of the widespread Bell Beaker artifacts as symbols of social differentiation. It was shown that most of the objects were largely restricted to adults, and that some of them were most probably also restricted by sex, factors which begin to explain some of the variation present in the graves and show that in these areas the artifacts did have a social significance. Further distinction was suggested by the fact that these goods were generally additional to the objects found in most of the graves and may be considered, from several points of view, as especially valuable. But, although it is clear that the widespread Bell Beaker goods were definitely connected with the symbolising of status, specifically high status, in certain areas, one must ask whether this in itself accounts for their currency over large parts of Europe. This is obviously a crucial question and it will be considered at length in a later chapter, but two points may be made here. Firstly, as we have already seen, the degree of ranking for which there is evidence in Bohemia and Moravia is not very marked, so to view the widespread Bell Beaker associated distributions as evidence for high-level inter-elite contact is inappropriate. This is well brought out by returning to our initial analogy with the Hopewell. There is no indication in Bohemia and Moravia of the hierarchy of centres which seems to have mediated transactions in the American Midwest, a lack which immediately points to a far less complex form of organisation. This is confirmed by a comparison of the degree of 'wealth' differentiation present in the Bell Beaker graves of Central Europe with that found in the mounds at such centres as the Hopewell

is only in keeping with this general trend.

In conclusion, it is necessary to consider the effect on the

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type site itself (Struever and Houart 1972). The analogy is clearly not very close in these important respects. Secondly, it is naive to assume that these goods are everywhere associated with a particular form of social organisation, or that they always symbolise the same distinctions. We have already seen that there are some important differences between Bohemia and Moravia, two areas which have always been implicitly assumed to be identical. The next chapter examines a third area, Central Germany, which is recognisably distinct in its material culture from the other two, in order to throw more light on these local differences within Central Europe.



## CHAPTER SIX: THE BELL BEAKER GRAVES OF CENTRAL GERMANY

It was emphasised in an earlier chapter of this thesis that no progress was possible without a detailed investigation of local contexts. The work already described has documented this context and its significance in two fairly similar areas - Bohemia and Moravia. It has been shown that the distribution of goods in the graves reflects the social organisation of these areas more than anything else, and that the role of the characteristic widespread Bell Beaker objects was most probably to express greater wealth/higher rank within this system. But, as we have suggested, there is no reason why the situation should be the same in other areas, and in order to follow up this question Central Germany was selected as an object of study. The area is, in effect, the basin of the Saale and its tributaries; it is geographically well-defined and represents one of the best agricultural areas in this part of Europe, with continuous occupation from the early Neolithic. Outside of Bohemia and Moravia it contains the greatest concentration of Bell Beaker assemblage finds in Central Europe.

The aims of the study were several, but the first was to find whether in Germany too the widespread Bell Beaker objects segregated from the other goods in the graves in the same way as they had done in Bohemia and Moravia. As we have seen, this was one of the most important points in the argument that they represented prestige goods in those areas. It was investigated by means of a cluster analysis of the artifacts in the way which has already been described (see chapter 3). Even while coding the information, it was clear that the situation was different. Many graves contained only a single object



and the range of goods which occurred was extremely narrow. Particularly marked in comparison with Bohemia and Moravia were the differences in the proportions of the goods: undecorated and decorated Bell Beakers far exceeded the other pottery types in quantity, with decorated Bell Beakers in almost a third of the graves. Apart from the decorated Bell Beaker, which occurred in greater quantities, and the wrist-guard and arrowhead, which were in approximately the same proportions as in Bohemia and Moravia, the other widespread Bell Beaker objects were either extremely rare or altogether non-existent. All these facts are reflected in the dendrograms (figs. 6.1, 6.2), which were produced by both single-link and average-link cluster analysis. The groupings obtained by the different methods differ widely, an indication in itself that they are unsatisfactory, and no obvious clusters appear. It is, however, interesting to note that in neither case do the decorated Bell Beakers associate with the wrist-guards or the arrowheads. It seems that even if the decorated Bell Beakers, wrist-guards etc. do represent prestige goods in the Saale area, the system in which they function differs from that to the south. It is important, therefore, to define the respects in which it is different, and to decide whether these are simply the result of a different material culture with a narrower range of objects usual in the graves, or whether it is the status system (as reflected in burial) which differs.

A necessary preliminary to this is an analysis of the importance of different types of variation in accounting for the differences observed. Intra-regional spatial differences, for instance, must be taken into account when treating a region's graves as a unit for the purposes of social analysis. More generally, if the amount of spatial



and temporal variation in the data is much greater than the variation which is of interest (here social), it indicates that the unit of analysis is at the wrong scale and needs to be reduced along one or both of these dimensions, by introducing chronological subdivisions and/or limiting the area which is to be analysed as a unit. Although such chronological and spatial distinctions have their own intrinsic interest, in this chapter they will only be considered insofar as they need to be documented and controlled, beginning with the spatial aspect since it is the most obvious.

As with so much archaeological measurement there is more to documenting this than might appear at first sight: there are at least three main aspects to consider. First and most basic of these is the simple placing of a particular object in the graves. However, even if an object occurs in the graves of a particular area, it may not be associated with the same objects as elsewhere and, further, even the same associations may be used in different ways as regards the expression of different social statuses. The first of these may be mapped simply by plotting the occurrences of the objects whereas the second two involve plotting associations: object with object and object with age/sex category. If it is believed that object typology may have social implications this too must be considered, although its main significance probably lies elsewhere. The final point which it is necessary to bear in mind is the nature of the archaeological record, which means that in many cases insufficient data will be available for any pattern to emerge, or the pattern itself will be an artifact of sampling.

Distributions were mapped for those object or grave attributes which occurred in sufficient quantity for a pattern to be detectable,



and this was essentially the sole criterion used. It was not necessary to impose any limitations based on presumed 'social relevance' of the features concerned, as the data set was small enough for all possibilities to be investigated. The maps are shown in figs. 6.3-6.9, and on the whole they present a picture of uniformity. The main exception to this is the distribution of stone cist graves (fig. 6.3), which are definitely restricted to a central area along and to the west of the Saale, south of the Bode and north of the Unstrut; this is essentially a geological constraint (Matthias 1956). The artifacts are more widely and evenly distributed. Decorated Bell Beakers (fig. 6.4) are found scattered over the whole of the occupied area, with perhaps a slight tendency for sites containing them to be concentrated along the main rivers; this pattern is especially marked in the south-western part of the region and may be an indication of the means by which the vessels were distributed (cf. Shennan and Wilcock 1975). Undecorated Beakers (fig. 6.5) are also distributed widely but they do not follow the rivers to the same extent as the decorated vessels and are perhaps slightly less frequent in the south-west. Wrist-guards too (fig. 6.6), while much less common, tend to be rather evenly scattered, although there does seem to be rather a concentration in the south, near the Erzgebirge, and this may be a reflection of a possible source area for the stone; on the other hand, it should not be forgotten that this is a distribution of the deposition of the wrist-guards in the graves, not of how many were in use in the area at a given time. Ordinary bowls, polypod bowls and handled vessels show no sign of concentration in any particular area (figs. 6.7-6.9).

Before considering the question of associations and their



distribution it is necessary to look for spatial variation in the distribution of the attributes of the various artifacts. This typological evidence is at least potentially one of the most important sources of information on relative chronology, and any spatial variation needs to be controlled if misleading results are to be avoided. The problem was approached in several different ways. Figures 6.10-6.12 show the distributions of the more common Bell Beaker motifs. The numbers of even these are relatively small so too much significance should not be attached to the results, but there is no sign of any local restriction. As well as this aspect the decorated and undecorated Bell Beaker shapes were also considered. A principal components analysis was carried out on measurements of the shape and the individual vessels plotted on a principal components scattergram (fig. 6.13). The first two components accounted for 90% of the variance, the first being easily the most important. In order to find out if this component represented any sort of spatial trend it was divided into intervals, and those decorated Beakers in a given interval were marked by the same symbol on the map (fig. 6.14); no spatial grouping emerged. Groups visible in the principal components scattergram were also plotted. with negative results for both decorated and undecorated Bell Beakers (fig. 6.15). Finally, the distribution of groupings of decorated Beakers based on visual inspection of the drawings was examined (fig. 6.16). These groupings took into account all the vessels' features, although zoning was probably predominant, and then shape, followed by motifs. The groups were, in fact, fairly distinctive and examples of each are shown in figure 6.17. There was no sign of regionality but again the numbers used were extremely small.

...it is necessary to look for spatial variation in the  
distribution of the attributes of the various attributes. This  
spatial evidence is at least partly due to the fact that  
sources of information on relative frequency, and any spatial  
variation tends to be concentrated in a few places and to be  
related. The problem was approached in a different way.  
Figure 2.10-1. It shows the distribution of the same seven fish species  
within. The numbers of each species are relatively small in most cases  
and the species are not as common as the others, but there is no  
apparent trend in the distribution of the species. It is not clear  
if any local trend exists. It may be that the species are distributed  
and associated with the same area and are not associated. A principal  
component analysis of the distribution of the species and  
the individual species in the same area. The principal component analysis  
of the species is shown in Figure 2.10-2. The first two components accounted for 80% of the  
variance, the first being nearly the most important. In order to find  
out if this component represented any sort of spatial trend it was  
divided into intervals, and these described species in a given interval  
were plotted on the same graph as the map (Fig. 2.10-3). No spatial grouping  
was evident. Groups visible in the principal component scatterplot were  
not related with negative results for both described and undecomposed  
all species (Fig. 2.10-4). Finally, the distribution of frequency of  
described species based on visual inspection of the species was compared  
(Fig. 2.10-5). These groupings took into account all the species' features,  
although some were probably predominant, and then shape, followed by  
size. The groups were, in fact, fairly distinctive and similar to  
what was shown in Figure 2.10-6. There was no sign of regionalism but  
again the numbers used were extremely small.

In turning to associations the problems are slightly different. In theory there are innumerable varying object associations which may be mapped, in practice virtually none occur in sufficient numbers to be worth mapping. Only three are, therefore, considered individually, and it may be said that even these are not really 'associations' in the usual sense of the word. They are as follows:

1. The distribution of decorated Bell Beakers occurring as the sole grave good.
2. The distribution of undecorated Bell Beakers occurring as the sole grave good.
3. The distribution of the 'richest' 25% of the graves.

The first two of these involve the lack of any association while the third is a composite of a variety of different associations with 'richness' in common.

The map, figure 6.18, shows those graves with undecorated Bell Beakers as the sole grave good and those with decorated Bell Beakers and no other goods, against all well-observed graves in the region; it may be added that decorated and undecorated Bell Beakers are never found together in the same grave. For the undecorated Bell Beakers we see a picture similar to that when simple presence of the undecorated Bell Beaker was mapped (fig. 6.5), again with the slight indication that they are less frequent in the south-west. The distribution of

In terms of association, the problems are slightly different. In many cases the association is not direct, but indirect, and is based on a common factor. For example, the association between the number of children and the number of children in the family is indirect, and is based on the common factor of the number of children in the family. The association between the number of children and the number of children in the family is indirect, and is based on the common factor of the number of children in the family.

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The first two of these factors are not directly related to the number of children in the family, but are related to the number of children in the family. The first two of these factors are not directly related to the number of children in the family, but are related to the number of children in the family. The first two of these factors are not directly related to the number of children in the family, but are related to the number of children in the family.

decorated Bell Beakers alone is identical to that for all occurrences of the vessel, except that the sample of well-observed graves includes none from the north-western part of the area with a decorated Bell Beaker. As a third index of spatial variation in associations, albeit an indirect one, the richest 25% of graves were mapped (see fig. 6.19); these were graves which scored in total 20 or more points on a scheme of values attached to the grave goods (see below p.125 for a fuller discussion of this aspect; also Clarke (1976) and S.E. Shennan n.d.). This distribution showed a fairly convincing restriction to the central and south-western part of the Saale area, with none being found in either the south-east or the north-west. The result is clearly of considerable interest for its suggestion that variation in richness may be a regional phenomenon and will be discussed in more detail below.

This point brings us on to the final aspect of spatial variation, whether objects are used in the same way throughout the area to express social status: the uneven distribution of rich graves might suggest otherwise. The point was tested further by examining the association of the decorated and undecorated Bell Beaker with the sex of the skeleton. This was the example for which the largest number of graves was available and it had the additional advantage of not pre-empting the results of the social analysis in any significant way. Several points emerge. In the south-west decorated Bell Beakers seem to have been used for both men and women: only one of the few examples of women with a decorated Bell Beaker is outside this area, where, as we have already seen, undecorated Beakers are rare. The map of those vessels associated with individuals of known sex suggests that decorated Bell Beakers are not found in the north-west, but this



impression is not correct, as examination of the full decorated Bell Beaker distribution shows (see fig. 6.4). Over the rest of Central Germany both decorated and undecorated Bell Beakers are found with men and virtually only undecorated Beakers with women.

Now that the main aspects of spatial variation have been analysed, it is possible to move on to the temporal dimension in the knowledge that most of the differences remain to be accounted for: thus, graves with undecorated and decorated Bell Beakers are not distributed in a complementary or mutually exclusive fashion, nor is there any indication of such a situation with the various types of decorated Bell Beaker themselves. As far as the graves are concerned, the most important contrast is the one between those with undecorated or decorated Bell Beakers. This is clearly seen in the dendrogram (fig. 6.20), which shows the results of an average-link cluster analysis on the Central German graves coded in terms of the goods they contain. There is a well marked division into two halves which corresponds very closely to the division between those graves with undecorated Bell Beakers and those with decorated Bell Beakers.

Schlette (1948) considered Bell Beaker chronology in Central Germany and came to the conclusion that the duration of the Bell Beaker phase was short. He believed that the undecorated and decorated Bell Beakers were contemporary, essentially on typological grounds, but that the so-called 'kesselformige' undecorated Beakers were late. Although such a view seems entirely reasonable, finding definite evidence for it is difficult. Stratigraphies are unknown, but this may perhaps in itself be taken as evidence for contemporaneity in view of the number of burial stratigraphic sequences in Central German barrows in which Beaker graves are secondary to Corded Ware burials and may themselves



precede Aunjetitz inhumations. The problem is made more difficult by the fact that most of the German graves only contain a single vessel. There is no association of an undecorated and a decorated Bell Beaker in the 107 graves which are more or less adequately recorded, a fact which emphasises their complementarity. Associations with other vessels are also rare; they occur in only 12 of the 107 graves. Bowls occur twice with undecorated Bell Beakers, undecorated handled Bell Beakers are twice associated with undecorated Bell Beakers and once with a decorated Bell Beaker, while there are four jugs with decorated and two with undecorated Beakers. This is marginal evidence in support of the view that the two types are contemporary but it would be easy to think of other possible explanations.

An alternative approach is to re-examine the typology of the vessels themselves. This depends on an analysis of the shapes and it is necessary to refer to the principal components scattergram (fig. 6.13), which has already been discussed in an earlier connection. It will immediately be seen that on neither component is there any suggestion of a trend from decorated to undecorated. What does appear is the fact that the decorated vessels are not at any of the extremes of variability; they tend to be concentrated in the middle. This points to a standardisation in shape which is paralleled in the decoration, and which may well be related to semi-specialist production (cf. Shennan and Wilcock 1975); it may be in this respect that they differ from the undecorated vessels, rather than in relative date of manufacture, since, as we have seen, they are all within the latter's range of variation.

Finally, perhaps the most convincing test is to find something else with which the distinction clearly correlates and to a large extent



this is found in examining the differences between male and female graves, as we have already suggested in our discussion of spatial variation. When all these considerations are taken into account it seems reasonable to accept that the two groups of graves are contemporary; indeed, it is a priori unconvincing that an assemblage without undecorated vessels could have existed, although it has to be admitted that these need not have been placed in the graves even if they were manufactured.

This discussion, however, has implicitly assumed that the decorated Bell Beakers are themselves undifferentiated when this is certainly not the case. As we saw earlier in this chapter, the presence of some not inconsiderable variation in shape, zoning and use of motifs is apparent even on a superficial examination. The question here is whether the type of Beaker relates in any way to the contents of the grave, as it might if the types represent a chronological sequence and grave contents too were changing with time. To find out if this was the case, the decorated Beakers were divided on an a priori basis into early, middle and late types, with the assumption that any sequence would follow that established in the Netherlands and Britain, representing a gradual process of zone contraction. The associations of each group were then studied although, unfortunately, typological details were available for only a small sample of vessels. Table 6.I shows the results. In both the 'middle' and 'late' groups there are graves containing decorated Bell Beakers alone, while jugs are found with both 'early' and 'late', and arrowheads with 'middle' and 'late' vessels. Most of the other objects occur only once, so on present evidence no more can be said than that there is little sign of any variation in grave contents which relates



to the vessel typology. This conclusion was supported by a study of the types of Beaker associated with skeletons lying on different sides i.e. left-hand-side or right-hand-side, which had the further advantage of using a rather larger sample. For both sides the most common was the 'late' variety, which is the most numerous type in the Saale area. Since, as we shall see, the side-lying reflects the sex of the individual buried, there seems to be no suggestion that males and females have different types of decorated Beaker.

The last point brings us on to our main interest in this chapter, which is an attempt to explicate some of the main features of the social organisation which existed in Central Germany at the time when Bell Beakers were in use. We know that there is a certain amount of spatial variation in the grave contents which will have to be considered since it may reflect organisational differences; on the other hand, although the evidence is slight, there is no indication that chronological variation, if any exists, is a significant factor affecting the associations of the goods put in the graves.

The first aspect which will be examined, however, does not depend on these results as it has its own independent means of verification: it is, of course, the relation between grave contents and the age and sex of the individual interred. Happily, owing to the work of Gerhardt (1953) and others, far more information exists on this subject in Germany than anywhere else in Central Europe.

Out of 64 burials where the age of the individual is known only seven are children. The small number of children present may mean simply that anthropologists have not examined many childrens' skeletons, or that children are genuinely under-represented in the known burials and were often buried in a different way from the



older members of the population; on present evidence it is not possible to distinguish between the two possibilities. It is similarly difficult to say whether any distinctions exist between children's and adults' graves as only seven definite burials of children are available for comparison and one of these is in a double grave with an adult. They contain nothing more than one or two vessels although in one case at least the vessel is a decorated Bell Beaker.

Opportunities to look at the socially recognised differentiation between men and women are more extensive since over 70 have had their sex determined by physical anthropologists . Less of these are female than male but it is doubtful whether any great weight should be attached to this fact since there are several possible reasons which could account for it. There might, by chance, be more males than females in the sample identified; the bias in favour of identifying skeletons as male by traditional methods (Weiss 1972) may well be a factor. It certainly cannot be claimed on the basis of the present sample that less females were being buried in a recognisable manner. The associations between males and females and all grave goods which occurred in any sort of quantity are shown in table 6.II. These also include two further aspects of the burial: the side on which the skeleton was lying and whether the grave included a stone cist or a wooden construction. As we have already seen that the presence of stone cists is regionally constrained, it is not surprising that the number of male and female graves without them is more or less equal. More interesting is the fact that of 20 cist graves with individuals of known sex 13 are male, but if a binomial test is carried out to find whether this differs from an assumed equal



distribution of the cists between males and females, the result is not significant at the 0.05 level.

The side-lying shows a more convincing distinction between male and female, with men predominantly on their left hand side and women on their right. It has often been claimed (e.g. Hájek 1968) that this is the characteristic rule for graves of the Bell Beaker phase in Central Europe, but the Saale region seems to be one of the few areas where it actually works; even here, however, it is not 100% valid.

Of the objects themselves a number show a sexually differentiated distribution but it is as a rule of a different sort, in which only one of the cells of the 2x2 table tends towards emptiness as opposed to the two of the previous example (cf. Boudon 1974). Thus decorated Bell Beakers are virtually all found with males but only half the males actually have decorated Bell Beakers. A similar situation may be observed with animal bones, wrist-guards and chipped stone, except that all of these are in much less than half the male graves. There is no object which shows a tendency to be restricted in this way to the female graves but the number of occurrences of pottery types other than decorated and undecorated Bell Beakers is very small and larger numbers might show such an association; the distribution of bowls and undecorated handled Bell Beakers could be taken as hinting at this. Those few decorated Bell Beakers which do apparently occur with females do not show any typological differences.

This outline of the variation which relates to the age, and particularly to the sex, of the deceased serves to show that at least some of the differentiation in the graves may be accounted for by this means, and it will be necessary to return to these results below. The analyses have further shown, however, that grave goods



and other attributes were used as a means of expressing social status and such a conclusion gives us confidence in attempting to extract more information from the data. In view of our initial hypothesis we are especially interested in whether there is any indication in the grave goods of wealth/status differentiation other than that already shown to be age/sex related. In fact, there are very few objects in the Central German Bell Beaker graves that could be considered to have any intrinsic value in terms of rarity of material or high-quality workmanship, except for the decorated Bell Beaker itself; tanged copper daggers are extremely rare, as is amber; wrist-guards occur with rather greater frequency. But although the range of variation in 'wealth' is relatively narrow, it may be assumed that if rank differences are symbolised at death they will be expressed with the means available, and, indeed, will be related to those means. In even the most egalitarian society other differences than those based on age and sex may be reflected in burial, for example kin group affiliation. It is necessary to distinguish these from those which relate to differences between higher and lower rank, or between greater and lesser wealth. It is assumed here that the axis of variation which best differentiates between higher and lower rank is one which orders the graves from 'rich' to 'poor' on the basis of specified criteria, an assumption based on the well-established association between wealth and power. Rathje (1973) argues that if this differentiation is very rigid it will, in fact, correlate with some of the other types of variation, for instance, that between different kinship groups. These other axes of variation will be considered in some detail below, but first the suggested rank differences will be examined.



The first prerequisite was to find out to what extent they existed at all. 'Wealth' was measured in two ways: in terms of the number of types of goods in the grave (most graves had only one of any given type) and of a points system which assigned values to the different goods on the basis of their rarity, inaccessibility of the necessary raw materials, and the effort and skill involved in manufacture (cf. Clarke 1976 and S.E. Shennan n.d.). Both these methods gave essentially the same results; the values attached to the goods are listed in table 6.III. They are, of course, disputable but probably represent a not unreasonable relative weighting. Bar graphs of the number of graves in each category are illustrated in figures 6.2<sup>1</sup> <sup>22</sup> -/ Both suggest that the majority of the graves are at the low end of the scale with a small number extending in a tail to higher values. This is a reflection of the fact that most graves have one, or very occasionally two, pots but a few have a vessel and some other objects.

It will be recalled from earlier in this chapter that graves with goods totalling more than 20 points seemed to be spatially restricted to the central and south-western part of the Saale region, and it is obviously relevant to the interpretation of these graves to find out whether this pattern has any significance. Tests were, therefore, carried out to see if those sites containing graves with over 20 points were randomly intermixed with the others; for this use was made of the nearest neighbour measure of spatial association already described (p. 84 ). The strength of the association may be measured by the phi coefficient:

$$\text{Phi} = \frac{bc - ad}{\sqrt{mnrs}}$$

The first paragraph of the report states that the purpose of the study was to determine the effect of the treatment on the growth of the plants. The results of the study are given in the following table. The first column shows the number of plants in each treatment group. The second column shows the mean height of the plants in each group. The third column shows the standard deviation of the heights. The fourth column shows the t-value for the comparison of the two groups. The fifth column shows the probability of the null hypothesis being true. The results show that the treatment had a significant effect on the growth of the plants.

The second paragraph of the report states that the purpose of the study was to determine the effect of the treatment on the growth of the plants. The results of the study are given in the following table. The first column shows the number of plants in each treatment group. The second column shows the mean height of the plants in each group. The third column shows the standard deviation of the heights. The fourth column shows the t-value for the comparison of the two groups. The fifth column shows the probability of the null hypothesis being true. The results show that the treatment had a significant effect on the growth of the plants.

or by the coefficient of segregation suggested by Pielou (1969),  
where

$$S = 1 - \frac{(c + b)N}{ms + nr}$$

This coefficient varies from +1 when the distributions are completely segregated to -1 when A and B are associated in isolated pairs of one A and one B. It is equal to zero when the two types are randomly intermixed. The contingency table for the German graves is shown in table 6.IV, together with the results of the various tests. The chi-square test indicated that there was a significant relation between the two distributions although it does not, of course, specify the nature of this relationship. This is given by the positive S value and the negative phi value as a slight tendency to segregation. The fact that these graves have more goods might merely be evidence of a tendency in the central and south-west area to put more goods in the graves, but this is not the case, since numbers of graves with one or even no goods are also to be found in the region. Given that the difference is genuine, it means that there is a greater differentiation between higher and lower rank in this part of the Saale area than in either the north-west or the south-east.

It is now necessary to ask what sort of social differentiation is implied by the differences observed along this axis from 'richer' to 'poorer'. The number of graves with more than 20 points is relatively small - only 18 out of 107 - and therefore constitutes less than 20% of the sample studied. If these graves are checked against the age and sex of the occupant where this is known, it appears that all of them are male except for one example which is, in fact, a double-grave; if the goods are divided in two to give the score for each individual



this does not come to 20 points. The males interred in these 'rich' graves all belong to the age groups *Adultus*, *Maturus* and *Senilis*, with most in the second one of these categories: reference to the table of male ages at death (table 6.V.) shows that such a distribution fits in with that for males in general. Of particular interest is the fact that the goods which make these graves outstanding are those which we have already seen to be restricted to males: animal bones, wrist-guards, tanged copper daggers, arrowheads, and other chipped stone.

These findings suggest certain tentative conclusions as to the nature of the social organisation in the part of the Saale area with which we are concerned. It seems likely that higher status was achieved; even though it remains uncertain whether children are really under-represented in the available graves, the few which are known have no more than the one or two vessels characteristic of most of the German graves. The achievement of such rank probably lay in fields of activity open only to men, an inference obvious from the types of goods concerned but further emphasised by the fact that it is only among men that any differences between 'richer' and 'poorer' are to be observed. There appears to be no female equivalent, simply the differences between graves with different kinds of goods which are found among men as well. There is no suggestion, for instance, that women achieved rank on marriage as there is at the early Bronze Age site of Bránč in south-west Slovakia (S.E. Shennan n.d.).

The particular aspect of the grave variation which has been the object of attention in the last section is, however, only one of several and not even necessarily the most important. In order to find out what other dimensions were significant a principal coordinates analysis was carried out. A detailed description of this technique



may be found in Blackith and Reyment (1971), but a brief outline will be presented here.

As the name implies, it is a variation of principal components analysis; however, instead of starting with the scores of units on variables it works from a matrix of distances or similarities. Eigenvectors of this matrix give the location of the units on the principal axes (Doran and Hodson 1975:194). The advantage over principal components is that it can be used on data which has initially been measured at the level of a nominal scale, so long as these observations can be turned into a measure of similarity/distance between individuals. The method's disadvantage compared with principal components is that it does not provide information about the loadings of the attributes in relation to the principal axes.

The graves were coded as usual for the variety of goods they contained and a program was then run on this data to work out the inter-grave similarities, using a similarity coefficient devised by Gower (1971). The resulting matrix was analysed by the principal coordinates routine in the GENSTAT computer package and the coordinates produced for each grave were output to a new file which in turn was used as input for subprogram SCAT/IB package; this produced scattergrams of the points in relation to the principal axes which are illustrated in figures 6.23-6.25. From the positions of the individuals it is possible to work out the meaning of the axes.

The significance of each of the vectors is given by the size of its associated eigenvalue, and for the German graves this may be seen from figure 6.26. The first two are clearly more important than the others but the next four are not entirely negligible. The poles of the first axis are those graves containing only a decorated Bell



Beaker and those with only an undecorated Bell Beaker; the division between undecorated and decorated Bell Beakers is the most important in the data - both occur a large number of times and are mutually exclusive. We have already seen that this represents a male/female dichotomy and the fact that there are more 'rich' graves at the decorated Bell Beaker end of the axis again makes the point that this richness is to be associated with male achievement.

The second axis contrasts graves with Beakers alone and those with bowls alone, the former at the negative end of the axis, the latter at the positive end. This too is the result of a situation where bowls and beakers almost never co-occur in the same grave but its significance in social terms is unknown; there are few bowls with skeletons whose age and sex has been ascertained: three of these are female, one is male and two are male and female double graves. Undecorated Beakers, however, at the other end of the axis, occur with both sexes and all ages, which suggests that other factors than these are involved in the contrast. The 'rich' graves are widely scattered along this axis.

The distinction between graves with a single object of one type and those with a single object of another type is, of course, both obvious and radical and the third axis is particularly interesting because it does not consist of such a contrast. At one end are graves with a bowl, or a bowl and another pottery type such as the undecorated handled Bell Beaker, at the other are graves with those objects characteristic of our higher rank group, including wrist-guards, animal bones and chipped stone artifacts such as arrowheads. Those graves with only a single decorated or undecorated Bell Beaker are found in between.

The implications of this result are several. First of all, since



it is based on the presence/absence of objects in the grave rather than on any 'richness' measure, but does, in fact, correspond fairly well to such a measure, it emphasises the close-knit aspect of the 'rich' group of graves - that it was characterised by a particular restricted set of objects. Secondly, the result puts this particular aspect of variation in the perspective of all the other (uncorrelated) types and suggests that it is the third most important, although considerably less so than the first two axes and more on a level with the next three. Finally, it indicates that this aspect of variation is independent of the opposition between decorated and undecorated Bell Beakers; we will return to this question below.

Perhaps the best discriminator between the 'rich' graves and the others, however, is a combination of axes three and four, as a glance at figure 6.24 will show. Axis four itself does not seem very meaningful as it presents a contrast between polypod bowls alone on the one hand and graves with ordinary bowls alone and those with the 'extra' goods on the other, although the latter graves are quite well spread out.

The fifth axis is represented at its extremes by the opposition of graves with polypod bowls and those with undecorated handled Bell Beakers. Examination of figure 6.25 shows that most graves are neutral on this component with the extremes characterised by a small number of outliers. Again the meaning of this variation is uncertain: what little evidence there is on the age and sex of associated skeletons again suggests that these are probably not relevant factors, while chronology seems unlikely; it is in any event almost certainly misleading to try and directly correlate the contrasts and oppositions represented by the different axes with, for instance, a specific



social division.

The sixth axis is more interesting because, although it is relatively unimportant, it is the first indication of a division in those graves with high-status goods. Moreover, the distinction is not between those with decorated or undecorated Bell Beakers, but between those with chipped stone artifacts, including arrowheads, and those with wrist-guards. This naturally raises the question of whether the wrist-guards are really associated with archery; there are also other reasons for questioning this assumption and the subject will be discussed more fully in chapter 11. More important here is the problem of what the contrast represents. Does it relate to different types of achieved rank? How significant is it that this vector is relatively unimportant and its associated eigenvalue only half that of the third vector, which emphasised the homogeneity of the 'higher status' graves? These are questions which cannot at present be answered. More work of a methodological nature is required, perhaps analysis of an ethnographic situation in which the answers are already known, so that the relation of the axes produced by principal coordinates analysis to structural features of the society can be examined.

The evidence for ranking, however, remains the centre of interest in this study, and everything that we have seen suggests that Central Germany was towards the egalitarian end of the continuum from egalitarian to stratified society. Although there is a not inconsiderable amount of variation in the graves, it is mostly at the same level. There is some indication of higher and lower rank among the men, but not among the women or children. Furthermore, the few rank distinctions which do exist seem to be restricted to the central and south-western parts of the Saale area - there appears to be no sign of rank



differences elsewhere, although this may stem from the relatively small number of graves analysed.

In the light of these conclusions it is necessary to consider the role of the Bell Beaker, particularly the decorated variety. It is far more common relative to other vessels than in Bohemia and Moravia, and the distinction between those graves with decorated and those with undecorated Bell Beakers is easily the most obvious in the graves of the Saale area: we have seen that it relates at least to some extent to the distinction between male and female. The majority of the graves which have been regarded as of higher status do actually contain decorated rather than undecorated Bell Beakers, and this clearly stems from the fact that both decorated Bell Beakers and higher status are associated with men. The emergence in the principal coordinates analysis of an independent axis which groups the 'richer' graves more successfully than the decorated-undecorated Bell Beaker axis would seem to be evidence for saying that the association of the limited range of objects characteristic of these graves with the decorated Bell Beakers is not especially close, a conclusion obviously different from that which came out of the analysis of Bohemia and particularly Moravia.

What are the implications of these conclusions for our initial hypothesis that the widespread Bell Beaker objects represent prestige goods? This may be the case for the copper dagger and the wrist-guard but does not appear to apply for the decorated Bell Beaker itself, except on the supposition that many graves of the period were buried without goods at all and have therefore not been taken into account; there are hints that this might be the case in Britain. It should not be forgotten, however, that the majority of those graves

different elements, although this may seem from the relatively small number of graves analysed.

In the light of these considerations it is necessary to consider the role of the Bell Beaker, particularly the decorated variety. It is the more common relative to other vessels than in Bohemia and Moravia, and the distinction between them is not so clear as it is with the undecorated Bell Beakers in which the great division in the graves of the same group: we have seen that it is not so clear as it is to the distinction between the decorated and undecorated Bell Beakers. The majority of the graves which have been reported as of the decorated variety contain decorated rather than undecorated Bell Beakers, and this clearly stems from the fact that both decorated and undecorated Bell Beakers are associated with them. The difference in the principal consideration of an individual site is that the 'decorated' graves are necessarily more numerous than the decorated-undecorated Bell Beaker sites would seem to be evidence for saying that the association of the decorated range of objects characteristic of these graves with the decorated Bell Beakers is not especially close, a conclusion obviously different from that which came out of the analysis of Bohemia and particularly Moravia.

What are the implications of these conclusions for our initial hypothesis that the widespread Bell Beaker objects represent products of a single source? This may be the case for the copper dagger and the wrist-guard but does not appear to apply for the decorated Bell Beaker itself, except on the supposition that many graves of the period were buried without goods at all and have therefore not been taken into account; there are hints that this might be the case in Britain. It should not be forgotten, however, that the majority of these graves

which did not possess the decorated form actually contained undecorated Beakers, not the jugs and bowls of Bohemia and Moravia; this makes it even more difficult to see the Beaker simply as a prestige introduction.

This sort of comparison raises problems however. It is relatively easy to compare social organisation in different areas, once they have been analysed separately, quite independently of the material cultural remains by which it is expressed. This is not so when trying to compare the roles and significance of objects, since this inevitably depends not just on the social organisation but on the significance of the other objects which are in use, and which will be specific to a particular area. In the next chapter the significance of the various inter-regional similarities and differences will be considered more closely.

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closely.

## CHAPTER SEVEN: INTER-REGIONAL CONNECTIONS IN CENTRAL EUROPE

### DURING THE BELL BEAKER PERIOD

The question of the nature of the inter-regional contacts lies at the very heart of the problems associated with the Bell Beakers. Finding a solution to these problems involves several stages, the first of which consists in defining what the inter-regional connections are. This must be followed by efforts to distinguish the processes likely to have produced such patterns, and finally an explanation must be offered of why the phenomenon appeared when it did. This is, needless to say, an ambitious programme, but an attempt will be made to complete it in the remainder of this thesis.

First it is necessary to recapitulate the general points made in chapter two concerning inter-regional similarities. Here attention was drawn to the fact that the settlement material associated with Bell Beakers varied considerably from region to region. The common links proved to be the decorated Bell Beaker, the polypod bowl, the wrist-guard, the tanged copper dagger, V-perforated buttons, arrow-heads and copper ornaments. It was suggested that all these objects had a social function, not simply a utilitarian one, especially as the great majority are found mainly or totally in funerary contexts. As a step in the move away from traditional interpretations of the Bell Beakers this realisation is important, but in investigating inter-regional variation it is only the beginning and it may be as well to consider it more closely at this stage, in order to differentiate the Bell Beaker from the other objects just listed. All the latter are rare wherever they occur and therefore may always be regarded as potential prestige artifacts. The same cannot be said of the



decorated Bell Beaker, as we saw in the previous chapter. Unless we assume that a considerable proportion of the population was not buried in an archaeologically recognisable way, it seems that in certain areas almost everybody was buried with a decorated Bell Beaker, and this seems to preclude a prestige function for the vessel in such areas as the middle and lower Rhineland and eastern Britain, where, it should also be noted, beakers of poorer quality play an important part in the domestic assemblages. This seems to indicate a core area of the type suggested by Clarke (1976), but referring only to the decorated Bell Beaker itself and not to any other part of the widespread assemblage. Such a core area would also be an obvious place for the origin of the vessel (cf. Lanting et al. 1973, on other grounds) although that is not our main concern here except insofar as it is necessary to think of a diffusion process producing the Bell Beaker distribution. On this view the core area itself is not in any way remarkable - the interest lies in the fact that a particular element in the assemblage of beaker-type pottery, the fine decorated Bell Beaker itself, expanded far beyond its original bounds, not least into Central Europe. The situation, however, is not as simple as this since, as we have just seen, part of the area, Central Germany, is characterised by an extensive use of the Beaker more like that seen in north-west Europe. Furthermore, this discussion does not take account of the other widespread types. These certainly did not diffuse from the west, and are not present there in the earliest phases - their probable origin lies in Central Europe (see below, chapter 11), and it was Sangmeister's recognition of this, as well as his awareness of the typological connections between Western and Central Europe, that led him to suggest his 'Rückstrom' theory, a hypothesis which has



long been unacceptable in the form in which it was proposed but which, nevertheless, contains some important perceptions.

A return to these general questions and an attempt to gather in all the lines of argument, will be made in the final chapter of this thesis; now it is necessary to specify in more detail the connections between the various regions of Central Europe, and to a lesser extent their connections with Western Europe, in order to try and draw conclusions about the manner in which the areas were linked and the processes which might have brought this about. Merely to suggest that the decorated Bell Beakers diffused from the core area proposed above is not particularly informative; furthermore, an examination of the inter-regional connections in Central Europe can provide information about the processes involved in those connections without any prior assumptions about where a given type of object may have originated. There is a number of aspects to be considered, not all relating to the objects themselves.

To begin with it should be remembered that the Central European Bell Beaker areas in general are differentiated from those of Western Europe by the range of pottery associated with the Bell Beakers: in the Upper Rhine area, Bavaria, Bohemia, Moravia, Austria, Hungary, and Poland, and to a lesser extent in Central Germany, this may be roughly characterised as consisting of dark grey cups, jugs, and conical thickened-rim bowls, as well as certain types of storage jar very different from the more beaker-like shapes further west; the distinctiveness of the area has been noted by a number of authors, e.g. Kraft (1947), Sangmeister (1964), Neustupný (1972). To emphasise this difference a comparison may be made between the small proportion of Bell Beakers in the funerary pottery of Bohemia and Moravia (see tables



7.I, 7.II) and the pottery from Britain illustrated by Clarke (1970), which consists almost wholly of decorated Bell Beakers.

Within Central Europe a question of considerable interest is whether the decorated Bell Beakers are associated with a uniform type of social organisation or are merely objects used in a variety of local social situations. For Bohemia and Moravia it was suggested that the funerary evidence indicated a system of achieved rank for which probably only adult males were eligible. The distance between richest and poorest was not, however, very large and it seemed likely that the degree of hierarchical complexity was not very great. This latter point was confirmed by the lack of any indication of a settlement hierarchy and the similar lack of evidence that a hierarchy was to be detected in the cemeteries. The situation in Central Germany was rather similar. Here too some degree of achieved rank, restricted to adult males, was apparent, although the extent of the differentiation between richest and poorest seemed rather attenuated when compared with the Czech areas, particularly Moravia, and this might be taken as evidence of less developed ranking. The relative similarity in the degree of structural complexity is not, however, so well matched in a number of other respects. The apparent difference between all three areas in the rules defining the side on which an individual was placed in the grave is worthy of note, as is the general indication that distinctions of every kind were better defined in Moravia than in Bohemia. Central Germany differs from both these in the way in which the objects were used, and possibly in the numbers which were manufactured. By and large a narrower range of types occurs in the graves, while decorated Bell Beakers do not form a cluster with other objects as they did in Bohemia and Moravia: the number of associations particularly



of any kind in Central Germany is, in fact, extremely small.

The final aspect which remains to be compared is the extent to which the widespread Bell Beaker artifacts, especially the decorated Bell Beaker itself, were prestige objects. This clearly seemed to be the case in Moravia, and to a lesser extent Bohemia, as we saw in chapter five. Here decorated Beakers appeared to be more associated with adults (although certainly not all adults) than with children, while graves with decorated Beakers contained more goods on average than those without. The 'cluster 1' objects discussed in chapter three, including the decorated Beaker, proved to be male-associated, but not enough data existed to say whether this also applied to the decorated Beaker alone.

In Central Germany insufficient information was available to come to any conclusion on whether children were less likely than adults to be buried with a decorated Bell Beaker, but it was possible to show clearly that the decorated Beaker was associated with males rather than females, and that the majority of the richer graves contained decorated rather than undecorated Bell Beakers. As we have pointed out above, however, Beakers, whether decorated or undecorated, are by far the most common form of pottery in the graves of Central Germany, a situation which cannot be accommodated within a model of the Beaker as a small-scale prestige introduction even if the decorated type did have some prestige significance.

The picture which seems to emerge then for Central Europe is of a relatively limited degree of rank differentiation probably based on male achievement. The means of rank expression in the area are similar and involve wrist-guards, tanged copper daggers and decorated Bell Beakers, to name the most striking features which the regions have in common. No connection need be postulated on the basis of the general

of any kind in Central Germany is, in fact, extremely small.

The final aspect which remains to be compared is the extent to which the widespread Bell Beaker artifacts, especially the decorated Bell Beaker itself, were greater objects. This clearly seemed to be the case in Norway, and to a lesser extent elsewhere, as we saw in chapter five. Here decorated vessels appear to be more associated with elite (although certainly not all elite) than with common, while graves with decorated vessels contained more elite than common items without. The 'elite' objects are found in larger sites, including the decorated beaker, proved to be elite-associated, but not enough data related to any further this also applied to the decorated beaker alone.

In Central Germany insufficient information was available to come to any conclusion on whether children were more likely than adults to be buried with a decorated Bell Beaker, but it was possible to show clearly that the decorated beaker was associated with elites rather than common, and that the majority of the richer graves contained decorated vessels, rather than undecorated Bell Beakers. As we have pointed out above, however, whether decorated or undecorated, are by far the most common form of pottery in the graves of Central Germany, a situation which cannot be recommended within a model of the beaker as a small-scale prestige introduction even if the decorated type did have some prestige significance.

The picture which seems to emerge from Central Europe is of a relatively limited degree of rank differentiation probably based on elite achievement. The means of rank expression in the area are similar and involve wrist-guards, ranged copper daggers and decorated Bell Beakers, to name the most striking features which the regions have in common. No connection need be postulated on the basis of the general

similarity in level of structural complexity, but the similar modes of symbolising apparently similar status positions do suggest some exchange of information. To understand the significance of this it is necessary to introduce some time depth, since the lines along which information went were now different from the preceding Corded Ware period, involving a closer link with the Carpathian area and a diminution in some respects at least of connections with northern Europe, although it should be noted that amber is more frequent in Bell Beaker than in Corded Ware contexts in Central Europe. What sort of processes were involved in this exchange of information and what were the reasons for the apparent reorientation? To try and answer these questions one has to look at some of the other ways in which the regions were and were not connected.

We have already commented on the recognisable distinctiveness of the Central European area, not simply in terms of its decorated Bell Beaker type, but also in the accompanying pottery, with its suite of cups, jugs and conical bowls. It is necessary to appreciate this for what it is, a functional set of table equipment, no doubt connected with particular eating and drinking habits. This group of vessels, with slight typological variations, is found from the Upper Rhine across Central Europe and the Balkans into south Russia at the beginning of the Bronze Age, and continues in use for a long period; in the Carpathian area its origins go back to the Baden period. The reasons why the equipment (and the associated customs?) spread so far west in the Bell Beaker period will be examined below, but it should be noted that the western areas, especially south Germany, which show connections to the east at this time are those which have similar connections at intervals throughout the Neolithic, a fact which suggests



that it is at least partly natural communications links which direct the lines of interaction here.

Merely looking at this data from a very general level, however, is inadequate. A more detailed specification of the inter-regional similarities is necessary if we are to establish the nature of the connections which were being maintained. Most of the documentation for these connections is to be found in Shennan (1977, see back of thesis) and reference will be made to the results presented there in order to avoid repetition. These results fall into two main classes: one concerned with quantities of certain artifact types in graves, the other concerned with variation within some of the artifact types. The first of these groups is particularly problematical, since the way in which these quantities relate to rates of manufacture rather than to preferences (and differential significance) in grave deposition is unknown. Figure 7.1, repeated from Shennan (1977) summarises the frequency diagrams representing the quantities of particular artifacts in the graves for four Central European regions: Central Germany, Bohemia, Moravia and Hungary; these quantities were standardised by the number of graves in each region as this varied considerably. Two points are immediately apparent. The first is the enormous variety of patterns represented by the different artifacts. Within this variety a distinction may be made between those artifacts which are found equally in the different regions apart from random variation, and those whose quantity differs markedly from one region to the next. The former include the copper dagger, the wrist-guard, the V-perforated button and the polypod bowl, which all maintain a low but more or less constant frequency across the four areas and are, of course, found in Western Europe as well. Funerary behaviour with regard to these

that it is at least partly natural communication links which direct the lines of information here.

Merely looking at this data from a very general level, however, is inadequate. A more detailed specification of the inter-regional distribution is necessary if we are to establish the nature of the connections which were being maintained. Most of the documentation for these connections is to be found in Volume 1, and lack of detail and reference will be made to the details presented there in order to avoid repetition. The data presented in this section are connected with an article on certain artifacts found in graves, the other connected with various other types of the artifact types. The first of these groups is particularly problematic, since the way in which these quantities relate to rates of manufacture rather than to reference (and differential) differences in these quantities is unknown. Figure 1.1, presented from Volume 1 (1977) summarizes the frequency diagrams representing the quantities of particular artifacts in the graves for four Central European regions: Central Germany, Bohemia, Moravia and Hungary; these quantities were standardized by the number of graves in each region as this varied considerably. Two points are immediately apparent. The first is the enormous variety of patterns represented by the different artifacts. Within this variety a distinction may be made between those artifacts which are found equally in the different regions apart from random variation, and those whose quantity differs markedly from one region to the next. The former include the copper dagger, the wrist-guard, the V-perforated button and the polygonal bowl, which all maintain a low but more or less constant frequency across the four areas and are, of course, found in Central Europe as well. Temporary behaviour with regard to these

artifacts was thus the same throughout Central Europe (i.e. they were put in a small number of graves), and it seems likely, in the light of the discussion earlier in this chapter, that this is a result of their being restricted to a small higher rank section of the population. Of special interest is the contrast between the distribution of undecorated Bell Beakers, which decline in number from Germany south-eastwards, and the decorated Bell Beakers, which do not show a directional fall-off although they are regionally variable. The reason for the difference may well lie in the decoration, which seems to have ensured the use of the decorated beaker in areas where the mere functional vessel type was either redundant or replaced by an alternative. Such a situation is unsurprising in view of the considerable amount of time and effort lavished on their ornamentation and gives further support to the role as prestige artifacts suggested for the decorated Bell Beakers on the basis of the analysis of the graves.

The significance of those patterns which show a marked difference from region to region is less certain. The directional decline should indicate that in some sense decreased interaction is responsible. The numbers of undecorated Bell Beakers and undecorated handled Bell Beakers both fall off from Central Germany south-eastwards, as does the number of polypod bowls expressed as a proportion of all the bowls from a given area. In absolute terms the number of polypod bowls remains very low but the number of ordinary bowls is much lower in Germany than elsewhere; similarly, the high absolute number of undecorated handled Bell Beakers may be compared with the low number of undecorated jugs. The explanation here may be that the south-eastern pottery equipment had not yet completely penetrated this more



north-westerly area as it had those regions to the south-east; this process may only have been completed in the early Bronze Age, with its Unetice inventory of typologically different jugs and bowls. Such a view has its problems, however: again it would be interesting to know the relation between the amount of the different pottery types manufactured and that used in the graves. Not all parts of a given distribution are, in fact, necessarily explicable in terms of the same factors. The low number of jugs in Hungary compared with Moravia may be a result of the widespread practice of cremation in Hungary which generally involved the deposition of an urn and a bowl but no jug (why not?), while in Germany a continued preference for the Beaker may be responsible for the low numbers there.

Rather more promising is the investigation of spatial variation in the decorative and morphological attributes of specific artifact types. Even superficial examination is enough to show that as far as pottery is concerned there can be no question of distribution from a single manufacturing centre in a particular region. Again the detailed results are to be found in Shennan (1977). Investigation of decorated Bell Beaker motif frequencies in the different areas showed that Central Germany was the most distinctive group because of the overwhelming proportion of metopic designs, which are far less frequent in any other Central European area. This, however, was only the most marked difference to emerge, since there were indications of regional variation in the use of other motifs, for example continuous zig-zags.

In order to investigate the extent to which variation in the other main morphological feature, shape, corresponded to that in motifs, multi-dimensional scaling was used on a number of groups initially produced by average-link cluster analysis. To quote Cowgill



(1972:396-7):

'multidimensional scaling is a way of seeking configurations of points, one point representing one entity, such that the rank order of distances between the points is the inverse of the rank order of similarities between the entities represented by the points.... In MDSCAL, the computer finds the best possible configuration in a specified number of dimensions, in terms of the stress, a measure of the extent to which the point configuration departs from the ideal of correctly representing all rank orders of resemblances between entities. Normally one begins with a space of several dimensions, computes the optimal configuration and the corresponding stress, moves to a space of one fewer dimension and repeats the process, and continues with spaces of progressively fewer dimensions.'

This work was carried out by means of the PLUTARCH system at Keele University (Wilcock 1974). The shape was digitised and described by means of Wilcock's 'Sliced method'; a random sample of 100 Beakers from all parts of Central Europe was used. The scalogram produced is shown in figure 7.2. Again Central Germany proved to be more distinctive - group MG 11 was exclusively Central German and MG 6 predominantly so. The main dimension of the scalogram represents the continuum from slim vessels on the right to squat vessels on the left. The Central German groups are clearly to the left, as are the Bavarian vessels, which form a significantly large proportion of group MG 2. Certain groups, MG1, MG4 and MG8 are not regionally restricted. It may be that these represent uniform preferences for certain types, or that they have a chronological significance and indicate a stage before regional diversification, but the latter is



unlikely since these three groups cover a great variety of types: MG44, for instance, is much closer to the German group MG6 than to MG1 or MG8.

The picture presented by the decorated Bell Beakers of Central Germany as the most divergent area is not matched when the undecorated jugs are examined (see again Shennan 1977). The positions of the groups of jugs on the canonical variates scattergram, illustrated again in figure 7.4 for convenience, indicate Hungary as the most extreme, with Bohemia, Moravia and Central Germany forming a relatively close-knit group on the right of the scattergram. Do these variations relate to differences in interaction, or, given the use of the jug, are modes for each area reached randomly and maintained by high intraregional connections? The example of the decorated Bell Beakers, where shape varies spatially in a similar way to the decoration, which is intrinsically likely to be dependent on connections, suggests that shape too may be dependent on interaction. The jug may well have spread to Central Germany from Bohemia, where it appears at an earlier date; this gives all the more reason for presupposing that the relative similarity in the jugs is a result of interaction. Why then are the Moravian and Bohemian jugs not similar to those of Hungary, since it has been suggested above that this ceramic equipment was developed in the south-east? The answer here is that the jug form had already spread to Bohemia and Moravia in the preceding Corded Ware period, and the close similarity between Corded Ware and Bell Beaker jugs is documented below in chapter 11.

With this basic description of the inter-regional connections it is possible to go on to consideration of the processes involved. These will first be approached from an organisational point of view.

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As we have seen there is no evidence whatsoever in Central Europe for any form of central place during the Bell Beaker period; this is in contrast with certain earlier stages in the Eneolithic of the area, and also with the contemporary situation in Britain and Iberia, as will be shown below. If this lack of evidence reflects the true state of affairs, and the relatively limited degree of achieved rank differentiation which has been demonstrated suggests that it may, it seems likely that any form of exchange other than the various reciprocal varieties (see Renfrew 1975) was non-existent: this therefore excludes redistribution and market exchange within the region, as well as directed long-distance trade from particular centres in one region to particular centres in another, although there might be preferential links with special resource areas. Given that this is a correct assessment of the situation it rules out a fortiori the possibility that exchange was organised in the same way as in the Hopewell Interaction Sphere. There exchange was mediated through regional and then more local transaction centres: directed trade followed by more local redistribution organised by the upper class in a stratified society. Within a given region in the Beaker case contacts would have been based on kinship and the exchange of marriage partners, together with interest in access to differentially distributed resources; transhumance too may well have played a part. Between settlement regions the most important of these connections, the kinship and marriage ties, would be likely to decline markedly, especially with transport at a primitive level; figure 7.4 shows how even today in less developed parts of North America natural barriers can affect such connections. One situation in which, at least initially, inter-regional kinship and marriage ties would not

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be low is the directional movement or expansion of population; the Bandkeramik is obviously an example of such expansion producing a high degree of similarity. In Central Europe, however, the evidence presented throughout this dissertation indicates that such population movements are most probably not to be associated with the Bell Beakers.

This basic organisational setting must now be supplemented by considering the facts already presented. The main point here is that we are not simply dealing with the exchange of objects since it is clear that many were manufactured locally, including decorated Bell Beakers. Because of this, it is at present impossible to specify the precise connections of one place to another in the way which can be done for easily characterised materials. Some work is being undertaken on the subject of pottery characterisation for the Bell Beakers and their associated vessels (Peacock and Shennan, work in progress), but this is not yet complete. Most probably, however, local manufacture was a result of the importation into Central Europe of examples of decorated Bell Beakers which were then locally imitated. If this exchange took place by means of down-the-line reciprocal exchange, no single vessel need have moved a very long distance, although again natural communications would have an effect - the Danube is particularly important here. At least semi-specialist potters are likely to have been involved in the process, manufacturing particularly high quality vessels which attained a relatively widespread distribution and were then copied with inferior techniques and materials (see Clarke (1976) for an extensive discussion of this point). The possibility of such a two-tier system operating in Central Germany was put forward by Shennan and Wilcock (1975).



We have postulated some of the processes involved in the connections, but to make further progress we have to consider precisely why inter-regional contacts should have been maintained at all. This point has already been touched upon earlier, when by implication it was suggested that the most important reason was interest in access to differentially distributed resources; these may be taken to include everything from pasture for flocks to luxury objects, or rather, in the less developed social context being considered here, what Dalton (1975) calls primitive valuables. It may be that the different patterns of interaction documented in the preceding part of this chapter are a reflection of these different needs and of the ways of fulfilling them. Seasonal exploitation of the low watershed between Bohemia and Moravia may well have led to the greater degree of contact between these two areas which the archaeological evidence indicates; certainly the natural barriers between these two areas and Germany and Hungary are considerably greater. This may seem surprising in view of the fact that Bohemia and Central Germany are both connected by the Elbe, but it should be remembered that the Bell Beaker settlement area in Central Germany lies largely up the tributaries of the Elbe, in the Saale-Unstrut area, and that these rivers actually join the Elbe well to the north of Bohemia. Such contacts, however, cannot be regarded as central to the problems we are trying to solve; these require a return to the overall picture. Within Central Europe the connections are quite extensive and many of them follow lines already well established in the Neolithic. It is the newly forged link between Central and Western Europe which must be the focus of attention if we are trying to explain the unusual features of the Bell Beaker distribution.

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development.

If inter-regional contacts are to be related to needs, what new needs had arisen to make the pattern of contact associated with the Bell Beakers different from that which preceded it? We have already seen that the long distances involved largely preclude kinship and marriage contacts, as well as the bulk movement of subsistence commodities. The importance of means of transport too should not be overemphasised - these continued to be available whereas the period of Bell Beaker contact is a single episode. It seems possible that there are three main factors to be considered, a group of innovations, all reinforcing one another in their effects on the network patterning: the spread of the domestic horse, the diffusion of the metallurgical skills required to exploit the complex copper ores of Western Europe, and the appearance and spread of the copper dagger as the status weapon, evidently, together with the wrist-guard, replacing the stone battle-axe. These features, as we will see, have their origin in Central Europe, particularly the Carpathian Basin, and it is suggested that it was interest in them which led to the connection of Central and Western Europe. Such a suggestion again invites comparison with the Hopewell Interaction Sphere which, whatever its purpose, had the effect of moving rare materials and objects over long distances, including items which clearly had a social/ritual significance.

First, the question of the domestic horse will be considered. It might perhaps be thought that this comes under the heading of subsistence economy and as such should be dealt with elsewhere, but it was in any event probably of social rather than economic significance, and here we want to examine the possibility that it may have played such a role as we have suggested in the formation of the Bell Beaker network. In order to do this we need to know the date of the



earliest occurrence of the domestic horse in the various parts of Europe, together with the possibilities of local ancestry. A number of authors have dealt with these problems, both in general (e.g. Nobis 1971, B8k8nyi 1974) and in relation to the Bell Beakers (e.g. Sch8le 1969, van Wijngaarden-Bakker 1974).

The lack of morphological or size distinctions between wild and domestic horses is well-known (see e.g. B8k8nyi 1974), so other criteria have to be used. Probably the main ones are whether the environment in the area in question would have been suitable for wild horses, and whether there is a more or less continuous history of horses in the area from the end of the Pleistocene. According to B8k8nyi (1974), horses are completely missing from Neolithic contexts in Hungary and, therefore, probably died out in or before this period. Sporadic horses are first found in the Middle Copper Age Bodrogkeresztur culture and then continuously into the Bronze Age. In the Baden levels at P8csk8, Hungary, (B8k8nyi 1968) a single horse bone was found; this is a hill-top site in an area forested to the present-day and B8k8nyi believes that it is a most unlikely environment for wild horses. His conclusion is, accordingly, that the Copper Age horses are domestic and must have been introduced. At a similar date there is much evidence for an increased use of horses in the south Russian Tripolje culture (Nobis 1971), a use which Nobis believes gradually spread westwards.

The evidence for western Europe has been summarised by van Wijngaarden-Bakker (1974); it appears that small populations of wild horses were present in the area during the Mesolithic and Neolithic, and that there is no break as there was in Hungary. Her main interest, however, is the late Neolithic horses from New Grange and she argues convincingly that there is very little evidence of post-glacial horses



in Ireland, indeed, that the densely forested terrain would have been most unsuitable for the wild horse. The New Grange horses are thus probably domestic and imported. According to Schüle (1969), the same applies to the horses (Equus caballus) from the site of Cerro de la Virgen, south-east Spain. The wild ass, E.hydruntinus, is also known from this site and Schüle considers the simultaneous occurrence of these two wild equids in the same region to be unlikely for ecological reasons.

If we can accept the evidence for domestication just presented, it is now possible to look in detail at the dates of occurrence of these horses, and particularly whether they are contemporary with the Bell Beakers. As we have seen, they appear sporadically in the Hungarian Copper Age from the period of the Bodroghkeresztur culture onwards. This pattern alters in the sites with Bell Beakers on the Csepel Island near Budapest, where, at Csepel-Haros, over 65% of the bones were horse. The Bronze Age (Nagyrév and later) sites examined by Bökönyi (1971) showed a steady but low frequency of horse bones. To the north-west, in Bohemia, the earliest evidence of horses is again of pre-Bell Beaker date, in Řivnáč contexts at Homolka (Ambros 1968) and Lysolaje (Pleslová-Štiková 1972a). There was some doubt about the Homolka find since Únětice Early Bronze Age material also occurs on the site, but its authenticity is given at least some support by the subsequent find at Lysolaje. In Moravia there is no evidence for horses in pre-Bell Beaker contexts. Half a lower jaw was found in a Bell Beaker pit at Mostkovice (Archive AU ČSAV report 928/50) while a Bell Beaker burial at Vyskov was accompanied by two horse skulls (AU ČSAV, report 1493/59). Of a similar date must be the double horse burial with late Corded Ware goods from Grosshöflein-Follik in the



Austrian Burgenland (Behrens 1964), and the horse in a late Corded Ware context at Gleina, Central Germany (Clason 1969).

Further west the earliest occurrences of domestic horses do seem to be contemporary with the appearance of Bell Beakers. Those discussed above from New Grange in Ireland are associated with Bell Beakers. In Spain the pre-Beaker phase at Cerro de la Virgen has not revealed any horses; these first appeared in the Bell Beaker levels. Finally, there are also occurrences of horses in the Netherlands with Bell Beakers (van Wijngaarden-Bakker 1974:347): beneath a Bronze Age barrow at Oostwoud Beaker sherds and a horse tooth were found, while at the site of Velsen horse teeth were also associated with Bell Beaker pottery. Both these sites are in the western part of the Netherlands where, as in Ireland, the environment must have been extremely unfavourable for wild horses.

The next question which must be asked concerns the purposes for which these horses were used: were they simply another food animal or were they used primarily for transport? Here it is important to differentiate the Csepel finds from all the others. These latter are all relatively sporadic and the burials from Vyškov and Grosshöflein-Follik can reasonably be interpreted as indicating a special importance for the animal. This evidence is in keeping with a situation in which the horse was a relatively rare and no doubt expensive animal used for transport and only killed at a fairly advanced age; unfortunately, information on the age at which they died is not available, but use as a subsidiary food animal does not seem very likely.

The Csepel Island sites with their very large proportion of horse bones are clearly different. Given that they do not indicate seasonal hunting of wild horses, which does not seem probable in the light



of the preceding discussion, what is their significance? They may well represent special purpose sites associated with horse exploitation, since they differ not only from other Bell Beaker contexts with horses but from other Hungarian finds of both earlier and later periods. Even at this date the Carpathian Basin may have been an especially favourable environment for domesticated horses (M. Levine pers. comm.), and it is tempting to see the area as a reservoir from which places further west obtained domesticated horses, perhaps before the establishment of local domestic breeding populations. The sites on the Csepel Island would then represent places where horses were concentrated for exchange. Apart from the large number of horses on the Csepel Island, the pottery assemblages themselves give some support to this interpretation. As we have seen earlier, these consist overwhelmingly of local proto-Nagyrév pottery, but mixed in with this is a constant small proportion of fine ware decorated Bell Beakers, which are found too in many funerary contexts. Although isolated finds of decorated Bell Beaker sherds have been made elsewhere in the western Carpathian Basin, the sites of the Budapest area are completely unparalleled in their frequency of Bell Beaker finds. Moreover, this concentration is completely isolated. There are virtually no finds of decorated Bell Beakers along the Danube west of Budapest until one reaches the Lower Austrian/Moravian group, although sites with the contemporary accompanying pottery are known; this fact strongly suggests that the decorated Bell Beaker distribution was not a simple monotonic fall-off, but was directed by some constraint. The hypothesis offered provides an explanation for this constraint and also for a situation noted earlier in this chapter. It was seen that the decorated Bell Beakers of Hungary are much more similar to those of



Moravia than are the undecorated jugs of the two areas. If one assumes that there were local jug-making traditions in each area but that the decorated Bell Beakers were introduced into Hungary, if not in exchange for horses, then at least in connection with this exchange, and were then perhaps imitated locally, the reason for the situation becomes clear. It should be remembered too that in the Budapest area the cremation burial rite continues to be predominant, in contrast to the inhumation rite further west: only the widespread Bell Beaker goods are introduced. These last points are not strictly dependent on the horse as a motive for exchange - other things may have been desired. The horse, however, may be particularly relevant when the precise date at which the connections occur is considered - the domestic horse, at least in any quantity, may not have been available at a much earlier date in Central Europe.

The horse then seems to be a new factor which might have changed the pattern of inter-regional relations. Another is the tanged copper dagger. It is not only in Temperate Europe that the dagger is important, Renfrew (1972) has documented its role in the Aegean Early Bronze Age. As we will see in a later chapter, there is evidence that tanged daggers were in use, and being manufactured, in the Carpathian area as early as the Baden period if not before, and that it continued through the Vučedol-Makó phase. In north-west Europe, however, and indeed in Central Europe west of the Carpathian Basin, it is introduced with the Bell Beakers, even though it now seems clear that sophisticated shaft-hole axes such as those of type Eschollbrücken (Müller-Karpe 1974) were being manufactured in that area in the preceding Corded Ware period - in fact, the sequence of development seems to be similar to that which the Balkans underwent at an earlier



date, with complex axes appearing before the dagger. The significance of the dagger is well described by Renfrew (1972:320).

'The plain fact is that until daggers were invented, no metal product was so remarkable or original as to be indispensable. Stone axes were nearly as efficient as copper ones, and shaft-hole axes of copper were not an enormous improvement upon those of antler furnished with a stone working edge. The dagger, on the other hand, was a new form and one which could not be, or at any rate was not, produced in the Old World from obsidian. Flint daggers apparently make their appearance in Europe only after that of the metal dagger.'

At the same time as it is introduced, the importance of the dagger receives social acknowledgement: the stone battle-axe goes out of use as an important item of male funerary equipment in large parts of Central and north-western Europe and its place is taken by the tanged dagger and the stone wrist-guard.

An attempt will be made elsewhere to answer the question of why there should have been a demand for new prestige equipment, for it is now time to turn to the last of the group of innovations defined earlier - the spread of the metallurgical knowledge necessary to exploit the copper ores of western and north-western Europe. The indications are fairly convincing (see Case 1966, Butler and van der Waals 1966) that the Bell Beaker period, although not its earliest phase, saw the introduction of an indigenous metallurgy to north-west Europe, an industry which manufactured not simply tanged daggers as prestige equipment, but also flat axes of a more functional nature. Copper metallurgy had been known in the Carpathian Basin and its



north-western peripheries for more than a thousand years before this expansion took place but it was only relatively late in this period that techniques were developed which allowed the exploitation of the more difficult unweathered ores which are the only type available in western Europe (Sherratt pers. comm.). This must certainly be a limiting factor in determining the date at which indigenous metallurgy began in the west although other reasons too were no doubt involved. It is worth recalling the association between Bell Beakers and metallurgical techniques given by the "smiths' graves" - Butler and van der Waals drew attention to several finds from the Netherlands and other areas in a Bell Beaker context, including one from Stedten in Central Germany; one of the Bell Beaker graves from Holešov, Moravia, may be added to this list (Ondráček, unpublished report, see fig. 7.5). The significance of these graves, however, lies not so much in documenting the connection between Bell Beakers and metallurgy, for which other evidence is available, but in demonstrating the social recognition of the smith's role, a recognition which may be seen as indicating the importance if not the novelty of the smith's position. As we will see below, there is no indication of this role in the graves of the preceding period.

If we now go back to our initial question about new needs being responsible for new connections, several points may be made. It is doubtful how far the movement of resources as such is the reason for the contacts. The connection is different, marked by the knowledge of a pottery type and metallurgical skills, the adoption of a 'status kit', the introduction, or considerably increased use, of the horse, and a change in the form of burial in some areas. Interest in acquiring those particular features for which we have already



suggested a Central European origin resulted in the establishment of relations oriented in the direction from which they came. Prestige equipment, use of the horse and metal technology moved westwards, while examples of the fine component of a basically Beaker local assemblage were abstracted from their context and moved east. Whether this was because of their intrinsic attractiveness, their contents, or their association with some fashionable drinking custom, is unknown. Certainly, as Clarke (1976) has shown, an interest in fine pottery for its own sake should not be regarded as improbable, especially at a time when metal had not yet completely taken over as a means of prestige expression. In this context it is worth recalling again the observation that the proportion of the ceramic assemblage made up of undecorated Bell Beakers falls off rapidly as one moves south-east through Bohemia and Moravia to Hungary, where there are none, while the proportion of decorated Bell Beakers is relatively constant - an indication that it may be the fine decoration which was particularly prized and imitated. The fact that developments in pottery decoration which had occurred in Central Europe began to be taken up in the west only further demonstrates the continuing ceramic contact, quite possibly involving the exchange of Central European Bell Beakers a long way to the west (cf. the vessel from Harskamp, Netherlands). It should perhaps be made clear that this hypothetical reconstruction of the events associated with the presence of the Bell Beaker assemblage in Central Europe only applies to the southern part of that area: Bavaria, Bohemia, Moravia, Austria and Hungary. In Central Germany with its largely Beaker assemblage the situation does not seem to be the same and it will be discussed in more detail below.

It is, however, insufficient to talk about innovations at this



large scale, as if their adoption was inevitable once they had appeared. Recent work in geography and sociology (e.g. Rogers 1962) has shown that this is certainly not the case. It is necessary to see how they relate to local developments before an adequate explanation can be offered. A beginning has been made with this task in the previous chapters dealing with the synchronic functioning of regional social systems, but the dimension of change through time must be introduced, both to see if our model is valid and, if so, to try and explain the situation it postulates.



CHAPTER EIGHT: THE CHRONOLOGY OF THE LATER ENEOLITHIC  
IN CENTRAL EUROPE

The establishment of satisfactory chronological frameworks remains as important today as it has ever been. Although aims have changed, and there is no longer any interest in space-time frameworks for their own sake (if there ever was), a knowledge of the sequence of remains is indispensable to any attempt at explaining them. In studying change we must define what changes took place. This problem is especially acute in the case of the Bell Beaker phenomenon in Central Europe since the sequence is both crucial and very much at issue. As we will see below, there are two main schools of thought on the Eneolithic chronology of Central Europe: one regards the 'cultures' of the later Eneolithic as largely contemporary with one another; the other, whose main proponent is E.F. Neustupný, believes them to be successive. Before discussing the actual evidence which has given rise to these different interpretations, it is important to discuss and evaluate the types of evidence which are admissible in a chronological argument; only when this has been done is it possible to come to a conclusion as to the merits of the various arguments advanced.

Probably the most satisfactory source is radiocarbon dating, although it is doubtful whether this is fine enough for some of the distinctions in which we are interested, once the dates have been recalibrated on the lines indicated by Clark (1975). Unfortunately, one of the main areas in which  $C^{14}$  dating has been contested, or at least ignored, is Central Europe. There are, as a result, very few dates available here for the later Eneolithic and early Bronze Age;



the situation is especially bad in the most important area for this study, Czechoslovakia. Good series are available from the Netherlands and Denmark, but use of these dates means the introduction of problems about the relevance of the situation in those areas to that in Central Europe. These will be discussed in detail below.

The other relatively incontrovertible source of data is stratigraphies. These too are not available in such large numbers as one would like, and many of them are on the periphery of our geographical centre of interest. They really provide the basis for the regional chronology although there is still room for dispute in their interpretation. The stratigraphies often depend on careful observation of pit intersections and their value is considerably diminished if the quality of the excavation is poor, while it is quite possible for the beliefs of the excavator to influence his observations. For example, it was long believed, under the influence of Kossina, that the Mansfeld group of the Central German Corded Ware represented the earliest phase of the development although it is now known to be the latest. When a barrow was excavated which contained a Mansfeld vessel in the upper grave and a herringbone Corded Ware beaker in the lower, it was assumed by the excavator that the latter must have been cut through the former, despite the fact that there was no visible evidence to support such a view (C. Fischer 1959).

The other main foundation on which the chronology rests is, of course, typology. This is certainly the least satisfactory, as many people now accept. The problem starts with the initial definition of entities. There is no denying that the Corded Ware and Bell Beaker assemblages are basically separate entities as regards typology and many other aspects, such as grave orientation, but at



the borderline between them use of these names, with their implied dichotomy, prejudges the very issues which are the object of investigation. Other difficulties arise when making use of typological correspondences from one area to another. First there is the problem of deciding whether similarities are significant, fortuitous, or functional, and second, the question of whether typological similarity means chronological equivalence (which it often does not). It will become clear below that many unsatisfactory typological arguments have been used, but a characteristic one may be mentioned here. Hájek (1966a:104) claims that a flower-pot shaped vessel from a Bell Beaker grave at Slany-Kvíček is similar to certain vessels of the Řivnáč culture, and that the Bell Beakers and Řivnáč are therefore likely to be contemporary. He ignores the point that it is a simple vessel shape, which no doubt had a particular function, and even overlooks the fact that if one must see the vessel as a reflection of connections with other groups these might just as easily be with the Mansfeld group of the Central German Corded Ware, which also has such vessels.

Typology at least involves the use of archaeological evidence. More dubious still are the a priori arguments which have been invoked by a number of authors, especially Neustupný (e.g. 1965). He assumes that if two material culture assemblages are contemporary in an area then one is likely to find numbers of associations between them, as well as mutual typological influence. This implies the naive view that contacts will invariably result in some degree of mutual acculturation. Other reactions, of course, are also possible, such as the building of strong cultural barriers to diffusion (cf. Barth 1969). Another of Neustupný's a priori beliefs is that, since Corded Ware sites are



densely distributed in Bohemia, there can have been no room left for any of the other groups that are supposed by other authors to be contemporary. This involves the assumption that the assemblage represents some sort of human group. This might in some circumstances be broadly correct but, even if it is, there is much ethnographic evidence that groups with different economies can live in the same area, as Ehrich (1968) and others have pointed out. Often, however, cultural assemblages do not represent such human groups, and to exclude a priori the possibility that different material assemblages can be in the same area at the same time cuts off part of the range of potential material culture distributions. To what extent it is possible is obviously relevant to the significance of such distributions and must be determined empirically.

It is now time to turn to the detailed evidence from the different areas, starting with the various regions of Central Europe but also including others which are relevant to the Central European chronology. The approach adopted is to present the evidence for each area in turn and more or less in isolation, before attempting a synthesis of all the information. The chronological span is roughly 2500-1650 b.c. in radiocarbon years which calibrates to 3250-2050 B.C. on the tables produced by Clark (1975:264). The first area is the Carpathian Basin since the chronology of this area is rather less controversial than that of the areas further to the north-west.

### 1. Carpathian Basin

The radiocarbon dates for the Carpathian Basin are shown in figure 8.1. A basic pattern emerges in which the Nagyrév culture is definitely later than most of the other groups, with Vučedol in the



middle; the Baden culture and, perhaps surprisingly, the Laibacher Moor material are the earliest. The dates for Bell Beakers and associated pottery cover about 500 radiocarbon years and overlap with both the Vučedol and the classic Nagyrév, so this evidence is hardly sufficient to establish a useful relative chronology. Stratigraphies confirm this sequence and provide some more information on the relative position of the Bell Beakers and their associated assemblage.

At Gomolava, a tell in Northern Yugoslavia, classic Baden levels are followed by Kostolac material, which in turn is succeeded by the earlier Vučedol culture (Neustupný 1972:99). At Vučedol (Schmidt 1941) and Sarvaš (Müller-Karpe 1974) there are similar stratigraphies of Vučedol on top of Baden. But Vučedol is only one of a group of cultures with fairly similar ceramic inventories which are found in the Carpathian Basin and its peripheries at this period: the others are the Zók culture, found stratified above Baden remains at Zók-Várhegy, a hilltop settlement in southern Transdanubia (Kalicz 1968: 100); the Makó group in central and eastern Hungary, stratified above Baden levels at the sites of Pécskö and Baglyashegy (Kalicz 1968: 100); and the Kosihy-Čaka group of south-west Slovakia, later than Baden at Nitriansky Hrádok and Malé Kosihy (Točík 1961). Unfortunately, the occupation patterns of the Bell Beaker associated assemblage and the Nagyrév culture seem to be different from the Vučedol groups as they only rarely occur at the same sites. Consequently, there is little direct stratigraphic evidence of the relations between them. An exception is the site of Zecovi, Bosnia (Müller-Karpe 1974), where pottery similar to that of the Nagyrév culture was stratified above Vučedol material. Others are Sarvaš, where some sherds of 'Bell



Beaker type' were apparently found at the top of the Vučedol levels, and the Laibacher Moor settlements where Bell Beaker sherds were likewise found in the top layers.

Before turning to the Bell Beakers it is necessary to outline briefly the position of the Nagyrév culture in relation to the rest of the Bronze Age sequence. This may be seen at such tells as Tószeg, Nagyrév and Mezőkomárom, where Nagyrév layers are found at the very bottom and are succeeded by the classic cultures of the Hungarian Bronze Age (Kalicz 1968:103). The site of Mezőkomárom near Lake Balaton in Transdanubia (Schreiber 1975) is the only place where the position of the Bell Beakers in relation to this sequence is definitely established. Here some decorated Bell Beaker sherds were found associated with the very earliest Nagyrév assemblage.

This sequence and those from the Yugoslav sites are extremely important because in the main area of Bell Beaker distribution in Hungary, the region on the Danube around Budapest, stratigraphies are not available and information on the sequence is more indirect (cf. Schreiber 1972, 1975). Lack of contemporaneity with Makó is inferred from the fact that associations between the two never occur although the Makó distribution includes that area in which the Bell Beakers are found. There are also typological differences between the two assemblages as the Bell Beakers are found with pottery much more similar to the definitely later Nagyrév culture. Although such evidence as this could not be considered chronologically conclusive, taken together with the various stratigraphies a fairly clear picture emerges which is not contradicted by the radiocarbon dates. This picture is the one outlined by Schreiber (1972, 1975) for the Budapest area, and which also seems valid for the greater part of central Hungary, which only lacks the decorated Bell Beakers. The first



Early Bronze Age phase (in Hungarian terms) is represented by the Makó group, the second by the Bell Beaker-Csepel group in the Budapest area and by the very similar material in central and southern Hungary defined by Bóna (1963) as the Okorhalom and Kotores phases of the early Nagyrév. This in turn is succeeded throughout the area by the classic Nagyrév (Kulcs-Szigetszentmiklos phase).

In the context of the present research this Carpathian Basin sequence does not have great intrinsic interest, but this is more than made up by its significance for the area to the north-west since it provides an opportunity to relate those regions to a fairly well documented stratigraphic succession, even though the dangers of extrapolating from one region to another must always be borne in mind.

## 2. Moravia

This is probably the least known of all the areas to be considered here. Although the beginnings of research go back to Falliardi and Červinka, less work has been done here than elsewhere and by no means all of this has been published. The usual Eneolithic and early Bronze Age cultures (or their Moravian equivalents) are found: the Jevišovice B culture, the Corded Ware, the Bell Beakers and the Únětice, but apart from the fact that the later Únětice is definitely later than any of the other groups, their chronological inter-relations are a matter of dispute, with little concrete evidence for making a decision of any kind. There are only two radiocarbon dates; one for the Jevišovice B layer at Brno-Líšeň which seems very late and is most probably either contaminated or does not relate to the material which it purports to; the other is for the Věteřov group of the Moravian late Únětice and is of marginal interest because it comes so late in



the sequence. Stratigraphies too are rare. The most important one is from the site of Holešov, where graves of the Nitra group cut into an earlier Bell Beaker cemetery. The Nitra group is known to be contemporary with the earlier Únětice from the association of early Únětice vessels in the Nitra group graves at Holešov, which is in the easternmost part of Moravia, on the borders of the Únětice distribution area. This makes the Bell Beakers precede the early Únětice but does not exclude contemporaneity with the initial Proto-Únětice material, which is clearly different from both the Bell Beaker Begleitkeramik and the succeeding phases of the Únětice. Other stratigraphies are less satisfactory. At the site of Jevišovice-Stary Zamek a few finds of Bell Beaker pottery appeared in the top level, layer B, but its relation to the latter is not clear from Palliardi's description (1972), and isolated Únětice and Hallstatt sherds were also found. Palliardi's own opinion was that the site was abandoned, 'als bei uns jene Kultur auftrat, die von Glockenbecher begleitet war' (1972:54), but he provides no evidence in support of this.

These are the only two sites where there is any sort of direct evidence. All the other chronological pointers depend on typological connections to other areas. Thus battle-axes of Glob's type A have been found in Jevišovice B contexts and have been taken as showing its contemporaneity with the early Corded Ware. It is, however, by no means certain that these axes are exclusively connected with the early Corded Ware (cf. Zápotocký 1966), and even if they were elsewhere this does not necessarily mean that they relate to the same chronological horizon in Moravia.

There are two other typological arguments which may be relevant, the first relates to the so-called Moravian 'hat-bowls' (see fig.8.2a).



These are small bowls of a rather striking type with a very wide rim. They are not found in Jevišovice B or Bell Beaker contexts but they are characteristic of the Moravian late Corded Ware (see e.g. Červinka 1938b) and in south-west Slovakia they have been found in a Kosihy-Čaka assemblage at the site of Sladkovičovo (Vladr 1966); they occur in Hungary too, in a Makó context, at the site of Budaors (Schreiber 1967). The lack of such bowls in Bell Beaker associations, where typologically different varieties are found, and their connection with the Kosihy-Čaka and Makó groups, which, as we have seen, precede the appearance of Bell Beakers in the Carpathian Basin, may perhaps be taken as evidence that the later Corded Ware broadly precedes the Bell Beakers in Moravia.

The other typological argument depends on the occurrence of several Schönfeld bowls in Moravia, at the sites of Smržice, Slezany and Marefy (Červinka 1938b). The first of these seems to be an isolated find, but the others appear to belong to late Corded Ware contexts. The bowls are of a very characteristic, indeed unmistakable, type, and originate in the Schönfeld group of the Central German Corded Ware (see e.g. Wetzel 1969). The particular examples found in Moravia are of a type known as Strahlenschalen (see fig. 8.2b) and belong to the Schönfeld south group, which is contemporary with the pre-Mansfeld phase of the Central German Corded Ware (see Wetzel 1969:129-30). This strongly suggests that the Moravian late Corded Ware is not contemporary with the Central German late Corded Ware but with its earlier phases, a point of some significance, as we shall see.

### 3. Bohemia

Far more research has been done here than in Moravia on the later



Eneolithic and Early Bronze Age, and there has been a correspondingly greater amount of ink spilt in arguing about the chronology and its implications. Before discussing these various opinions, which are largely based on typology and a priori reasoning, it is necessary to describe the definite stratigraphies and associations which are relevant to the problem, as well as the two absolute dates which are available. These are 2350-2250 b.c. for the Řivnáč culture from Homolka and 1950-1850 b.c. for the early Únětice at Prasklice. This sequence, for what it is worth, is confirmed by the stratigraphic relations between the two as we will see below.

Stratigraphies are as follows:

- i) Lysolaje (Pleslová-Štiková 1972a:136-7). At this site in central Bohemia a later Corded Ware grave (of Buchvaldek's phase II/CCC) destroys a Řivnáč feature, although unfortunately the find is not completely documented.
- ii) Obrnice (Buchvaldek 1967:110). In the fill of a grave with late Corded Ware goods (Buchvaldek's group III) were found residual sherds of the Řivnáč culture.
- iii) Tušimice (Neustupný 1965:453). Sherds of Řivnáč (according to Neustupný its latest phase) and Globular Amphora type were found in the fill of a grave with late Corded Ware goods (Buchvaldek's group III) in north-west Bohemia.
- iv) Dobřichov (Buchvaldek 1967:110). An early Corded Ware grave (Group I) is supposed to have been destroyed by a Řivnáč pit but the reports are not consistent.
- v) Homolka (Ehrich and Pleslová-Štiková 1968). Řivnáč remains beneath Únětice occupation at the site.



vi) Slanská hora (Moucha 1966). Řivnáč material beneath Únětice occupation.

vii) Vraný-Čertovka (Pleslová-Štiková 1968:186). This site is not yet published, and the excavator, A. Knor, is now deceased. According to Pleslová, a small part of the inventory in one of the huts outside the palisade is supposed to be different from the normal Řivnáč pottery. In a pit near by sherds of the Bell Beaker culture are supposed to have been found in the lower part of the fill while the upper part contained Řivnáč material. Until further details are known the significance of this find cannot be evaluated (cf. Pleslová-Štiková 1972).

viii) Isolated finds of such Bell Beaker objects as wrist-guards and tanged copper daggers have been made at several Řivnáč sites, including Vraný-Čertovka, Šarka and Řivnáč itself, but again nothing is known about the stratigraphic context of these objects and they certainly cannot be regarded as proof of contemporaneity between Bell Beakers and Řivnáč.

ix) Břežanky (Buchvaldek 1967:111). A grave with Corded Ware goods of Buchvaldek's group II/III was destroyed by an Únětice grave which belongs at the earliest to the third phase of this culture.

x) Bohušovice (Buchvaldek 1967:111). A Corded Ware grave of Buchvaldek's group III was destroyed by a grave of the earlier Únětice culture.

xi) Dablice (Buchvaldek 1967:111). At the bottom of a grave pit 120 cm. deep was a skeleton on its left-hand-side with its head to the east. Behind its back were a flint knife and sherds of a Corded



Ware Beaker (?Buchvaldek's group II/III). In the fill of the grave, about 70 cm. deep on the south side, was a nest of four vessels of Bell Beaker Begleitkeramik not accompanied by any skeletal remains. There are, as Buchvaldek says, several possible explanations of this, but unfortunately no evidence to decide between them. One is that the whole assemblage is a unit with elements of two cultures: the pottery of both groups is very similar in fabric and vessels are quite often found high in the fill of Corded Ware graves. Buchvaldek's second possibility, that the beaker on the bottom is an imitation of a Corded Ware beaker, seems perhaps less likely. The third, of course, is that the upper deposition is later.

xii) Lysolaje (Hájek 1968:63-4). This grave contained two copper earrings, two jugs, two decorated handled Bell Beakers, a bowl, a jar, a copper awl, and a small Corded Ware beaker of Buchvaldek's group III. Unfortunately, the grave was found by workmen and the positions of the artifacts, and the assertion that all the objects belong to a single grave, are based on their reports. Corded Ware graves are known from the site and it may be that the Corded Ware beaker belonged to one of these.

xiii) Sulejovice (Hájek 1968:119-20). In a triple grave which included a decorated handled Bell Beaker were found two decorated bone belt-plates and three small shell discs. Both in Bohemia and elsewhere these belt-plates are generally found in Corded Ware contexts, but this fact need not have any chronological implications for the Bell Beakers in Bohemia since there is no question that the Corded Ware continues in areas to the north where Bell Beakers do not appear; apart from Bohemia the belt-plates are found in Central Germany, Little



Poland and East Prussia and might easily have been imported from there.

The chronological implications of these stratigraphies are that there is definitely a succession of Řivnáč to late Corded Ware to earlier Únětice, and, much more doubtfully, that the late Corded Ware may be contemporary with the Bell Beakers. This still leaves a lot of questions unanswered and it is now necessary to consider the arguments which have been used to try and answer them.

Pleslová (1968) comments on the fact that Řivnáč occupation is only slight in north-west Bohemia, where Buchvaldek's group II Corded Ware is much more strongly represented than in central Bohemia, which is the heart of the Řivnáč distribution; she argues that this may be evidence that the two are contemporary. The main opponent of such a view is Neustupný, who believes that, 'Es gibt nicht die geringsten Belege für diese Gleichzeitigkeit, ganz im Gegenteil alles zeugt für eine Abfolge' (1972:98). As we discussed earlier, part of his argument is entirely a priori and may be rejected: for instance, his belief that the Corded Ware sites are so densely distributed in Bohemia that there was no room left in the area for any of the groups supposedly contemporary with them (1965:453). His argument from the stratigraphies may be admitted, but it should be pointed out that they only show a succession of Řivnáč and late Corded Ware and say nothing about the earlier Corded Ware phases. Neustupný's final argument depends on associations: out of hundreds of Corded Ware graves in Bohemia none contain any Middle Eneolithic type. As it stands this evidence is not satisfactory since it is well known that grave contents are culturally selected and do not represent any sort of random sample of the artifacts of the period in which they were deposited. The Globular Amphora 'culture' is a relevant comparison. This is only ever



found in a 'pure' form in grave assemblages and clearly represents just such a selection; in settlements it is found mixed with other material, in Bohemia with the Řivnáč culture. What may be chronologically significant is that Corded Ware pottery is not found in such Řivnáč associations and this question is considered again below, when the evidence from Central Germany has been examined.

The other problem which has been equally hotly debated is that of the chronological relations between Corded Ware and Bell Beakers. Again Neustupný has tended to be in a minority of one in arguing that they are successive, but Pleslová (1972b:29) seems to be coming round to this view. As we have seen, there is some suggestion from the associations and stratigraphies that the two may be contemporary, although the evidence is fairly dubious. The little other evidence that exists is equally unsatisfactory and comes from horizontal stratigraphies. At Lysolaje (Pleslová 1972a), where Bell Beaker and Corded Ware graves are found on the same site, there is no spatial separation between the two groups of graves (see plan fig. 8.3). At the site of Brandýsek on the other hand (Kytlicová 1960), there is a marked spatial separation, with the Bell Beaker graves in the eastern part and the Corded Ware graves mostly in the west, including what are supposed to be the latest ones (see plan fig. 8.4). The different orientations and contents of the two groups of graves are striking.

The other piece of evidence comes from the site of Vikletice (Buchvaldek and Koutecký 1970). Here, in the middle of a Corded Ware cemetery which represents the whole development of the Corded Ware in Bohemia, especially the middle and late phase, was an occupation pit containing Bell Beaker Begleitkeramik. Neustupný (1972:101) regards it as extremely unlikely that the settlement to which the pit



belonged could have existed at the time that the cemetery was in use, but this again seems to be rather dubious a priori reasoning.

The final subject of this section must be the relation of the Bell Beakers to the Únětice. In Moravia, as we have seen, they precede the early Únětice, and in Bohemia too this is most probably the case. The main evidence in favour of such a view is the horizontal stratigraphy at the cemetery of Polepy near Kolín (see plan fig. 8.5). At one end are the well-known classic Únětice cups, a late form, while at the other are four graves with jugs of the type associated with Bell Beakers. Unfortunately, as there are no proto-Únětice graves from this site, the relationship of this material to the Bell Beakers remains unknown. Moucha (1963) believes that the two are contemporary, but this is not the only possible explanation of the typological similarities on which his argument is based.

#### 4. Central Germany

More information is available from this area on the relative chronology of the later Eneolithic and Early Bronze Age than from either Bohemia or Moravia, mainly as a result of the widespread habit of placing successive burials in a single barrow. There are also more radiocarbon dates although these are not as useful as they might be, because of the relatively large standard deviations; they are illustrated in figure 8.6. As elsewhere, a picture emerges of a marked chronological separation between the Middle Eneolithic and the Early Bronze Age, while the period in between is relatively confused. The late TRB dates overlap with the earlier Corded Ware, as does the single Globular Amphora date. The Bell Beakers appear squarely contemporary with most of the Corded Ware succession. In



order to obtain a more detailed picture it is necessary to look at the stratigraphies.

The latest TRB in this area is the Walternienburg-Bernburg group. Several barrows are known with Corded Ware secondary graves stratified above graves of the Walternienburg-Bernburg group: Burgorner, Ditzfurt, Helmsdorf, Hohen, Tröbsdorf, and Wettin (Müller-Karpe 1974:214). No stratigraphy is known with a grave of the latter group on top of a Corded Ware grave. There is one possible association between the two in a grave at Schraplau, where an early amphora and beaker are supposed to have been associated with a Bernburg cup, but, according to Müller-Karpe (1974:231), this may point to a continuing tradition in cup manufacture rather than definite chronological overlapping. The situation with the Globular Amphora culture is rather different. This too is found stratified above Walternienburg-Bernburg graves, at the sites of Frohndorf, Zörbig, and Stobra (Müller-Karpe 1974:214); there are, however, also several finds of Bernburg cups in Globular Amphora graves, which suggests at least a certain amount of chronological contact: the sites are Hindenburg, Barby, Börtewitz and Müglitz. The cup from Börtewitz is apparently typologically late in the Bernburg sequence. This situation corresponds to that in Bohemia, where, as we have seen, Globular Amphora sherds are found in Řivnáč contexts.

Information on the internal chronology of the Corded Ware period in Central Germany is also available from stratigraphies. At the sites of Peissen, Braunsbedra and Forst Leina (Fischer 1959:139) graves containing pottery of the Mansfeld Corded Ware group were found above others with earlier varieties of Corded Ware pottery. This late position for the Mansfeld group is confirmed by three closed finds



from Ilbersdorf, Kuckenburg and Zappendorf which, on the basis of the associated axes, should be contemporary with the Upper Grave period of the northern Single Grave culture. Further divisions in the Corded Ware may be possible but this is the only one which is stratigraphically documented.

As in other areas the relative chronology of Corded Ware and Bell Beakers is not clear, but in Germany there is at least some stratigraphic evidence. At Neuses, Kr. Gelnhausen, Hesse (Müller-Karpe 1974:938) a barrow contained a main grave pit with a rectangular wooden construction inside which were a Corded Ware amphora, remains of another vessel and a flint blade. About half a metre above this was a secondary grave containing a decorated Bell Beaker and an arrowhead. At Haldorf, Kr. Fritzlar-Homberg (Müller-Karpe 1974:935) the primary grave of a barrow included sherds of a herring-bone beaker, while above this was a grave containing remains of a cremation and what is supposed to be a Bell Beaker, although it is decorated with cord and the decoration only comes down to the maximum belly width. Both the two finds just mentioned come from Hesse but there are three other less well documented stratigraphies from the Saale area itself. At Sömmmerda (Fischer 1956:301; Neumann 1929:62) a grave with a Bell Beaker assemblage jug was apparently secondary to a Corded Ware grave and beneath a Leubingen culture 'Fürstengrab'; the excavation was a very early one, however, and the observation may not be entirely reliable. The same applies for the site of Sachsenburg (Fischer 1956:300; Neumann 1929:50). This was excavated in 1904 and a grave with a decorated Bell Beaker is supposed to have been secondary to a Corded Ware grave; the Bell Beaker grave was oriented West-East with the skeleton facing South, the orientation characteristic of the Corded



Ware. Similarly at Gleina, excavated in 1900, a Corded Ware grave apparently preceded one with Bell Beaker goods (Fischer 1956:298; Neumann 1929:58).

A grave which is believed to document contemporaneity of Corded Ware and Bell Beakers is Bleckendorf (Behrens 1952). This contained a Corded Ware herring-bone beaker, a tanged copper dagger, a copper awl and a hammer-head pin. The dagger, together with the fact that the grave was oriented north-north-east - south-south-west, is generally held to indicate either strong Bell Beaker 'influence' on a Corded Ware grave or the reverse. The hammer-head pin is a very unusual find in this area as they are characteristic of the south Russian Pit-Grave culture, in which identical tanged copper daggers and awls are found as well, thus it may not be necessary to see any connection whatsoever with the Bell Beakers.

In summary, the stratigraphies show a succession from Walternienburg-Bernburg to earlier Corded Ware to Bell Beakers; the Globular Amphora 'culture' overlaps with both Walternienburg-Bernburg and earlier Corded Ware. The relations between the Bell Beakers and the later Corded Ware are not given by any stratigraphies or associations and will be discussed in the following section, which reviews the chronological evidence provided by typology and real or supposed connections with other areas.

Typological arguments have been extensively used in discussing the relations between Corded Ware and Bell Beakers in Central Germany (Behrens 1969; Matthias 1969:24). Influence of the Bell Beakers on the Corded Ware is believed to be reflected in the fact that on some Corded Ware beakers grouped cord lines alternate with undecorated zones; that some of them have metope-like decoration zones while on



others there is a multiple alternation of groups of zig-zag lines and groups of straight lines. The presence of polypod bowls and arrowheads, both tanged and concave-based, is also ascribed to the same reason, despite the fact that wooden polypod bowls are known much earlier in the area, and that arrowheads of similar types are found in Bernburg graves. All this 'evidence' is then used as an argument that Bell Beakers must have been present in the area as early as the pre-Mansfeld phase of the Saale Corded Ware. It would be far more relevant if the dates of the various groups could be established independently by radiocarbon since then a study could be made of the extent (if any) of mutual acculturation.

Until recently a general contemporaneity of the Bell Beakers with the Mansfeld group of the Saale Corded Ware would have had to be regarded as probable, but it is now less certain. The main argument has been the closed finds of Mansfeld style pottery with axes of Glob's type K, belonging to the Danish Upper Grave period. Bell Beaker material has been found in what were believed to be Upper Grave contexts in Denmark (e.g. Myrhøj, see below), while Dutch Veluwe beakers are associated with supposed K axes. Recently, however, Lomborg ( 1975 ) has said that the axes associated with the Dutch Veluwe beakers do not belong to group K, and sites such as Myrhøj he places not in the Upper Grave period but in the succeeding Late Neolithic A. The conclusion that the Mansfeld group and the Bell Beakers are not necessarily contemporary is supported by a number of arguments: first, there is a complete absence of battle-axe finds with Bell Beakers in Central Germany; secondly, the total number of Bell Beaker sites in the area is only a quarter of the Corded Ware site total, a situation which may result from Bell Beakers being current



for a much shorter period of time. Finally, the typologically developed nature of the vast majority of Central German Bell Beakers must be taken into account: it is only a very small proportion which shows similarities to neighbouring Bohemia, the other belong to a markedly regional German type. This may be because they are later and, like the Myrhorj Beakers are contemporary with Late Neolithic A and not with the Upper Grave period; it is in this latter period that the Bohemian and Moravian Bell Beakers must largely belong, as well as the Mansfeld Corded Ware in Central Germany.

The areas just described, although they are the centre of interest in this study, do not provide sufficient information in themselves to make an adequate chronological synthesis possible. For this it is first necessary to describe the situation in certain other areas which have similar material culture assemblages and where the relative and absolute chronology is better known. Although this may be misleading, the information available cannot be neglected when that from Central Europe itself is so unsatisfactory.

## 5. Poland

Poland is included here and not in the previous section because the number of known Bell Beaker sites is relatively small. On the whole its later Eneolithic chronology is no better known than elsewhere in Central Europe, but there are some particularly relevant finds.

Probably the most important site is 'Nad Wawrem' in southern Poland (Neustupny 1972:98-9; Krzak 1969, 1976). Here a cemetery of the Złota culture (a local Corded Ware group) was preceded by a Globular Amphora settlement. The settlement material includes some characteristic pottery found in the fill of a number of Złota graves, some of



which have goods belonging to the earliest Złota phase. The site has further interest since a Bell Beaker cemetery was also found, in the middle of the Corded Ware one. The most likely explanation is that the Bell Beaker cemetery succeeds the Kraków Corded Ware, which itself follows the Złota culture at the 'Nad Wawrem' site. This would make the Bell Beakers contemporary with the Chłopice-Veselé group since this in general succeeds the Kraków Corded Ware. There are finds to confirm such a relationship and the most important of these is from the site of Święcice (Prokopowicz 1964), a cemetery of four graves. One of these was empty, two contained characteristic Bell Beaker goods including an undecorated handled Bell Beaker and a bowl, while the fourth contained a wide 4-hole wrist-guard and a Chłopice-Veselé jug.

The information provided by the radiocarbon dates (see fig. 8.7) does little to confirm or deny the picture presented by the stratigraphies and associations of a succession from Globular Amphora to Corded Ware to Chłopice-Veselé group and Bell Beakers, and finally to the Early Bronze Age. Perhaps most interesting is the fact that the two dates for typologically early Corded Ware are quite late compared with Holland, and overlap almost totally with the earliest dates from the Early Bronze Age site of Iwanowice, which probably represent an initial Chłopice-Veselé phase of occupation (see Machnik and Machnik 1973). More dates are necessary before the question arises of to what extent the Polish Corded Ware sequence really is correct, and this is not in any case the main interest of our study. Here it may merely be said that the Chłopice-Veselé dates fit perfectly well with their being contemporary with the Bell Beakers, but then so do the 'early Corded Ware' dates.

The other two areas which need to be separately considered are the



Netherlands and Denmark. Although they are some way from Central Europe, and their relevance to chronological problems here cannot be automatically assumed, both of them have a special importance. The Netherlands has the best radiocarbon dated sequence for the period under consideration, and Denmark is the foundation for any wide-ranging synchronisations in the Corded Ware because of its known stratigraphic and typological sequence.

## 6. Denmark

Becker's view, that the Jutland Single Grave culture ran essentially parallel with the later TRB has now been conclusively refuted by the radiocarbon dates, which point only to a certain amount of overlap between the early Single Grave culture and late TRB (see fig. 8.8). Independent confirmation of this has come from Dutch work on associations between late TRB and early PFB, which suggests the conclusion that the last phases of the south Scandinavian TRB coincide with the Bottom Grave period of the Single Grave culture only (Bakker and van der Waals 1973).

The Danish-North German Single Grave sequence is a large subject in itself and in the following discussion it will be considered solely insofar as it relates to the Bell Beakers. The outline has been verified by a number of workers, including Glob (1944) and Struve (1955), and is further confirmed by the radiocarbon dates, so it is sufficiently well-founded to use in defining the position of the Bell Beakers. There is a number of important finds, the most recent of which is Myrhøj (Jensen 1973). This settlement site in Jutland contained pottery now ascribed by Lomborg ( 1975 ) to the beginning of Late Neolithic A, immediately following the Upper Grave period, as



well as Bell Beaker vessels. Other evidence for the presence of Bell Beakers in northern Europe is presented by Struve (1955). At Grossenbornholt, Schleswig-Holstein (Struve 1955:173-4), a K1 battle-axe of the early Upper Grave period was found in a grave with two amber beads, a flint dagger, and a decorated Bell Beaker. Two K axes of the early Upper Grave period were also associated with a Bell Beaker at Achim, Kr. Verden; in this case the beaker was a 'typologically early' Barbed Wire type. Finally, at Elmshorn/Kruck (Struve 1955:57) a Zonenbecher was found with a flint sickle; these are supposed to belong to the northern Late Neolithic.

More tenuously, the appearance of comb decoration is also ascribed to Bell Beaker influence. The earliest indications belong in the late Bottom-Grave or beginning Ground-Grave phase: a comb decorated beaker from Denmark and a piece of a beaker with inturned rim from Tiste, Kr. Bremervörde (Struve 1955:58), on which the alternating oblique strokes are supposed to imitate comb impressions. A more general use of comb first appears towards the end of the Ground-Grave and in the Upper-Grave period. The situation is similar elsewhere in the north European Single Grave culture and in the closely related Oderschnurkeramik (Schröder 1951), where apparent 'Bell Beaker influences' also occur (cf. Behrens 1969).

## 7. The Netherlands

The situation here has recently been admirably reviewed (Lanting et al. 1973) so there is no need here to give a detailed account of the evidence. The radiocarbon dates are shown in figure 8.9 and, as these authors suggest, point to some overlap between late TRB and early Corded Ware, as well as between late Corded Ware and early



## Bell Beakers.

According to Lanting et al. (1973) the PFB culture in the Netherlands is to be equated with the earlier and later Bottom-Grave period, and with the early, and partly the late, Ground-Grave period of the south Scandinavian Single Grave culture. Battle-axes and beakers of the later phases of the northern Single Grave culture are rare or altogether absent west of the Weser - by then the Bell Beaker culture had developed in this area.

Apart from the radiocarbon dates, Lanting et al. provide other evidence for an overlap between later Protruding Foot Beakers and the All-Over-Ornamented Bell Beakers. Clearly most important are the associations of Protruding Foot and All-Over-Ornamented beakers from Hanendorp-Emst, Soesterberg, Swalmen, Ahsen and Wiesbaden-Hebenkies. Also relevant is the occurrence of Grand-Pressigny flint daggers with Older Ground-Grave Protruding-Foot-Beakers as well as with All-Over-Ornamented Bell Beakers; they are not found with beakers of Lanting et al.'s 'true' Bell Beaker series.

Finally, the radiocarbon dates support, and indeed are one of the main pieces of evidence for, the proposed typological sequential scheme of Bell Beaker phases, from All-Over-Ornamented to Maritime to the local Veluwe types.

## Conclusion

It is now necessary to try and synthesise the information which has been presented in order to build up at least a provisional picture of the chronological inter-relationships between the various material culture assemblages in the main areas of interest. These are Bohemia, Moravia, and Central Germany, and it will have become clear from the



fore-going that the first two in particular are extremely intractable.

In Moravia there is only a single piece of chronological data which does not involve inferences from other areas: the stratigraphic relation between Bell Beakers and the Nitra group which shows that the former are earlier. External evidence, however, does demonstrate fairly convincingly that the Bell Beakers most probably follow the late Corded Ware in this region. It has been shown that in the Carpathian Basin the Bell Beaker proto-Nagyrev assemblage follows the Makó and Kosihe-Čaka groups. In Makó and Kosihe-Čaka contexts is found a very characteristic bowl type which also occurs, in identical form, in Moravian late Corded Ware contexts. This points to the contemporaneity of the Moravian late Corded Ware and the Carpathian groups and thus suggests that it may precede the Bell Beakers. Such a view is confirmed by the lack of these bowls in Bell Beaker contexts, although this would not in itself be definite proof of non-contemporaneity since one could imagine other reasons for their absence. Another point in favour of the view offered here is that in general the similarities of the Moravian Bell Beaker jugs and bowls are to the Hungarian Bell Beaker-proto-Nagyrev assemblage rather than to the preceding groups. Finally, one more corroboration of the view presented here comes from an entirely different direction.

As we saw in the section on Moravia, there are several examples of Schönfeld bowls from late Corded Ware contexts (again never with Bell Beakers), and these are almost certainly imports. In their area of origin in Central Germany they are associated with the Schönfeld south group which belongs to the earlier part of the Central German Corded Ware. The fact that Moravian late Corded Ware seems to be contemporary with German earlier Corded Ware shows the dangers of



assuming that 'equivalent' phases are contemporary; changes may occur in some regions earlier than others. More important, however, the Central German Bell Beakers do not seem to appear before the late Corded Ware of their area and would, therefore, be no earlier than the Moravian Bell Beakers. In fact, as we have seen, there are arguments for suggesting that the majority of the Central German Bell Beakers may even be later than those of Bohemia and Moravia.

If all this indicates fairly strongly that the Bell Beakers follow the late Corded Ware in Moravia, it does not say anything about the relations between Bell Beakers and the Jevišovice B culture. In some ways these are even more important because the distributions of these two correspond almost completely while the Corded Ware is concentrated in the north. Two factors suggest that the Jevišovice B is earlier than the Bell Beakers: first, its very close similarity to the geographically adjacent Bohemian Řivnáč culture, which is known from stratigraphies to precede the late Corded Ware; second, the presence in Jevišovice B of A-hammer axes which, even if they are not specifically to be associated with the earliest Corded Ware (cf. Zapotočský 1966), are certainly an early type. Finally, the marked complementarity of the Corded Ware and Jevišovice B distributions hints that they may be contemporary. This gives us a picture in which the Bell Beakers are successive both to the late Corded Ware and to Jevišovice B but themselves precede the early Únětice.

For Bohemia too the internal evidence is extremely exiguous. It suggests that the Řivnáč culture precedes the late Corded Ware of the area, which in turn is earlier than the early Únětice. The horizontal stratigraphy from Polepy indicates that the Bell Beakers too precede the early Únětice. There is a small amount of evidence which has been



interpreted as demonstrating that Bell Beakers and late Corded Ware are contemporary, but the finds are either dubious or open to other interpretations. The situation in Moravia might be thought to argue against such contemporaneity, although, as we have seen, it is dangerous to assume that equivalents are of the same date. There are none of the characteristic 'hat-bowls' in Bohemia; a few Schönfeld bowls of the same type as in Moravia do occur but they are assigned by Buchvaldek to his group II/III rather than to his final group III. It is still not clear, however, whether this means that group III (the Bohemian late Corded Ware) must, therefore, be contemporary with the Central German Mansfeld group. Certainly, none of the definitely late hammer-axes of the northern sequence are found in Bohemia as they are in Central Germany in Mansfeld contexts, and this might be an indication of a fairly early end for the Corded Ware in Bohemia. It is also relevant to recall Neustupný's point about the lack of associations between Corded Ware and Bell Beakers in Bohemia, and its chronological implications. Although the absence of associations cannot be used simply as an a priori argument that they are not contemporary, it is worthy of note when contrasted with the not inconsiderable number of associations between Protruding foot beakers and early Bell Beakers in the Netherlands; here an overlap is clearly documented in the finds. All in all, taking into account the evidence from the adjacent areas of Moravia and Central Germany, it is most likely that the Bell Beaker assemblage succeeds the Corded Ware development in Bohemia. The chronological relation of the Bell Beakers to the proto-Unetice remains unclear, but the latter probably represents the immediate typological transform of the Bell Beaker Begleitkeramik assemblage.



Elucidation of the Central German situation requires much less external support. Stratigraphies show that the Bernburg culture precedes the Corded Ware, and that within the Corded Ware the late phase is represented by the Mansfeld group, which, on the basis of associated axe finds is contemporary with the northern Upper grave period. Although Bell Beakers are stratigraphically later than the earlier Corded Ware at some sites, there are indications of what might be regarded as 'Bell Beaker influence' on Corded Ware pottery typology before the late Corded Ware phase developed. It should, however, be realised that such 'influences', if acceptable, cannot come from the Central German Bell Beakers but must be from western Europe since only west European Bell Beakers have those features which are supposedly transmitted to the Corded Ware (cf. Behrens 1969); such a situation would not be impossible in view of the probable earlier appearance of Bell Beakers in western Europe. The Central German Bell Beakers may be contemporary with the Mansfeld Corded Ware but could well be rather later.

Despite the unsatisfactory nature of many of his arguments, it seems necessary to agree with Neustupný (1972) that in those parts of Central Europe where they occur the Bell Beakers are the chronological equivalent of the Upper Grave phase of northern Europe, in which Bell Beakers constitute a limited but undeniable presence. There seems no reason for Bohemia to be an exception to this situation, which is supported by some general considerations as well as by the evidence from Poland. This, it will be recalled, showed that the Bell Beakers were contemporary with the Chłopice-Veselé group, the very latest Corded Ware of the area, which immediately precedes the Early Bronze Age Mierzanowice culture.



The more general considerations are not specific to any particular part of Central Europe but together confirm the interpretation just outlined. First, if one accepts the Dutch typological-chronological sequence as valid it has a number of implications. It is only the earlier Dutch beaker types which are contemporary with the northern Ground-Grave period; more developed varieties belong in the Upper Grave phase. As virtually all the Central European vessels are typologically developed they too are not likely to be any earlier. Secondly, the few radiocarbon dates available from the area broadly support such a view. Finally, there is a strong suggestion, both in the radiocarbon dates and in the marked typological uniformity of Bell Beakers and their associated vessels, that the Bell Beaker assemblage was short-lived in Central Europe, particularly in Bohemia, Moravia and Hungary. Although this uniformity might merely be interpreted as a reflection of conservatism or lack of stimulus to change, it makes a striking contrast with the developments seen in both the Netherlands and Britain, which are known to have had a long Bell Beaker occupation.

Use of all the available evidence has established at least a provisional sequence of assemblages and also shown which ones are likely to be contemporary. The necessity of establishing this will become abundantly clear in later chapters, which will make a detailed investigation of the changes which were associated with the appearance of Bell Beakers in Central Europe. It is also important when trying to explain internal variation in the Bell Beaker assemblage itself, since our view of this would naturally be different if we knew that there was another assemblage in the same area at the same time. With the foundation created in this chapter it is possible to tackle both



these aspects in the knowledge that the chronological assumptions made are those best supported by the currently available evidence.

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## CHAPTER NINE: ECONOMY AND SETTLEMENT PATTERN IN THE LATER

### ENEOLITHIC OF CENTRAL EUROPE

In the following chapters various aspects of the change from Corded Ware to Bell Beakers in Central Europe are examined in detail. Here the aim is to stay at the more general level adopted when dealing with the chronology of the area and to examine a number of important aspects which have not yet been discussed: these are environment, subsistence economy, population and settlement pattern. It is not necessary to regard these as in any sense more basic (or more explanatory) than others to acknowledge their potential significance. They are both interesting in themselves and likely to be of relevance to understanding those other aspects more specifically related to the material items whose variability we are trying to explain. If changes in the material assemblage or the social organisation were accompanied by alterations in economy or population, for instance, we would come to entirely different conclusions about their nature than if they were not.

In order to understand the changes which occurred with the appearance of the Bell Beaker assemblage, the prime focus of attention, it is important to take the wider perspective already mentioned. A word is also required on the extent to which it is meaningful to talk about economy in relation to material assemblages, especially when they consist largely of objects from graves. There is certainly no a priori reason to connect the two. The justification is that by and large the Bell Beaker assemblage characterises a particular time span in the areas studied, so that our real interest is in the economy of, for example, Bohemia in the time span when the Bell Beaker



assemblage was current.

Given that this argument may be accepted, it is possible to move on to an examination of the evidence. The view we have to take is extensive in two senses. The first of these is chronological: it is necessary to look further back than the Corded Ware, because if there is a major break in the later Eneolithic sequence with respect to such features as economy or settlement pattern, it is between the Corded Ware and what preceded it, rather than between the Corded Ware and Bell Beakers, or indeed between Bell Beakers and early Unetice. A wider spatial view is also both possible and necessary: possible because the subjects under consideration here do not require the sort of detailed data analysis undertaken in other chapters; necessary because the evidence from any single area, and especially from the important areas of Bohemia and Moravia, is extremely inadequate. It is, of course, dangerous to assume that the development of settlement in one area will be similar to that in another, nevertheless, there are features common to all the areas under consideration which make comparison worthwhile, particularly in view of the poor quality of the evidence in general. All were occupied continuously from the time of the Linearbandkeramik and consist of fairly extensive tracts of excellent arable soil, predominantly black earths (although the date when these originated is still in some dispute). Probably the best region with which to begin is the loess uplands of Little Poland, in the area of the upper Vistula, since this has recently been the subject of a detailed study by Kruk (1973); it represents the furthest north-eastern extent of the Bell Beaker distribution.

Kruk distinguishes three zones of settlement: the first immediately



above the valley bottom, the second on the edge of the interfluve<sup>1</sup> areas, and the third the environments of the deeper part of the interfluve, which were not heavily used and are characterised by the presence of a scatter of unassociated stone artifacts. With the appearance of the TRB culture in the southern Polish loess area there was apparently a major change in land use, with a move away from micro-regions in the lower parts of the valley margins. In addition to areas along the main rivers the TRB population exploited the surroundings of small valleys that cut deep into the large watersheds, thus the majority of sites, including all large settlements, lie on the interfluve, especially its marginal zone (see fig. 9.1). The distribution of Corded Ware barrows and flat graves is almost identical to that of TRB sites (see fig. 9.2) and, while he points out that it is hard to say how far the distribution of Corded Ware sites reflects the way in which the area was used, Kruk concludes, reasonably enough, that the main environmental zone used by the Corded Ware population was the dry loess interfluve. The deeper parts of the interfluve were not permanently settled but were presumably exploited seasonally.

Kruk does not satisfactorily account for the change in settlement distribution that occurred with the TRB except to argue that there is no evidence that climatic change was responsible. His centre of interest is in the form of agricultural activity implied by the change in distribution and the transfer of economic activity to the interfluve. The main conclusion drawn is that intensive agriculture could not have played an important role in the TRB since the soils of the higher

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1 An interfluve is an area of higher ground between river valleys.



zones are not sufficiently rich or durable for this kind of farming. The dry environments of the oak-pine forests did, however, offer favourable conditions for slash-and-burn agriculture - this would have demanded the control of wide tracts of woodland and involved the use of temporary camps, accompanied by dispersion of settlement, and Kruk believes the distribution and structure of TRB settlement is consistent with this: permanent villages with surrounding temporary settlements for slash-and-burn (see fig. 9.3).

Less satisfactory is his analysis of the change from TRB to Corded Ware, which is characterised not by a different settlement area, but mainly by the changed character of the archaeological remains, which become exclusively funerary. Kruk, like many others before him, interprets the lack of settlement as indicating the predominance of pastoral activities, and argues that evidence for the occupation of already deforested areas by the Corded Ware is provided by the numerous large barrows, which it would have been difficult if not impossible to build on wooded ground. That extensive clearance had already begun to take place is not at issue and may be paralleled by similar and more or less contemporary evidence in the British Isles (Evans 1975). Apart from his pastoralist hypothesis, Kruk's outline of the sequence of events seems inherently plausible. The TRB population exploited the area using slash-and-burn on a large scale, so that the dry forests of the higher landscape zone were successively burnt out, while the open spaces thus obtained served as pastures for large herds and flocks. The simultaneous use of these two forms of environmental exploitation soon resulted in the formation of relatively durable dry upland meadows and, over several centuries, in fairly major changes in the natural landscape, although these would



have been restricted to parts of the interfluve.

The issue of pastoralism will be considered below, but similar evidence for clearance in this period is known from other areas. Britain has already been mentioned, where the evidence from buried soils beneath henges in the southern chalk area suggests a period of about 500 years during which an environment of grassland existed, maintained, it is assumed, by grazing animals (Evans 1975). In the PFB period in the Netherlands too there are indications of a more open landscape than in the preceding TRE period (Waterbolk 1956). Little evidence is available from Bohemia and Moravia on the subject of clearance, but attention may at least be drawn to the barrow cemeteries, both Corded Ware and Bell Beaker, of eastern Moravia, in areas which are now densely wooded (unpublished information AÚ ČSAV Brno) - these must at the time have been relatively clear. Finally, Central Germany must be mentioned. This region has been fairly thoroughly investigated; nevertheless (or perhaps therefore) its landscape history remains the subject of considerable controversy, particularly over the extent of its post-glacial afforestation before the arrival of human agricultural interference, a question of considerable importance for the understanding of later Neolithic agricultural activity (see e.g. Behrens 1973). The pollen analysts believe that the Central German Trockengebiet, the main settlement area, was covered with closed forest up to c.3000 b.c. Soil evidence, however, suggests that the black earth of this area was in existence in the Atlantic period and open conditions are, of course, necessary for its development. This is confirmed by the snail evidence (see fig. 9.4) which, in the heart of the Trockengebiet, always consists largely of open country species. Mania (1972) would thus see human activity during the Neolithic as



merely stopping the expansion of the forest rather than making extensive clearances. The snail composition diagram for the Sub-Boreal (see fig. 9.5) shows a more marked representation of open country species but the picture is not very different from that of the preceding period - the landscape had never been closed and was now a bit more open.

So far this outline has dealt largely with the history of clearance in various regions, and the general picture of fairly extensive open areas in certain places during the late Neolithic seems reasonably clear. In Little Poland the appearance of the Corded Ware seems merely to see the continuation of extensive clearance which was already developed in the TRB period; in Holland, on the other hand, Waterbolk (1956) believes that the change from TRB to Corded Ware coincides with a marked expansion of the cleared area. These areas are, of course, a long way apart, but distance is probably not a significant factor: Evans has shown that even within southern England there were important differences in the extent and permanence of clearance in settled areas around this time. Clearly the main factor involved is intensity and type of use as exploitation developed over time, and it is not possible to generalise about this from one region to another. In Central Germany it seems probable that the forest was never entirely closed and that clearance proceeded gradually, as in Poland; certainly there is nothing to associate a major episode of clearance with the Corded Ware/Bell Beaker late Neolithic period. Unfortunately, evidence for Bohemia is at present simply unavailable, and although it may be assumed that clearance was going on, almost nothing is known about its pace, its permanence or its extent.

The next task is to look at the various cultural distributions, as representing settlement areas, in relation to soils, and to see

simply showing the expansion of the forest rather than making extensive clearances. The small composition diagram for the Sub-Boreal (see fig. 9.2) shows a more marked representation of open country species but the picture is not very different from that of the preceding period - the landscape had never been closed and was now a bit more open.

So far this outline has dealt largely with the history of clearance in various regions, and the general picture of fairly extensive open areas in certain places during the late Neolithic seems reasonably clear. In Little Britain the evidence of the Corded Ware seems merely to see the continuation of extensive clearances which was already developed in the 2nd period; in other words, on the other hand, substantially (1934) believes that the Corded Ware is linked with coincident with a marked expansion of the cleared areas. These areas are, of course, a long way apart, but distance is probably not a significant factor; some has shown that even within southern Britain there were important differences in the extent and permanence of clearance in certain areas around this time. Clearly the main factor involved is intensity and type of use as exploitation developed over time, and it is not possible to generalize about this from one region to another. In Central Britain it seems probable that the forest was never entirely closed and that clearance proceeded gradually, as in Ireland; certainly there is nothing to associate a major episode of clearance with the Corded Ware/Beaker Late Neolithic period. Unfortunately, evidence for Ireland is at present largely unavailable, and although it may be assumed that clearance was going on, almost nothing is known about its pace, its permanence or its extent.

The next task is to look at the various cultural distributions, as representing settlement areas, in relation to soils, and to see

what changes, if any, are discernible in the late Eneolithic. The only region for which a detailed micro-area study is available is, as we have seen, southern Poland. Here Kruk was able to demonstrate a series of alterations in the pattern of exploitation through time. Elsewhere the evidence consists only of large scale blanket distribution maps. Maps of the later Neolithic/Eneolithic cultures of Bohemia, Moravia, and Central Germany against the soils of their respective areas are shown in figures 9.6-9.7. Probably the first feature which becomes apparent is that in each region virtually all the distributions are broadly the same, and that the underlying constraint is the soil distribution - they are essentially restricted to the areas of black earth and other easily worked fertile arable soils. Thus in Central Germany, Baalberg, Bernburg, Corded Ware and Bell Beakers are all extremely similar, while the same is true of later TRB, Řivnáč, Corded Ware and Bell Beakers in Bohemia; only Moravia is rather different, with Jevišovice B and the Moravian Corded Ware tending to be complementary to one another, while Bell Beaker finds occur over the whole area. At this rather coarse level, then, it does not seem possible to see any great change occurring with the introduction of Bell Beakers, or, indeed, of Corded Ware. The only obvious prehistoric breaks are at the beginning of the Neolithic when the pattern was first established, and in the Late Bronze Age, which saw, in certain areas at least, an expansion of settlement not matched until the Middle Ages (Mildenberger 1972).

The fact that there is no change in distribution in the late Eneolithic is the most important conclusion to be drawn, a point perhaps insufficiently appreciated, but something must also be said about the type of subsistence activity implied by such a distribution. Buchvaldek



(1967) for instance, has said that evidence indicating Corded Ware settlement of fertile arable soils only is insufficient to show that the population of the time was agricultural. There is certainly some truth in this, but it overlooks the fact that such distributions reflect constraints on settlement, and if the population of Bohemia, or indeed Central Germany, at the time when Corded Ware was in use, were the pastoral nomads Buchvaldek would have us believe, it is at least questionable whether they would be governed by the same constraints on settlement as those affecting both earlier and later populations whose mixed agricultural subsistence base is unquestioned. The same argument applies, of course, for the Bell Beakers.

But large-scale distribution in relation to soils is not the only available line of evidence for subsistence economy; there are the actual plant and animal remains to be considered. Unfortunately, as research has progressed it has revealed an ever-increasing number of pitfalls in interpreting this type of information, even when it is initially of high quality, and perhaps no problem is more difficult than assessing the relative importance of plant and animal foods on the basis of this kind of evidence. For the Central European later Eneolithic the data is extremely poor, partly because the pottery has attracted far more attention than economic questions, and partly because the Corded Ware and Bell Beakers, at least in the regions of prime interest here, are largely known from grave and cemetery remains. It is thus not possible to look at change through time in plants or animals exploited other than on a presence/absence basis.

The faunal data for Central Germany are given in table 9.I. This shows, unsurprisingly, that the usual domestic animals are present from the early TRB onwards; the one exception to the pattern is the



Bell Beakers, where only pig bones have been noted in the graves; as Behrens (1973) says, this cannot in any way reflect the real situation. The fauna from Bottendorf, the one Central German Corded Ware settlement for which more detailed evidence is available (Clason 1969:173) indicated that in the late Neolithic proportions of animals too may have been similar to those of an earlier date, with cattle predominant, followed by pig and then sheep/goat. The one newcomer late in the Neolithic of Central Germany is the horse, found at the Corded Ware settlement of Gleina (Clason 1969:173). For Bohemia and Moravia the sequence is similar (see table 9.II). Again the usual domestic animals are found, with the addition of the horse, which, as we have seen elsewhere, already occurs in Rivnac contexts in Bohemia.

The information concerning plant crops is even more exiguous and is, in fact, only available for Central Germany, where work has been carried out by Schultze-Motel (1969); even this, however, is based solely on grain impressions found in pots for the later Neolithic. A list of occurrences is given in table 9.III. Emmer and barley seem to be the most important, from the small amount of quantitative evidence which exists - out of 81 Corded Ware grain impressions 23 were barley and 17 emmer; like the animals the pattern is more or less the same throughout the Neolithic, but this evidence is far too slight to draw any firm conclusion.

Taken all together, the gross outlines available from the plant and animal remains confirm the distribution evidence in indicating no basic economic change occurring with either the Corded Ware or Bell Beakers. The one thing which is an exception to this is the horse, which has already been discussed in an earlier chapter.

In the light of the immediately preceding emphasis on continuity



it is worth recalling the earlier evidence that clearance was gradually becoming more extensive, and in some places permanent. Almost certainly associated with this development was the use of the plough, although it should be said at the outset that there is no direct proof of it in Central Europe at this time - the evidence comes mostly from north-west Europe. The British examples of ploughing are well-known; there are marks too in Corded Ware contexts in the Netherlands, as well as TRB and Single Grave examples in Denmark (Neustupný 1969). From Central Europe come interments of cattle, often in pairs, with grave goods indicating a Middle Eneolithic Globular Amphora/Baden date, therefore pre-Corded Ware (Neustupný 1969). Suggestions as to the date of introduction of the plough into Central Europe must be made cautiously given the relatively flimsy evidence available but it was certainly long before the appearance of Bell Beakers, and the most likely terminus ante quem, if it was not any earlier, is the Middle Eneolithic Baden/Late TRB period, when wheeled vehicles were certainly in use in parts of Central Europe, and when the evidence from some areas indicates that extensive clearance had been taking place. Thus Neustupný (1969) presents a convincing picture of the Corded Ware-using population of Central Europe continuing previously established patterns of plough-using agriculture involving the use of permanent fields and a gradually increasing cleared area, which may be seen as an alternative to Kruk's interpretation of the same phenomenon. The two are, moreover, not entirely incompatible, at least as regards an increase in the number of animals. The value of animal manure in maintaining the fertility of permanent fields is obvious, as is their role in preventing regeneration of the forest. Apart from the mutually beneficial effects of keeping larger numbers of animals and maintaining



permanent fields, more animals, or at least maintaining some of them to a greater age, had actually become necessary for other reasons: cattle for use as draught animals and sheep (which also prefer open environments) for their wool. Spindle whorls first appear in any quantity in Central Europe in the Baden/late TRB period and large numbers, as well as loom-weights, are found in the hill top settlements of the epi-Baden Řivnáč and Jevišovice B cultures in Bohemia and Moravia, while a piece of woven woollen cloth was found preserved in a Bernburg culture barrow from Central Germany (Schlabow 1959). It thus appears likely that it was in the Middle Eneolithic, if not earlier, that major economic changes were taking place, and that they were already established by the late Eneolithic period of Corded Ware and Bell Beakers. We have already seen that there is evidence to associate both of these with arable agriculture, while the occurrence of spindle whorls confirms a continuing production of textiles.

A point which should perhaps be discussed here is the question of transhumance. It will be appreciated that although settlement areas in the Central European Neolithic were restricted to relatively small, well-spaced areas of good arable soil, the areas between did not remain unused even at a very early date. They are sharply distinguished, however, by the nature of the evidence, which generally consists of isolated finds of stone axes; the situation around the Thüringer Wald and the Harz mountains of Central Germany is shown in figure 9.8. These finds may be ascribed to such activities as hunting and collection of specialised resources, but as herds grew larger transhumance from the lowland basins to their upland peripheries might well have become important. This would obviously have depended on the extent of upland forest cover, about which very little is known. It is, however,



interesting that in the Middle Eneolithic, contemporary with the Rivnac culture, sites are found in the upland region of the Bohemian-Bavarian border in areas unsuitable for arable agriculture. The sites themselves are generally small enclosures on hill-tops and they are distinguished, in terms of their pottery, as belonging to the Cham group (Hundt 1951, Pleslová-Štiková 1969). The fact that the pottery is distinct from, although similar to, that of the Rivnac culture suggests that the phenomenon may not be as simple as ordinary transhumance; if this were going on one might well expect the pottery to be identical rather than merely similar. Nevertheless, the point to note is that a more specifically upland adaptation seems to be developing at a time when other evidence points to increasingly large numbers of livestock necessary for such things as wool production. It should perhaps be emphasised that the Corded Ware and Bell Beaker distributions coincide with that of the Rivnac culture and not the Cham group.

The preceding discussion of subsistence economic developments inevitably brings us to the question of population increase, which since the appearance of Boserup's book (1965), has often been regarded in the archaeological literature as the motor for such changes (e.g. Sherratt 1972). The tide has now turned against this type of blanket explanation as the complexities of the real world have reasserted themselves and both theoretical and empirical studies have shown that the population of a given area does not automatically go on increasing through time. One relevant example comes from Central Europe, where surveys in south-east Hungary have indicated that, after allowing for the greater length of the period, occupation was at its densest during the Early Neolithic Körös phase and declined thereafter until the



beginning of the Bronze Age (Sherratt pers. comm. 1976). Nevertheless, even if demographic determinism is rejected, population remains an important variable which cannot be neglected.

One of the main difficulties, of course, is deciding whether the population has in fact changed, a question of more relevance here than the still more fraught problem of estimating absolute numbers. In the present case further difficulties exist because of the changing nature of the evidence: up to and including the Middle Eneolithic (late TRB/Rivnac) the remains largely consist of settlements, while the Corded Ware and Bell Beakers are almost entirely represented by graves. Comparison in terms of numbers of sites, a questionable method in the best of circumstances, therefore seems even more inappropriate across this division, although it might have some relevance in comparing Corded Ware and Bell Beakers.

In Central Germany more than 1200 Corded Ware sites are known compared with 250-300 for the Bell Beakers. The difference in numbers raises the question of whether the Bell Beaker sites do actually represent the total population of the Saale area at a particular period of time; this is obviously a necessary assumption in using such remains for population estimates, and it is a point on which the chronological evidence is in some doubt - it may be that at least some of the Mansfeld Corded Ware sites are contemporary, but it is also possible that the Bell Beaker period was much shorter (see the previous chapter). In Bohemia the numbers of Corded Ware and Bell Beaker sites are approximately equal, with c.300 known for each. This perhaps confirms our belief that they are successive but provides no evidence of a population increase, or decrease, from one to the other. Finally, in Moravia there are only about 70 known Corded Ware sites compared



with c.300 Bell Beaker, but, as we have already seen, the Corded Ware distribution is limited to the more northerly part of the region and cannot represent the total population of the area which was later to be occupied by Bell Beaker remains.

Rather more satisfactory than this approach is comparing the areas occupied through time. If other reasons can be ruled out, expansion of the settled area, especially if it is onto worse soils, may give an indication of population increase. Agricultural intensification is obviously another possible response, as Boserup has shown, but this could also occur for other reasons, such as anthropogenic changes in the environment. As we have already seen earlier in this chapter, large-scale extension of the settled area does not seem to have taken place in the period under consideration, indeed, probably not until the Middle to Late Bronze Age. This does not exclude the possibility that small-scale infilling did in fact take place, but in most of our area of interest the work which would detect such processes has not been carried out. The main exception is the work of Kruk (1973), already described. This documents a process of increasing clearance in the interfluvial areas during the TRB, expanding out from the more restricted micro-areas occupied in the earlier Neolithic. No real explanation is offered by Kruk for this process except the statement that climatic change was not responsible, but increasing population may well have been a factor. Certainly, the sort of geomorphological events which have been demonstrated by Dennell and Webley (1975) in Bulgaria are unlikely to be relevant to changes in land use in the Polish loess.

The other region where similar work has been carried out is Central Germany. Here Kaufmann (1967) has studied the area of the



lower Bode, a tributary of the Saale. The map on which he bases his conclusions is illustrated in figure 9.9. Sites of the TRB Baalberg group, like those of the preceding Bandkeramik, are found in the valley edge zone on both sides of the river Bode, between the black earth areas and the moist silty soils of the flood plain; the same is true for finds of the Bernberg culture. It is in the Corded Ware period that most sites are found, and, more important, not only on the edges of the flood-plain but also on the ridge between the villages of Hecklingen and Neundorf and around Gross-Bornecke. In fact, there is a general tendency for Corded Ware sites to be in higher areas, poor in water and far from the Bode, more in the middle of the black earth, and marking a slight expansion of the settled area. As we have already had occasion to remark, it may not be correct in Central Germany to regard the Bell Beakers as representing the material culture of the inhabitants at a later date than the Corded Ware, so the significance of the Bell Beaker sites in the Bode Valley is uncertain. They are fewer in number than the Corded Ware and mostly along the border of the flood-plain and the black earth; they do, however, join some Corded Ware sites in the earliest occupation of the Stassfurt - Lößnitz - Rathmannsdorf area.

In summary, over half the total Neolithic material from the lower Bode valley is late Neolithic (including Corded Ware, Bell Beaker, Schonfeld, and Single Grave), even though this period did not last as long as the Bandkeramik alone. Combined with the more significant evidence that it was in the later Neolithic that certain areas with a lower water-table were settled for the first time, it seems possible that we can see here an indication of population increase. Whether this conclusion may be extended is another matter; Fischer (1958) has long



suggested that the Corded Ware period in Central Germany sees a process of 'innere Kolonisation' in response to population increase, although he has presented little evidence in support of the idea. No work at all of this nature has been carried out in Bohemia and Moravia so very little can be said of the implications of population change for the transition from Middle Eneolithic to Corded Ware, or from Corded Ware to Bell Beakers in these regions. In general, on the basis of the scanty data available, the late Neolithic/Eneolithic may have been marked by some increase in population in Central Europe, but it is far less certain that anything similar occurred within the late Eneolithic on the change from Corded Ware to Bell Beakers. Whatever increase did take place during the Central European Neolithic was not on the dramatic scale to be seen in the Late Bronze Age or the Middle Ages.

So far no sharp differences have been found in economy, population or degree of clearance which divide the late Neolithic/Eneolithic from what went before. One change has, however, long been recognised: that which occurs in the nature of the settlement remains, and it is this which must now be examined. There are two main questions to be answered. The first, and most important, is the extent to which the dramatic change in the archaeological evidence reflects changes in what was happening in the past. Given that an answer to this can at least be essayed, it is necessary to consider the significance of any such changes. As we will see these distinctions are between the Corded ware and what went before, and not between the Corded Ware and the Bell Beakers. The character of the remains from these latter two periods in Bohemia is identical: they are almost exclusively funerary. In Central Germany too the change in this respect is from Middle



Neolithic to Corded Ware, which again, like the Bell Beakers, is known very largely from graves. Only in Moravia, of the areas with which we are concerned, may it be possible to associate such a change in remains with the appearance of the Bell Beakers, because it is possible that in the south-east part of this region they directly succeeded the Jevišovice B group, since the Corded Ware of Moravia is restricted to the centre and north.

The middle Neolithic/Eneolithic period in Central Germany, Bohemia, and Moravia is known largely through the remains of settlements, some of which are quite extensive, while it is virtually graves alone which characterise the late Neolithic/Eneolithic of the area. The distinction, however, is not universal throughout Central Europe: in the Carpathian Basin, where Bell Beakers are also found, there is no such break, but it may be significant that the Corded Ware does not occur here. To understand the significance of the change it is necessary to examine where exactly the differences lie. Corded Ware settlements are not entirely unknown. At Gleina, Central Germany, a habitation layer 25-60 cm. thick was found, with traces of hearths, over an area of 195 sq.m., nor did this represent the whole of the settlement (Schlette 1969). Another Corded Ware settlement is known from the Luckaer Forst, Kr. Altenburg, Central Germany (Behrens 1973, Schlette 1969); the plan is illustrated in figure 9.10. Eleven houses with slightly dug-in floors were discovered; there were no post-holes and it is possible that the sleeper beam technique was used: according to Behrens (1973:198) a wooden sleeper beam construction was found as a grave chamber in a Corded Ware barrow. As well as the houses there were pits, together with stray finds of sherds, flakes, pieces of grind-stones etc. Phosphate investigations have also been carried out



in Germany (Höckner 1957), and may indicate that cemeteries were placed on (?former) settlement sites (cf. the plan of Luckaer Forst above). No Corded Ware settlements are so far known from Bohemia and Moravia which are, however, better provided with Bell Beaker settlements than Central Germany. Here Bell Beaker sherds are known from sites in the Orlagau area, south of Jena (Neumann 1969), but according to Fischer (pers. comm.) it is likely that these sites represent a palimpsest of several periods and not the homogeneous Bell Beaker assemblage of Neumann's interpretation.

The Bell Beaker settlements of Bohemia and Moravia (Hájek 1968, Archive AÚ ČSAV) are all very similar to one another and consist in general of a few pits containing potsherds; it is conceivable that some of these pits represent house floors as they are shallow and rectangular although small (see e.g. Klobouky, figure 9.11). The one apparent exception to this pattern is the site of Kozly, on the Elbe in central Bohemia (Zápotočský 1960), where extensive post constructions were found. Unfortunately, it cannot be excluded that these are of Early Bronze Age date since Unetice remains are also known from the site, and it is possible that residual Bell Beaker sherds found their way into the post-holes (E. Neustupný, pers. comm.).

The settlements of the Middle Eneolithic are comparatively large and densely occupied, while the houses are often post-built. Thus, at the simplest level, there are two main distinctions to be made: one in settlement size, and probably also degree of nucleation, the other in hypothesised building techniques; in this latter connection Bradley's work at Belle Tout (1970) suggests that an improvement in Central European excavation methods may be necessary if further late Eneolithic houses are to be found. But to gain a proper understanding



of the differences one has to go beyond this descriptive level and look at the picture which has been built up by Central European prehistorians of the socio-economic conditions of the Middle Eneolithic.

Many settlements are in defensible hilltop or steep spur positions and some of these are further strengthened by artificial fortifications of greater complexity than the simple palisades and ditches of the earlier Neolithic; relevant examples are the Baden settlements of Jezera, Jevišovice Cl and Hlinsko in Moravia (Pavelčík 1973), and such Řivnáč culture sites as Stehelčeves-Homolka, Vraný-Čertovka, and Žalov-Řivnáč itself (Pleslová-Štiková 1968). These are not the only type of site; others are found in low-lying positions without man-made defences, and it has been suggested (although not in these terms) that the differences indicate a settlement hierarchy with two different levels and not simply special and general purpose sites of different kinds (see e.g. Pleslová-Štiková 1973). There are several aspects to these higher-level sites, first the defences already mentioned, which imply the availability of labour and presumably the need for defence. Various reasons for such a need have been put forward, including external threat from Corded Ware and Bell Beaker folk (Pleslová-Štiková 1968), disturbances in the Carpathian Basin (Pavelčík 1973), protection from a rebellious peasantry (Mašek, quoted in Pleslová-Štiková 1968) and warfare between neighbouring groups (Behrens 1973). A second aspect of these sites is their apparent use in performing 'central place' functions: 'apparent' is used advisedly since few of the 'lower-level' sites have been examined as yet. In the Bohemian Řivnáč culture local versions of the widespread Slavonian footed bowls are known predominantly from the hilltop settlements, as are Globular Amphora sherds (Pleslová-Štiková 1966). At Vraný-Čertovka, a defended

The difference can be seen in the way the two authors handle the same material. The first author, who is more of a generalist, tends to present the facts in a straightforward manner, without any attempt to analyze or interpret them. The second author, on the other hand, is more of a specialist, and his writing is characterized by a deep knowledge of the subject and a willingness to explore the complexities of the problem. This is evident in the way he uses the facts, which he does not merely list but rather weaves into a coherent and compelling narrative. The result is a work that is not only more interesting to read but also more useful to the reader, as it provides a deeper understanding of the issues at hand. The first author's approach is more like a map, showing the general outline of the territory, while the second author's is more like a journey, taking the reader through the intricacies of the landscape and allowing them to discover the meaning of the journey for themselves. This difference in style is not just a matter of personal preference but reflects a fundamental difference in the way the two authors view the world and their role as writers. The first author sees himself as a reporter, while the second sees himself as a philosopher, and this difference in self-perception is what ultimately shapes their writing.

Řivnác site, a pottery kiln was found with large numbers of wasters nearby (Knor 1966). In all the hilltop settlements there is evidence of textile production but this also occurs at other sites as well (e.g. Lysolaje, Pleslová-Štiková 1972a).

A detailed study of this aspect of the fortified Baden culture site of Hlinsko, Moravia, has been made by Pavelčík (1973). He believes that production of the stone industry was concentrated here, including the manufacture of polished stone axes, grindstones and chipped stone. Contacts with relatively distant areas were indicated by axes of Babia Gora flint from Little Poland; by radiolarite from the White Carpathians and obsidian from the Bükk mountains, not to mention shells from the Mediterranean. Finally, a cup of Retz-Krepice-Bajč type and the hoard of six copper ornaments found in it point to contacts with the south and south-east.

In the light of the evidence which has been described, it is important to try and distinguish which of the explanations that have been offered, if any, best matches the situation. As Pavelčík (1973) says, the period of origin of the hill settlements does not correspond to any period of external threat, even supposing that this became a factor at some later stage. Mašek's proposal of an upper class restricted to the hill top settlements seems more appropriate to the Middle Ages than to the Middle Eneolithic. Some versions of Behrens' suggestion that warfare between neighbouring groups was an important factor may well be a factor, especially if Pleslová proves correct in her argument that the hill settlements are concentrated in areas of denser population; we have already seen the evidence for agricultural intensification. Such a competitive situation may well have led to a more developed form of organisation which, in turn, may have involved



centralised redistribution. If one simply supposes that there was a concentration of functions in accessible places for least effort reasons, the defensive nature of the positions, as well as the defences themselves, go unaccounted for. Awareness of the complexity implied by the situation described above has led Pavelčík to the conclusion:

'Das aber wurde bedeuten dass sie das Territorium Mitteleuropas nicht mit solcher Verspätung hinter dem progressiven Mittelmeermilieu betrat, wie bis jetzt angenommen wurde' (Pavelčík 1973:48).

Unlike the Mediterranean, however, Central Europe does not seem to have seen a continued increase in complexity. All the indications are that with the late Eneolithic the settlement hierarchy broke down. Settlement seems to be dispersed in small units, with no evidence of defences, or of specialisation of function. Apart from the occasional Bell Beaker sherd, the sites of the hill settlements do not seem to have been re-occupied until the later Early Bronze Age, when Únětice remains appear, for example, at Homolka and Slanská hora. The change cannot, however, be classified with such phenomena as the demise of Mycenaean Greece since, as we saw earlier, there is no indication that population declined, and it is possible that it may have increased, in the Corded Ware period. It may be that the evidence from Central Germany points to where the answer lies, in expansion by small-scale infilling onto previously unoccupied inferior land rather than continued competition. A change in the size of the economic unit might well have accompanied any such developments. Regrettably, testing of these hypotheses for Bohemia and Moravia demands a detailed topographic analysis which may not be forthcoming in a country where virtually all maps are regarded as secret.



But the main aim of this chapter is not to attempt an explanation of the end of the Middle Eneolithic settlement system in Central Europe. The purpose has been to investigate the subsistence economic and settlement background in which the Bell Beaker assemblage appeared. In summary, the appearance of the assemblage does not seem to be correlated with any great change in population, subsistence or settlement, at least in Central Germany and Bohemia. The beginning of the new settlement pattern which we see with the end of the Middle Eneolithic is to be associated with the Corded Ware - when the Bell Beakers appeared the pattern had already changed. Southern Moravia, however, presents a possible exception to this pattern: as we saw in the preceding chapter, it is possible that the Jevišovice B settlements may have continued until the appearance of the Bell Beaker assemblage since there is no Corded Ware in this area - it is only found in the north of the region. If there were a succession from Jevišovice B to Bell Beakers in this area, it would have some interesting implications; in particular it would indicate that a similar process to that which went on in Bohemia and Central Germany, i.e. a change in settlement pattern, could appear in different 'cultural' circumstances - in Moravia a change to a Bell Beaker rather than a Corded Ware assemblage. This would demonstrate the independence of 'cultural' and 'settlement' processes in two slightly different ways: firstly, by showing that in different areas the same settlement change occurs with the appearance of different assemblages, in two cases Corded Ware and in one case Bell Beaker; and secondly by making it clear that the appearance of the Bell Beaker assemblage can correlate with settlement pattern change under certain conditions of economy, settlement and population.



CHAPTER TEN: SOCIAL ORGANISATION AND ITS CHANGES IN THE  
LATE ENEOLITHIC OF CENTRAL EUROPE

The last chapter gave a general review of the changes in economy and settlement which went on in the later part of the third millenium b.c. in Central Europe. Although these factors are important, they are at a remove from the sphere in which, we have argued, the Bell Beaker artifacts functioned, that is the expression of social differentiation. This chapter is concerned with social organisation in the time immediately preceding the appearance of the Bell Beakers, and a comparison with the succeeding Bell Beaker phase. This largely static form of looking at change is really imposed by the nature of the data. In order to look for structure in social relations using funerary evidence, it is necessary to look at large numbers of graves together. Provided due care is given to chronology this need not cause any problems, but it does mean that through time we will end up with a series of successive structures rather than a true trajectory and may, therefore, see change as a sequence of jumps.

All the Central European areas in which Bell Beakers are found also have preceding occupation and could therefore be investigated for the purpose of defining change in social organisation. In fact, however, the possibilities are severely limited by a lack of available information, and for this reason only one area could be examined. The region selected was Bohemia which, as we have seen, is characterised by a Corded Ware assemblage before the Bell Beakers appear. There were several reasons for the choice. First, a large amount of data on the Corded Ware has been gathered together and published by Buchvaldek



(1967); secondly, a single large cemetery, Víkletice (Buchvaldek and Koutecký 1970), has also been excavated and provides an extremely useful control on results derived from the graves of the region taken as a whole. The same purpose is served by the work which has already been done on the social aspect of the Corded Ware graves of Bohemia (Buchvaldek and Koutecký 1972; Neustupný 1973). It may be said at the outset that the results obtained below agree entirely with those of Buchvaldek and Neustupný, as do the interpretations on the whole, but attention is also devoted to aspects which they do not consider. The final point in Bohemia's favour is that there is sufficiently good information on the Bell Beaker graves of the region to make possible a meaningful comparison with the earlier period.

The chapter will be in two parts. The first will present an analysis of the Corded Ware graves from Bohemia with the aim of making statements about the main features of social organisation which may be inferred from the results. The second part will be a comparison of these results with those produced for the Bell Beaker graves; this will be concerned both with the organisation itself and with the roles of the objects. The second of these presents some problems since it requires the argument that substantively different artifacts may be regarded as equivalent, a point which will be discussed further in the appropriate section. This difficulty does not arise when looking at organisation because the level of abstraction is sufficiently high for the concrete details of its expression to be irrelevant.

One of the most important dimensions of variation in the Corded ware has long been recognised as chronology. This is so throughout its distribution area and the sequence is founded both on stratigraphies and on detailed analysis of typologies and associations (e.g. Glob 1944,



C. Fischer 1959). A scheme for Bohemia has been evolved by Buchvaldek (1967). He defines three basic groups whose significance is believed to be largely chronological, together with a transitional group between the second and the third. For the purpose of the analysis undertaken here only the later graves were considered, so that as much chronological variation as possible was eliminated. The earlier graves could, of course, have been studied separately but this was not done for two reasons. The centre of interest was not development within the period occupied by the Corded Ware assemblage but between Bell Beakers and the period immediately preceding. Secondly, about 80% of the graves belong to the late Corded Ware period, which is, therefore, not comparable with the earlier; the significance of this is uncertain but it may be related to indications that the early Corded Ware overlaps in time with the Rivnac.

As already mentioned, two sets of Corded Ware data were analysed, each separately. These were the graves from the cemetery of Vikletice and those graves of the later Corded Ware in Bohemia as a whole. At Vikletice only those graves were considered which had neither been recently disturbed nor robbed in antiquity, while for the other set of data attention was restricted to those graves which Buchvaldek (1967) had given a reliability value of 1 or 2 on his scale from 1 to 5.

The first part of the investigation was concerned with the sex and age of the individual buried. The importance of these will be abundantly clear from previous chapters and they have been considered in great detail in another context by S.E. Shennan (e.g. 1975). Independent evidence is available for them so that we have an indication of whether the grave attributes really do relate to the individual buried. Social distinctions based on sex and age are present in every



society even when there are almost no others, while if other differences are present, a knowledge of their distribution over different age and sex categories is essential if they are to be understood. Finally, the sort of objects with which they are associated may give an idea of the type of role which was considered appropriate for the different categories.

For the Corded Ware the main distinction between the two sexes in burial is generally believed to be the side on which the skeleton is lying, with men on their right-hand-side and women on their left. This point was tested with the data from Vikletice, where the skeletons have been anthropologically analysed. The result is shown in table 10.I. Women are only ever found on their left hand side, never on the right, but men seem to be found on both. It is usually claimed that this is a consequence of poor sex identification by the anthropologist, but as the men are equally split between the two sides this seems unlikely. The smaller sample from Bohemia as a whole presents a similar picture (table 10.II).

The next question was whether such distinctions between the sexes were also apparent in the grave goods with which they are associated. There was an insufficient number of anthropologically sexed skeletons for this purpose so the side on which the skeleton was lying was used. The reasoning behind this was as follows. Those on their right are definitely male, while at least some of those on the left are female; in any event, the distinction between left-hand-side and right-hand-side for certain goods is sharp enough to give support to the suggestion that those males who are on their left-hand-side are different from the others. Results for those objects on which the two sides differ are shown in table 10.III. Two very similar vessel types are more associated with the right-hand-side: decorated Beakers and decorated lugged



Beakers; the other four pottery types all belong with the other side. Axes and maces are found almost exclusively with the right-hand-side, while such ornaments as perforated teeth and shells associate equally strongly with the left-hand-side group and are most probably to be connected at least partly with the women. These results are significant from several points of view and confirm those obtained by Buchvaldek and Neustupný. They show first of all that there is a definite association between the goods and the individual buried. This is, as we have seen, crucial to any use of funerary evidence for the study of social organisation, and further support for it lies in the fact that double graves often have two of some of the objects deposited in the grave. Another point which emerges is that it is essential in studies of other aspects to treat the left and right hand side groups of graves separately as they are not entirely comparable. Finally, as these differences are present, it seems reasonable to relate them to different social roles, and to consider what sort of roles they might signify. The impression given is entirely traditional: the right-hand-side men connected with weapons and heavy tools and the side which includes women associated with ornaments, although it should be noted that chipped stone blades are found equally with both sides.

All these conclusions refer to individuals in the juvenile age category or older, and it is now necessary to consider the extent to which children were treated differently from these. As regards grave goods, children have examples of almost all the vessel types, including the decorated Beaker and the decorated lugged Beaker. The great difference is in the presence of other goods. Like a large number of adults many children have a blade deposited with them. There are, however, only two examples of other object types being found



with children, a mace-head in one grave and two copper spirals in another. The implication is that children almost never have some of those objects which are characteristically male, specifically those which may well relate to achieved status in male-oriented activities - battle-axes, mace-heads and flat axes - objects which are not found with all males anyway. Nor do children have the left-hand-side associated perforated tooth and shell ornaments which most probably characterise women. It is clear that children were differently treated; the way in which this was done gives an indication of the sort of differences which were involved. There is also a suggestion that children were buried in a different place from the adults. At Vikletice only a single Infant I skeleton was found, far too few for expected rates of infant mortality, but the possibility that others have decayed should not be forgotten.

It was mentioned earlier that sex and age distinctions will be present in any society, and that where the level of organisation is simple they are likely to be almost the only ones present. On the other hand, if a society is very sharply stratified, then the differences between classes are likely to be much greater than the sex and age distinctions within a given class. In the present case we have already seen that age and sex linked status differences are reflected in the grave goods so it seems at least possible that if rank differences were present they would be reflected in the graves. In order to evaluate the importance of the various distinctions and to try and establish their nature two principal coordinates analyses were carried out. It will be recalled from chapter six that this method works out the eigenvectors of a similarity matrix, together with the associated eigenvalues, and gives the location of the individuals being



studied in relation to the eigenvectors produced. As with principal components analysis, the vectors account for successively smaller amounts of the variation in the data. The size of the eigenvalue indicates the importance of the vector.

Figure 10.1 shows the fall-off in the size of the first twelve eigenvalues from principal coordinates analyses of the Vikletice and the Bohemian Corded Ware graves. The gradual nature of this fall-off contrasts sharply with the equivalent graph for the Central German Bell Beaker graves (see fig. 10.2) and the first two eigenvalues are much smaller. This picture gives an indication of the relatively disorganised complexity of the data - there is obviously a large number of uncoordinated factors involved in explaining the variation in the matrix, few of which are any more important than any of the others. As in the earlier example of this method, the graves placed at each end of the different axes were examined to find out the vector's meaning.

For Vikletice, axis 1, the most important, represented a contrast between those graves without any goods and most of the others, particularly those with certain standard combinations, mostly male, such as decorated beaker, amphora, blade and flat axe. The contrast between graves with goods and those without is obvious and requires little further comment, except to note that the latter are not restricted by age or sex. Factors 2 and 3 seem to reflect slightly different aspects of the distinction already mentioned between the sexes and are, therefore, proof of its importance. Table 10.IV shows the contents of the graves at each end of the axis together with the side on which the skeleton was lying where this is known. Also indicated are those graves at opposite ends of axes 4 and 5, and these



bring home one of the difficulties of all those methods which extract vectors from data, especially when, as in principal coordinates analysis, no loadings of the variables on the vectors are available: this is the difficulty of interpretation. At either end of axes 4 and 5 are graves of both sexes and both the major age categories, nor does examination of the contents of these graves provide any real lead as to the meaning of the axes. In as much as several of the graves at, for instance, the negative pole of axis 5 have literally nothing in common with one another, it is natural to wonder how meaningful the axis really is. This is clearly something on which much further work is required, preferably of an ethnographic nature so that the significance of the remains is already understood. The meaning of the remainder of the axes was equally obscure.

The results from the Bohemian Corded Ware graves excluding Vikletice were slightly different. One of the main reasons for this is that graves without any goods could not be used since none were to be found in Buchvaldek's catalogue of graves in categories 1 and 2. Inevitably, therefore, the first factor could not correspond to that for Vikletice; allowance must also be made for this point in looking at the fall-off in the eigenvalues.

The first axis in this case contrasts graves containing characteristic male objects with those which seem to be female, or at least left-hand-side associated. The second axis is less clear but appears to oppose those graves with common pottery types and those without i.e. the less usual grave combinations; it is noticeable that the latter are in the middle of the first axis and thus clearly not diagnostic of sex. The third vector once more brings out a sex distinction, this time between graves with female non-ceramic goods (shell beads etc.)



and male non-ceramic goods (flat axes, hammer axes, mace-heads). As we have seen, at Vikletice too sex differences are expressed by two different axes. Axis 4, although clearly contrasting graves containing undecorated jugs with the others, is not immediately susceptible to any deeper explanation. Graves of both sexes, all ages and with varying amounts of goods are found at both ends of the axis. The same goes for the remainder of the axes, where it is even difficult in terms of objects to see why certain graves are opposed. Again the question arises whether these obscure axes represent behavioural factors of importance whose meaning we do not understand, or whether the vectors are simply mathematical artifacts of the method adopted.

The results of the analysis of the Vikletice and Bohemian Corded Ware graves confirmed the importance of the division between left-hand-side and right-hand-side which had already been established, and which must be at least partly sexual. On the other hand, it failed to pick up the distinctions between children and adults which we have already seen to exist, a failure shared, incidentally with the factor analysis carried out by Neustupný (1973); nor did the method suggest any obvious further lines for investigation. To find out what other sorts of distinction were present in the grave contents use was made of cluster analysis. The reasons for using this technique have been discussed in earlier chapters and are well summarised by Tainter (1975). In the present analysis both monothetic divisive and polythetic agglomerative methods were used, starting with the Bohemian Corded Ware data.

The 'Information Analysis' monothetic divisive method was carried out using the program DIVIDE from the CLUSTAN IB package (Wishart 1970). The resulting dendrogram may be seen in figure 10.3; the



graves in each of the groups are listed in table 10.V. The first division was on the basis of the presence of object number 24, the flat axe. As we have already seen, this is one of the characteristic male artifacts, so the division initially separates off a number of the males. The final groups on this positive branch (1-15 on the dendrogram) are thus all fairly homogeneous, with slightly varying combinations of male goods; the number of types of goods present varies from two to six. The negative branch, however, includes virtually all the left-hand-side graves as well as a not inconsiderable number of individuals on the right-hand-side, and because of the largely negative characterisation the majority of the groups are large and heterogeneous in terms of their content.

The average-link cluster analysis of the same data, using the HIERAR program from the CLUSTAN IB package did not produce the same basic division along sexual lines, as we may see from the dendrogram (fig. 10.4). On the other hand, it does isolate several groups whose members are almost solely either left- or right-hand-side, and which are scattered at intervals across the dendrogram. Moreover, none of these groups is as heterogeneous as some of those produced by the information analysis technique. The division by side-lying is the main feature of the groupings and it is especially marked for the skeletons on their right-hand-side. That it should not be so clear with left-hand-side individuals is not surprising when it is remembered that some at least of these are likely to be men. Given the assumption that grave good combinations represent social identities, there appear to be several groups of similar identities, some restricted to right-hand-side and some to left-hand-side individuals, as well as others which are mixed. The analysis of the Vikletice cemetery by the same



means produced very similar results (see fig. 10.5), only here, because of the more extensive age and sex information, it was possible to see that one of these mixed groups contained an unusually large number of children and juveniles.

These results confirm the importance of the sexual division and also bring out, to a much lesser extent, the distinctiveness of the children's graves which we have already seen. On the other hand, it is clear that the divisions are not restricted to this; there are several right-hand-side and several left-hand-side clusters, a pointer to definite differences, certainly within the men and possibly also within the women. The next object of study must be the meaning of these differences, particularly whether they represent distinctions between higher and lower rank. This aspect can only be examined now that we have a knowledge of what are arguably the most basic distinctions.

The investigation of rank differentiation is of particular interest from the point of view of a comparison with the Bell Beakers. The appearance of a new prestige kit, which is what the widespread Bell Beaker objects appear at least partly to represent, is something which might well emerge in the context of increasing rank differences. As we have argued in an earlier chapter, that axis which best distinguishes between higher and lower status in a social hierarchy seems to be a ranking from rich to poor based on specified criteria. The criterion generally preferred (cf. Tainter 1975, S.E. Shennan 1975) is labour value, i.e. the input of energy which the presence of a particular attribute requires, rather than use or exchange value. The main importance of the latter is for objects or raw materials which have clearly been imported from some distance. These may be given a labour value on the basis of the distance travelled, although such an argument

and produced very similar results (see Table 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000).

fails to take into account aspects such as rarity. Symbolic significance too may not be properly represented by regarding energy as crucial, nevertheless, together with some allowance for rarity of certain objects or materials, energy input represents probably the best approximation for the archaeologist, to whom the extinct emic value systems are no longer readily accessible.

Among the Corded Ware graves of Bohemia there is little variation in terms of elaboration of the grave or the addition of funerary monuments. There are variations in the size of the grave pit but these relate mainly to the size of the body interred. The biggest differences as regards energy input are in the number and types of grave goods. An initial approximation of this variation is given by the number of types of goods in the grave. This is especially appropriate for the Corded Ware since generally no more than one of a particular type occurs and there are no great energy input differences between the various goods. Figures 10.6-10.8 are bar graphs of the number of graves containing different numbers of goods types, for Vikletice, the other Bohemian Corded Ware graves and a combination of the two. There is a clearly marked cut-off at five goods types. Very few graves have more than this and several of these are double graves, for which the number of goods per person falls in the usual range. Within this there is no single modal value; the quantities from 2 to 5 are more or less equally represented.

The question which must be answered is whether, or to what extent, this constitutes evidence for any great degree of rank differentiation. More detailed information on this point may be gained by using a system of goods values (cf. S.E. Shennan 1975) to see if this sustains the picture of a relatively narrow band of variation with roughly equal

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numbers of graves in the different wealth/energy input categories. A list of the values is given in table 10.VI, and the bar graphs of the numbers of graves with different numbers of points in figures 10.9-11, which show a pattern more or less identical to that for the number of goods types. The well-marked upper limit for the majority of the population is striking, and the shape of the bar graph contrasts with the exponential type of distribution usual in hierarchic situations and based on the fact that hierarchies are pyramidal, with less people in each ascending grade. The narrow limits of the band of variation in points for most of the graves fits in with an interpretation of the organisation as relatively egalitarian, and at least some of the variation within this narrow band may be ascribed to the age and sex distinctions already discussed. A few graves, however, fall beyond the top end of this band and it is these which must now be considered. It has already been mentioned that some of these are double graves, but it cannot simply be assumed that these reduce to a normal number of goods per person: it might be that on occasion people were killed to accompany more important individuals to the grave. In fact, there is no evidence for this. In one case the two burials are probably successive, in several of the others there are two of at least some of the objects deposited in the grave, an indication that the goods were intended for two people who were each recognised in the burial rite. Finally, the majority of the burials are adult and child and not two children or a man and a juvenile girl, which seems to be more usual in such cases (The Leubingen burial may be contrasted with the graves under discussion here). Such an interpretation means that these double graves cannot be considered especially rich; the goods must be divided between the individuals present and this brings down the number of



goods per individual to the normal level in all cases but one. Double graves, however, account for only 8 of the 22 graves which appear unusually 'rich'. The remaining fourteen include both males and females but no children and this situation can perhaps be interpreted as suggesting that rank was achieved and not ascribed at birth. All the children are relatively uniform, but it is not simply the case that all adults have more goods than all children - among the older groups the differences are much bigger, both in total energy input value and in types of goods: the greater points values and new goods are not simply indicators of adulthood; by no means all adult men, for instance, have axes or maces. On the other hand, this small minority of 'richer' graves is not separate from the rest in the sense of having goods not possessed by those lower down the scale: they merely have more of the goods. Males may have both a flat axe and a hammer-axe, or even a mace-head as well, instead of just one or the other. A similar situation is to be found with the few 'richer' female graves, but to a lesser extent: although goods such as beads and perforated teeth do occur lower down the scale, they are more frequent at the higher end. This is especially noticeable in the case of copper, which is, in fact, largely restricted to graves which are presumptively female on the basis of their associated goods.

That there was some degree of rank achievement seems fairly clear. Much less certain is the form or degree of ranking which was present, whether this involved simply individual achievement, or whether there was an institutionalised higher rank which might be achieved. Comment has already been made on the shape of the frequency distribution of graves with differing numbers of points. It has been argued that this does not fit in with reasonable assumptions as to the appearance of a



distribution resulting from a hierarchical form of ranking, except for the one distinction between the great mass of graves and the very small number of 'richer' ones. The sharp break in the bar graph, with a small minority higher up the scale, might perhaps be taken as evidence for an institutionalised higher position as there seems no obvious reason for this if only increasing individual social success was being reflected. The small size of the upper group could then be interpreted as reflecting its very restricted membership. The fact that there are only two groups, with a single step between them, indicates only a limited degree of rank differentiation - possibly a community leader may have been differentiated from the rest of the population.

Now that an analysis of the Bohemian Corded Ware graves has been carried out, it is possible to move on to the next task, a comparison of the results with those obtained for the Bell Beakers. The aim of this is to establish what changes took place in Bohemia concomitant with the replacement of the former assemblage by the latter. Fischer (1975) has recently devoted some attention to the nature of the differences between Corded Ware and Bell Beaker burial in Central Europe, and his work anticipates some of the conclusions presented here. His main interest, however, is in the uses of the objects and the particular ways in which statuses were symbolised, rather than in the nature of the organisation itself, so his views will be examined in more detail later in this chapter. Lanting et al. (1973) have compared the Dutch Protruding Foot and Bell Beaker burials, again concentrating more on the objects and their changing use, although their approach suffers from regarding the similarities and differences discovered simply as traits to be listed in arguments about cultural continuity,



and not as evidence for different types of behaviour changing in different ways and at different rates. In the comparison presented here the focus of interest is on two aspects: first, the extent to which social organisation changed and secondly, whether the way in which objects were used to symbolise this organisation also altered. Of particular concern to the first of these is the question of social ranking: is it possible to detect an increase in the degree of ranking after the appearance of the Bell Beaker assemblage?

To recapitulate briefly, the conclusion reached in the Corded Ware case was that rank seems to have been achieved. It is possible that this was not simply individual achievement in a completely egalitarian organisation, but that there was an institutionalised higher position to be achieved; the bar graph pattern indicates only a single step in this suggested hierarchy.

In the analysis of the Bohemian Bell Beaker graves too it appeared that rank was achieved. There were no great differences among the children's graves and the number of objects present in the graves was small. Among the adults there were much wider differences in the number and value of goods found in the graves. Children also largely lacked ornaments and weapons, which were restricted to only a minority of the adults. It was suggested that only on arrival at adulthood did individuals have the possibility of changing status and achieving further distinctions. On this basis there is thus no evidence for a change from achieved to hereditary rank between the Corded Ware and the Bell Beakers, a change which is one of the main concomitants of developing stratification. Other aspects, however, must also be considered, in particular whether there was an increase through time in rank differentiation, a question which must be investigated both



from a quantitative and a qualitative point of view.

Figure 10.12 presents bar graphs of the number of graves with different numbers of goods types for the Bohemian Corded Ware and Bell Beakers. It may be seen that the ranges are very similar, with the Corded Ware in fact slightly wider. The shapes of the two diagrams are, however, very different. In the Bell Beaker case there is a low modal value of two goods types and then a gradual decrease in the number of graves as the number of goods types increases, in contrast to the Corded Ware pattern discussed at length above. The Bell Beaker distribution corresponds much more closely in appearance to the shape which it was suggested would result from a hierarchical form of ranking, and this might perhaps be taken as indicating an increase in differentiation even though the range in quantity of goods is similar.

As far as qualitative distinctions are concerned, we have already seen (in chapter 5) that the so-called Bohemian 'cluster 1' goods, the decorated Bell Beaker, the wrist-guard, the copper dagger and earrings, occur more frequently in graves at the upper end of the scale in numbers of goods types, and may, to some extent, be regarded as additional to the standard repertoire although there are no hard and fast qualitative differences between graves at opposite ends of the quantitative scale. Again the situation is similar in the Corded Ware graves, where shell and tooth ornaments, as well as copper, tend to be found more frequently in those graves at the upper end of the distribution. There is an important distinction here, however. The Corded Ware goods just mentioned are most probably female associated, while the Bell Beaker 'cluster 1' goods are equally probably characteristic of adult males. This is, in fact, only part



of what seems to be a more general difference between Corded Ware and Bell Beakers with regard to the position of women. They seem to be at least as frequent as men at the upper end of the Corded Ware scale, in marked contrast to the Bohemian Bell Beakers. There is almost no definite sex information for Bohemia, as we saw in chapter five, but the majority of 'richer' graves contain such objects as the 'cluster 1' goods just mentioned, which there is every reason to believe are male associated. Female ornaments are rare in Bell Beaker graves in Central Europe and seem to be mainly restricted to the V-perforated buttons. Even if we cannot infer a definite decline in the position of women, these results do suggest a change in the position which was thought appropriate for them.

Although the degree of ranking before and after the appearance of Bell Beakers was the main point to be investigated, it is by no means the only aspect of importance. One of the most obvious differences is the switch in burial orientation from an east-west to a north-south axis, a change for which we do not know the reason. Similarly, although there is still an opposition between skeletons lying on their left and those on their right hand side, it is reversed, as Fischer and others have noted. They have regarded it, however, as an opposition between males and females, with men on their right in the Corded Ware and on their left in the Bell Beaker period, whereas, in both cases, on the basis of the anthropological evidence, it seems likely that it is an opposition between certain men on the one hand and the remainder of the men and the women on the other; this certainly seems to be the case for the Corded Ware and the Moravian Bell Beaker graves, but more anthropological information is required for the Bohemian Bell Beakers and there are indications (see above chapter 5)



that the situation there might be different. The ninety degree shift in the orientation, as well as the change in the side-lying rule perhaps suggest a conscious opposition to earlier practice rather than simple stochastic change.

Further light is thrown on burial changes from Corded Ware to Bell Beaker in Bohemia by comparing the results of principal coordinates analyses carried out on the two sets of graves. These results have two aspects: the significance of the vectors themselves and the fall-off pattern in the eigenvalues, illustrated in figure 10.13. In order to obtain a better comparison, the fall-off for the Moravian Bell Beaker principal coordinates analysis is also included. The contrast between the Corded Ware and Bell Beaker fall-off patterns is marked for the two most important vectors but thereafter they are all very similar. The difference in the significance of the first two vectors indicates that the Corded Ware and Bell Beaker grave assemblages are differently structured; in the latter case a larger proportion of the variation in the graves is 'explained' by a smaller number of new factors than the former. For the Corded Ware graves one or two factors are not nearly so dominant, reflecting a situation where the variation is more disordered and its different aspects are less highly correlated with one another.

When we turn to the significance of the vectors, there are two points to be considered: do the same factors emerge as important and are they in the same order in both Corded Ware and Bell Beakers. Unfortunately, an evaluation of the similarities and differences is fairly difficult because, as we have seen, there is very little information available on the sex of the Bell Beaker skeletons from Bohemia although slightly more is known about Moravia from this point



of view. In the Bohemian Corded Ware case two of the first three vectors clearly reflected a male-female distinction; the only parallel among the Bell Beakers was the relatively unimportant sixth axis, which contrasted the small group of graves with daggers and wrist-guards, male associated objects, with the remainder (fig. 10.14). Although the information available is slight, there is at present no indication whatever that any other of the first six axes relate to a sex distinction, and one may conclude from this that in the Bell Beaker period there was far less social emphasis on the male-female distinction, at least as far as its expression in funerary ritual is concerned, than in the Corded Ware phase. For the Bell Beakers the most important axis was that which opposed the standard Central European combination of jug and Bowl to associations which included other important but less usual objects, such as decorated Bell Beakers, undecorated handled Bell Beakers, and polypod bowls. This clearly subsumes the contrast between decorated Bell Beakers and the local pottery which has been a centre of interest throughout this dissertation.

It is now possible to see that social changes of various kinds took place with the change from Corded Ware to Bell Beakers in Central Europe. Although it is important to be aware of the dangers of assuming that correlations are explanations, these social changes clearly cannot be neglected and it may be as well to summarise them before moving on to examine the changes in the assemblages themselves. The results of the principal coordinates analysis just discussed indicated that the structure of the two groups of graves differed, and that the variation in the Corded Ware graves was more disordered, with the different aspects less highly intercorrelated. They showed too that the Corded Ware emphasis on sexual distinction in the grave



attributes declined in the Bell Beaker graves of Bohemia, although it did not disappear. This suggestion of a change in the attitudes to sexual distinctions is confirmed by the fact that female graves seem to be less 'rich' compared with male graves in the Bell Beaker phase; in the Corded Ware they are roughly equal, and both are found at the top end of the scale. Finally, even though there is no sign of the appearance of hereditary wealth, the change in the appearance of the bar graphs of the numbers of graves with particular numbers of goods suggests the possibility of increased ranking with the Bell Beakers, an argument further supported by the fact that the widespread male-associated <sup>objects</sup> tend to be found in graves at the upper end of the scale in terms of quantity of goods, and thus seem to point to a certain degree of qualitative distinction not manifest in the Corded Ware male graves.



CHAPTER ELEVEN: THE APPEARANCE OF THE BELL BEAKER ASSEMBLAGE  
IN CENTRAL EUROPE

Changes in the material assemblage of an area lie at a more obvious level than many of those considered in the previous chapter, but still require a more sophisticated treatment than they have often received in the past. To many an investigation of the emergence of the Bell Beaker assemblage still means a search for the origins of the Bell Beaker vessel. This, admittedly, should not simply be neglected or overlooked, nevertheless, it is only a single aspect of a more extensive phenomenon, a fact which should already be clear from earlier chapters. Furthermore, as we have also seen, finding origins is likely to be made much more difficult by the realisation that change is not always regular and incremental unless interrupted by replacement with a totally new population or cultural tradition. The assumption that it is has guided all those searches for cultural antecedents in the European archaeological literature, and if these searches have anything in common it is their general lack of success. Not all changes, however, follow the same trajectory and it may be possible to distinguish different processes by means of this fact. A basic distinction which may be made is between variation in the morphological details of a particular artifact type and variation in the extent to which it was manufactured or placed in the graves. It is the first of these which usually comes into question when discussing Bell Beaker origins, but the second point too is an important one.

Unfortunately, in the present case it is extremely difficult to establish the relative numbers of particular artifact types produced



because virtually all the evidence is from graves, and the relationship between production and grave consumption is difficult to estimate. For Bohemia and Moravia a small amount of settlement evidence is available which may be used as a guide (see table 11.I). The main conclusion to be drawn is that decorated Bell Beakers are probably over-represented in the graves. For the Corded Ware, however, we do not possess even this small amount of evidence, so it is not possible to make any comparisons with regard to changing demand for pottery of different functions (which changing manufacture patterns must largely represent). The factors operative here are manifold and should not be forgotten: they include changing social habits of eating, improvements in pottery technology, and changing preferences in food or drink. At present differences as a result of such factors cannot be distinguished from others relating to what grave goods were thought to be appropriate, but, given a close relation between form and function in pottery, we can see the continuation of such functional types as beakers, cups, bowls, and storage vessels between the Bell Beaker and Corded Ware assemblages.

On changes in the burial deposition of particular artifact types we are rather better informed. Because this relates to the burial practice it should perhaps have been included in the previous chapter, but in practice it is very difficult to separate it from other aspects of the pottery. It might be thought too that it is affected by rates of manufacture; this, in fact, is unlikely to be the case, since if a demand had existed for a particular type for burial it could presumably have been supplied. The biggest difference between the

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Corded Ware and Bell Beaker graves in this respect is the virtual disappearance of the amphora as a grave good for inhumations; that the type was still manufactured is witnessed by its occasional appearance as an urn in some Bell Beaker cremation burials, but this may be compared with the fact that 39% of the vessels from the Corded Ware cemetery at Vikletice were amphorae. Other differences are also marked; the increase in the proportion of jugs from 8% to more than 40%, and in bowls from about 5% to 23%. The proportion of beakers, however, changes little: 15% of the vessels at Vikletice and 11% in the Bell Beaker graves of Bohemia. As we have already indicated, these figures refer to the proportions of vessels used in graves rather than to the relative numbers manufactured, and, given that the grave goods relate to individual social identities, and thus to the people buried, the changing proportions of different types must reflect changing social uses for the vessels concerned, or changes in the number of people in the population who were entitled to that vessel. On the whole, apart from the similar proportions of beakers, we see a fairly marked change in the burial rite, especially when the evidence discussed in the previous chapter is taken into account.

The next stage must be to investigate the extent to which these apparent changes in the burial rite are matched by developments in the conventions and traditions of manufacturing pottery. This brings us back to the question of variation in the morphological details of particular artifact types mentioned at the beginning of this chapter. Changes of this nature must be treated in the manner which has been advocated throughout this work, by examining different aspects separately. Pottery has differing functions, varies in quality, and different types may well be made by different people. If the bulk of



the pottery being produced were to change radically, it would have very different implications for our interpretation than if only a small proportion of fine pottery were to alter.

It is the latter situation which obtains at such Portuguese sites as Zambujal and Vila Nova de Sao Pedro with the appearance of Bell Beakers at the end of the Vila Nova de Sao Pedro culture (Harrison 1976), and it is clearly important to try and obtain comparable information from Central Europe if we are to understand the nature of the transition there. The situation is rather different from Portugal because of the differing nature of the evidence. There decorated Bell Beakers are found in the top layers of Vila Nova de Sao Pedro culture settlements, in association with a ceramic inventory largely unchanged from the preceding period. In Central Europe we have two separate groups of single graves with associated goods. It is necessary to find out whether there is an equally large break in all the traditions represented, indicating some sort of change affecting all the pottery manufactured; or whether there are differences of varying extent, pointing to different factors affecting the different types. Superficial examination of the pottery suggests that it may be possible to trace a trajectory, with intermediate steps, from the jugs, bowls and Töpfe of the Corded Ware assemblage to their Bell Beaker counterparts. Is this the case with the beakers themselves or is there a more marked break in this part of the assemblage? If the latter proved to be the case, at the very least we would have an indication that change was more volatile in this category of pottery. Taken together with other arguments it might even be grounds for saying that the decorated Bell Beaker vessel itself did not originate in Central Europe, although the evidence would not, of course, be sufficient on its own.



Before describing how these questions were investigated it may be appropriate at this point to consider what has previously been said on the problem of Bell Beaker origins in Central Europe, since several authors in the last few years have proposed that this is where they should be sought (see e.g. Neustupný 1961, Schubert 1973). These suggestions have generally been made in relation to possible antecedents in the Vučedol culture, although it is clear that only the Corded Ware assemblage in Central Europe provides an antecedent vessel which is functionally a beaker; furthermore, the Corded Ware beakers actually have a horizontally arranged scheme of decoration. It thus seems correct to centre our attention on the Corded Ware beaker when the origins of the Bell Beaker itself are being considered. The Vučedol relations have been very much overplayed in this connection, and are based on the alleged similarity between the decoration of Vučedol pottery and certain motifs found on Central European Bell Beakers, especially the use of ornament arranged in metopes, as well as connections with the Bell Beaker associated pottery, particularly the thickened rim bowls. The relevance of these similarities to the decorated Bell Beakers has been asserted largely as a result of two basic misconceptions. First, there has been a failure to distinguish between the decorated Bell Beakers and the accompanying pottery when discussing the Bell Beaker assemblage in Central Europe: the vital importance of this distinction should be clear from earlier chapters. Secondly, the cultures of the late Eneolithic of the Carpathian Basin and adjacent areas to the north-west are often referred to under the generic term Vučedol, but the characteristic decoration, seen, for example, in Schmidt's 'Die Burg Vučedol', is restricted to the true Vučedol group of north-west Yugoslavia and southern Hungary. The Bell Beaker distribution, on the other hand, lies in



Bohemia, Moravia, and north-west Hungary, where the pottery of the 'Vučedol Kreis' is similar in form but almost totally undecorated apart from the well-known Slavonian bowls. The Jevišovice B group of southern Moravia to some extent provides an exception to this, but examination of the decoration (e.g. Medunová-Benešová 1972) shows that there are no very close similarities with Bell Beaker decoration. Moreover, it should not be forgotten that the post-Baden groupings of the Carpathian Basin and its adjacent areas are relatively long-lived and certainly not all contemporary with one another, as Neustupný (1966) has shown in his consideration of the decorated bowls. The Jevišovice B group is one of the earlier of these and may well not continue as late as the Kosihy-Čaka and Makó groups, which themselves predate the appearance of Bell Beakers in Central Europe.

Finally, to complete this study of Vučedol connections, it should not be forgotten that the metopic decoration is most common in Central Germany, even further from the 'Vučedol influence', and declines towards the south-east, being less frequent in Bohemia, and less common still in Moravia and Hungary (see fig. 11.1).

We can now return from this digression on the Vučedol to an examination of changes in the individual ceramic functional categories already mentioned. This will be centred on the pottery of the Corded Ware rather than the Vučedol, for several reasons, including the unconvincing nature of the Vučedol - Bell Beaker connections just described. The Corded Ware contains the beaker functional type and it is the assemblage which precedes the Bell Beakers in Bohemia, the one area where sufficiently good information on the pottery is available to make a detailed study possible. Four functional categories were used: jugs, bowls, Töpfe and beakers. These comprise



the major part of the Bell Beaker grave ceramic assemblage, with the decorated Bell Beakers a relatively minor proportion of the total. These forms are also fairly important in the Corded Ware grave assemblage but, as we have seen, its most frequent vessel type, the amphora, is no longer deposited in Bell Beaker graves, or only very rarely. The variable investigated was vessel shape; the jugs, bowls and Töpfe are undecorated and it seemed most satisfactory to examine the beakers too from the point of view of shape alone, so that the results from the different pottery types might be comparable. To obtain a precise measure of the difference between Corded Ware and Bell Beaker vessels of the same type the vessels were measured and a principal components analysis was carried out on the resulting measurements. The shape was expressed according to Wilcock's 'sliced method' (Shennan and Wilcock 1975), with the addition of the height of the maximum body width and the height of the base of the neck (where these were relevant), as experiments had shown that these did not represent redundant information.

First to be analysed were the jugs; 33 Corded Ware jugs and the same number of Bell Beaker vessels were used. A principal components analysis was carried out and a scattergram produced of the jugs in relation to the first two components (fig. 11.2). Only these first two were considered as they accounted for over 78% of the variance in the jug measurements. The two represent the general slimness or squatness of the jugs and the relation between rim and base width and the height of the maximum width and the neck. In the scattergram of the jugs against these components (fig. 11.2) Bell Beaker and Corded Ware jugs are represented by different symbols. Examination of their distribution shows some separation but a considerable degree of



intermixing, and it may be concluded from this that there is no marked difference between Corded Ware and Bell Beaker in the morphological details of the jugs, but only a gradual trend from one to the other with a considerable degree of overlap.

In the case of the bowls (16 Bell Beaker and 11 Corded Ware bowls were used) the first two components accounted for over 91% of the variance. The first is again a general measure of height in relation to width, while the second reflects the covariation of rim and base diameter. As before, the Corded Ware and Bell Beaker vessels in the scattergram are represented by different symbols (fig. 11.3). The results too are very similar to those for the jugs: some segregation but a very extensive overlap; there appears to be no sharp break in the bowl-making traditions of Corded Ware and Bell Beaker potters in Bohemia.

The Töpfe were the third group of vessels to be examined and they were analysed by the same technique as in the other cases to produce a representation of the relations between the vessels (12 Bell Beaker and 13 Corded Ware examples). The first two components again accounted for a very large proportion of the variation in the measurements - here over 82%. The main axis is the slim to squat continuum, the other focuses on the relationship between the middle body measurements and the others. Examination of the resulting scattergram (fig. 11.4) shows a better division between the Corded Ware and Bell Beaker vessels than in the case of the jugs and bowls, but there is still no distinguishable break, only a trend from one to the other.

Finally, the beakers themselves were investigated; shape alone was considered, for reasons already discussed, and there were 33 beakers in each sample. The first component, representing the same height-width



relationship as in the other examples, accounted for over 90% of the variance, the second, the relation between base and rim width, for another 6%. The scattergram (fig. 11.5) shows an extremely large break between the Corded Ware and Bell Beaker groups of vessels unparalleled in the other three cases although the results were obtained by identical means. Corded Ware and Bell Beaker beakers are strikingly different from one another in their shape as represented by the measured ratios. The contrast between the beakers and the other vessel types is further emphasised if the differences between the ornamentation on the two groups of beakers is considered.

The results just described are indisputable as far as they go and provide a reasonable basis for the more dangerous activity of drawing archaeological conclusions. It seems fairly certain that with respect to vessel morphology the transition from Corded Ware to Bell Beakers in Bohemia is really only indicated in the beakers themselves and cannot be regarded as a wholesale break in the pottery tradition of the area. Several possible reasons for this change present themselves, but at least the idea that one tribe replaced another seems an inappropriate conclusion, a suggestion which fits in with other evidence already cited pointing in the same direction. We are on less firm ground in inferring that the Bell Beaker itself did not originate in this area on the basis of these results. Given that the jugs, bowls and Töpfe show continuity from the Corded Ware while the beaker does not, to link the change in the beaker to an introduction from outside is a possible explanation which has something to recommend it although it is by no means the only option - fine wares are well-known to be more susceptible to change, whether from internal or external sources, than more mundane pottery, especially if they are



made by specialists, certainly a possibility for the beakers. Fortunately, however, this is not the only evidence bearing on the question of whether the decorated Bell Beaker was introduced to Central Europe from elsewhere; it was argued in chapter seven that this was the case and the results presented here certainly give further support to the argument.

But this demonstration has presented us with only part of the picture, and the remainder is important both in itself and because it is relevant to parts of the Bell Beaker assemblage which have not so far been considered. In the graves of the earlier phases of the Bohemian Corded Ware jugs, bowls, and Töpfe do not occur, although, as we have seen, they are present in the later stages. The change which the assemblage underwent, however, was not autonomous. It involved the taking up of functional categories of vessel which suggest a change in eating and drinking habits. These categories first appeared in the Carpathian Basin in the Baden culture, and in Bohemia and Moravia in the Řivnáč and Jevišovice B groups. Whether their appearance in the Corded Ware relates to their antecedent presence in Řivnáč and Jevišovice B, or to a new adoption of Carpathian functions and styles, is difficult to say, but the latter is probably preferable. Certainly, the Moravian Corded Ware types bear a far closer resemblance to the contemporary Carpathian Kosiň-Čaka and Makó groups than to Jevišovice B, and the same applies to a lesser extent in Bohemia. Furthermore, in the succeeding Bell Beaker phase the similarity in the styles of such items as jugs and bowls is extremely striking, it is not merely the functional type which the areas have in common. The increasing connection is finally emphasised by the presence of small numbers of decorated Bell Beakers in Hungary, a phenomenon unparalleled



in the Corded Ware phase: Corded Ware beakers are never found in Hungary. The form changes in the non-beaker part of the Corded Ware-Bell Beaker ceramic assemblage are thus not simply a local transition, but represent a growing similarity of the Bohemian-Moravian assemblages to those of the Carpathian Basin. This is not a development into which the appearance of the decorated Bell Beaker fits satisfactorily. To account for this it seems necessary to accept the Dutch arguments (Lanting et al. 1973) as we have done in chapter seven.

There are, however, other aspects to the assemblage than pottery alone, and one of the most obvious contrasts between the Corded Ware and Bell Beaker grave goods is that in the prestige male equipment between the polished stone battle-axes of the former and the copper daggers and wrist-guards of the latter. Although this change apparently occurs simultaneously with the appearance of the rest of the 'Bell Beaker culture' it is not satisfactory to treat it simply as another trait in that change. The first question to be asked is whether it is a change in the objects deposited in the graves or in those which were manufactured. As we have seen for the pottery, there is little information on which to base an answer to this question. The flat axes which frequently appear in Corded Ware graves are known from a small number of Bell Beaker graves in Bohemia, but there are no battle-axes in Bell Beaker graves in Central Europe and no copper daggers or wrist-guards in Corded Ware contexts although arrowheads are known. This total exclusivity may indicate that it is not just a difference in grave deposition. The change seems to indicate an alteration in the preferred prestige weapon which appears to have been a very general phenomenon over Central Europe at this time. It may reflect changes



in fighting techniques or, more probably, the developing use of metal. Although battle-axes could be made of copper and late Eneolithic examples are known (Jacob-Friesen 1970), the blade exploits more of the qualities of the metal, particularly its ability to be thin yet strong. The impact of this change in northern Europe is indicated by the term 'Dolchzeit', when the northern flint industry began to manufacture superb flint daggers which clearly imitate metal prototypes. The earlier Grand-Pressigny blades may well represent a similar response, significantly occurring with both late FFB and early Bell Beakers in the Netherlands. Finds of both the artifacts themselves and moulds for their manufacture show that tanged copper daggers were already in use in the Carpathian Basin in the Baden period and continued through the Vučedol. The fact that by far the greater part of the Bell Beaker ceramic assemblage in Czechoslovakia is, as we have seen, closely related to Carpathian types in the tradition of the Vučedol 'Kreis' is surely not irrelevant when the origins of this dagger type in the Bell Beaker assemblage are being considered.

The other well-known object which begins to be deposited at this time is the stone wrist guard. Piggott (1972) point out that bone ones are known from Denmark in the early TRB, but connects their appearance in Bell Beaker contexts with the appearance of the short composite bow, which, he argues, is represented in the Bell Beaker pendants from Central Europe. Nevertheless, it is by no means certain that the 'wrist-guards' are to be definitely connected with archery. Müller-Karpe (1974:243) argues against this on several grounds: their careful workmanship makes such a purpose improbable; the form of most of them is strikingly unsuitable for such a function; they are by no means always found on the wrist and, finally, they are only very

In digital technology, the representation of data is binary. This means that all information is reduced to a series of 0s and 1s. The 0 represents the absence of a signal, and the 1 represents the presence of a signal. This binary system is the foundation of all digital computing.

The binary system is also the basis for the way data is stored in memory. Each bit of data is stored in a specific location, and the entire set of bits forms a word. Words are then organized into larger units called bytes. This hierarchical structure allows for efficient storage and retrieval of information.

One of the key advantages of digital technology is its ability to represent a wide range of data types. Whether it's text, numbers, or images, everything can be converted into a binary format. This makes digital systems highly versatile and capable of handling a vast array of information.

Another important feature of digital technology is its precision. Because data is represented by discrete bits, there is no ambiguity in the information being processed. This ensures that calculations and data manipulations are performed accurately, which is crucial for many applications.

Digital technology also enables the easy transmission of data over long distances. By converting data into a binary format, it can be sent as a series of electrical pulses or light signals. This makes it possible to communicate information quickly and reliably across the globe.

Finally, digital technology is highly scalable. As the amount of data being processed grows, the system can be expanded to accommodate the increased load. This flexibility is one of the reasons why digital systems are so widely used in modern computing environments.

occasionally associated with arrowheads. His first argument misses the point that the stone wrist-guards are clearly special prestige objects, perhaps mainly intended for the grave, nor are his next points entirely convincing. The final argument is more serious since examination of the Bohemian and Moravian grave associations, and indeed of Britain as well, shows a marked lack of joint occurrences of arrowheads and wrist-guards, the opposite of what one would predict if there were an association between wrist-guards and archery. Perhaps even more striking is the fact that there is a close association between the presence of wrist-guards and copper daggers (clearly visible in the dendrograms of object associations figs. 3.4, 3.5); if they were not used as whetstones, they might perhaps be connected with some form of wrist protection when fighting with daggers. Whatever the actual function, it is clear that it was a piece of equipment used for the expression of status - that it is social expression we are dealing with as much as practical function. Wrist-guards might well have been in use for a considerable time, but made of perishable materials and not used as a vehicle for prestige elaboration. On the other hand, one might venture the generalisation that it is innovations which tend to be taken up in this way, and this brings us back to Piggott's idea of the introduction of the composite bow or to developments associated with the appearance of the dagger. It is important to remember that neither the dagger nor the wrist-guard occur in north-west Europe during the earliest Bell Beaker phases, but this is not the case in Central Europe, where both are present from the beginning. This demonstrates the independence of these other objects from the Bell Beaker vessel itself and also, incidentally, confirms the dissociation



of the arrowhead and the wrist-guard since the former are found in the very earliest Bell Beaker graves of north-west Europe.

The final change in goods which it remains to document and discuss concerns ornaments. A number of Corded Ware female graves in Central Europe have necklaces of perforated animal teeth and shell or bone beads, while bone pins are also known. The main Bell Beaker female ornament is the V-perforated button. From their position in the graves it appears that these were worn in a variety of ways, apart from their probable function as buttons, including a use as necklaces. Indeed, it is probably preferable to see this difference between Corded Ware and Bell Beakers as one of ornaments rather than of totally different types of clothing, button-fastened for the Bell Beakers and pin-fastened for the Corded Ware, since pins too are known from Bell Beaker contexts in Central Europe, both bone and occasionally metal, of the very distinctive 'doppeltgekröpfte' type (see fig. 11.6).

The V-perforated buttons have been surveyed in detail by Hájek (1957), who has shown their wide distribution both in space and time. Only one example is known from Central Europe before the appearance of the Bell Beakers, from a Globular Amphora culture grave at Brozany in Bohemia. It is significant, however, that this is made of amber, since V-perforated buttons of this material are well-known from the Haffkühlen culture of the Prussian Baltic coast. This is supposed to be an earlier Corded Ware group (see e.g. Müller-Karpe 1974) and could, therefore, be contemporary with the Globular Amphora culture. No radiocarbon dates are available, however, and it seems likely that it continued sufficiently late to be contemporary with the Central European Bell Beaker culture. In Bell Beaker contexts in Bohemia and Moravia amber is by no means uncommon, far more common, in fact, than



in the Corded Ware of the same areas which one tends to think of as more northerly connected than the Bell Beakers. This point is worthy of comment since ceramic similarities between the Bohemian Corded Ware are much greater than those between the Haffkusten and the Bell Beakers, yet the latter seem to have had better access to the northern amber. Amber objects in Bell Beaker contexts include both beads and V-perforated buttons, and the northern contacts are confirmed by the find of a decorated belt-plate in a Bell Beaker grave at Sulejovice, Bohemia, identical to some found at Haffkusten culture sites. The chronological position of the V-perforated buttons within the Bell Beaker phase in Central Europe is difficult to determine. As female ornaments they tend to be associated with Begleitkeramik pottery rather than decorated Bell Beakers, but as we have seen, this accompanying pottery can no longer be assumed to be late. Like several of the other objects discussed, V-perforated buttons are not found in the earliest phase in north-west Europe.

Finally, although the history of the tanged copper dagger has been outlined, it remains to make some comments on the use of metal in general. Almost no Corded Ware metal analyses are available for Bohemia and Moravia so it is impossible to say to what extent the kinds of copper in use changed between the two phases. In Corded Ware graves only relatively small and simple copper ornaments are found, thus it tends to be thought that the industry associated with the Bell Beakers was both more sophisticated and more productive. This may not necessarily be the case, however, since it is clear that objects were current in the Corded Ware areas of Europe which were not deposited in the graves. The most striking of these are the battle-axes of



Eschollbrücken type already mentioned (Jacob-Friesen 1970 ). Müller-Karpe (1974) has suggested that the copper ores of Hesse were being exploited for their production, but a mould for an axe of this type has been found on a site in the Salzburg area (Müller-Karpe 1974: 923 ). The axe-heads are metal versions of Corded Ware stone types and several are provided with metal hafts; they clearly required large amounts of metal and developed casting techniques. Furthermore, Ottaway's (1973) examination of Corded Ware metal analyses has shown that fahlerz ores were definitely being used. Central European Bell Beaker metal objects which have been analysed are extremely variable in composition; some are almost free of impurities while others are of more complex type and must have involved the use of sulphide ores. The techniques for exploiting these ores were a necessary prerequisite for the local appearance of copper metallurgy in north-west Europe as other types were not available, and all the evidence suggests that these developments are to be connected in some way with the Bell Beakers. In Central Europe itself, on the other hand, such ores were already being used in the Baden period on the western edges of the Carpathian Basin (see e.g. Sherratt, in press) and it is doubtful if the Bell Beakers are to be associated with any metallurgical innovations except the taking-up of the tanged dagger outside the Carpathian Basin area. The use of Central German and Bohemian ores may well have begun in the preceding Corded Ware period on the basis of Ottaway's evidence, while the type of information available does not permit any assessment of differences in the number of metal objects produced in the two periods.

Now that the various changes in the late Eneolithic assemblage of Central Europe have been discussed in some detail, it is possible



to consider their overall implications. The great majority of them do not seem to have an exogenous source; they represent developments occurring in different parts of Central Europe, particularly in the Carpathian Basin. Most of the pottery shows an increasing similarity to that of the Carpathian area from the later Corded Ware onwards. The relatively limited degree of the changes from late Corded Ware to Bell Beakers was clearly reflected in the results of the principal components analysis. Only in the beakers was there a sharp break between Corded Ware and Bell Beaker vessel types, and, as we saw in an earlier chapter, there were already reasons for thinking that the decorated Bell Beaker was an exception to the general pattern of local development. Daggers, wrist-guards and V-perforated buttons, which do not occur in the earliest Bell Beaker phases of north-west Europe, fit into this overall picture. All the evidence suggests that they are present from the beginning of the Bell Beaker period in Central Europe; the tanged daggers certainly have a long tradition in the Carpathian Basin and the wrist-guards are most likely to be an innovation of the Bohemian - Moravian - Central German area, quite conceivably connected with the introduction of the dagger to these regions.

An overall synthesis relating the developments in the assemblage to those discussed earlier in this thesis will be attempted in the next chapter. What definitely emerges here is the inadequacy of regarding these changes simply as a replacement of the Corded Ware culture by the Bell Beaker culture in the face of the complexity which obviously exists.



## CHAPTER TWELVE: CONCLUSION

In this final chapter there are several aspects which need to be considered. In the first place it is necessary to summarise the overall results, and in particular to see how the conclusions we have reached in the second part of the thesis, concerned with change through time, relate to the largely synchronic picture presented earlier. Secondly, it is important to try and place the Bell Beaker situation in Central Europe in a wider European Bell Beaker context. It may, however, be appropriate to begin by saying something about the methods used in approaching the subject with which this thesis is concerned.

It will have become apparent that the aim of this dissertation is to follow through a particular problem. For this reason some aspects of the Bell Beaker phenomenon in Central Europe have perhaps been neglected while others have been strongly emphasised. No apology is offered for this varying emphasis since it is essential to the problem oriented approach adopted. This has occasionally involved the application of multivariate statistical techniques; in all cases their use has followed directly from the line of argument and reasons for their appropriateness have been presented whenever they have been employed. In general their purpose has been to provide a precise specification of degrees of relationship and to search for patterning among them, in order to escape from subjective assessments of the extent of similarities and differences between objects. This has been of considerable importance in the arguments used throughout the thesis, from establishing the extent of association between the different objects in the graves, in chapter three, to defining the degree of ceramic similarity between the Corded Ware and Bell Beaker assemblages in Bohemia, in chapter eleven.



Of particular interest is the use of principal coordinates analysis in attempting to sort out the different dimensions of variation in a matrix of inter-grave similarities: as Doran and Hodson (1975) have shown, this is a much more appropriate technique for this type of data than the factor analysis used in many American investigations. It is, however, impossible to pretend that the potential and limitations of the method have been completely examined. What is required is principal coordinates analysis of inter-grave similarities in ethnographic situations where the main dimensions of variation present in the grave attributes are independently known. In the present study, however, the methods are essentially a means to an end, and the main aspect to be considered is the success of the approach adopted in throwing new light on the problems with which it is concerned.

The model initially proposed drew attention to certain apparent similarities between the Bell Beaker phenomenon and the Hopewell Interaction Sphere. It soon became apparent that the analogy was satisfactory in some respects but not in others. The nature of the limited assemblage of widespread Bell Beaker objects and the small numbers of Bell Beakers in Central Europe suggested that they were prestige artifacts, and were not the result of a movement of 'Bell Beaker people' into the area. Further support was given to this interpretation by the demonstration that the differences between the Bell Beaker assemblages of Central and Western Europe were not a result of the later differentiation of an originally uniform culture which had been transferred wholesale from one area to another, while it was also shown that in Bohemia and Moravia the widespread Bell Beaker artifacts were actually associated with the expression of prestige. On the other hand, not all the regions of Central Europe had such limited numbers of

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decorated Bell Beakers (see below for a discussion of Central Germany), and in other respects the Hopewell analogy was less close. The degree of hierarchical complexity in the Bell Beaker areas of Central Europe was far less than that seen in the Hopewell, and there was no evidence for large centres such as those which mediated transactions in the Hopewell case.

As we have seen, the lack of such centres and the fairly low degree of ranking which analyses demonstrated would argue against redistributive exchange at the local level, and also against inter-centre long-distance trade at the inter-regional level. The main mechanism must have been reciprocity. At relatively short distances this would have involved movement of individuals in kinship and marriage networks, beyond this the hand-to-hand exchange of locally unavailable objects and resources. Along such lines would have moved information of all kinds, including new ideas, as well as examples of new types of object, for example decorated Bell Beakers or tanged copper daggers.

It is, however, necessary to qualify this picture. We have seen that in Bohemia and Moravia the widespread Bell Beaker objects seem to be associated predominantly with certain males who probably achieved higher rank and, although such males may have been fairly thickly distributed across the landscape, they represent a small part of the total population. If it is assumed that the pattern of circulation of the objects when in use is equivalent to the pattern seen in their distribution in graves (see immediately below for discussion of this assumption), then their exchange cannot have been an unconstrained process - they must have moved between individuals who had the status to obtain them, although there might have been one of these in every community. The validity of assuming that the patterning of the objects



when in use is equivalent to that seen in the graves must remain uncertain. The fact that such objects as decorated Bell Beakers were selected for higher status graves may perhaps be taken as an indication of their overall rarity, and this idea is certainly not contradicted by the little settlement evidence which exists. It should, of course, be asked why they were relatively rare. Copper daggers and wrist-guards both probably involved inaccessible raw materials which would have had to travel some distance, but such an answer is less convincing for the decorated Bell Beaker since it seems certain that these were manufactured locally, within the individual settlement regions. It may be that the best ones at least were manufactured by semi-specialists and took a long time to produce, or, as Clarke (1976) has suggested, that clays of the necessary quality were uncommon and unevenly distributed, although it is also possible that there were rules restricting the number manufactured.

Within the settlement region then, the widespread Bell Beaker objects fit into an overall exchange pattern of no great complexity which would have included both people and other artifacts. As we have seen, such general contacts extend over large parts of Central Europe, particularly those linked by the Danube, which all have an essentially similar ceramic inventory, a pattern noticeable at earlier periods in the Neolithic and again in the Bronze Age, and one which is presumably strongly related to natural lines of communication. The whole significance of the Bell Beaker distribution, however, lies in the fact that it extends beyond such 'natural' provinces and links areas not usually connected. If it had not been for this fact, the Bell Beaker distribution would only have attracted a small fraction of the interest it has generated, and one of our main concerns must be to examine the possible reasons for



its unusual nature.

It has been shown that in Bohemia and Moravia the widespread Bell Beaker objects functioned to communicate prestige, but that is not the same as claiming that this is in itself the reason why they spread. It has been argued that fine decorated Bell Beakers were abstracted from their context in full Bell Beaker domestic ceramic assemblages in north-west Europe and expanded far beyond their original bounds into Central Europe. It has also been suggested that their expansion in this direction was a response to the appearance of certain innovations in the western part of Central Europe: the tanged copper dagger, developed copper metallurgy and use of the domestic horse. These diffused west along the lines on which the Beakers had moved eastwards. Although it was clearly not a simple exchange process with Beakers being exchanged for daggers, the connection seems too close to be fortuitous. Even if the spread of the decorated Bell Beaker was the result of a new fashion or a new ritual, its spread eastwards may have stemmed from an interest in establishing relations oriented in the particular direction from which these innovations could be obtained.

This argument depends on several factors and those concerned with Western Europe will be discussed below. We have already seen that from Central Europe, again excluding Central Germany, the suggestion receives some support. It has been shown that the tanged copper dagger has a long history in Central Europe and must have had its immediate origin there; it is likely too that this is the area of origin of the wrist-guard. Similarly, use of the domestic horse appears to be earlier in Central than in Western Europe, where it seems to be Bell Beaker associated. Finally, it has been demonstrated by a detailed comparison of the Bohemian Bell Beaker pottery with that of the period before in



the same area that the majority of the Beaker ceramic assemblage has local origins. The one exception seems to be the Bell Beaker itself which, on the evidence available, is likely to be an introduction from outside. A similar situation has also been documented in the Budapest area of Hungary (Schreiber 1973, 1975). It should be added that this demonstration of continuity in the ceramic assemblage apart from the Bell Beaker also has some implications for other arguments which have been presented in this thesis, not just for the question of the external origin of decorated Bell Beakers. It fits in with the conclusions of the chapter on the internal chronology of the Bell Beaker assemblage in Bohemia and Moravia, which showed that the Begleitkeramik must have been present from the beginning of the Bell Beaker phase in these areas and was not a later development. It provides further support for the inference drawn from this conclusion, that there never existed an originally uniform Bell Beaker culture which became locally differentiated when the 'Bell Beaker people' settled down, and is, indeed, another reason for rejecting such an invasion hypothesis.

As we have already suggested, however, Central Germany is an exception to many of the generalisations made in the preceding pages, which are only valid for the areas to the south and east. As regards organisation there is much in common between Central Germany and the others. The evidence pointed to a similar but more egalitarian situation for Central Germany, in which there was probably some degree of achieved male ranking. This, combined with the lack of any centres, again indicated reciprocal forms of exchange in which objects and information moved on a hand-to-hand basis. Similarly too, such objects as copper daggers and wrist-guards must have been more restricted in their distribution, given that there were as few in circulation as there



are in the graves. On this same assumption, however, the Bell Beaker cannot have been so restricted here, and it is this apparent contrast in the role of the Bell Beaker in what seems to be a fairly similar system that divides Central Germany from the areas to the south. In Central Germany Bell Beakers form the greater part of the ceramic assemblage found in the graves, and half of them are decorated. The fact that the Bell Beaker seems to have a different role in this area is important, because it suggests that even within Central Europe itself it is not possible to think in terms of a single uniform explanation for the Beaker phenomenon. It is, however, worth examining the distinctiveness of Central Germany more closely and looking at the reasons behind it.

Although the Bell Beakers are preceded by Corded Ware in Central Germany as in Bohemia, the Corded Ware of the two areas is very different: Central Germany has very few of the bowls and jugs characteristic of the later phase of the Corded Ware in Bohemia and its assemblage consists predominantly of Beaker forms. The same may also be said of the Bell Beaker ceramic assemblage of the area. Again what we may be seeing is the introduction of a new beaker type into an assemblage which is otherwise very similar to that which preceded it. Because this differs markedly from that to the south we inevitably see a sharp contrast in the Bell Beaker phase as well, which is emphasised by the different role of the decorated Beaker in the graves. In fact, the situation in Central Germany arguably shows more affinity with areas to the north than to the south. This distinctiveness is apparent not just in the low proportion of Carpathian jug and bowl forms in the assemblage, but also in the Bell Beaker decoration, which generally consists of two broad zones containing metopic motifs. Beakers with a similarly developed form of decoration occur at Myrhøj in Jutland, for example, in the context of a



local late Neolithic A domestic assemblage consisting of Beaker shapes. It may be that the presence of Bell Beakers in Central Germany is the result of a secondary spread of the new Beaker type and such apparently associated features as the change in burial orientation from Bohemia; such a situation would account for the developed, and presumptively later, decoration already discussed and may stem from the fact that Central Germany does not lie on the communication lines between Western Europe and the Carpathian source of the innovations enumerated above.

Although it is essential to analyse each area on its own if the Bell Beaker phenomenon is to be understood, it becomes necessary eventually to return to the larger scale and look at its distribution as a whole. It will be clear, for instance, that some of the statements in the preceding part of this chapter, and elsewhere in the thesis, presuppose certain situations in Western Europe. Probably the most important assumption is that the decorated Bell Beaker originated in the Lower Rhine area. The argument has been extremely well documented by Lanting and van der Waals (1973, 1976), and it receives a certain amount of negative support from our own detailed analysis of the Bohemian pottery, which suggested that the Bell Beaker was an introduction from outside. The Dutch radiocarbon dates are also important since they confirm the existence in the Lower Rhine area of an early Bell Beaker phase, before the addition to the assemblage of such 'classic' items as the V-perforated button, the stone wrist-guard and the tanged copper dagger, whose place is taken by the Grand-Pressigny flint blade in the early phase. There are also indications of such an early phase in Britain, probably in Brittany and south-east France, and in Portugal, where comb-decorated 'maritime' Beakers are associated with late phases of the Vila Nova de Sao Pedro culture (Sangmeister 1976). The other



widespread Bell Beaker artifacts are not found in these Chalcolithic settlement contexts but do occur later in association with Beakers characterised by incised and complex comb-impressed decoration, as well as with Early Bronze Age Argaric pottery.

Here then is evidence for an early phase in which the decorated Bell Beaker alone diffuses over long distances, linking up a whole series of disparate regional traditions. It will, of course, be noted that these same areas, together with others, are linked earlier in the Neolithic by the presence of megalithic tombs, and although Renfrew has recently offered a general explanation for their independent appearance in terms of population pressure, he certainly does not exclude the possibility of contact and 'a borrowing of architectural devices from adjacent regions' (Renfrew 1976:219). These contacts certainly demonstrate that there was maritime traffic along the Atlantic coast of Europe, so to that extent the appearance of Bell Beakers over large parts of the area should not be considered surprising. What they actually signify is another matter. It is possible that they represent a cult or ritual phenomenon, as Burgess (1976), for example, has suggested. Certainly, to ascribe the spread of a single vessel type to the migration of a distinctive 'Bell Beaker people' seems totally unwarranted, especially when the Bell Beakers in a domestic context at Zambujal in Portugal (Sangmeister 1976) clearly represent a special fine ware of the local late Copper Age culture. It is also relevant here to consider the suggestion that Harrison has made (pers. comm.), that the Bell Beakers in north-west Africa are, in fact, imports from Portugal which were exchanged for such things as the ivory and ostrich shell found in Portuguese late Copper Age Contexts: the importance of such exchange in explaining the distribution of Bell Beakers along the



Atlantic coast is something which has yet to be investigated and it certainly should not be excluded from the range of possible explanations for their dissemination.

There is, finally, another reason why the Portuguese situation is of interest. Sites such as Zambujal are undeniably centres, something for which, as we have seen, there is no evidence in Central Europe. Exactly what role they played in the manufacture and distribution of Bell Beakers will not be known until more work has been carried out, particularly excavation at contemporary sites lower down the spatial hierarchy, but the existence of these centres with their sophisticated architectural conceptions (see Sangmeister 1976) is in itself enough to suggest that here Bell Beakers were in a very different social and economic milieu from that of Central Europe.

Although this last point is important, it is a digression from our examination of the Bell Beaker sequence in different parts of Europe, and it is now necessary to look at the second main phase of Bell Beaker development, for which we have to go back to Central Europe. There, as we have seen, no evidence exists for such an early phase as that just described. Although decorated Bell Beakers with cord-defined zones and cord decoration inside the rim do exist, they are found associated with wrist-guards and tanged copper daggers. We have already seen too that the decorated Bell Beakers are an outside introduction into an indigenous ceramic assemblage, while the tanged dagger and wrist-guard, and probably the V-perforated buttons as well, originate in the Central European area. It is in this area then that the 'classic' but rare Bell Beaker grave assemblage of decorated Beaker, tanged dagger and wrist-guard comes together, while at the same time the Beaker itself undergoes a certain amount of typological change.



The use of these other objects, the tanged copper dagger, the wrist-guard and the V-perforated button then spreads westwards, and a small number of graves is found scattered across Europe, as far west as Britain, containing the 'classic' combination of decorated Bell Beaker, tanged copper dagger and wrist-guard. Although the number of graves concerned is only a very small proportion of the total, a point which often goes unappreciated, the standardised nature of the combination over a very wide area remains remarkable. The new artifacts are found throughout the area in which the early Bell Beaker phase is present but their introduction is not the only change these regions undergo. The decorated Bell Beakers are typologically distinct, and in some places at least, such as Britain and the Netherlands, include motifs of Central European origin. Thus there is evidence not just for the spread of a prestige male assemblage but also for the transmission of information about pottery motifs, perhaps as a result of the exchange of actual vessels.

How the flat-grave burial rite fits into this picture is uncertain. In north-west continental Europe, and in Central Europe as well, single grave burial, whether or not under a mound, was well established in the preceding Corded Ware phase. In Britain the position is less clear - Burgess (1976) has recently argued that the break in burial practice between the earlier Neolithic and the Bell Beaker/late Neolithic period has been much overemphasised. Such changes as did take place, however, seem to appear already in the earliest Bell Beaker phase, since AOC Beakers in Britain are found with flat inhumations, although it is possible that these represent a continued use of the AOC style in later periods. In Portugal, on the other hand, the situation seems to be different. Sangmeister (1976) sees an early phase in which 'maritime' Beakers are



found in the fortifications of the coastal area. These continue in use while Beakers with more complex decoration are manufactured and it is only in this stage that burials with 'gelockerten Flachgrabritus' - a 'loosened' flat-grave burial rite - are deposited in the megaliths and rock-cut tombs built earlier in the Copper Age. Sangmeister does not specify whether he thinks the burial rite or the new developments in pottery decoration are autonomous or not, but the implication certainly exists that the initial introduction of the Bell Beaker and the burial rite are separate events.

Next there is a third stage in which incised and Kerbschnitt decoration is predominant on the Bell Beakers. This is found, for example, at the settlement of Montes Claros, Portugal, and in the flat graves of the central Spanish Ciempozuelos group, and may be at least partly contemporary with the Early Bronze Age El Argar culture, which is concentrated in south-east Iberia. It is with these later two phases that the wrist-guard and the tanged copper dagger are associated and this must in itself be an argument in favour of the view that we have a second phase of Beaker contact, introducing the tanged copper dagger, the wrist-guard and the flat-grave burial rite, as well as stimulating changes in the pottery decoration. Finally, there seems to have been a period of very local Bell Beaker evolution.

The basic sequence of two phases of Beaker contact followed by local developments appears to be quite widespread. Apart from Iberia it seems to apply in southern France (Guilaine 1976), in Britain, and in north-west continental Europe, in all of which local developments of the decorated Bell Beaker go on to produce very distinctive regional types. In Central Europe this is not the case. The decorated Bell Beakers are extremely homogeneous and the succeeding phase is characterised by a proto-Únětice



assemblage of local dark-grey burnished jugs, bowls and amphorae, an immediate typological transform of the Begleitkeramik which, as we have seen, formed the bulk of the pottery throughout the Beaker phase too. Local continuations of the decorated Bell Beaker do not occur and other Early Bronze Age reminiscences of objects which appeared with the Bell Beakers are restricted to certain special artifacts, such as the wrist-guard and the bow-pendant.

If one reviews the results of this brief general survey, one feature which emerges particularly clearly is the complexity which has become apparent in all areas as more detailed work has been carried out, but at the same time the considerable degree of parallel development in the sequences of the different regions. In western parts of Europe there seems to be an early Bell Beaker phase in which the only widespread object is the decorated Beaker itself; this is followed by a phase when typologically more complex Beakers are associated with stone wrist-guards and tanged copper daggers. In other areas, notably Central Europe, the latter is the earliest or even the only phase. We thus have two phases of widespread contact over Central and Western Europe. For the first of these, on the assumption that the Dutch hypothesis is correct, the origin is in the Lower Rhine area. It involves the decorated Beaker and possibly the single grave burial ritual in some areas. The second phase sees the spread of the classic Bell Beaker 'package': the decorated Beaker, the stone wrist-guard, and the tanged copper dagger, together with the V-perforated button. This assemblage appears to have come together in Central Europe and must have diffused from there after the introduction of the Bell Beaker from the west; associated with the assemblage is the spread of decorative motifs which also appear to have their origin in Central Europe.



It is easy to see that the pattern just described is very similar to that which Sangmeister tried to explain with his Reflux hypothesis except that the places of origin have changed. The unconvincing nature of the hypothesis in no way disproves the reality of the pattern it was trying to explain. It was found unconvincing at least in part because the idea of a 'Bell Beaker people' migrating from one place and then migrating back from another, having picked up some items of material culture on the way, is rightly regarded as implausible. The possibility of migrations being connected with the dissemination of Bell Beakers in certain areas, perhaps across the North Sea from the Lower Rhine to eastern Britain, should not be excluded, but such movements do not constitute an adequate blanket explanation when the Bell Beaker distribution is looked at as a whole - indeed, no single explanation seems adequate to account for the varieties of Bell Beaker presence (see Clarke 1976) - nor do they fit in with the picture which detailed investigation has revealed in Central Europe.

But to say this is not to deny that any change took place. It has simply been argued that the beliefs which underpinned previous explanations of the Bell Beaker presence in Central Europe are no longer tenable. The later chapters of this thesis have constituted an attempt to define precisely the respects in which change did occur, not with the aim of producing a simplistic correlation explanation but in order to establish all the various dimensions of the problem, some of which may be no less important for being less immediately tangible in archaeological terms. We have already recalled that the ceramic assemblage is a gradual development from that which preceded it in the area, apart from the Beaker itself. Further to this it has been argued that the hypothesis of an origin for the decorated Bell Beaker



in Central Europe, either as the sole or one of a number of independent centres, must be rejected.

Another aspect of activity which alters with the appearance of Bell Beakers in Central Europe is the prevailing practice of grave orientation, which changes from east-west to north-south. This may well suggest a ritual aspect to the Bell Beaker phenomenon, although again, when looking at the larger-scale, the dangers of single overall explanations should not be forgotten, since different areas of the Beaker distribution do not show a uniform orientation.

As we have seen, however, the burials also provide information which has been less often exploited, on the nature of social developments which took place in Central Europe at the end of the Eneolithic. Analysis of the Corded Ware and Bell Beaker graves of Bohemia showed that they were very similar in certain respects, such as the relative poverty and uniformity of children's graves and the restriction of certain types, particularly ornaments and weapons, to adults. Differences also existed, however. Both women and men were among the richer Corded Ware graves, while the indications were that almost all the richer Bell Beaker graves were male. Furthermore, there was evidence for a rather greater degree of ranking in the distribution of goods in the Bell Beaker graves. Associated with these developments was the adoption of new male prestige grave goods, notably the copper dagger and stone wrist-guard, replacing the Corded Ware battle-axe.

There is then a not inconsiderable amount of evidence that the changes contemporary with the appearance of Bell Beakers in Central Europe had a social dimension which has not previously been appreciated. If, on the other hand, we look at settlement and economy, we find a different picture. Subsistence economy has played a part in earlier



explanations of the Bell Beaker distribution as an important causative agent, although there has been no working out of the consequences of the different subsistence hypotheses in any given area. What evidence there is in Central Europe points to a continuation of the mixed farming which was prevalent throughout the Neolithic, although the stock component of the economy may have become more important as the land was cleared, sheep being increasingly reared for their wool and cattle for draught purposes. It is probable, however, that such developments had already set in by the beginning of the Corded Ware period. The same may be said for changes in settlement pattern. As we saw in chapter nine, settlements of the Middle Eneolithic in Central Europe are comparatively large and densely populated; there is some indication of a settlement hierarchy, with specialised production, and concentration of traded objects in settlements with sometimes quite developed fortifications. On the appearance of the Corded Ware settlement locations change, they seem to become smaller and more dispersed, and there is no sign of defences, or of a hierarchy. Whatever the explanation for this, and the question cannot be examined here, it is clear that the Bell Beaker settlement pattern does not differ from that of the Corded Ware: settlements must have been small and dispersed.

At a local level then, in Central Europe, the change marked by the appearance of Bell Beakers seems to have affected social organisation to some degree, as well as certain aspects of the burial rite and material culture. At a larger scale it appears to be associated with an extensive reorientation of patterns of contact, linking hitherto unconnected areas. In the Corded Ware period, at least in its earlier phase, Bohemia and to a lesser extent Moravia are connected in terms of material culture similarities to the north European plain, extending from the Netherlands



to Russia. Hungary is not part of this sphere and there is little trace of Corded Ware in Bavaria, while in Western Europe south of the Netherlands and in Britain the Corded Ware does not occur at all. As we have indicated in chapter eleven, this situation changes during the Corded Ware phase and the pottery in Bohemia becomes more like that of the Carpathian Basin than that of the areas to the north. This process continues in the Bell Beaker phase and is emphasised by the fact that decorated Bell Beakers also appear in Hungary. Furthermore, while the Corded Ware is largely restricted to the northern part of Moravia, the Bell Beaker distribution covers the south as well.

This change in the areas of material culture similarity in Central Europe is, however, cyclical, as we have already observed. Similarly, the Bell Beaker areas along the Atlantic coast were already linked earlier in the Neolithic by the distribution of megaliths, so to that extent it is not surprising that the Bell Beakers should follow a similar pattern. Perhaps both these coastal patterns are to be connected with the exploitation of migrating fish shoals, as Clark, for example, has suggested (pers. comm.). But it is the unique features of the Bell Beaker distribution which are the most interesting, and part of that uniqueness stems from the connection established by the Bell Beakers between the Carpathian Basin and north-west Europe. In the Corded Ware, and indeed the TRB, period, north-west continental Europe was connected with its hinterland to the east, but the uniformity which is seen belongs largely to the north European plain and not to the areas south of the Carpathian-Hercynian arc. In fact, perhaps the most remarkable feature of the Bell Beaker distribution east of the Rhine is not that it actually extends into Central Europe but that it does not cover most of northern Europe as well, given the Corded Ware pattern of connections.

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The answer may be that interest in acquiring the innovations which have been discussed in chapter seven led to the establishment of relations oriented in the direction from which they came; this would exclude the north European plain. It may even be suggested that some such reason lies behind the Atlantic connections. Perhaps the one feature which Central Europe and Iberia have in common before the appearance of the Bell Beakers is the existence of a Copper Age metal industry. With the Bell Beakers north-west Europe establishes links with both these areas, although it is clear that it was the Central European industry which had the major impact - perhaps because it had a more appropriate technology.

Why the decorated Bell Beaker as such should have been so significant is not known, but its consistent presence in graves may indicate something more than intrinsic attractiveness. At all events, once it had reached southern Central Europe (i.e. excluding Central Germany) it became part of an obviously prestigious male grave assemblage found in very limited numbers but quite regularly over large parts of Central and Western Europe, its prestige probably derived at least partly from the innovations which some of the objects represent. Connected with this assemblage is the diffusion of a new series of Beaker decorative motifs. The appearance of a Bell Beaker assemblage in Central Germany is probably part of this secondary process.

Why the innovations and prestige equipment should have been taken up at all, and specifically at this time, is another important question which it is difficult to answer. It may have been the result of a trend towards increased ranking: possible evidence for such a trend might be the appearance of increasingly large henge monuments in Britain around this time, or such rich Bell Beaker graves as Exloo in the Netherlands,



while attention has already been drawn to the possible indications of an increase in the degree of ranking from the Corded Ware to the Bell Beaker phase in Bohemia. Such developments may well have led to the creation of a demand for symbolic differentiation which innovations satisfied. The horse, for instance, probably played a social rather than an economic role, and the products of the metal industries of this period, particularly the dagger, also fit into such a picture. These trends come to fruition in the more obviously ranked societies of the Central and West European Early Bronze Age and it is obviously attractive to seek their beginnings at a rather earlier date, in the Bell Beaker period.

This is obviously not adequate as an overall explanation, but then one of the main points of this dissertation is that no single explanation is likely to be valid, least of all a simplistic one which accounts for everything by means of tribal migrations. The problems involved are complex ones involving many dimensions, some of which could barely be touched on here, and all of which require a great deal of work in the future if an adequate explanation of the Bell Beaker phenomenon is to be found. Nevertheless, to define precisely what we have to explain is an important first step which has generally been neglected and if this thesis has made some progress in this direction it will have achieved its aim.

This attention has already been drawn to the possible indication of  
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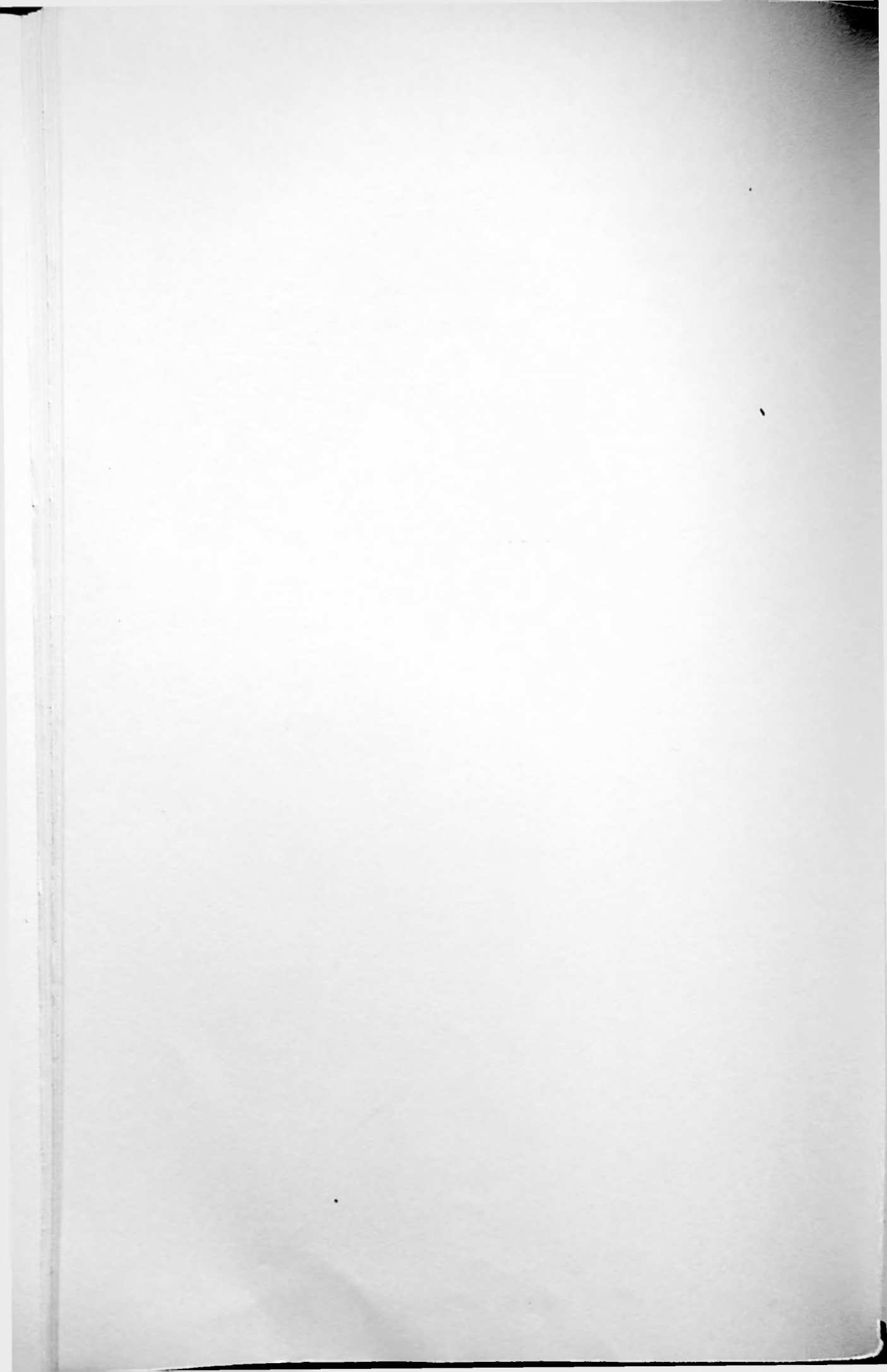
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ARCHAEOLOGICAL 'CULTURES': AN EMPIRICAL INVESTIGATION

S.J. SHENNAN

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THE UNIVERSITY OF CHICAGO

THE UNIVERSITY OF CHICAGO  
CHICAGO, ILLINOIS

## Archaeological 'cultures': an empirical investigation

The archaeological 'culture' concept has come under increasing attack in recent years (e.g. Higgs 1968, Renfrew 1974). These criticisms, however, have been largely theoretical, and there has been no attempt to make an empirical investigation of a particular 'culture' in order to show why the entity is unsatisfactory in a given case. As a result of this, one finds deprecation of the 'culture' concept in the archaeologist's theoretical moments combined with the study of individual 'cultures' in practice. The aim of this paper is to try and remedy the lack of such a study by considering a particular example, the Bell Beaker 'culture' in Central Europe, and seeing what conclusions may be drawn from it.

### Introduction

In later European prehistory the 'culture' has been the basic unit of study from virtually the beginning of this century to the present day, especially in those parts of Europe which have been dominated by the German prehistoric tradition. Perhaps the main feature of the 'culture' is that it is an archaeological entity, consisting of a variety of types of material remains known to be contemporary, associated with one another, and occupying a continuous geographical area. It is well-known that none of the distributions of archaeological types which compose a 'culture' exactly coincide with one another, but no great attention has ever been paid to this fact except by Clarke (1968). He defined 'cultures' as polythetic

# Introduction

The anthropological 'culture' concept has been the basis of many theories of human development. It is a concept which has been used in many different ways, and it is difficult to see how it can be used in a consistent manner. In order to use the concept in a consistent manner, it is necessary to define it in a precise manner. This is the purpose of this book. It is a book which is intended to be a guide to the use of the concept of 'culture' in anthropology. It is a book which is intended to be a guide to the use of the concept of 'culture' in anthropology. It is a book which is intended to be a guide to the use of the concept of 'culture' in anthropology.

## Definition

In many languages including the 'culture' has been the basis of many theories of human development. It is a concept which has been used in many different ways, and it is difficult to see how it can be used in a consistent manner. In order to use the concept in a consistent manner, it is necessary to define it in a precise manner. This is the purpose of this book. It is a book which is intended to be a guide to the use of the concept of 'culture' in anthropology. It is a book which is intended to be a guide to the use of the concept of 'culture' in anthropology. It is a book which is intended to be a guide to the use of the concept of 'culture' in anthropology.

entities, an approach which both approximated more closely to reality and at the same time obscured some of the difficulties (cf. Renfrew 1974).

The 'culture' approach would be entirely satisfactory if the aim of archaeology was solely the definition and description of these entities. In fact, of course, prehistorians have always wanted to construct an historical picture from these units and this has generally involved the rarely declared assumption that the 'culture' is a reflection of human group territoriality in its areal extent. The whole of later European prehistory has been written in terms of this view, which is a natural result of a number of even more basic conceptions.

The first of these stems from the very process of defining entities; once 'cultures' are regarded as things, it is possible to attribute behaviour to them, and to talk about them as if they were living organisms (see Harvey 1969:442). Secondly, 'cultures' have been regarded as formal rather than functional regions, as areas of uniformity on a map rather than as networks created by flows of people, goods and information. A third factor is the idea of the core area, which is perhaps the spatial equivalent of the type concept. On this view, although it is acknowledged that different aspects of the 'culture' have differing distributions, it is implicitly assumed that they all have more or less the same core. Finally, the approach depends on taking the normative view of culture so successfully criticised by Binford (1962); once the Binfordian viewpoint is accepted, it means that each aspect of the 'culture' must be investigated on its own terms.

A more recent view (e.g. Sherratt 1972:528) regards the 'culture'



as merely representing an area of high interaction, and to that extent escapes some of the more basic criticisms. I hope to show, however, that even this view is of limited value. The very imposition of 'culture' entities on the spatial trends in artifact distributions which do exist not only restricts the amount of information which these distributions can provide, but actually creates spurious problems, such as having to look for the origins of the (non-existent) ----- 'culture', an activity which has occupied European archaeologists for over fifty years. Consequently, although the study of prehistoric society has been one of the proclaimed goals of archaeology for many years, attention has been diverted from the evidence for social interaction which is latent in artifact distributions.

#### The Bell Beaker 'culture' in Central Europe

The example which will be used to illustrate the points just outlined is the so-called Bell Beaker 'culture': a restricted group of artifact types (figure 2) found in numerous areas of Western and Central Europe in the centuries around 2000 b.c. This 'culture' has been consistently interpreted as a reflection of human group territoriality, specifically as documenting the spread of the 'Beaker folk'. One particular area will be examined in detail - Central Europe (see map, figure 1) - where cemeteries, isolated graves, and artifact distributions extrapolated from these, constitute the main source of evidence for an understanding of past conditions in this period. The aim is to illuminate the nature of these distributions by a process of mutual comparison and internal analysis.



One mistake which has often been made in the past is to regard one of these distributions as in some sense more basic than the others, and then to consider everything else in relation to it. Pottery style has frequently been used in this way, with the implicit assumption that it directly reflects territory and its boundaries, a view which has been criticised by Bradley (1971) and others. Rather than take any single artifact distribution as a base from which to work, it would be most satisfactory to start from a vitally important distribution which is in some ways less directly visible - that of the prehistoric population - and to map everything else onto it. Unfortunately (because material has only been collected in terms of 'cultures'), adequate information is only available in the areas distinguished by the presence of decorated Bell Beakers, so this provides an initial limitation; I should emphasise, however, that I do not a priori attach any special significance to their presence.

Within Central Europe around 2000 b.c., two types of burial were practised: inhumation and cremation. These vary in relative number from area to area, with cremation most frequent in the Carpathian basin. Figure 3 shows the proportion of cremation graves in the four main Central European settlement areas which contain decorated Bell Beakers: Hungary, Moravia, Bohemia, and Central Germany. The fall-off in the proportion of cremations with distance from the Carpathian basin is immediately apparent. This fall-off may be considered at two levels - a macro-scale and a micro-scale - and it is very important to distinguish between the two. At the first level it is possible to say that the relative frequency of cremation declines with distance. Consideration of the second level, and particularly its relation to the first, presents more problems. Given the assumption that the type



of burial, inhumation or cremation, which a person received was not merely a random factor based on relative location, why was cremation used in a particular case in each of these areas? This is an individual decision between two types of behaviour, and it is possible (and necessary) to investigate it at this level, to see what role it played in local funerary practice. It is equally important to understand why these local decisions in aggregate form a regional pattern of marked fall-off. In this case, the fact that the proportions are so different suggests a variety of possible explanations. One possibility is that cremation was used in different places for different purposes - in Bohemia perhaps for an elite and in Hungary for the majority of the population. As it stands, however, this seems unsatisfactory since it does not take account of the clear directional trend in the proportions. A second answer would be to postulate that it is the influence of the preceding tradition in each area which is responsible for the difference, but this only pushes the problem one step back and is equally unsatisfactory. On the other hand, if cremation were dependent on a second variable, for instance some religious belief, it might be that the prevalence of this declined with distance from the Carpathian basin and the consequent decreased interaction.

Relating these macro-scale and micro-scale patterns to one another is clearly of considerable importance if archaeological distributions are to be understood. As a rule, 'cultures' are only considered at the macro-scale, a level at which the individual distributions appear superficially similar, since they are merely regarded as traits. It is only at the neglected micro-scale that the differences between burying someone and making a pot become apparent. Unfortunately, the



differences in the behaviour which produces the 'cultural traits' are by no means conclusive arguments against holding the 'culture' view as it is still possible to argue that all the behaviour eventually depends on the cultural tradition. In order to counter this view it is necessary to stay at the regional level of description and analysis and show that the spatial patterns produced by artifact distributions are so many and varied that it is meaningless to regard them as evidence for a coherent cultural tradition. It is important to remember, however, that for the purposes of explanation this level is likely to be unproductive and requires the integration of the local aspect which has just been described.

A series of frequency diagrams was compiled from a number of artifact distributions in the same way as for the cremation burials. They are illustrated in figures 4-14. These represent the quantities of particular artifacts in the graves of each region; they were standardised by the number of graves in each area since this varied considerably. It was postulated that if there was no regionality in the proportions from the different regions, they would be equal apart from random variation. The differences between these expected values and the observed values were then tested by chi-square (see e.g. Cole and King 1968:130), as the cremation distribution had been. The results of these tests are recorded in Table 1.

Those distributions in which regional membership is significant are clearly by no means homogeneous. The fall-off patterns for undecorated Bell Beakers (fig. 4), polypod bowls relative to all bowls (fig. 5), and undecorated handled Bell Beakers relative to jugs (fig. 6) seem to be of similar type to that for cremations, but the direction of trend is reversed, with most in Central Germany and least



in Hungary. The number of bowls (fig. 7) falls off in the same direction as the cremations; the rate is apparently different, however, without the marked initial drop seen in figure 3. This difference was tested by the chi-square statistic for two samples:

$$\chi^2 = 44.20 \text{ with } 3 \text{ degrees of freedom}$$

This result is significant at the .001 level so there is only a 1 in 1000 chance that the two features do not differ in their distribution over the four regions. The fall-off in the number of jugs/100 graves (fig. 8) appears to be from a peak in Moravia and itself seems to differ from that of the undecorated handled Bell Beakers (fig. 9). This difference was also statistically tested:

$$\chi^2 = 71.87 \text{ with } 3 \text{ degrees of freedom}$$

This result too is significant at the .001 level so here again there is a difference in the way the quantities of the two objects are distributed over the area.

The distributions just discussed (figures 4-9) clearly show a considerable amount of variation with distance and it should be noted that two of them (figures 5 & 6) are compound distributions and perhaps reflect functional/stylistic alternatives in a sense competing with one another. Thus polypod bowls/100 graves do not seem to trend significantly with distance (fig. 10), and ordinary bowls, as we have seen, have a significantly different trend pattern from that under discussion here. When the two are combined we see a marked distance related trend from one end of the area to the other. (Here there may be evidence for the influence of earlier traditions since polypod bowls have a long history in Central Germany.) A similar situation occurs



when the undecorated jugs and undecorated handled Bell Beakers are put together (fig. 6).

The distribution of the undecorated Bell Beakers (figure 4) deserves special comment in view of the strong contrast it makes with the decorated Bell Beakers (figure 11), which do not show a directional fall-off. The difference between the two clearly lies in the decoration, which seems to have ensured the use of the decorated Bell Beakers in areas where the mere functional vessel type was either redundant or replaced by an alternative. This situation is unsurprising in the light of the considerable amount of time and effort lavished on their ornamentation (cf. Clarke 1976), and further supports their hypothesised role as prestige artifacts in this area (see below).

In fact, perhaps the most important division in the frequency diagrams is between those objects which show a directional fall-off in relative quantity (figures 4-9) and those which do not (figures 10-14). The latter include most of the characteristic Bell Beaker artefacts: the decorated Bell Beaker itself, which does not show any directional trend although it is regionally variable, and the copper dagger, the wrist-guard and the V-perforated button which all maintain a low but more or less constant frequency across all four areas. This is particularly interesting as the objects just enumerated further distinguish themselves from the others by being widely distributed in Western Europe as well; moreover, it has been shown on other grounds (Shennan n.d.) that these artifacts are likely to have had some special prestige significance. It is tempting to postulate that since funerary behaviour with regard to these artifacts was the same throughout Central Europe (i.e. they were put in a small number of graves), the reasons for this behaviour were likewise the same, but this hypothesis requires

and the subsequent steps are the same as in the case of the first step.

Section 11. 1.

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testing.

So far the regional variation in the Central European distribution area of the decorated Bell Beakers has been approached at a relatively crude level, but even this has produced significant results in differentiating a variety of macro-scale patterns. A rather different approach is to investigate distributional variation in particular attributes of specific artifact types. This is of especial interest in those cases where the quantity of the artifact is invariant with distance. Even when there is regional variation in quantity, it is important to compare the pattern with that produced by variation in style: for instance, if objects are stylistically uniform throughout an area in which they decline in number it might be argued that they are diffusing from a single manufacturing centre. In either situation, if stylistic variation does alter with distance when quantity in graves does not, or if they change with distance in different ways, it enables a distinction to be made between the factors involved in depositing an object in a grave and those involved in manufacturing and distributing it, even if we cannot specify what those factors are.

The decorated Bell Beakers perhaps have the greatest potential for an investigation of this sort since they are relatively constant in quantity over all four of the areas studied and at the same time possess a considerable amount of internal variability. The aspect selected for analysis was the use of motifs, which was chosen for several reasons: a wide variety of motifs is used on the vessels; there is evidence for a considerable degree of correlation between motif type and other variables such as zoning arrangement; and, not



least, it presents fewer practical difficulties in analysis than these other variables.

Two methods were used to demonstrate regional variation in the use of motifs. The first method consisted of producing frequency diagrams of the percentage of decorated Bell Beakers in each area which possessed a particular motif; for this only the more common motifs could be used as the others were too infrequent for consideration. The diagrams are illustrated in figures 15-21. All these were tested by means of the chi-square statistic to find out if the occurrence of a particular motif was equally likely throughout Central Europe. In all cases the results were significant at the .01 level, showing that the particular motifs are almost certainly not evenly spread and, therefore, that there are regional differences.

Examination of the frequency diagrams reveals a variety of patterns. Metope motifs (those in which the design is in panels and does not run continuously round the zone) are relatively more prevalent in Central Germany (figures 15-17), and when all forms of metopic decoration are combined together and plotted there is a very clear directional fall-off. The other figures (except figure 18) to some extent show the converse of this, as these motifs are all continuous and therefore, by definition, are mutually exclusive to metopes; consequently Central Germany always has low frequencies. But if the difference between Central Germany and the other areas is the most marked feature of these diagrams, it is not the only one. Hungary, for instance, shows a preference for continuous zig-zag motifs which is not matched elsewhere (figs. 19 & 20), while in Bohemia there is a significantly higher number of vessels with oblique-comb filled zones (figure 18).



The other method employed in this investigation of regional variation in the use of Bell Beaker motifs was cluster analysis. An equal number of vessels was randomly selected from each region and each vessel coded in terms of the motifs it possessed. They were then clustered on the basis of these motifs by the program HIERAR in the CLUSTAN IB package (Wishart 1970) on the Cambridge IBM 370/165 computer. This is an hierarchical clustering program which produces dendrograms of the relations between objects. Three different clustering criteria were available for the type of data used here: single-link, double-link and average-link (see e.g. Everitt 1974). All three were used for comparative purposes and all produced broadly the same groupings. The aim was to find out to what extent the clusters correlated with the regional groupings. The method used was to select by inspection of the dendrogram the large coherent clusters. The numbers from each region in a given cluster were counted. It was assumed that the number of individuals from each region in a given cluster would be equal if region was having no effect on the clustering. The difference between observed and expected frequencies could be tested by the chi-squared statistic. The three methods had two basic clusters in common but average-link produced a third group not present in the other two. As 18 out of the 24 members of this latter group were Central German beakers it was clear that this showed a considerable regional factor. The largest cluster, 69 members, produced a chi-squared result significant at the .01 level, again showing that there was not an even distribution of vessels from all the regions, in this case because of the low number of Central German vessels - only 3. The third cluster, of 36 members, did not produce a significant result on chi-squared so regional affiliation does not seem to be a



factor in membership of this group on the basis of present evidence.

The results from the cluster analysis correspond to those from the study of motif frequencies in emphasising the difference between Central Germany and the other areas. In fact, this is the only inter-regional difference which the cluster analyses detect, so the motif frequency method, based on single attributes, seems to be more sensitive than cluster analysis, based on multiple attributes, in detecting regional groupings; on the other hand, this lack of sensitivity may merely be a result of the particular clustering method used.

Perhaps the most important outcome of these analyses is the clear contrast between the relatively even distribution of decorated Bell Beaker deposition in graves and their marked internal stylistic variability. The methods employed make it possible to measure these on the same scale and strongly suggest that there were different distributional factors at work in the two cases. Also, the difference between Germany and the other areas may be seen in a wider perspective as only one of a number of different spatial trends in which all these regions share. When the degree of difference between Germany and the other areas is compared with the differences between these three latter groups, the idea of a simple dichotomy between two distinct areas (the usual view) is shown to be inadequate.

Concerning the regional variation in the motifs as such, several things may be said. First, the differences may be regarded in the broadest sense as reflecting differential regional interaction. In all cases inter-regional differences are significant and this points to local manufacture of the decorated Bell Beakers and/or local motif preferences even in Hungary, on the very edge of the distribution,



and where it has been suggested that the Beakers were imported. This regionality need not have prevailed throughout the period in which decorated Bell Beakers were current. It does not exclude the possibility that there was a phase in which regional situation did not affect motif use, and that inter-regional contact later declined. This, of course, is the traditional view, and it is not entirely without support. The third cluster of vessels described above, which did not show significant regional variation, was linked together basically by the use of the oblique-comb fill motif, which has always been regarded as early.

It is interesting to compare the spatial patterning in Bell Beaker motifs with that in other artifact categories, to obtain a measure of the extent to which they covary. Similar patterning of variation might suggest that similar factors were involved in manufacture and distribution, although the problem of equifinality must be borne in mind. Investigating the internal variation of another artifact type has two more points of interest. It is again possible to compare variation in the quantity of objects deposited with internal morphological variability, and, further, to compare the relation between deposition and internal variation in two different artifact categories.

The class of objects analysed was the undecorated jugs. These were described by a series of measurements which were standardised for vessel size. 38 vessels were selected from each area and two related analyses carried out, to discover whether region of origin corresponded in any way to morphological variation in the vessels. The methods used were discriminant analysis and canonical variate analysis, both carried out by means of the program BMD07M from the



Biomedical Computer Programs package (Dixon 1973) on the Cambridge IBM 370/165 computer. Discriminant analysis is defined by Jardine and Sibson (1971) as a set of methods 'whereby linear combinations of quantitative attributes which give optimal discrimination of populations are calculated from the joint distributions over the attributes of each population'. In this case, the populations were the groups of jugs from each region. The aim was to see if these could be discriminated by means of the descriptive ratios. A measure of the success of the discrimination (since significance tests could not be used on this data) is given by the classification matrix which the program produces (Table 2). This shows how many of the members of each regional group were correctly classified. It can be seen that for three of the groups the classification is good. The exception is Bohemia, which has twice as many mistakes as there are correct assignments; interestingly enough, there are equal assignments to the areas immediately on each side. Hungary is the most distinctive area.

From the discriminant function canonical variates may be produced, which can be used as axes for the production of scattergrams of the groups. The scattergram of the regional groups against the first two canonical variates, which account for 90% of the cumulative dispersion, is shown in figure 22. Here again, unsurprisingly, Hungary is the most extreme group, having little overlap with the others; these are closer together, but with Germany distinctly separate from Moravia and to a lesser extent from Bohemia. The relative distances of the group means correspond quite well to the relative geographical distances apart from the position of Moravia.

The feature which clearly emerges is that once again there is regionalisation in the production and/or distribution of the pottery,



or at least regional preferences in jug shape. In this respect the jugs reflect a similar situation to the decorated Bell Beaker motifs. On the other hand, they also show a marked difference, for in terms of motifs Central Germany was the most distinctive region, while as regards jug shapes it is obviously Hungary. But if there is some similarity in the regionality present in the jugs and that present in the Bell Beaker motifs, there is once again a complete contrast between the distribution pattern of jug quantities deposited in the graves (figure 8) and the internal variation in the shape of the jugs, as there was in the Bell Beaker motif case. The inference of different factors operating to produce these distributions seems unavoidable, and demonstrates the importance of considering different types of interaction separately.

The documentation of this enormously varied range of spatial trends could clearly be continued almost ad infinitum, but before turning away from them it is necessary to consider one more example. So far I have been dealing with the rather obvious level of cultural content. On a slightly more abstract level is the study of grave associations, which focuses on the relations between objects. These will have a meaning in a particular context which may very well be exclusive to that context - indeed, it is possibly the association, rather than the mere presence of a particular item, which is significant, since it can be shown for the Bell Beaker case that the associations between objects are by no means random (Shennan n.d.). A similarity measure may be computed between all pairs of graves and these similarities plotted against distance from a specified base point. This provides a very detailed picture of whether the associations are changing over space because within- as well as between-region patterns



are documented. Figures 23-25 show the results of such analyses on the Bell Beaker graves of Bohemia and Moravia; in each case a different type of grave association from a different part of the area was used as a base point. The lack of any fall-off is clearly apparent, and thus the fact that a given type of association may occur anywhere within the area. To the extent that such associations had an identical significance in different parts of these regions, they are evidence for a considerable uniformity of role and status recognition over the area, but unfortunately this cannot be assumed.

Despite this, cemeteries, and graves in general, exemplify a point of theoretical importance to the whole 'culture' problem. It has already been demonstrated that there are different proportions of graves in the various regions containing particular goods; one possible explanation of this phenomenon is that the objects were used for different purposes in different areas, a situation which could also occur, of course, even when the proportions of the objects are the same. Conversely, it is entirely possible that the same roles and statuses were recognised in different areas but were expressed in different material ways. In terms of the material content of assemblages such a behavioural uniformity would not be apparent at all - it can only be discovered by elucidating the structure of the funerary assemblage together with its relations to such known independent evidence as the age and sex of the buried population. Comparison of results from a number of areas or sites will then allow a macro-scale picture to be built up, although whether we can explain it is another matter.



## Conclusions

It is now necessary to consider all these findings in the light of the aim which was declared at the beginning - to show why the use of the 'culture' entity was unsatisfactory in a particular case. In the first place, a vast number of complicated trends has been revealed which were previously barely even suspected. It follows from this that a view of artifact distributions in terms of dichotomies between different 'cultures' is simplistic and misleading, and conceals large amounts of information. It is significant that these complexities have been revealed by a quantitative approach, albeit a simple one. Dichotomies are inevitable when information is purely qualitative, of the presence/absence variety, as it has been in archaeology. It is only recently, indeed, that archaeological measurement has advanced beyond this simple level: the concepts have been as primitive as the quantification.

This point may best be demonstrated by a diagram showing the differences in results between a qualitative analysis of the information used in this paper and the quantitative approach actually used (see figure 26); in each case the area is initially defined by the presence of decorated Bell Beakers. The first approach is essentially self-contained (fig. 26a). We see that most of the artifacts are present over most of the area and thus correspond to the distribution of decorated Bell Beakers; there seems no need to look any further. Figure 26b shows lines derived from all the frequency distributions plotted on a single diagram. It presents a bewildering degree of variety, in marked contrast to the previous uniformity; moreover, the very fact that some of the distributions fall-off from the edge of the decorated Bell Beaker distribution area prompts us to



ask how they behave beyond this area, and demonstrates how unsatisfactory has been the collection of information in terms of 'culture' units. At least as serious, and partly a result of this, is the fact that spurious 'cultures' based on qualitative information have been regarded as things which can and should be explained, no doubt one of the main reasons for the lack of progress in later European pre-history to which Neustupný (1971) has drawn attention. Even those modern views of the 'culture' which merely regard it as an area of high interaction are untenable, since it is by no means certain that it is possible by traditional methods to identify high interaction as opposed to some other reason for similarity over space. But even if it is assumed that this can be done, the spatial interaction patterns are all so different that it is only valid to talk about 'high interaction' in a specific field of activity, and not in general terms. An exception may be made to this at the intra-settlement region level which is likely to have greater interaction purely on a least effort principle.

It might be argued at this juncture that 'cultures' are defined not so much by single artifact distributions as by artifact combinations and, therefore, that the results which have just been described are irrelevant; in fact, however, this will not do. First, a combination means the presence of a site at which objects are combined. Some correlation between particular aspects of material is, therefore, bound to arise since virtually every post-Mesolithic community in Europe had some sort of pottery, lived in houses, and somehow disposed of its dead, to name only a few activities which leave material traces. On this view in its extreme form the particular combination depends solely on the position of the site in relation to the spatial trends



of the individual artifacts, which are thus crucial. It is well-known, of course, that this is by no means the whole truth. Artifact function, and site function, are vitally important, a fact which brings us back to the micro-scale of analysis discussed earlier - particular artifact combinations may well be a result of local behavioural factors which the normative cultural approach fails to take into account. The example of this most relevant to the present case is variation in burial, which authors such as Binford (1971) and Saxe (1970) have shown to be extremely complex. These variations, as we have already discussed, will correlate with social and other distinctions which have a meaning in a particular context and which may be understood by analysis of individual cemeteries. Even such work as this, however, although essential, only pushes back the problem of understanding the regional variation as it remains unknown to what extent uniformities and discontinuities in the funerary treatment of status categories actually relate to such things as the territories and boundaries of social groups (cf. Renfrew 1974). Less obviously perhaps, pottery too requires micro-scale analysis: in order to understand the organisation of production, for example, or to find out whether the use of a particular decorative motif is restricted to a certain social group. It is only when information of this type is available that it is possible to begin comprehending the macro-scale pattern: if production were domestic, for instance, an explanation of two complementary pottery distributions in terms of 'competition' might well be inappropriate.

This brings us to the final stage of the analysis - attempting to understand the distributions obtained - for micro-scale analysis is not sufficient to explain macro-scale patterns. These are something about which very little is known so it is only possible to make some

the individual, which may be considered. It is well-known, however, that this is by no means the whole story. The individual is not a static entity, but a dynamic one, and his behavior is determined by a complex of factors, including his environment, his heredity, and his own experiences. The study of the individual must therefore be a study of the whole man, in all his complexity and in all his variability. This is the task of the social sciences, and it is a task that requires the most careful and most comprehensive investigation. The study of the individual is not a study of the isolated individual, but a study of the individual in his social context. It is a study of the individual as he is affected by his environment, and as he affects his environment. It is a study of the individual as he is shaped by his heredity, and as he shapes his heredity. It is a study of the individual as he is influenced by his experiences, and as he influences his experiences. The study of the individual is a study of the whole man, in all his complexity and in all his variability. This is the task of the social sciences, and it is a task that requires the most careful and most comprehensive investigation.

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suggestions.

An obvious one which has already been used to some extent is to establish source areas for such products as pottery and other movable objects by characterisation techniques like thin-section analysis. This allows the definition of flows of material in particular directions over known distances, from which it may be possible to say something about the mechanisms involved (see Hodder 1974). Another possibility is to carry out spatial ethnographic studies of various distributions in operational contexts. Not a great deal has been done on this aspect of 'action-archaeology' and it seems potentially very useful. A further solution, which may yet be the most productive, is not to try and 'explain' the distributions at all, but merely to use them in testing hypotheses external to them. This is a natural reaction against merely letting the data present problems since it frees the archaeologist from the constraints of his poor quality information provided that he can operationalise his model in a convincing way (cf. Binford 1968).

But if one rejects this answer and still regards explanation of the distributions, both visible and not so visible, as a valid goal, then one clear outcome of this paper is that it will be completely impossible without first adequately documenting the spatial variation in quantitative terms and understanding the relevant micro-scale behaviour. In this light it is perhaps ironic that the adherents of Hawkes' (1954) views on the scale of difficulty in archaeological inference should have attached such significance to 'cultures'. Not only do these fail to stand up to a quantitative approach, but even explaining the distributions on which they were based can now be seen to depend on the shakier rungs of their inferential ladder.



Acknowledgements: I would like to thank Ian Hodder for several discussions on the subject of this paper. I am also grateful to Fred Hamond and to my wife for reading and commenting on previous drafts.

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... of the subject of this ...  
... and to be able to ...

Table I Results of chi-square tests for regional differences in quantities of particular artifacts in graves. Figure numbers refer to the bar graph in which a particular objects frequency by region is presented.

Figure	$\chi^2$ value	Significance
3	> 100	> .001
4	> 44	> .001
5	> 65	> .001
6	> 99	> .001
7	> 48	> .001
8	> 43	> .001
9	> 21	> .001
10	6.1	< .05
11	13.0	.01
12	.4	< .05
13	3.8	< .05
14	No $\chi^2$ test carried out because values for Hungary unknown.	
15	> 25	> .001
16	> 40	> .001
17	> 103	> .001
18	> 25	> .001
19	> 33	> .001
20	> 41	> .001
21	> 36	> .001

Number of children under the age of 16 years in  
 possession of passport or visa in 1950. (Data subject  
 refers to the last entry in which passport or visa  
 frequency by region is presented.)

Region	1950	1951
1. Africa	1,000	1,000
2. Asia	2,000	2,000
3. Europe	3,000	3,000
4. Latin America	4,000	4,000
5. Middle East	5,000	5,000
6. North America	6,000	6,000
7. Oceania	7,000	7,000
8. South America	8,000	8,000
9. Western Europe	9,000	9,000
10. Eastern Europe	10,000	10,000
11. Northern Africa	11,000	11,000
12. Southern Africa	12,000	12,000
13. Central Asia	13,000	13,000
14. South Asia	14,000	14,000
15. Southeast Asia	15,000	15,000
16. East Asia	16,000	16,000
17. Oceania	17,000	17,000
18. Northern Europe	18,000	18,000
19. Southern Europe	19,000	19,000
20. Central Europe	20,000	20,000
21. Eastern Europe	21,000	21,000
22. Western Europe	22,000	22,000
23. Northern Africa	23,000	23,000
24. Southern Africa	24,000	24,000
25. Central Asia	25,000	25,000
26. South Asia	26,000	26,000
27. Southeast Asia	27,000	27,000
28. East Asia	28,000	28,000
29. Oceania	29,000	29,000
30. Northern Europe	30,000	30,000
31. Southern Europe	31,000	31,000
32. Central Europe	32,000	32,000
33. Eastern Europe	33,000	33,000
34. Western Europe	34,000	34,000
35. Northern Africa	35,000	35,000
36. Southern Africa	36,000	36,000
37. Central Asia	37,000	37,000
38. South Asia	38,000	38,000
39. Southeast Asia	39,000	39,000
40. East Asia	40,000	40,000

Table II    Classification matrix produced by discriminant analysis  
showing number of jugs correctly classified as to region  
by means of their measurements.

Actual regional group	Number of cases classified into each regional group on basis of measurements			
	GERMANY	BOHEMIA	MORAVIA	HUNGARY
GERMANY	23	8	3	4
BOHEMIA	10	12	11	5
MORAVIA	5	8	24	1
HUNGARY	2	3	0	33

The following table shows the results of the experiments conducted on the 15th and 16th of May 1881, at the Agricultural Station, Cambridge, Massachusetts. The experiments were conducted by Mr. J. H. Comstock, and the results were recorded by Mr. J. H. Comstock and Mr. J. H. Comstock.

Experiment 1				Results	
Experiment 2				Results	
1	2	3	4	5	6
1	2	3	4	5	6
1	2	3	4	5	6
1	2	3	4	5	6

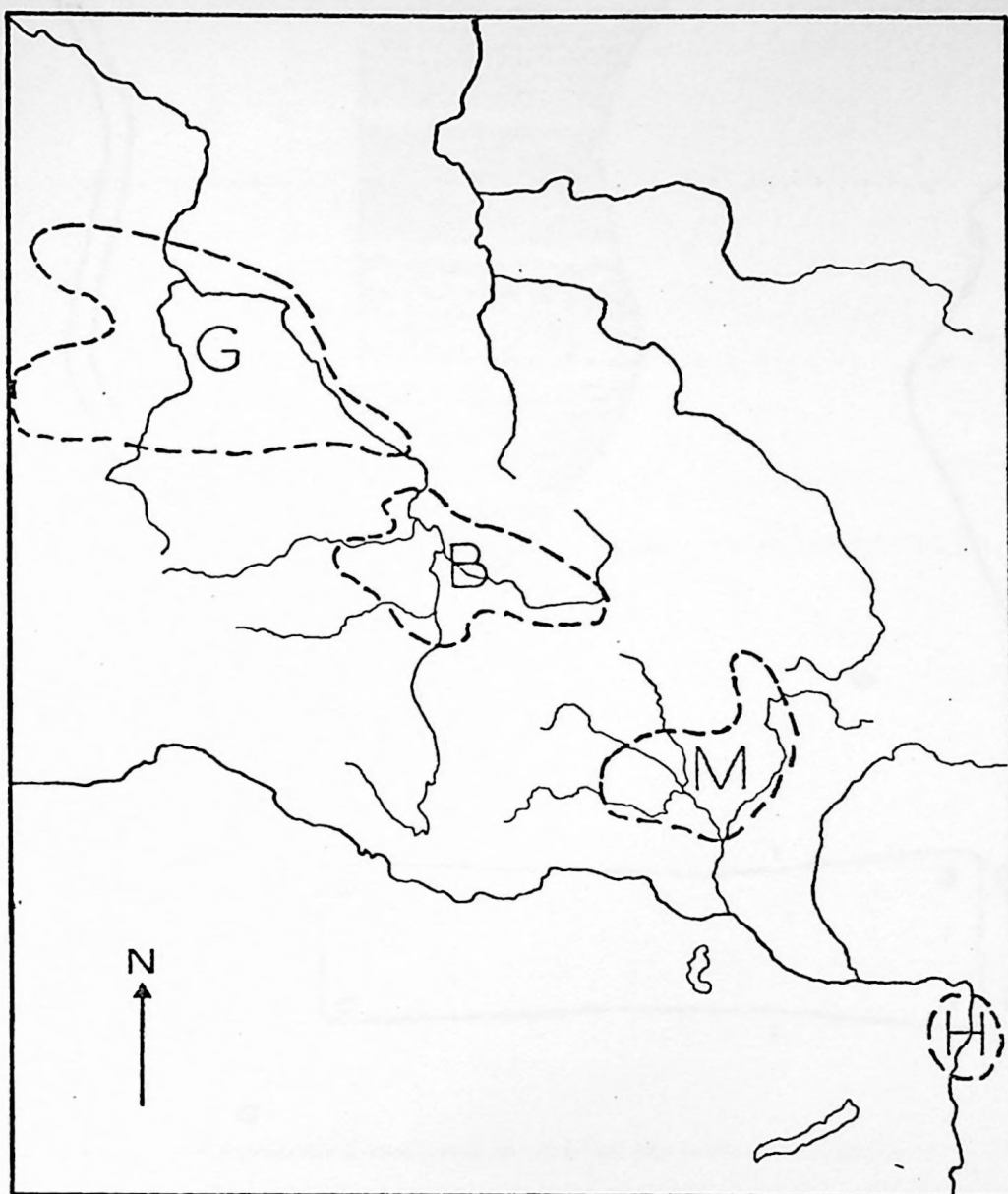


Figure 1 Map of Central Europe showing areas studied.

H = Hungary, M = Moravia, B = Bohemia, G = Germany.

Scale 1:5,000,000.



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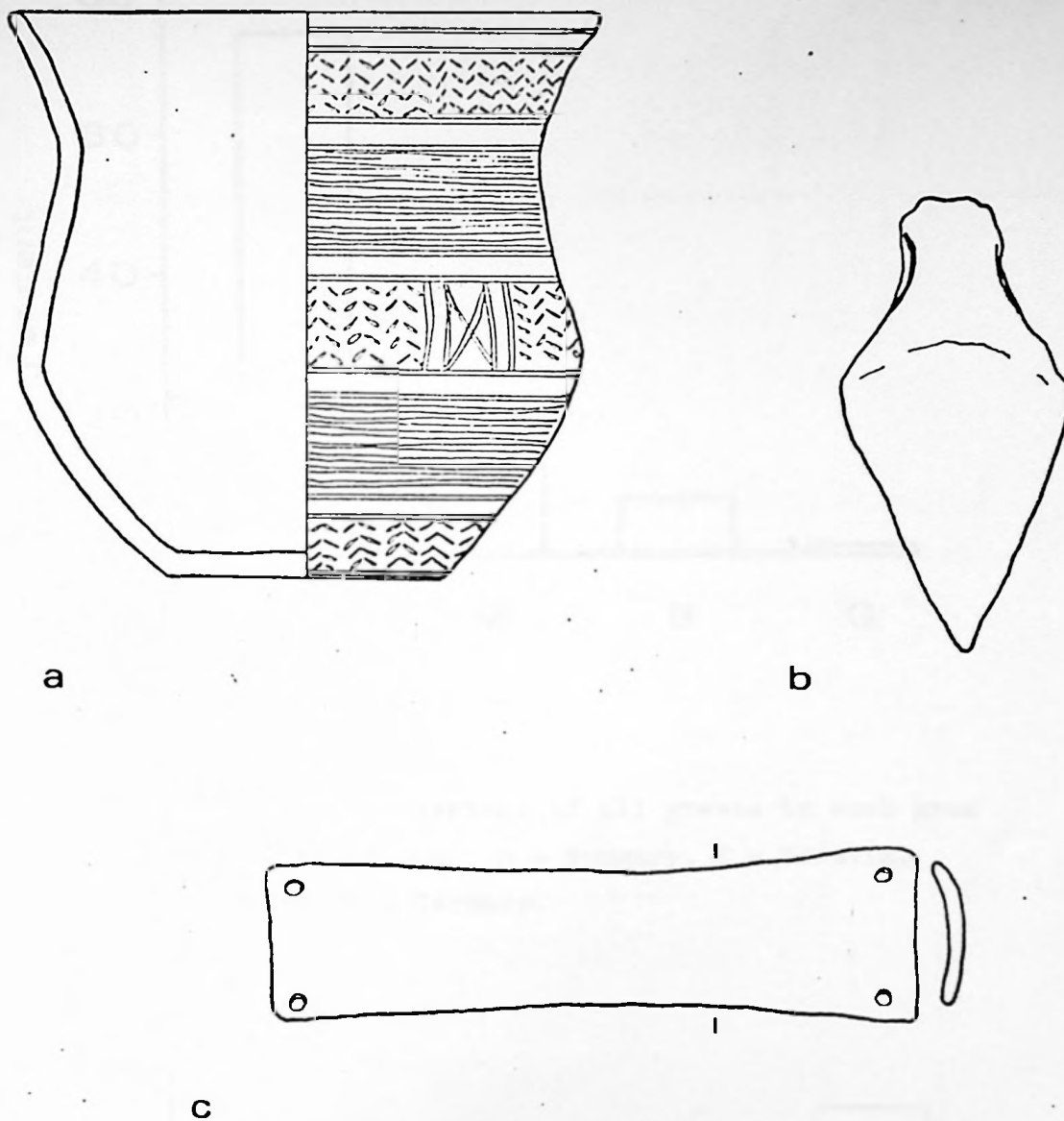


Figure 2 Three of the most widespread Bell Beaker artifact types. a) Decorated Bell Beaker 1:2. b) Tanged copper dagger 1:1. c) Stone archer's wrist-guard 1:1.



Figure 1. View of the base of the object. The object is a diamond-shaped object, possibly a gemstone or a piece of jewelry, with a small rectangular feature at the top.

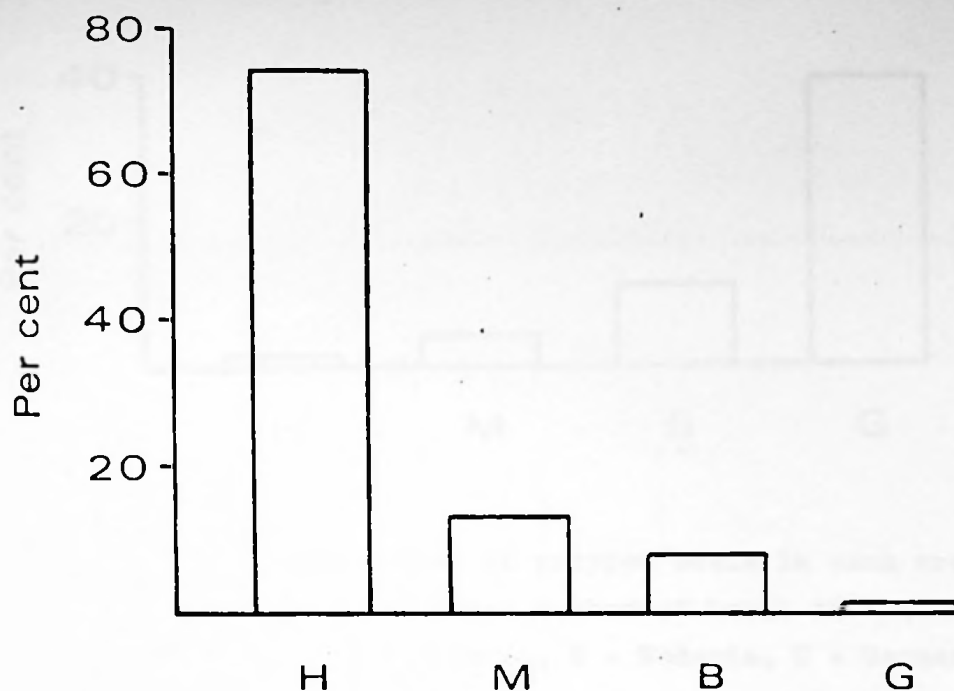


Figure 3 The percentage of all graves in each area that are cremations. H = Hungary, M = Moravia, B = Bohemia, G = Germany.

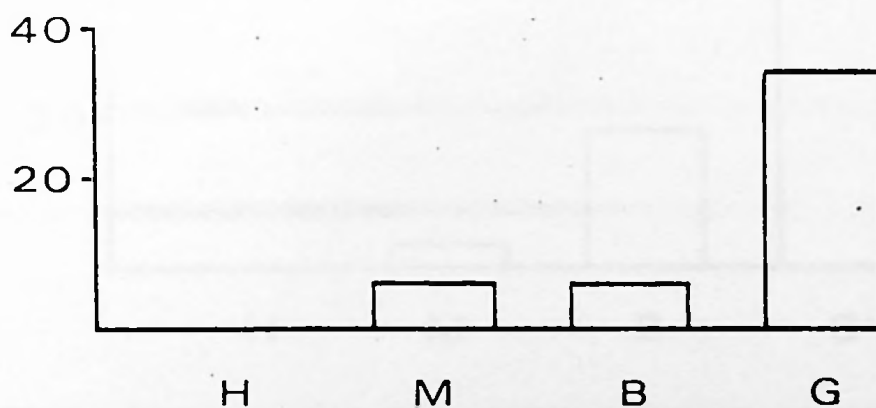


Figure 4 The number of undecorated Bell Beakers/100 graves in each area. H = Hungary, M = Moravia, B = Bohemia, G = Germany. The vertical axis represents the number of vessels/100 graves.



Figure 1. The number of vegetated plots for three treatments: C = Control, B = Bare, M = M. The number of vegetated plots is shown on the y-axis.



Figure 2. The number of vegetated plots for three treatments: C = Control, B = Bare, M = M. The number of vegetated plots is shown on the y-axis.

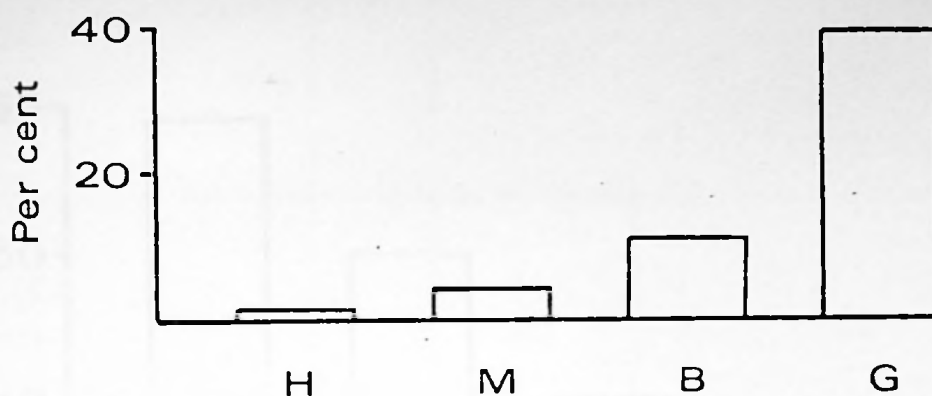


Figure 5 The number of polypod bowls in each area as a percentage of the total number of bowls in that area.  
H = Hungary, M = Moravia, B = Bohemia, G = Germany.

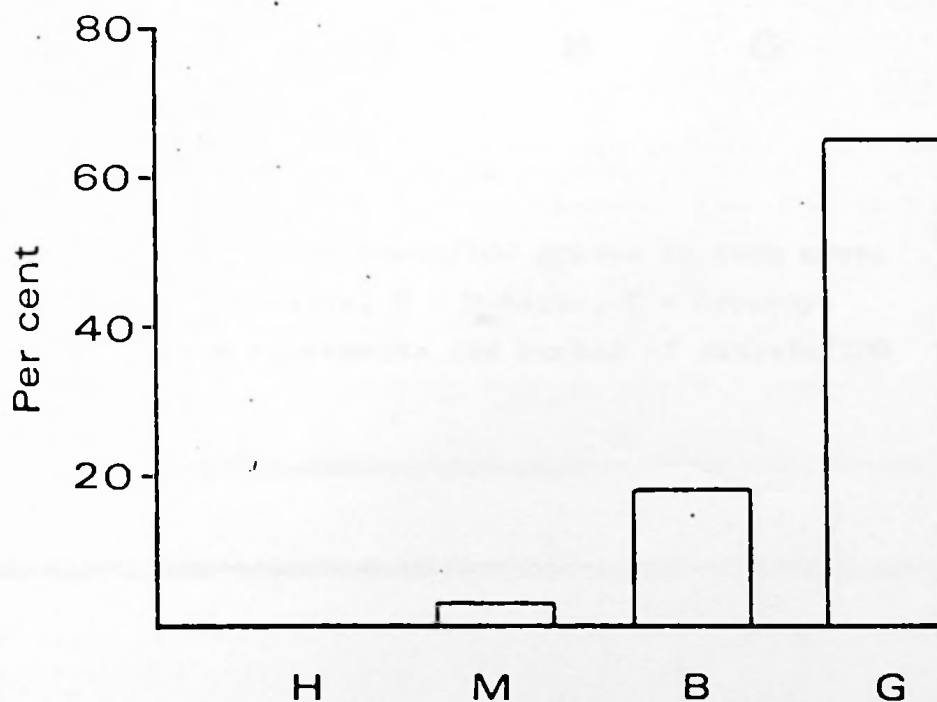


Figure 6 The number of undecorated handled Bell Beakers in each area, as a percentage of the total number of undecorated handled Bell Beakers and jugs in that area.  
H = Hungary, M = Moravia, B = Bohemia, G = Germany.



Figure 1. The number of subjects for each group. G = Group 1, D = Group 2, M = Group 3, H = Group 4.



Figure 2. The number of subjects for each group. G = Group 1, D = Group 2, M = Group 3, H = Group 4.

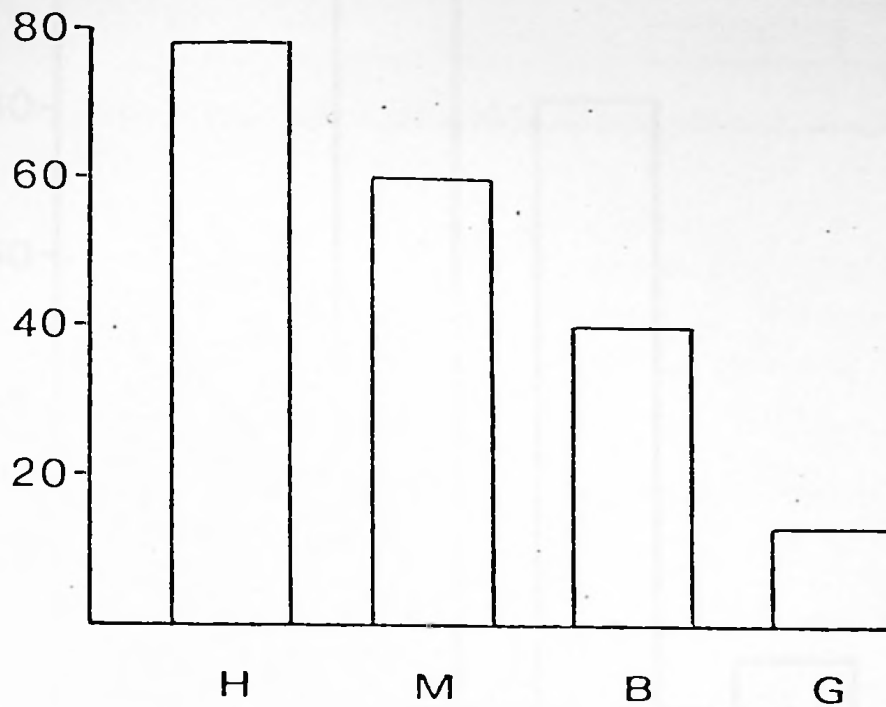


Figure 7 The number of bowls/100 graves in each area.  
H = Hungary, M = Moravia, B = Bohemia, G = Germany.  
The vertical axis represents the number of vessels/100 graves.



Figure 1. The relative to the total number of cases in the population. The relative to the total number of cases in the population. The relative to the total number of cases in the population.

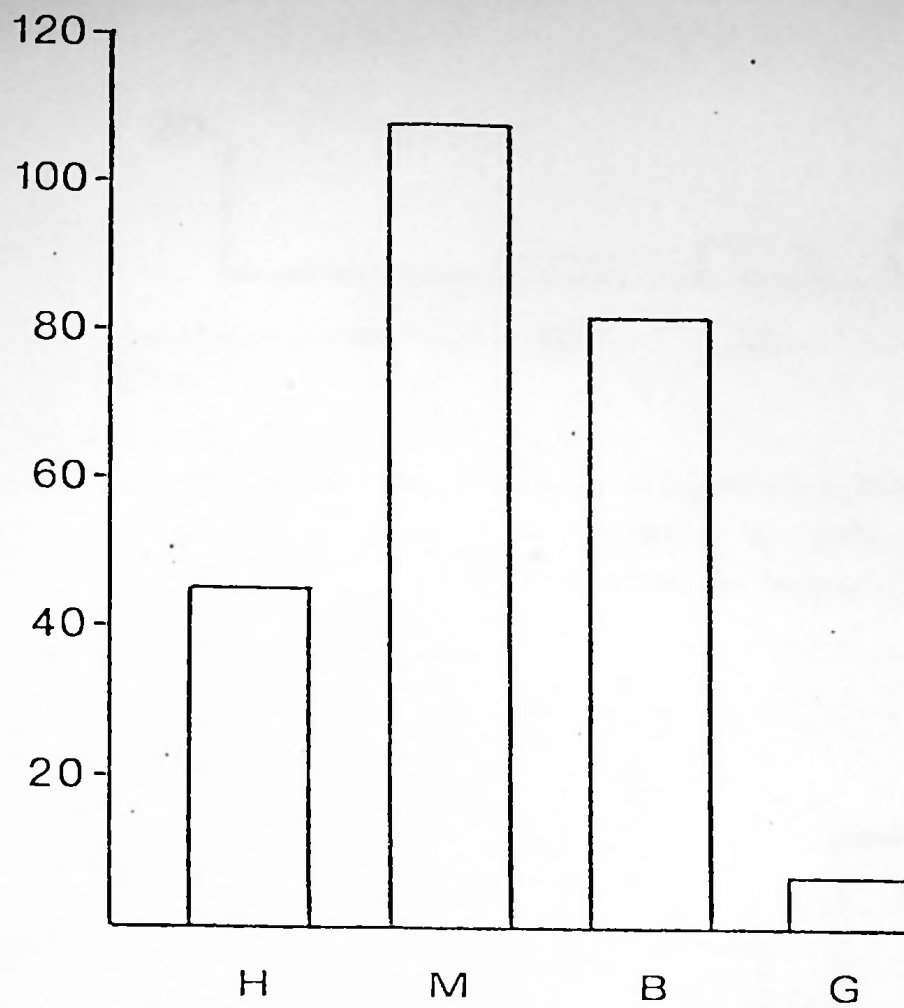


Figure 8 The number of jugs/100 graves in each area.  
 H = Hungary, M = Moravia, B = Bohemia, G = Germany.  
 The vertical axis represents the number of vessels/100 graves.

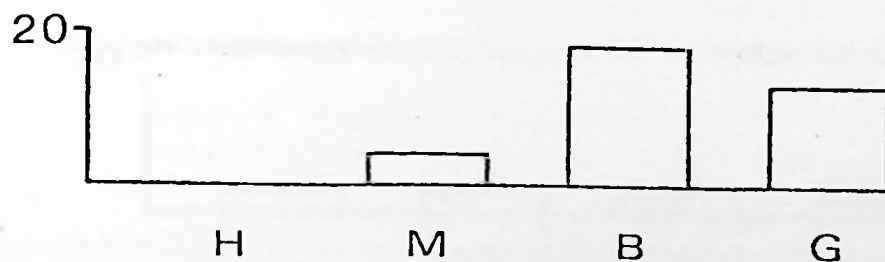


Figure 9 The number of undecorated handled Bell Beakers in each area. H = Hungary, M = Moravia, B = Bohemia, G = Germany. The vertical axis represents the number of vessels/100 graves.



Figure 1. The number of subjects in each group for the first experiment. D = Deaf, S = Signed, M = Mixed, H = Hearing.



Figure 2. The number of subjects in each group for the second experiment. D = Deaf, S = Signed, M = Mixed, H = Hearing.

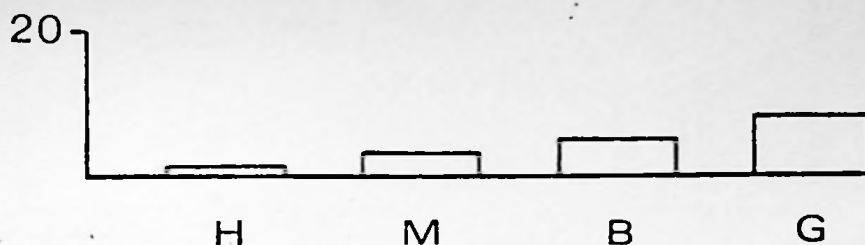


Figure 10 The number of polypod bowls/100 graves in each area. H = Hungary, M = Moravia, B = Bohemia, G = Germany. The vertical axis represents the number of vessels/100 graves.

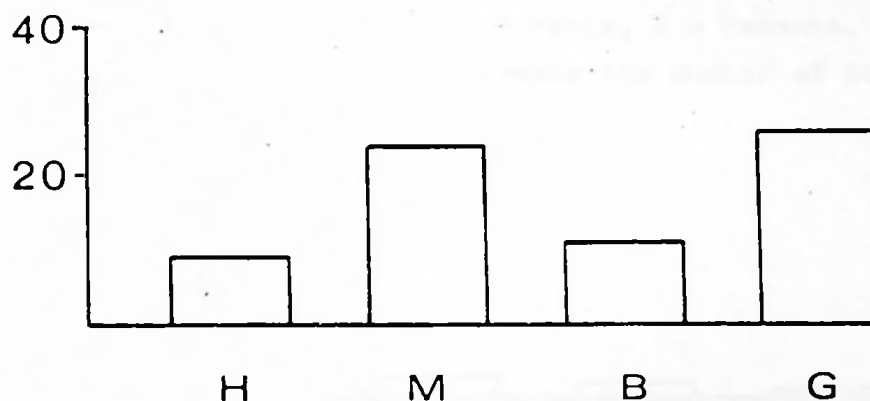


Figure 11 The number of decorated Bell Beakers/100 graves in each area. H = Hungary, M = Moravia, B = Bohemia, G = Germany. The vertical axis represents the number of vessels/100 graves.

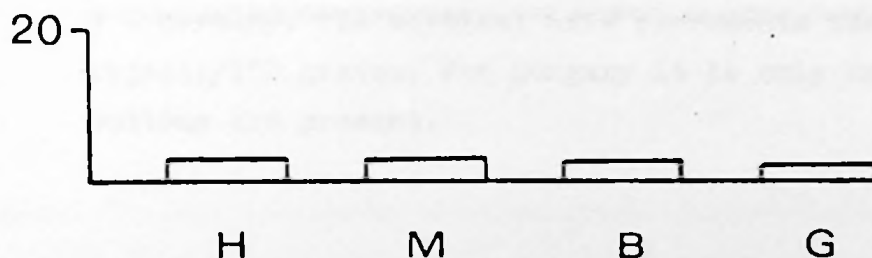


Figure 12 The number of copper daggers/100 graves in each area. H = Hungary, M = Moravia, B = Bohemia, G = Germany. The vertical axis represents the number of objects/100 graves.



Figure 11. The number of...  
 D = ... S = ... M = ... H = ...  
 The number of...  
 ...



Figure 12. The number of...  
 D = ... S = ... M = ... H = ...  
 The number of...  
 ...



Figure 13. The number of...  
 D = ... S = ... M = ... H = ...  
 The number of...  
 ...

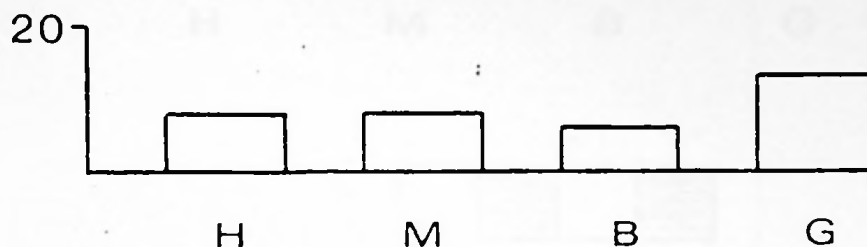


Figure 13 The number of wrist-guards/100 graves in each area. H = Hungary, M = Moravia, B = Bohemia, G = Germany. The vertical axis represents the number of objects/100 graves.

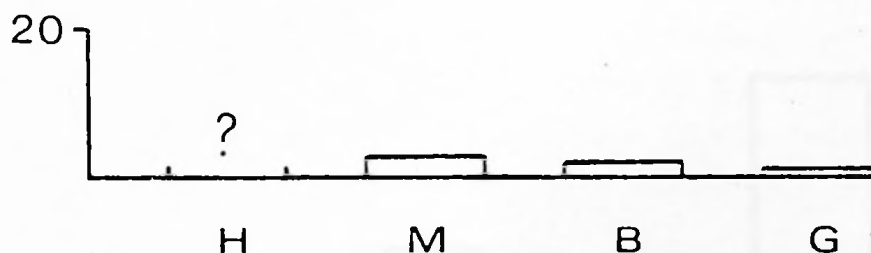


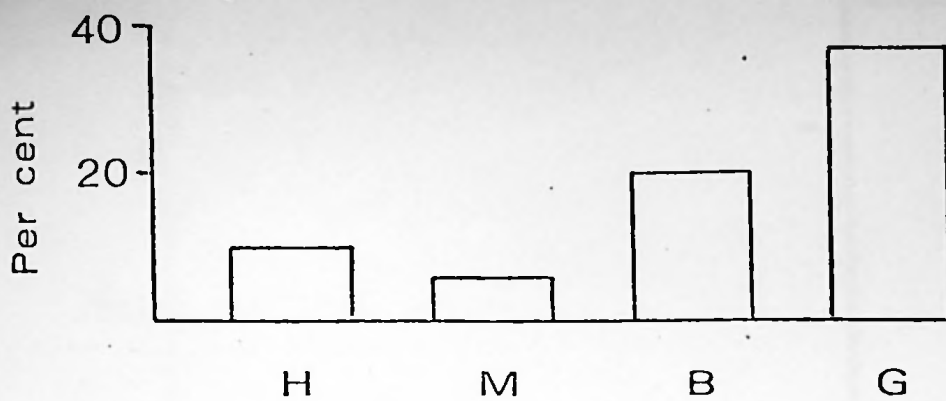
Figure 14 The number of V-perforated buttons/100 graves in each area. H = Hungary, M = Moravia, B = Bohemia, G = Germany. The vertical axis represents the number of objects/100 graves. For Hungary it is only known that the buttons are present.



Figure 11. The ratio of the maximum to the minimum value of the function  $f(x)$  as a function of the parameter  $\alpha$ . The curve starts at  $(0, 1)$  and decreases to  $(1, 0)$ .



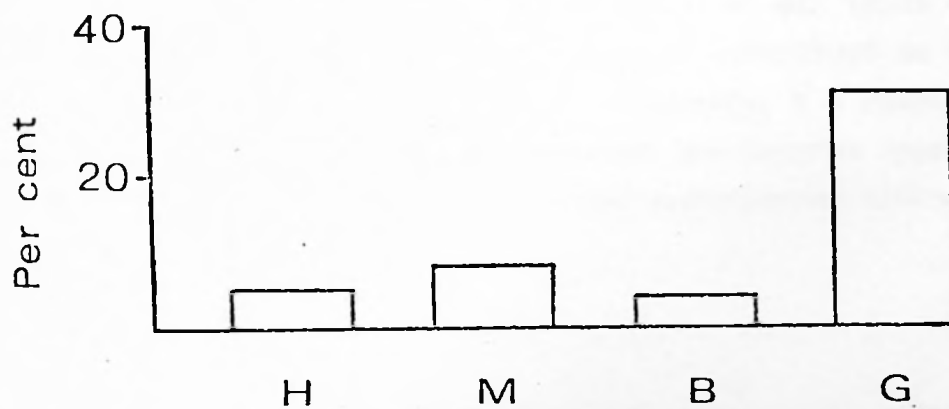
Figure 12. The ratio of the maximum to the minimum value of the function  $f(x)$  as a function of the parameter  $\alpha$ . The curve starts at  $(0, 1)$  and decreases to  $(1, 0)$ .



Motif 1



Figure 15 The percentage of the decorated Bell Beakers in each area possessing Motif 1. H = Hungary, M = Moravia, B = Bohemia, G = Germany.



Motif 2



Figure 16 The percentage of the decorated Bell Beakers in each area possessing Motif 2. H = Hungary, M = Moravia, B = Bohemia, G = Germany.



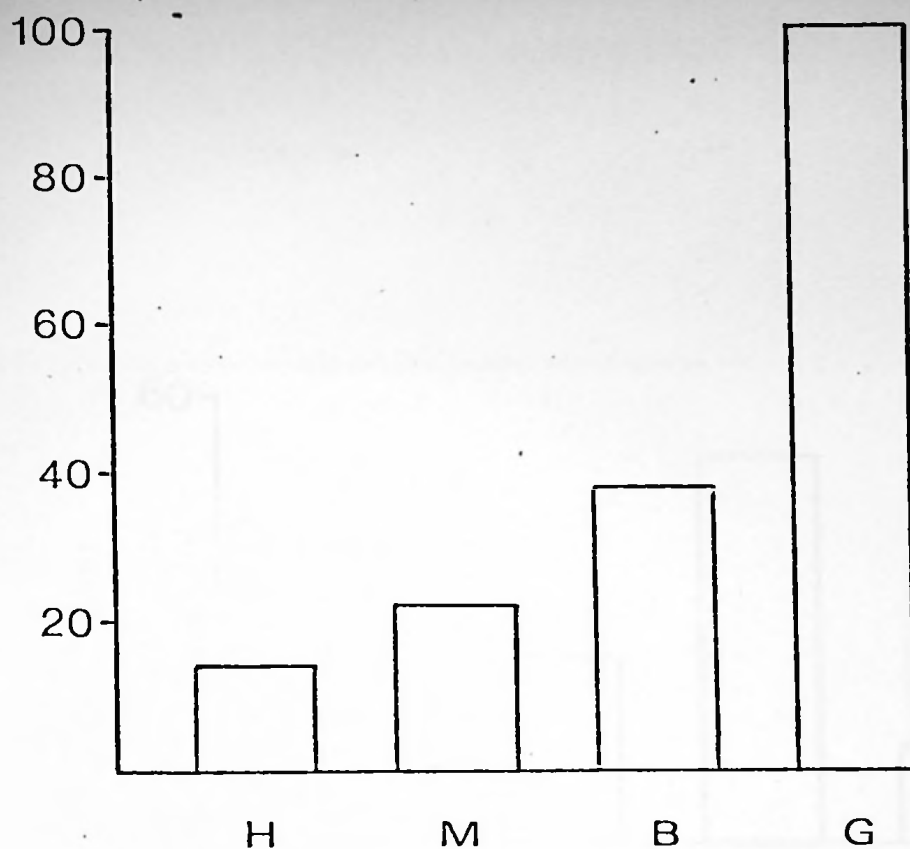
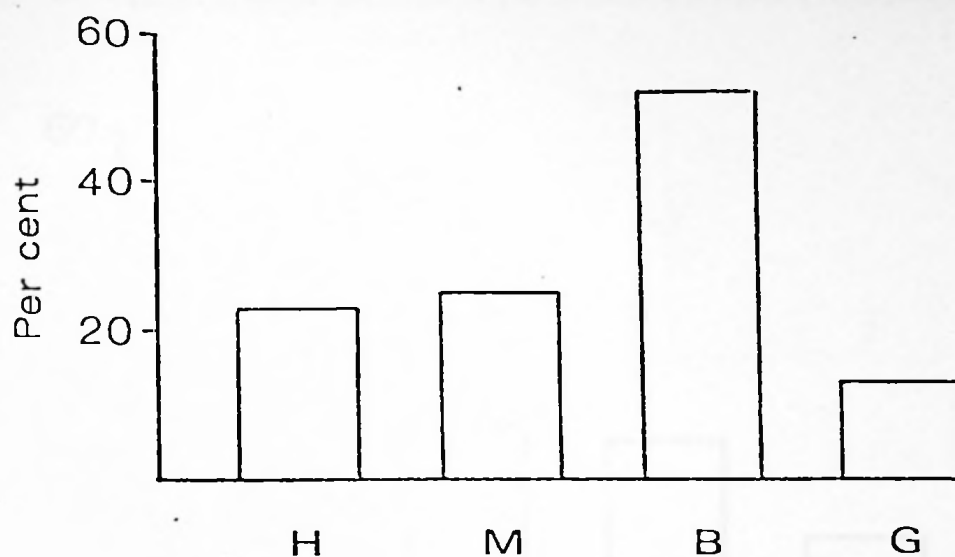


Figure 17 The number of occurrences of all types of panel motif/100 decorated Bell Beakers, standardised so that Germany = 100. H = Hungary, M = Moravia, B = Bohemia, G = Germany. The vertical axis of the diagram represents the standardised number of motif occurrences/100 vessels.



During the study, the following results were obtained. The first result was that the majority of the subjects (80%) showed a significant improvement in their performance over the course of the study. The second result was that the subjects who received the treatment showed a significantly higher improvement in their performance compared to the control group. The third result was that the subjects who received the treatment showed a significantly higher improvement in their performance compared to the control group. The fourth result was that the subjects who received the treatment showed a significantly higher improvement in their performance compared to the control group.



Motif 3



Figure 18 The percentage of the decorated Bell Beakers in each area possessing Motif 3. H = Hungary, M = Moravia, B = Bohemia, G = Germany.

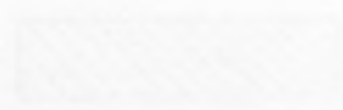


Figure 3

Figure 3 is a bar chart showing the frequency of three categories: a, b, and c. The y-axis is labeled 'Frequency' and ranges from 0 to 60. The x-axis is labeled with the categories a, b, and c. The bar for category a has a height of 15, the bar for category b has a height of 60, and the bar for category c has a height of 25.

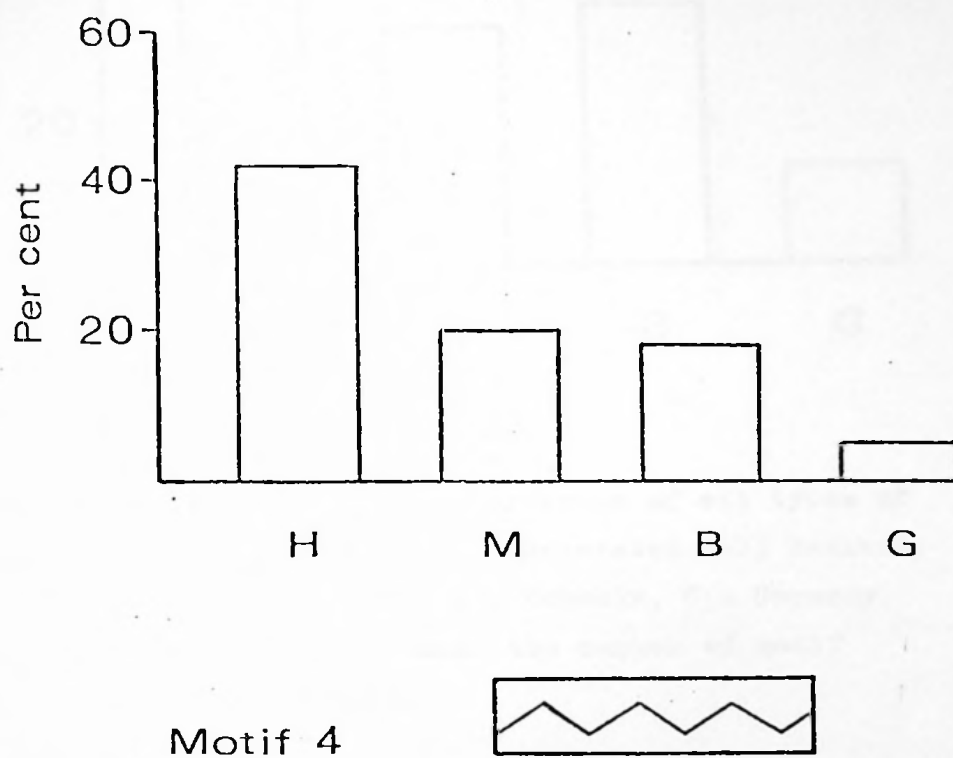


Figure 19 The percentage of the decorated Bell Beakers in each area possessing Motif 4. H = Hungary, M = Moravia, B = Bohemia, G = Germany.



FIGURE 4

Figure 4 shows the waveform of the signal for the first 100 samples. The signal is a periodic waveform with a period of 10 samples. The signal is a square wave with a duty cycle of 50%. The signal is a square wave with a period of 10 samples. The signal is a square wave with a period of 10 samples.

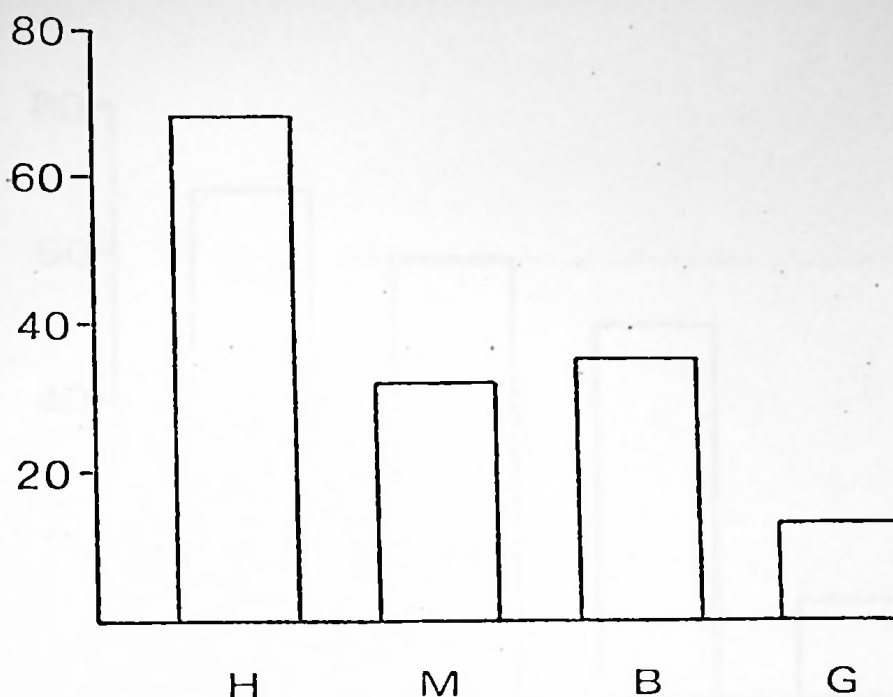


Figure 20 The number of occurrences of all types of continuous zig-zag motifs/100 decorated Bell Beakers. H = Hungary, M = Moravia, B = Bohemia, G = Germany. The vertical axis represents the number of motif occurrences/100 vessels.



Figure 1. The effect of the concentration of the solution on the rate of the reaction. The reaction was carried out at 25°C. The concentration of the solution was varied from 0.1 to 0.5 M. The rate of the reaction was measured by the change in the absorbance of the solution at 440 nm. The data are shown in Table 1.

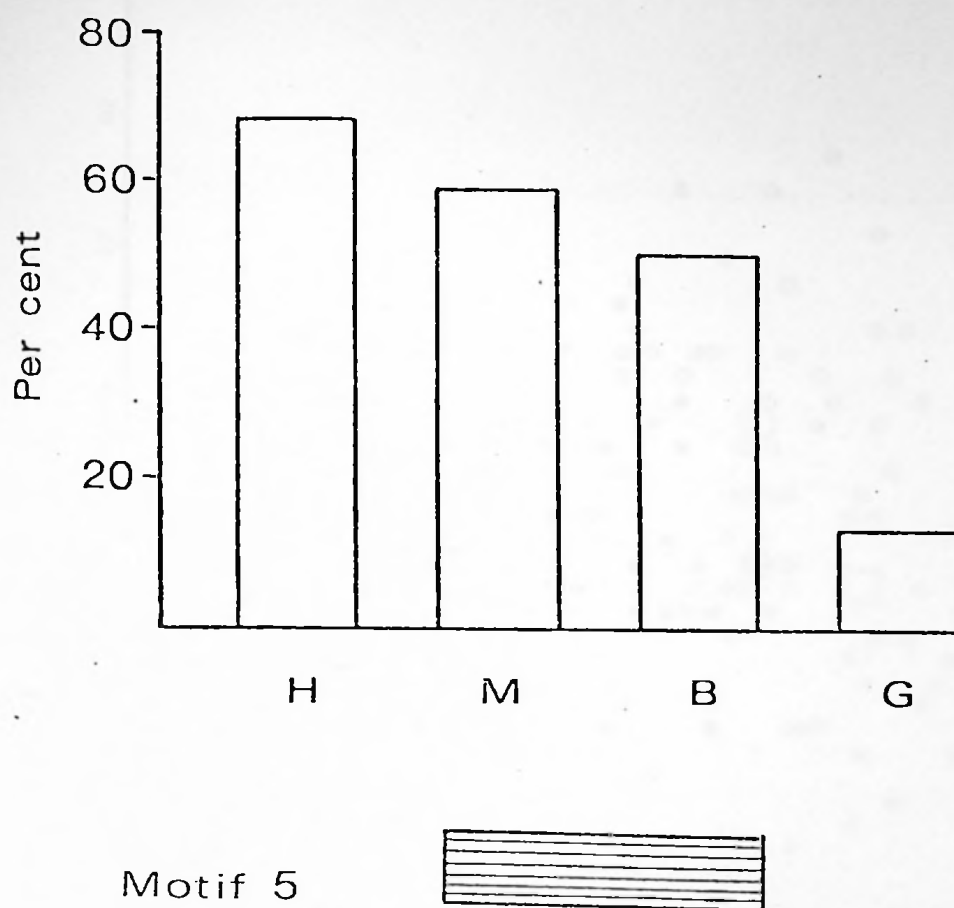


Figure 21 The percentage of the decorated Bell Beakers in each area possessing Motif 5. H = Hungary, M = Moravia, B = Bohemia, G = Germany.



Figure 1. The percentage of the population in the lowest 10% of income for four groups. Group 1 is the control group, Group 2 is the group with the lowest income, Group 3 is the group with the second lowest income, and Group 4 is the group with the third lowest income.

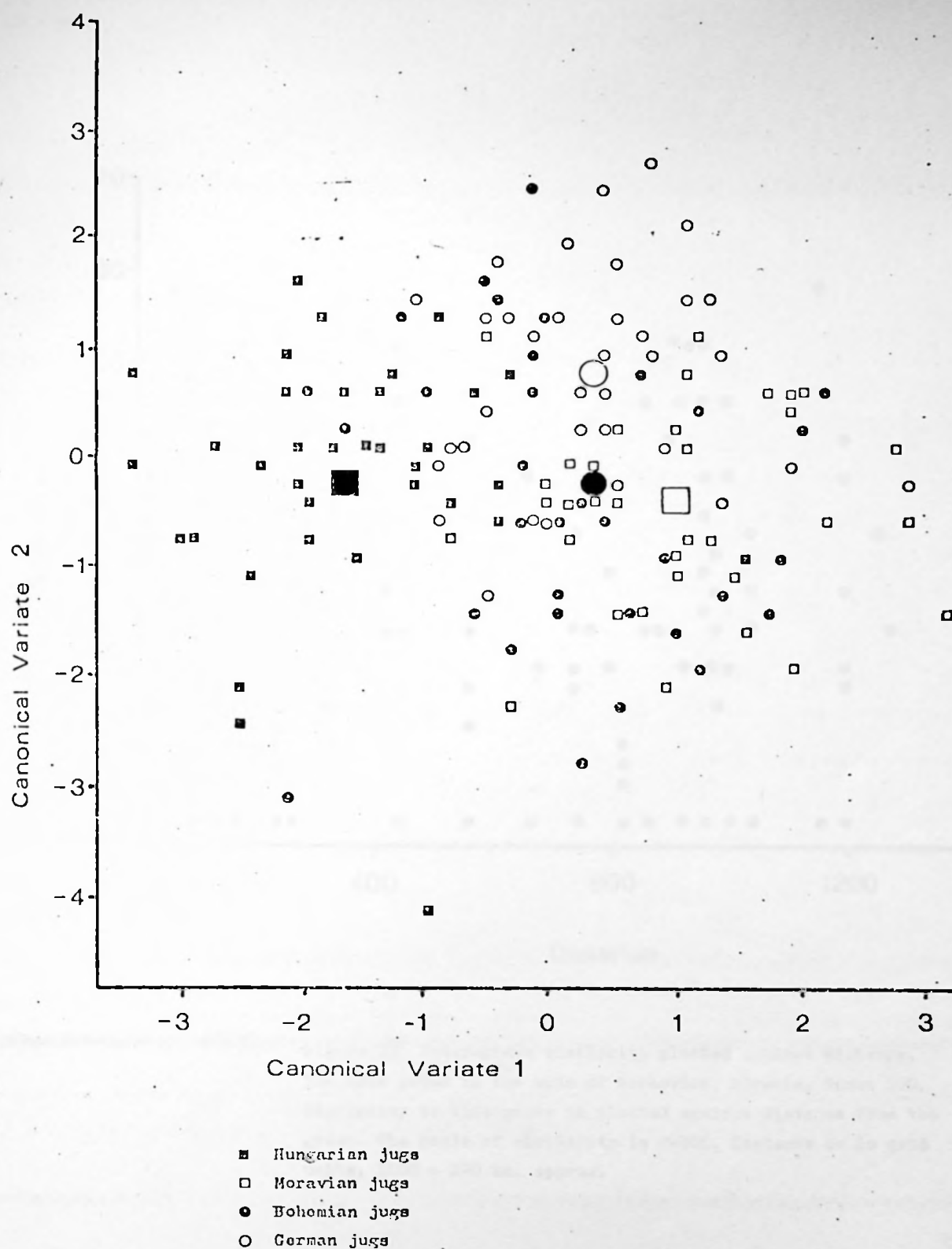


Figure 22 Scattergram of the undecorated jugs positioned in relation to the first and second canonical variates. The large symbols represent the means of their respective groups.



Figure 12. Position of the instrument for  
positioning is related to the flow and current  
velocity. The large velocity measured  
the mean of the velocity.

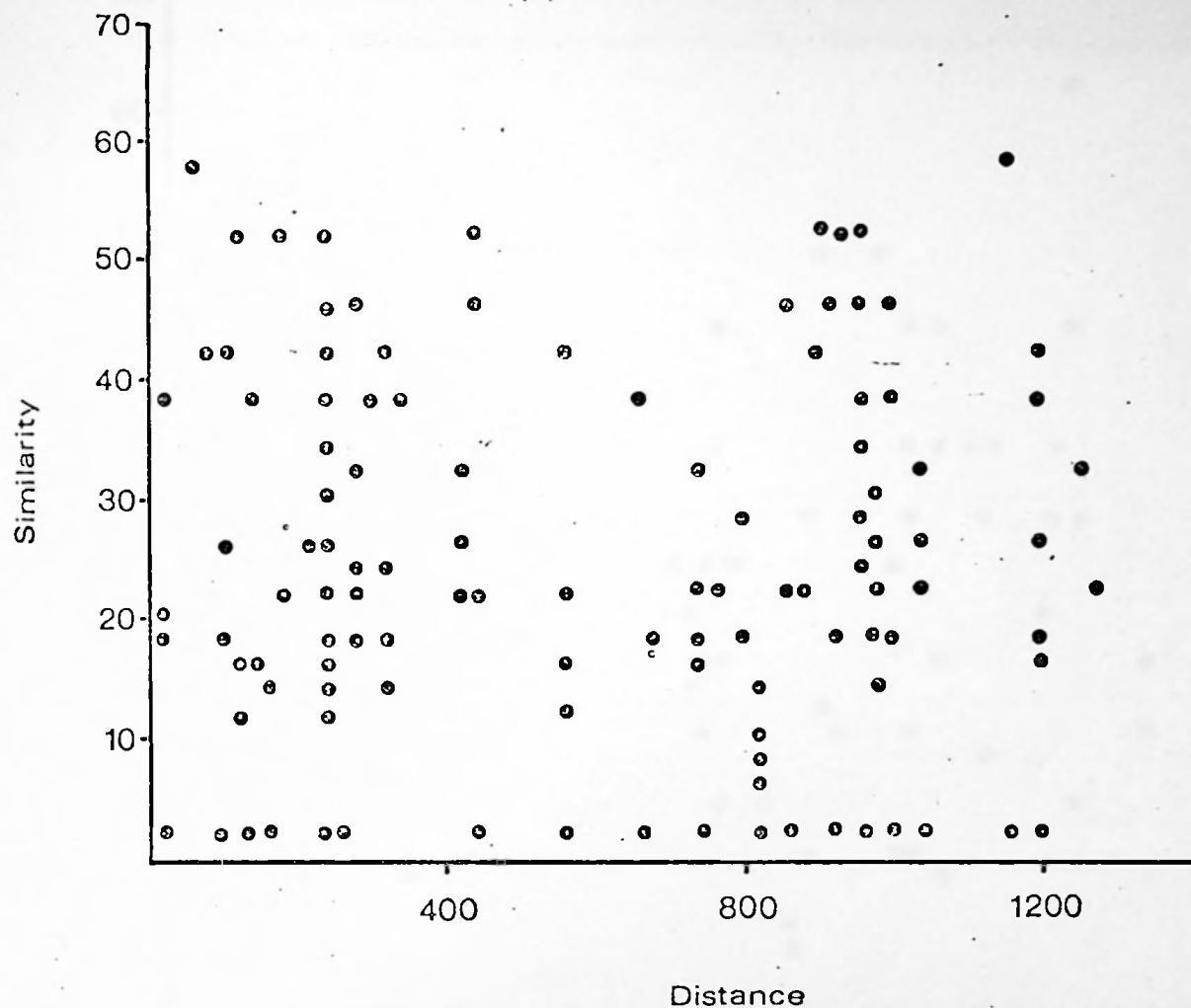


Figure 23 Inter-grave similarity plotted against distance. The base point is the site of Lechovice, Moravia, Grave 200. Similarity to this grave is plotted against distance from the grave. The scale of similarity is 0-100. Distance is in grid units, 1000 = 200 km. approx.



There is a significant positive correlation between distance and frequency. The data points are scattered, but the overall trend is clear. The frequency of occurrence increases as the distance from the source increases. This is evident from the cluster of points at higher distances and frequencies.

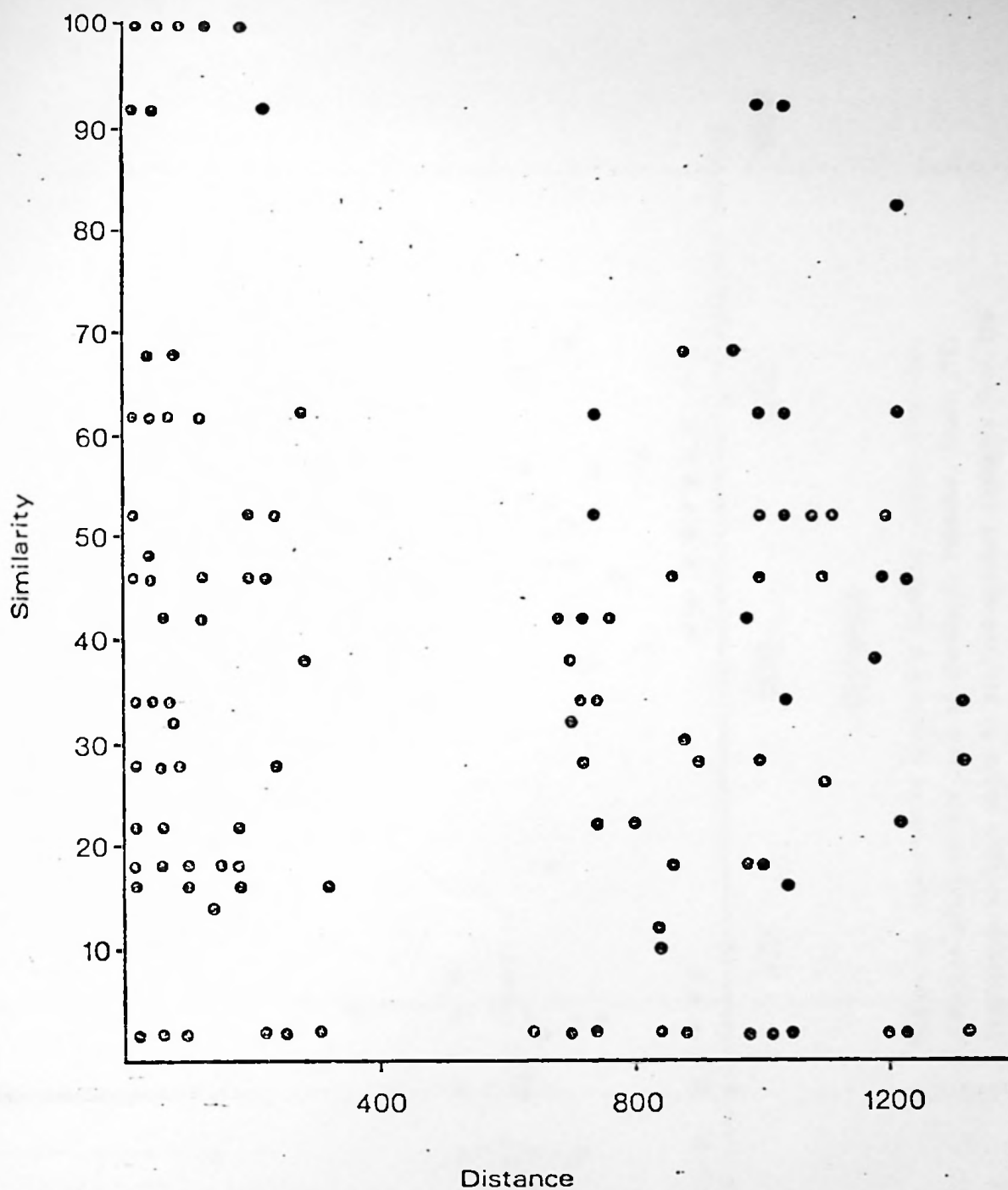


Figure 24 Inter-grave similarity plotted against distance. The base point is the site of Šlapanice, Moravia, Grave 160. Similarity to this grave is plotted against distance from the grave. The scale of similarity is 0-100. Distance is in grid units, 1000 = 200 km. approx.



Figure 1. The relationship between the number of species and the number of individuals in a community. The data are from a study of the number of species and the number of individuals in a community. The data are from a study of the number of species and the number of individuals in a community. The data are from a study of the number of species and the number of individuals in a community.

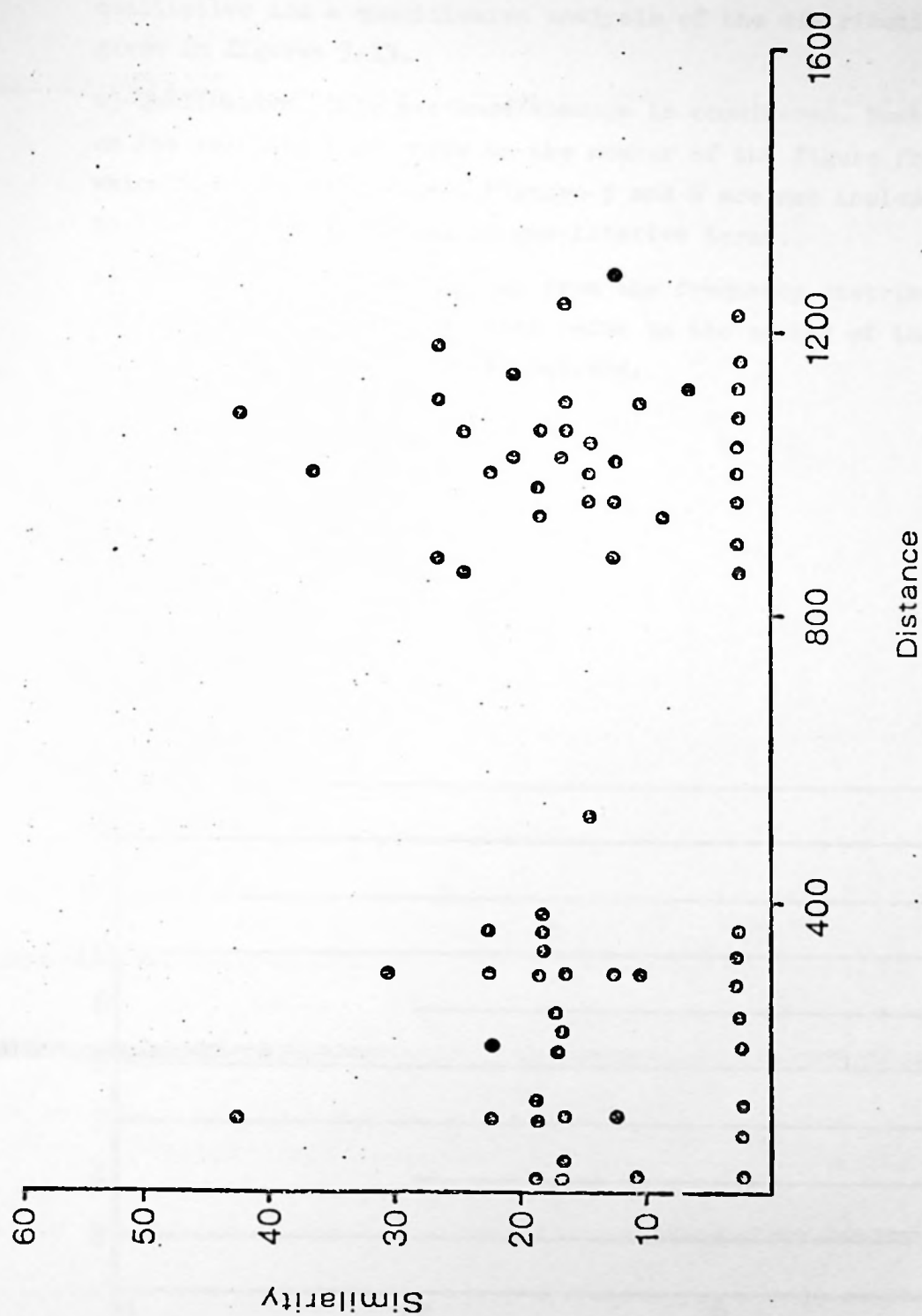


Figure 25 Inter-grave similarity plotted against distance. The base point is the site of Lysolaje, Bohemia, Grave 313. Similarity to this grave is plotted against distance from the grave. The scale of similarity is 0-100. Distance is in grid units, 1000 = 200 km. approx.

1954 July - 100 per cent

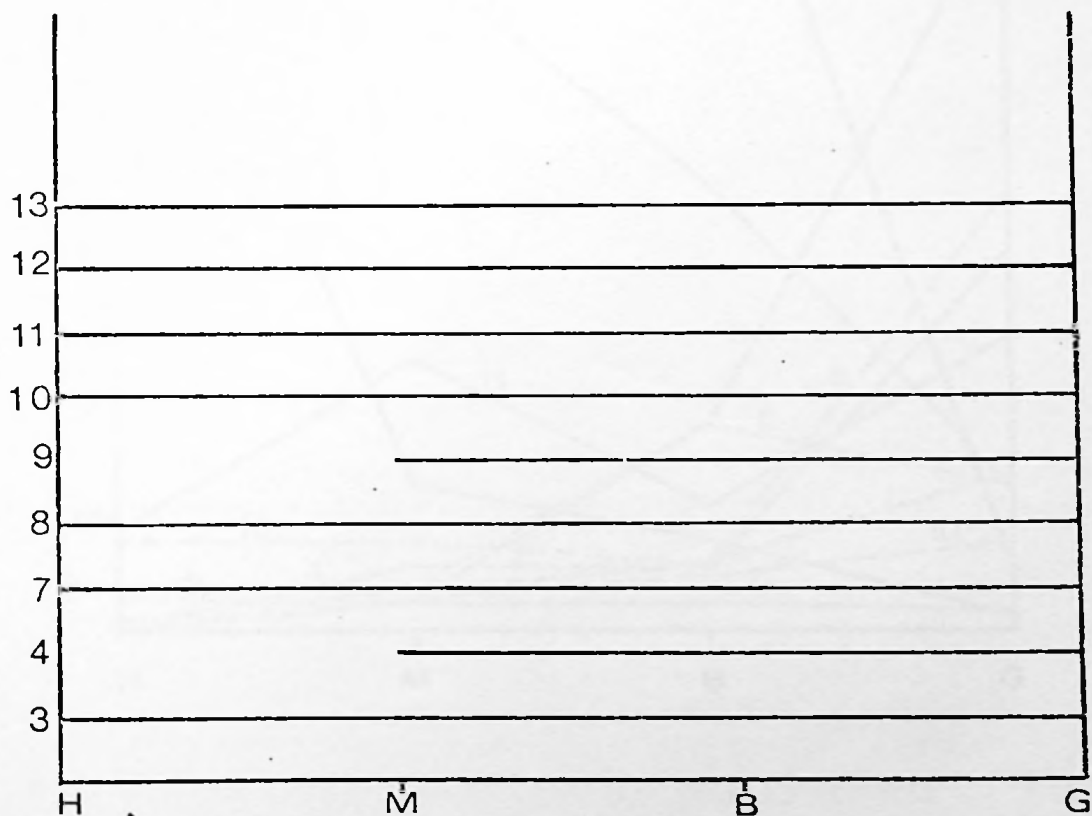
1. 100 per cent of the total number of birds  
2. 100 per cent of the total number of birds  
3. 100 per cent of the total number of birds  
4. 100 per cent of the total number of birds  
5. 100 per cent of the total number of birds  
6. 100 per cent of the total number of birds  
7. 100 per cent of the total number of birds  
8. 100 per cent of the total number of birds  
9. 100 per cent of the total number of birds  
10. 100 per cent of the total number of birds



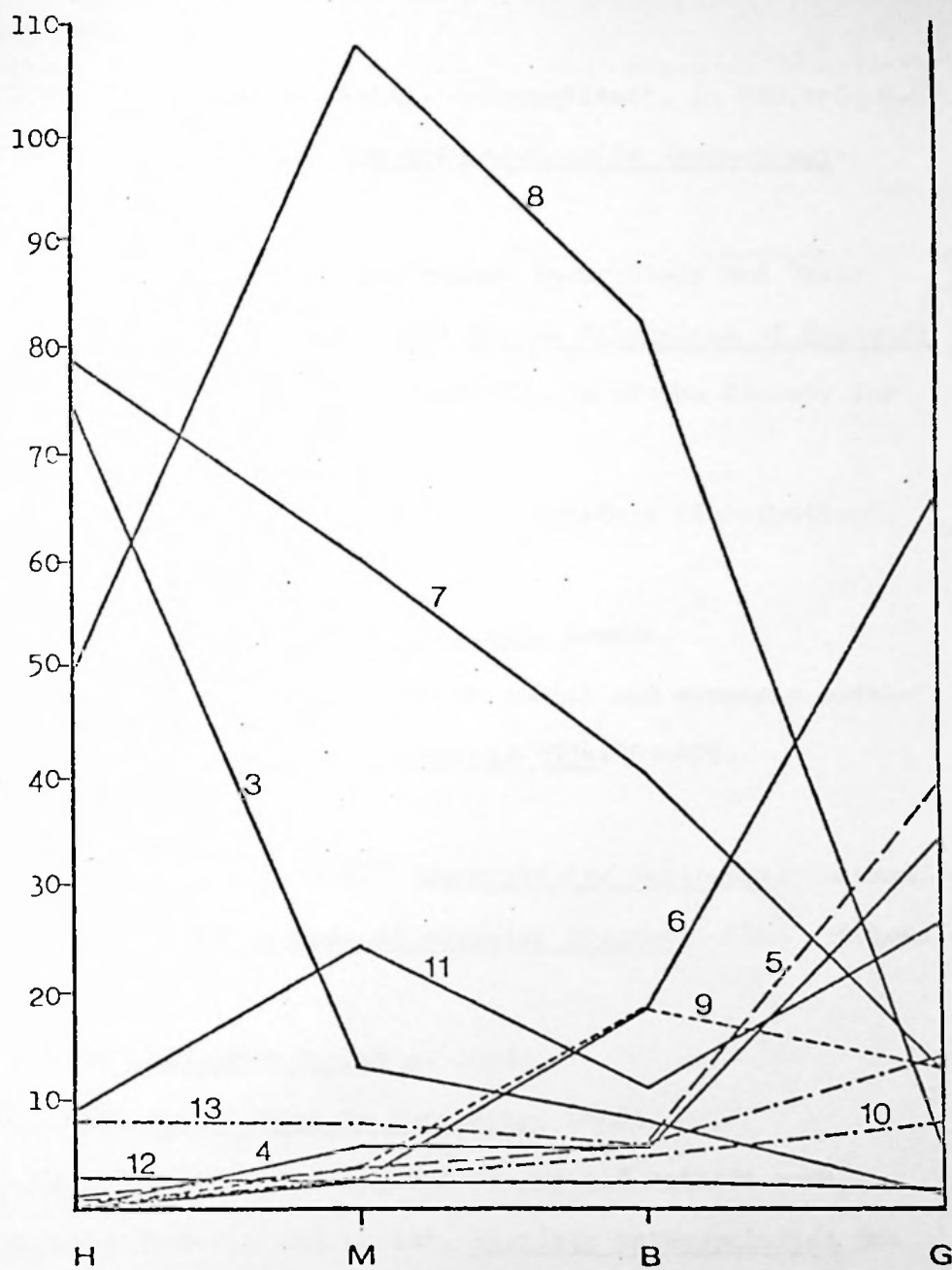
Figure 26 Diagram of the differences in results between a qualitative and a quantitative analysis of the distributions given in figures 3-13.

a) Qualitative. Only presence/absence is considered. Numbers on the vertical axis refer to the number of the figure from which the line is derived. Figures 5 and 6 are not included as they only have meaning in quantitative terms.

b) Quantitative. Lines derived from the frequency distributions in figs. 3-13. Numbers of lines refer to the number of the figure from which the line is derived.







b



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**BELL BEAKERS AND THEIR CONTEXT IN CENTRAL  
EUROPE**

**S.J. Shennan**

Reprint from: GLOCKENBECHERSYMPOSION OBERRIED 1974



## BELL BEAKERS AND THEIR CONTEXT IN CENTRAL EUROPE

S. J. Shennan

The main object of this paper is to try and show that the way in which the Bell Beaker culture has been studied in the past is no longer satisfactory, and represents at least one of the reasons why so little progress has been made since Castillo's synthesis in 1928 (cf. Neustupný 1971). This lack of progress alone would suggest that some change is necessary, preferably more than merely suggesting different areas of origin, but there are also two other reasons for a reconsideration: first, the accumulating evidence concerning Bell Beaker settlements, and second the new theoretical approach, initially derived from American archaeology, which has shown both the naivety of the culture-people hypothesis, and, more generally, the enormous amount of structured complexity existing in the archaeological record (cf. Binford 1972).

The settlement evidence comes from most parts of the Bell Beaker distribution. Its most significant feature, for present purposes, is how widely it varies from area to area. Although this has been commented on by other authors (e.g. Schüle 1969, p. 88), its importance has not been generally appreciated. There is very little resemblance, for instance, between the contents of the East Anglian settlement sites in England, such as Fifty Farm or Chippenham (Leaf 1935, 1940), and the material from the settlements excavated by Schreiber in the environs of Budapest, Hungary (Schreiber 1967, 1973a, 1973b). In terms of pottery, it is only Bell Beakers which to two areas have in common and while these are numerically significant in England, in Hungary they are represented only by a few sherds in pits mostly full of pottery of the so-called proto-Nagyrév culture (Schreiber 1967, 1973a, 1973b). A further point to note is that these local wares, such as the proto-Nagyrév pottery, are often merely an intermediate stage in an ongoing local tradition, in this case from the Makó group to the Nagyrév culture (Schreiber 1972). A similar

situation is seen in Jutland, where Beakers appear as a minority element in the Upper Grave phase of the Single Grave culture at the settlement of Myrhøj (Jensen 1973). At Cerro de la Virgen in Spain Bell Beakers are found in small numbers (never more than 10%) in the context of a local pottery typological development from Neolithic to Bronze Age (Schüle 1969). The main area which may be an exception to this pattern of a minority Beaker presence is Britain and the Lower Rhine, where there is some evidence of a true Beaker domestic assemblage: a possible point in favour of Van der Waals and Lanting's beliefs about Bell Beaker origins (Lanting, Mook and Van der Waals 1973).

To some extent these regional differences are also apparent in the grave goods. The contents of the graves, however, are obviously a result of social conventions concerning what are, and what are not, appropriate goods in particular circumstances (Binford 1971), thus it is only the settlements which provide evidence of the complete range of domestic pottery.

If one looks at the Bell Beaker distribution area as a whole then, on the basis of the settlement evidence, the one common link is the Bell Beaker vessel itself, in different regional forms. The grave material extends this inventory of widespread objects to include wrist-guards, tanged copper daggers, V-perforated buttons and arrowheads, together with some copper trinkets, all of which are very rare in settlement contexts.

From this discussion (which will be continued below in relation to Bohemia and Moravia), the main conclusion to be drawn is that the Bell Beaker "culture" is not a discrete entity with a sort of "objective existence" of its own, which is how prehistoric cultures tend to be regarded, albeit implicitly. It is a restricted set of artifacts found in a variety of local contexts; moreover it is restricted

in an interesting way. The wide-ranging objects are not subsistence-producing tools, or a basic assemblage of domestic pottery. They are a single ceramic type (with the subsidiary presence of polypod bowls) which, in East-Central Europe at least, is only found as a fine ware, together with a number of other objects which are almost never found in settlements and are rare even in graves, but which, by their nature and context are most likely to be connected with the social persona of the deceased: note, for example, the care devoted to the fine stone wrist-guards which would have been perfectly functional in wood or leather. It is worth pointing out, too, that, while one intuitively accepts the reality of a Bell Beaker complex, certain of the artifacts are much more widely found. The tanged triangular copper dagger is a frequent occurrence in the graves of the south Russian Catacomb Grave culture (Cernych 1966, 129, fig. 36), which has radiocarbon dates very similar to the Bell Beakers. V-perforated buttons are also a widespread type, both in space at time (Hájek 1957).

The variety of the local contexts has already been briefly described and is worth emphasising. The first stage of research was, of necessity, the recognition that the distribution of Bell Beakers constituted a unity which needed explaining; now, in attempting to explain it, the differences need to be considered as much as the similarities: the fact that there are Bell Beakers in virtually all the Beaker culture graves in Britain, but in only a small proportion of those in East-Central Europe is clearly not accidental – it is a difference which must be explained. These differences suggest the further possibility that it may be misleading to think in terms of a single explanation valid for all the Beaker groups of Europe, as has always been assumed. Progress, if there is to be any, is more likely to come through the informed study of local situations, in order to define the nature of the Bell Beaker presence in each area.

It will readily be seen that these views are not consonant with ideas of wandering warrior pastoralists of metal prospectors, which I believe to be unsatisfactory anyway, for several reasons. First, the belief in a one to one correlation between a restricted material inventory and burial custom and a particular economy is naive a priori and

stems from a view of economy as dependent on culture rather than on such things as environment and population; it is especially naive in this case since the Bell Beaker area is ecologically enormously diverse, stretching as it does from North Africa to northern Scotland and Hungary. Furthermore, at least in large parts of Britain and East-Central Europe, the occupation by the Bell Beaker "culture" continues to be concentrated in the same fertile arable areas as were occupied throughout the Neolithic by cultures whose mixed farming economy is confirmed on other grounds. If the same constraints were not operating this would surely not be the case. As far as metal prospecting is concerned, the evidence is equally negative, or at least the "Beaker people" were remarkably unsuccessful in Central Europe, as the quantities of metal found in Beaker contexts are very small.

To some extent such "catastrophist" explanations were a product of the necessity to squeeze a large amount of material into what was believed to be a very short span of time. This had already been lengthened by conventional radiocarbon dating and now recalibration has changed the picture even more drastically, so that it is no longer necessary to see in the late Neolithic a sudden quickening in the pace of cultural evolution. The great majority of Bell Beaker dates cluster between 2200 and 1700 b.c. Even on a conservative recalibration (e.g. Switsur 1973) this becomes 2700-2000 B.C. If one uses Suess's curve the period may expand even more, c. 2950-2100 B.C. This makes the spread of Bell Beakers and their disappearance seem a much slower process, and suggests that new explanations may be required to cope with the greatly increased scale of the phenomenon. Another side-effect, perhaps not so often considered, is that the longer time span makes the sample we have to work with still more sparse in relation to the once existing totality, since it has to be spread that much further.

I must now turn to a more detailed treatment of the Central European material, which has long been recognised as distinctive because of the presence of undecorated jugs and conical thickened rim bowls in the graves; these link up an area consisting of the Upper Rhine, Bohemia, Moravia, Hungary etc. (Kraft 1947, Sangmeister 1964) and

distinguish it from groups to the north and west, as Neustupný has also noted (1972). There is not a great deal of settlement evidence from this region, but what there is confirms its individuality. The Hungarian sites have already been mentioned and are well described by Schreiber (1973a) so I will restrict myself to a short description of those from Czechoslovakia, specifically Moravia (shortly to be published in detail by Ondráček).

These settlement traces consist almost solely of pits, isolated or at most in small groups. Characteristic are sites such as Klobouky, Brno-Obřany or Střelice "Klobouček". Some of these finds are reported as containing virtually no other pottery than sherds of decorated Bell Beakers, for example Mořice, Náklo or Koberžice. The reports on these finds, however, are invariably inadequate, and the very fact that they consist only of fine pottery sherds (beakers are never coarse vessels), generally few in number, suggests that such finds are more likely to represent destroyed graves than settlement debris. Virtually all the pits which have yielded large amounts of material contained a few decorated beaker sherds together with sherds of jugs, expanded rim bowls and numerous coarser vessels of a local type e.g. Těšetice (Kalousek 1956), Želešice, Klobouky, Dolní Sukolom and others, including Brno-Obřany which had only one comb decorated sherd. Thus the picture we see in Moravia is very similar to that already known from the Hungarian settlements – a "mixed culture" with Bell Beakers very much in a minority. That the situation may be rather more complicated here is hinted by the finds from a pit at Rajhrad (S. Moravia) which contained no decorated beaker sherds among its extensive inventory of jugs, bowls and coarse vessels, but this remains an isolated instance (see below).

The Moravian settlement evidence then supports the view that the presence of Bell Beakers merely represents the appearance of a restricted set of artifacts in a Central European milieu. These sites, however, possess an additional importance as an indication of Bell Beaker chronology in this area. The two main schemes advanced are those of Sangmeister (1964) and Hájek (1966). The latter has received far more support among Central European archaeologists. It discerns three phases: an early one in which only Bell Beakers are

present; a middle phase consisting of an overlap between Bell Beakers and the appearance of the so-called Begleitkeramik, and a final stage with the Begleitkeramik alone. Sangmeister, on the other hand, argued that the jugs and bowls were present from the beginning of the Beaker development, on the basis of typological connections with the Baden culture. Radiocarbon dating has now shown that the Baden culture is considerably earlier than Bell Beakers, but the evidence that Sangmeister's idea was preferable on other grounds is now increasing.

First of all, as Schreiber has said (1973b), it is difficult to imagine a phase represented by a single pottery type and the associated wrist-guards, daggers etc. This intuition is supported by the Budapest settlements where, as we have seen, Bell Beaker sherds are consistently found in small numbers in pits full of proto-Nagyrév pottery of the Bell Beaker-Csepel group. There are no known pits containing only, or even mostly, Bell Beakers. It might be argued that evidence from Hungary need not necessarily be relevant to Bohemia and Moravia; however, the settlements from Moravia already discussed show that here too the picture is the same. This evidence does not support the idea that there was an early phase consisting solely of Bell Beakers.

The grave associations (together with typology) on which Hájek's arguments were based, such as Praha-Bubeneč or Předmostí, are open to other interpretations. Lack or presence of association between artifacts in graves may well be a result of social constraints rather than chronology, particularly when all the indications from the settlements suggest that chronology is not the reason in this case. Indeed, it is worth noting that a good number of the graves designated as the earliest are also the richest, like those just mentioned. It is quite possible that these graves belong to high status individuals, and for social reasons contained special equipment that did not include Begleitkeramik jugs and bowls. We have already seen that the very nature of the complex of widespread Bell Beaker artifacts points to their having some social significance.

In Hungary the Bell Beaker-Csepel group was succeeded by the Nagyrév culture, pottery of which is never associated with Bell Beakers. The typological changes in the various forms of cups,

jugs, bowls etc. which resulted in the formation of the Nagyrév assemblage seem to have been "archaeologically simultaneous" with the disappearance of Bell Beakers in this area. The situation in Bohemia and Moravia is less clear. The pottery of the early Únětice culture, which follows the Bell Beaker phase here, is clearly a typological transform of the Bell Beaker Begleitkeramik assemblage without Bell Beakers. What is not at present certain is whether the Bell Beakers disappeared at the same time as these typological changes, or before. If the latter is the case there would indeed be a final phase represented by the Begleitkeramik alone. The pit at Rajhrad already mentioned may perhaps be taken as evidence of this.

Since Bell Beakers are such a minority presence in both the settlements and the burials of this period in eastern Central Europe, it is obviously necessary to turn our attention to the context in which they are found. The Hungarian chronology is now well established (Kalicz 1968, Schreiber 1972, 1973b), but further north-west chronological relations remain contentious (Pleslová 1968, 185-190; Neustupný 1972), particularly as regards the connections between the Corded Ware and Bell Beaker assemblages which, taken as a whole, are distinct in material culture and in burial orientation.

There are two diametrically opposed views concerning the relations between these two assemblages. According to the first, which has the larger following (e.g. Pleslová 1968, 185-190; Buchvaldek 1967, 119), they are essentially contemporary; according to the second they are chronologically successive (e.g. Neustupný 1972). Failure to decide this problem one way or another has meant that the late Eneolithic in Czechoslovakia has no satisfactory time framework and has resulted in numerous inconclusive discussions on the part of those who hold the first view concerning the relations between various "invading tribes" (e.g. Pleslová 1968, 185-190). In Bohemia itself, the main focus of this discussion, the evidence is too slight and ambiguous to come to any decision. If one takes into account the situation elsewhere, however, I believe it is possible to arrive at a firm conclusion consistent with all the available evidence.

Holland, strongly suggest that there is an overlap between early Bell Beakers and late Corded Ware in that area (Lanting, Mook and Van der Waals 1973). This compares well with the evidence from Jutland of a Bell Beaker presence here in the Upper Grave phase of the Single Grave culture (Jensen 1973). What would be the implications of such a situation in Bohemia?

On the whole, as we have mentioned, the Bell Beaker and Corded Ware assemblages are very different, despite the fact that they occupy identical areas and that graves are sometimes found on the same site, e.g. Brandýsek, Bohemia (Kytlicová 1960); this in itself may be taken as an argument against general contemporaneity. Buchvaldek (1967, 89-90) has proposed a three phase sequence for the Corded Ware in Bohemia which is widely accepted, and which I intend to use here. In his final Corded Ware phase, corded beakers and decorated amphorae are no longer so important and the ceramic range is considerably extended by various jugs, bowls and "Töpfe". These bear a strong resemblance to certain forms of the Bell Beaker Begleitkeramik and are considered by Buchvaldek to represent "influences" from the Carpathian Basin. This similarity between the late Corded Ware pottery and the Bell Beaker Begleitkeramik is well known and, since the Begleitkeramik was regarded as late, it was natural to consider the "earlier" (sic) Bell Beaker phases as contemporary with the greater part of the Corded Ware. This is not borne out by the Dutch C14 dates, however, nor by the Danish evidence which point to an overlap and no more. Moreover, it has already been shown on other grounds that the Begleitkeramik is not to be considered a late development in the Bell Beaker culture of East-Central Europe, and is, in fact, present from the start. Thus it is possible to trace a local typological development in Bohemia and Moravia from the late Corded Ware assemblage through to the so-called Begleitkeramik which, after all, makes up by far the greater part of the Bell Beaker culture in these areas (see Tables I and II).

TABLE I.

*Bell Beaker Culture Pottery in Bohemia (excluding settlements)*

Decorated Bell Beakers (including those with handles)	11 <sup>0</sup> / <sub>0</sub>
Undecorated jugs	42 <sup>0</sup> / <sub>0</sub>
Undecorated bowls	23 <sup>0</sup> / <sub>0</sub>
Others	24 <sup>0</sup> / <sub>0</sub>
Total number of vessels	1647

This view to some extent combines the arguments in favour of a complete "nacheinander" position (e.g. Neustupný 1972) with such counterarguments as the association of a Bell Beaker with a Corded Ware belt-plate at Sulejovice, Bohemia (Hájek 1968, 119-120). It is further reinforced by the find of a convex 4-hole wrist-guard together with a cup of the Chlopice-Veselá group (a late phase of the Corded Ware) at Świącice in Little Poland (Prokopowicz 1964).

This scheme provides a framework in which to place the changes that occurred in the late Eneolithic; it also gives some indication of what it is we have to explain. For on this view, the development of the Begleitkeramik in East-Central Europe is no different from any of the regional transformations of ceramic style which went on throughout prehistory. We do not at present have a great deal of evidence to tell us if this was merely a fashion change, or if it related to any developments in the socioeconomic subsystems. The spread of the so-called Bell Beaker "package", however, does not fit into this general class – the scheme outlined says nothing specific about the origins of Bell Beakers themselves, except, by implication, that these do not lie in East-Central Europe; or about why the distribution of the Bell Beaker complex happened as it did, although here again it excludes certain possibilities, as we have seen.

But the appearance of the Begleitkeramik does have a certain significance of its own: in terms of ceramic similarity it marks a period of renewed

TABLE II.

*Bell Beaker Culture Pottery in Moravia (graves only)*

Decorated Bell Beakers (including those with handles)	17 <sup>0</sup> / <sub>0</sub>
Undecorated jugs	41 <sup>0</sup> / <sub>0</sub>
Undecorated bowls	21 <sup>0</sup> / <sub>0</sub>
Others	21 <sup>0</sup> / <sub>0</sub>
Total number of vessels	2132

connection with the Carpathian Basin. Areas near the boundaries of cultural regions tend to fluctuate in their "cultural allegiance", a process known as "unit reorientation" (Sherratt 1972, 480).

Bohemia and Moravia are between the Carpathian Basin and North European Plain "culture areas" and this process is clearly visible here in the Eneolithic.

Period	Culture	Orientation
Early Eneolithic	TRB/ Jevišovice C2	north-west
Middle Eneolithic	Channelled Ware/ Rivnáč/ Jevišovice C1/B	south-east
Late Eneolithic	Corded Ware	north-west

In the following phase, the Bell Beakers themselves keep up this north-western orientation but the greater part of the assemblage switches to the south-east, starting at the end of the Corded Ware.

This does not mean that we should now start looking for new invasions from the south-east. The changes may merely reflect, for instance, the spread of new eating habits involving the use of the jugs/cups and bowls which characterise the Begleitkeramik and continue throughout the Úně-

tice culture. This equipment has a continuous history going back to the Baden culture in the Carpathian Basin. Looked at in terms of function, the Bell Beakers, given that they were drinking vessels, make a rather striking contrast with the small jugs and show more of an affinity to the Corded Ware beakers. In fact, it is plausible to see both forms originating in an area where the ceramic handle had not yet arrived.

It is unsatisfactory, however, to consider pottery in a disembodied fashion if we are attempting to explain processes rather than just constructing chronologies, as this is likely to lead to naive conclusions. Pottery serves a purpose and the amount and types produced will be a function of demand as well as many other factors (cf. David and Hennig 1972). Production is conventionally considered to have been organised solely on a household basis at this time, while the detailed types produced are believed to have been ethnically, or at least tribally, determined, owing to a number of implicit assumptions. These are the domestic mode of production already mentioned; the belief that ceramic style preferences are a function of tribal affiliation; and the idea that the tribe is the communicating group for pottery manufacture and distribution. The truth of these assumptions has never been investigated, except for the first (household organisation of production), which is more readily susceptible to empirical testing and which in fact may well not be valid. Peacock's work on early Neolithic pottery from south-west England (1969) has shown that pottery was exchanged over considerable distances as early as 3000 b.c. It must be remembered, too, that exchange of other commodities was widespread in the Central European Eneolithic, from flint and other hard stone to amber and copper (cf. Sherratt, forthcoming). Then there is the hoard of about 40 almost identical small jugs and beakers from Křečhoř, Bohemia (Jelínková 1959), ascribed to the proto-Únětice culture, which may well, as Jelínková says (1959, 20) represent manufacture for exchange. The obvious test, of course, is some sort of petrographic analysis of Bell Beaker and Begleitkeramik fabrics and this is now being carried out on a limited scale (work in progress, SJS), although it needs to be greatly expanded.

The regional differences which exist among the Bell Beakers themselves suggest at least that there was no single centre of Bell Beaker manufacture even though individual vessels may have been exchanged between regions, e.g. the Bell Beaker of Moravian type from Harskamp, Netherlands (Butler & Van der Waals 1966). Within particular regions the position is less clear: both Bell Beakers and Begleitkeramik are often very similar from site to site. Sometimes, on the other hand, vessels from the same site are more or less identical (for example a series of decorated jugs from Šlapanice, Moravia), but they could as easily be part of a single batch from some sort of specialist as products of the same local household.

While on the subject of pottery production, an important question which needs to be asked is why Bell Beakers are so few in eastern Central Europe compared with the other contemporary pottery. This is the case in settlement pits as well as in graves so it cannot just be ascribed to preferences in the funerary offerings. It is tempting to relate it to different rates of manufacture as a result of differences in demand. This is not simply a question of smaller quantities of fine ware relative to coarse ware, which would not be surprising, since the bowls and small jugs too are of good quality. It seems possible to account for it by arguing that the jugs and bowls continued in use longer, but here again the settlements provide a counterargument. For, as we have seen, Beakers are not just a small proportion of the total, they are also a minority in particular settlement pits. Effects like the differential life-span of different pottery types noted by David (1972) may well be operating, but, whatever the original proportions, we will know the reasons for them only when we understand why a Bell Beaker was made (or used) rather than a jug on any given occasion.

One thing at least, I believe, becomes abundantly clear from what I have said, and that is the complexity of the Bell Beaker problem. To achieve an understanding of this it is necessary to separate out the various strands. So far I have mainly dealt with pottery, and it has been shown that the simplifying assumption of domestic pottery production can at present only be considered as unproven. I mentioned two other assumptions behind the

view that pottery style correlates with tribe: the idea that ceramic style preference is related to tribe membership and that the communicating group for the manufacture and distribution of pottery is defined by tribal boundaries; both of these may be true in particular circumstances, but they need to be investigated in ethnographic contexts and should not be assumed to be true in pre-history. They belong to the more general question of the relations between material cultural and social entities: the same material symbols, for instance may be used in different social expressions. Thus the cemeteries of Branč and Vyčapy-Opatovec in south-west Slovakia are both recognised as belonging to the early Bronze Age Nitra group on the basis of their material culture, but in the former beads are found with both sexes, while in the latter they are only with women (S.E. Shennan, pers. comm.), indicating a clear difference in funerary behaviour, and possibly in life as well. The material culture group should not be, considered more significant just because it is more obvious to us.

Hymes (1968) has shown in linguistics that for different purposes there are different communicating groups, each with their own code, and that monolithic language blocks are a myth. Other cultural behaviour too may be regarded as a kind of language (cf. Lévi-Strauss 1963). In the Bell Beaker case, type of burial, orientation, typological variations in particular ceramic types, quantities of different types of pottery and other objects, in graves and in settlements, are all complex phenomena with many determinants (cf. Binford 1971), involving different kinds of communication uniting different groups. Bohemian Bell Beakers, for example, are quite similar to Hungarian ones and are likewise few in number relative to the total amount of pottery. On the other hand, cremation is very rare in Bohemia, while it is virtually universal in Hungary, where it links up groups possessing Beakers with others which do not. Less immediately tangible factors such as social organisation represent yet another code, also complex, and, as the Nitra group example suggests, very probably not coterminous with anything else, although there will, of course, be mutual connections – indeed, obtaining information about prehistoric society would be impossible without them. Other

aspects of the Bell Beaker problem, such as the physical anthropology and the local subsistence base, are different again. All these things certainly cannot be considered additive culture traits forming a unitary Bell Beaker culture, as they have been in the past. Behind this lies a simplistic model of human behaviour: as Binford has vividly commented, people do not just “spew out” their culture.

The new interpretations suggested above make a beginning in analysing some of this complexity, and they point to a very different picture of the meaning of the Bell Beaker culture from those usually given. Work is currently in progress to investigate thoroughly the reasons for Bell Beaker culture variability in East-Central Europe, including the extent to which variability in different spheres of activity is differentially determined, and particularly the possibility that differences in grave contents were at least partly a result of social factors in any given region (cf. Neustupný 1973). But this is not merely of regional importance, since, if it were shown that the widespread Bell Beaker artifacts were only fashionable or symbolic objects which not everyone was allowed to use, it would have considerable implications for the meaning of the Bell Beaker “culture”. In fact, the ultimate aim must be the explanation of the structure of the Bell Beaker assemblage, and of its distribution in time and space. The traditional approach, insofar as it thought about these questions, believed the answers were obvious, because of its *a priori* assumption that culture = people and that internal variation is significant; the only problem to solve was where the objects originated. This can now be seen to be of minor significance.

Binford (1968) has outlined two stages in the process of explaining the prehistoric past. The first of these is understanding the significance of archaeological remains for past conditions, the second is explaining those conditions. The former is peculiarly the problem of the archaeologist, but the latter is not specifically archaeological and must be resolved in terms of what we know about the functioning of human economies and societies. As yet we know almost nothing of the economies and societies connected with the distribution of the Bell Beaker assemblage so we are hardly in a position to take this second step. On the other

hand, the description already given of the Beaker "package" and its local Central European context points to a model which may take us at least some of the way on the first stage. This is the "interaction sphere", which has different properties from a culture:

"It denotes a situation in which there is a regular cultural means of institutionalising and maintaining intersocietal interaction and is reflected in items that are widely exchanged and which occur in a context of social distinctiveness... These interaction spheres may cross-cut both traditions and culture areas while the sharing of symbols and the appearance of similar institutions are less a function of the traditional enculturative milieu of individual societies than of complex articulation of societies of different ethnic backgrounds, levels of cultural complexity, and social types (Binford 1965, 208)."

This concept introduces a new type of entity which has not really been considered in European prehistory although it is well known in America, where the Hopewell "culture" is an example. It is not claimed as a panacea for all problems connected with the Bell Beaker "culture". It is put forward as a hypothesis which significantly widens the range of suggestions as the meaning of the Beaker distribution and does not have the disadvantages of earlier views, which have taken only a very limited number of possibilities into account. The "interaction sphere" is much more flexible. It accommodates the enormous differences in regional assemblages already outlined and anticipates the social character of the widespread Bell Beaker artifacts which has been emphasised. Exchange of rare material is another characteristic feature that fits in with what is known about the presence of copper and gold in Beaker contexts. Moreover, the Bell Beaker distribution transcends culture area boundaries in an unusual way – a feature which also corresponds with an "interaction sphere" situation, as defined above.

Needless to say, this model does not acquire any great validity on the basis of such a short sketch; it remains as yet merely plausible. The next task, which I have now begun, is working out the consequences of the model and relating these in detail to the Central European evidence discussed earlier in this paper. Even if the specific hypothesis pro-

posed here proves unsatisfactory, I believe that a new research orientation is required if further advance is to be made.

Acknowledgements: I would like to thank the Archaeological Institute at Brno, and particularly Dr. J. Ondráček, for permission to study their invaluable archives, and for many kindnesses received during my stay. I am also most grateful to Prof. J. Neustupný and Dr. I. Hásek of the National Museum, Prague, and to the Director and staff of the Moravian Museum, Brno, who were most generous with their assistance. Finally I wish to express my gratitude to Dr. E. Neustupný, who, after being informed without warning that he was to be my supervisor in Prague, gave up enormous amounts of his time and helped to solve all sorts of problems.

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STEVE J. SHENNAN

## DIE SOZIALE BEDEUTUNG DER GLOCKENBECHER IN MITTELEUROPA

In diesem Vortrag bediene ich mich, eines in nordamerikanischer Archäologie entwickelten Begriffs, auf Grund einer nochmaligen Überprüfung des Charakters der Glockenbecher und ihrer Verbreitung vorzunehmen, nämlich des Begriffs des Wechselwirkungskreises (Caldwell, 1962). Diesen Begriff benutzten die Amerikaner Struven und Houart (1972) anlässlich ihrer Studien der Hopewellkultur. Die Zugehörigkeit zu einem Wechselwirkungskreis hat zur Folge, dass die einzelnen, lokalen Gruppen nicht nur einen eigenen charakteristischen Satz von Geräten aufweisen, sondern auch einen kleineren, mehr eingegengten Satz von Geräten, weil sie teilnehmende Mitglieder eines ausgedehnteren Austauschsystems sind.

Inwieweit ist diese Tatsache auf die Glockenbecherkultur anwendbar? Die Bedeutung der Verbreitung der Glockenbecher über fast ganz Europa ist bis heute zweifelhaft geblieben. Mehrere Forscher meinten, die eigentlichen Träger für die Verbreitung der Glockenbecher seien Hirten, Kupferschürfer oder urgeschichtliche Zigeuner gewesen (Sangmeister, 1972), aber keine dieser Erklärungen hat sich als völlig befriedigend erwiesen. Meistens ist die Glockenbecherkultur mit einem einzigen Stamm in Übereinstimmung gebracht worden. Doch ist diese Annahme irreführend; einfach deshalb, weil es Glockenbecherscherben auf einem zusammenhängenden, aber sehr unterschiedlichen Gebiet von ungefähr 2500 mal 2500 Kilometern gibt; einem Gebiet also, das viel zu gross ist für einen einzigen Stamm. Überdies haben alle Autoren dieser Untersuchungen vermutet, dass es nur eine gültige Erklärung für alle Glockenbechergruppen Europas gibt. Das ist nicht unbedingt so. Meine Untersuchungen sind hauptsächlich den Glockenbechergruppen Mitteleuropas gewidmet.

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There is also no reason why shape should covary with decoration. This is not to deny that particular shape types can be especially appropriate for particular modes of decoration, as Clarke (1970) has shown for the British beakers.

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Es ergibt sich, dass diese Feststellungen nicht ohne weiteres auf andere Gebiete ausgedehnt werden dürfen.

Viele frühere Erklärungen der Glockenbecher haben sich, aufgrund fehlender Beweise, für entsprechende Siedlungen, für ein sehr bewegliches Glockenbechervolk entschieden. Jetzt steht fest, dass diese Beobachtung überbetont war. Simpson (1971) hat vor kurzem die Belege für Glockenbecherhäuser in England zusammengefasst. Es gibt auch viele vereinzelte Siedlungsfunde, meistens ohne die dazugehörigen Häuser, besonders in East Anglia. Verschiedene andere Siedlungen können aus fast dem gesamten Glockenbechergebiet angeführt werden, die sogenannten Kolonien und Cerro de la Virgen in Spanien; Embusco in den Pyrenäen (Guilaine, 1967, S. 93-96), Sion an der oberen Rhone; mehrere Fundorte im Tal des Po; auch in Ungarn gibt es eine wachsende Zahl der Fundorte in der Umgebung von Budapest (Schreiber, 1973a). J. Ondráček wird demnächst eine Bearbeitung mehrerer Glockenbechersiedlungen aus Mähren publizieren.

Fast allen diesen Siedlungen ist gemeinsam, dass sie, zusammen mit diagnostischen Glockenbechergeräten, die Gebrauchskeramik eines betont lokalen Charakters geliefert haben. Das ist beispielsweise die Keramik mit aufgerauhter Fläche von den Fundorten East Anglias, die unverzierte Keramik aus Cerro de la Virgen, sowie das Protonagyrever Material vom Budapester Gebiet. Diese Verschiedenheit war nicht sichtbar solange nur das Grabmaterial bekannt war; sie ist erst vor kurzem zum Vorschein gekommen. Ich hoffe zu zeigen, dass mein Denkmodell der Glockenbecherkultur solche Situationen, die Schwierigkeiten für die traditionellen Theorien bieten, in Einklang bringt.

Der Inhalt der Glockenbecherkultur Mitteleuropas unterscheidet sich z. B. erheblich von demjenigen in England oder Holland. Vor allem ist es bemerkenswert, wie es wenige echte Glockenbecher im Vergleich zu den dunkelgrauen geglätteten Krügen und Schüsseln gibt; das ist noch ausgeprägter, wenn man das Siedlungsmaterial, zum Beispiel von der Csepelinsel (Ungarn) untersucht. In Anbetracht der allgemeinen anerkannten Ansichten über Keramikentwicklung und -typologie, ist es ganz klar, dass man die Entstehung dieser Keramik in den mit Vučedol verwandten Gruppen des Karpatenbeckens suchen muss. Des weiteren bildet dieses Material — die Krüge und Schüsseln, auch, obgleich weniger wichtig, die grösseren Töpfe — die Grundlage der Glockenbecherkultur in Böhmen, Mähren, Ungarn, Niederösterreich usw. In diesen Tonwaren karpatischer Entstehung finden wir ein ganzes Ensemble der Keramik: schöne Krüge und Schüsseln, bis zu grober Gebrauchskeramik und praktischen Vorratsgefässen wie die besenstrichverzierten Amphoren. Das ist nicht der Fall bei den echten Glockenbechern, die eine ausschliesslich feine Keramik darstellen, auch wenn sie in Siedlungen gefunden werden.

Im Lichte dieser Situation ist es vielleicht nicht angebracht, über eine Glockenbecherwirtschaft zu sprechen, ganz gleich, wo man auch immer Glockenbecher findet, weil diese Wirtschaft auf die lokale einheimische Kultur bezogen ist. Die Glockenbecher, Armschutzplatten, Dolche usw., sind nur ein äusserlicher Zusatz.

Was bedeuten diese besonderen Geräte? Wenn man den Satz von Geräten, der im gesamten Glockenbecherkreis zu finden ist, näher betrachtet, entdeckt man, dass er sehr eingengt ist. Er schliesst echte Glockenbecher, Füsschenschüsseln, Pfeilspitzen, Armschutzplatten, Kupferdolche, Knöpfe mit V-Bohrung, Kupferahlen und Kupferschmuck mit Ohringen ein, und das ist fast alles. Zunächst die Gefässe selbst: nur der charakteristische feine Becher, und zwar in verschiedenen Grössen, erscheint häufig und in weit eingegrenzterem Umfang die Füsschenschale. Wie ich bereits oben erwähnt habe, ist das nur ein kleiner Teil des sonst gebräuchlichen Keramiksatzes.

Eine andere Sache sind die Pfeilspitzen. Man könnte annehmen, dass sie sich auf den Lebensunterhalt, vielleicht die Viehzucht, beziehen; etwa so wie die Verwendung von Pfeilen bei den Massai in Ostafrika mittlererer sie die Rinder zur Ader lassen; auch als Jagdgeräte, obwohl die Beweise, die wir haben, die Hypothese, dass die Jagd ein wichtiger Teil der Wirtschaft ostmitteleuropäischer Gruppen war, bei denen wir Glockenbecher finden, nicht stützen. Das ist weder durch die Verbreitung der Glockenbecherkultur in bezug auf den Boden zu belegen, gewöhnlich im besten Ackerland, noch durch die aufgefundenen Tierknochen, noch durch das reichlichere Zeugnis aus den vorangehenden Kulturen in denselben Gebieten. Das offenbart, dass die Jagd, wirtschaftlich gesehen, keine bedeutende Rolle gespielt hatte. Ich nehme an, dass diese Pfeilspitzen auf keine wichtige Funktion des Lebensunterhaltes hindeuten, dass die Jagd nichts anderes als Sport war, worauf ja die Eberhauer, die manchmal in Gräbern gefunden werden, hinweisen. Höchstwahrscheinlich benutzte man die Pfeile zum Angriff und zur Verteidigung. Am Rande sei vermerkt, dass die Pfeilspitzen nicht so häufig wie die echten Glockenbecher auftauchen, die selbst auch nicht regelmässig vorkommen.

Was entschied, wem Pfeilspitzen und wem Glockenbecher in seinem Grab beigelegt wurden? Meiner Meinung nach war die Entscheidung, diese Beigaben wie die charakteristischen paneuropäischen Glockenbechergeräte betreffend, einschliesslich der Gefässe, mit der sozialen Stellung des Toten verbunden. Diese Meinung wird bestärkt durch die Beachtung, die den damals schon erzeugten steinernen Armschutzplatten geschenkt wird, die sich ebenfalls nur auf einen Teil der Glockenbecherbevölkerung beziehen. Diese Armschutzplatten, wie auch die damaligen Sitten, Bogenausstattungen in die Gräber zu legen, liefern den Beweis, dass das Bogenschiessen von mehr als rein praktischer Bedeutung war;

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es ist sozusagen als ein besonderes Mittel für eine soziale Äusserung gewählt worden. In einigen schnurkeramischen Gruppen spielte die Streitaxt eine ähnliche Rolle.

Wenn wir uns den Kupferdolchen zuwenden, so finden wir dasselbe Bild. Diese sind auch sehr gleichförmig im gesamten Gebiet, wo es Glockenbecher gibt. Die Seltenheit ihres Materials und ihre Eingrenzung auf wenige Gräber deuten darauf hin, dass bestimmte soziale Regeln die Bestattung der Verstorbenen festsetzten. Die verschiedenen Kupfer- und andere Schmucksachen widersprechen dieser Ansicht nicht.

Zweifellos sind die meisten Archäologen, es geht um die anderen Geräte, dieser Meinung. Anders sieht es aus, wenn es um die Glockenbecher selbst geht. Die wichtigste Sache hierfür sind die chronologischen Schemata, die für die Glockenbecherkultur in Mitteleuropa entwickelt worden sind (Hájek, 1966). Darin wird im allgemeinen Folgendes behauptet: Auf eine frühe Phase mit nur echten Glockenbechern folgt eine Phase, in der die entwickelten Glockenbecher zum erstenmal mit der sogenannten Begleitkeramik im Zusammenhang stehenden Geräte vorkommen; später ist diese Begleitkeramik dann allein gefunden worden.

So ist alle Variabilität in der Glockenbecherkultur vom Standpunkt der Chronologie, aber auch durch Bewegungen der Bevölkerung, sowie durch den Abstand der Funde in Raum und Zeit, von einem vermutlichen Entstehungspunkt aus interpretiert worden. Darum gilt immer nur, auf Grund gewisser typologischer und anderer Vermutungen, eine sehr kleine Anzahl reicher Gräber in Böhmen und Mähren, z. B. Praha-Bubeneč oder Předměstí, als Vertreter dieser frühen, keine anderen Keramiktypen enthaltenden Phase der Glockenbecherkultur auf diesen Gebieten (Hájek, 1966).

Aus verschiedenen Gründen können aber diese wenigen Gräber nicht eine ganze Kultur repräsentieren, besonders weil sie einen so eingegengten Satz von Geräten enthalten. Diese Glockenbecher kommen nicht aus einem leeren Raum; sie sind nicht um ihrer selbst willen da. Ferner gibt es keinen überzeugenden Beweis dafür, dass die Gräber, die nur Begleitkeramik enthalten, späteren Datums seien als diejenigen, die nur Glockenbecher enthalten. Es gibt keinen Weg, die eine oder andere Annahme ohne gute Beispiele vertikaler Stratigraphie endgültig abzusichern. In der Tat suggerieren die Beweise, die wir haben, das Gegenteil, nämlich die Tatsache, dass die Begleitkeramik gleichzeitig mit den verzierten Glockenbechern zu datieren sei. Ich weise auf die Ausgrabungen von Frau Schreiber in der Gegend von Budapest hin. Hier sind in fast jeder Grube der verschiedenen ausgegrabenen Siedlungen, z. B. Csepel Haros oder Csepel Hollandi St., wenig verzierte Glockenbecherscherben zusammen mit einer grossen Menge der dunkelgrauen geglätteten Krüge und Schüssel und mit den besenstrichverzierten Amphoren gefunden worden, welche die lokale einheimische Kultur kennzeichnen.

Auf einigen Friedhöfen, z. B. Bekasmegyer, werden Begleitkeramik und Glockenbecher in einigen Gräbern gemeinsam gefunden, während typologisch dieselbe Begleitkeramik in anderen Gräbern ohne Glockenbecher gefunden wird. Demnach gibt es keinen Beweis dafür, dass die Gräber ohne Glockenbecher späteren Datums seien. So soll der häufige Mangel, an Verbindung zwischen Glockenbechern und Begleitkeramik, in Böhmen und Mähren, wo sie auch manchmal gemeinsam auftreten, nicht nur auf chronologische Gründe zurückgeführt werden. Es ist bemerkenswert, dass viele Gräber, die als die frühesten betrachtet werden, auch die reichsten sind; Praha-Bubenec und Předměstí sind wieder offensichtliche Beispiele dafür. Es ist durchaus möglich, dass es Gräber von Individuen mit einem hohen Status waren, und eine besondere Ausstattung enthielten, die — aus sozialen Gründen — unverzierte Krüge und Schüsseln nicht zuliess.

Einige Gebiete, wie z. B. das Burgenland und der angrenzende Teil Ungarns, haben keine (oder fast keine) echten Glockenbecher, nur Begleitkeramik. Es wurde immer angenommen, dass diese Gebiete bloss in einer späteren Phase der Glockenbecherkultur besiedelt wurden. Doch scheint das unwahrscheinlich, weil das Burgenland ungefähr zwischen zwei Regionen liegt, nämlich zwischen Niederösterreich und der Gegend von Budapest, die verzierte Glockenbecher besitzen; ferner grenzt das Burgenland an jene Gebiete, wo die Begleitkeramik vermutlich ihre Entstehung hatte. Demzufolge kann man annehmen, dass diese Gebiete hier später besiedelt wurden. Meiner Meinung nach ist es wahrscheinlicher, dass diese lokale „Begleitkeramikkultur“ sich, aus welchem Grunde auch immer, des Verkehrs, über den sich die Glockenbecher und die mit ihnen zusammenhängenden Geräte verbreiteten, nicht bediente.

In einem kleineren Umfang gibt es eine ähnliche Situation in Böhmen und Mähren. Dort findet man einige Gräberfelder, oft ganz grosse, z. B. Blažovice in Mähren, allerdings ohne Glockenbecher beziehungsweise mit sehr wenigen. Wenn die Beigabe echter Glockenbecher in Gräbern mit persönlichem sozialem Status der Verstorbenen zusammenhängt, so ist es möglich, dass die Gräber dieser Friedhöfe keine verzierten Glockenbecher enthalten, weil diese Standespersonen des öfteren auf einer anderen Stelle begraben wurden. Das würde auch erklären, warum Friedhöfe mit echten Glockenbechergräbern oft sehr klein sind — sie beziehen sich auf einen besonderen Teil der Bevölkerung. Ihr weit grösserer Teil wurde in diesen grösseren Gräberfeldern begraben. Also deuten diese kleinen Gräberfelder auf keine beträchtliche Beweglichkeit der sogenannten Glockenbecherleute hin, wie man immer vermutet hat.

Auch gibt es, typologisch gesehen, keinen Grund, warum die Begleitkeramik später einzuordnen sei als die ersten Glockenbecher. Die Kulturen des Karpatenbeckens, wie Kosihe-Čaka und Makó, aus denen sie entstand, gehen sicherlich der Erscheinung der Glockenbecher voraus.

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Ausserdem, wenn man Dr. Néustupny's sehr polemisches chronologisches Schema anerkennt (Néustupny, 1972), kann man Einflüsse aus dem Karpatenbecken schon in der späten Schnurkeramik erkennen, die den Glockenbechern vorangegangen sein muss. Ich meine schon oben dargestellt zu haben, dass bei den Glockenbechern die vorhandene Sammlung der Nichtglockenbecher-Geräte, insbesondere die Keramik betreffend, die lokale Bevölkerung charakterisierte. Diese Sammlung besteht aus dunkelgrauen Tassen, Krügen und Schüsseln, die in den Gräbern sehr oft die Mehrzahl bilden; noch öfters aber in den Siedlungen, wo sie mit vielen Töpfe- und Amphorenscherben gemeinsam vorkommen. Dieses Material beschränkt sich hauptsächlich auf Mitteleuropa und repräsentiert mit den Siedlungen die lokale Lebensweise. Vielleicht wäre es besser, die Bezeichnung Glockenbecherkultur nicht zu benutzen, sondern lokale Namen anzugeben, wie Frau Kalicz es bei ihrer Csepelgruppe gemacht hat (Schreiber, 1973b).

Die echten Glockenbecher und die mit ihnen verbundenen Geräte stellen sicherlich eine Sache anderer Art dar. Darauf deutet ihre „paneuropäische“ Verbreitung hin, vor allem die besonderen und lokal begrenzten Arten der Geräte und ihr verhältnismässig seltenes Vorkommen in Siedlungen, wo lokale einheimische Keramik überwiegt. Der Gegensatz zu einer anderen sehr weit verbreiteten Kultur, der Linearbandkeramik, welche die gesamte Lebensweise der ersten Ackerbauer in Mitteleuropa widerspiegelt, ist klar.

Was repräsentierten demnach eigentlich die Glockenbecher? Man sollte sie als eine allgemein anerkannte Geräteform betrachten, die vermutlich eine bestimmte Bedeutung besitzt. Es ist die weitverbreitete Anerkennung dieser Geräte und nicht die Bewegung der Bevölkerung, die gegenseitige Verbindungen zur Folge hat. Siedelbewegungen werden ausgeschlossen, weil der Charakter der paneuropäischen Glockenbechergeräte, über den ich gerade einen Überblick gegeben habe, im Gegensatz zum Angenommenen steht und mit der lokal wechselnden Gebrauchskeramik nicht übereinstimmt. Einen weiteren Beweis dafür liefert der Vergleich des Wiedergespiegelten Fundmaterials, das die Wanderungen der Träger der Linearbandkeramik zum Ausdruck bringt. Kleinere Bewegungen der Bevölkerung kamen vielleicht in einzelnen Regionen vor. Es gibt diesbezüglich grosse Ähnlichkeit zwischen Böhmen und Ungarn, die mehr als nur Glockenbecher, Armschutzplatten usw. aufweisen. Aber auch hier gibt es insofern Probleme; in Ungarn werden die Einflüsse aus dem Nordwesten, in Böhmen aus dem Südosten gesucht. Eine wechselseitige Verbindung scheint die richtige Antwort zu sein.

Eine weitere Möglichkeit besteht darin, dass die Glockenbecher innerhalb grosser Gebiete ausgetauscht wurden. Das kann man zwar noch nicht in jedem Fall annehmen, aber die sichtbaren regionalen Unterschiede, sowie die genaue typologische Ähnlichkeit, welche die Glocken-

becher aus demselben Fundort oft charakterisiert, beweisen, dass es sich wohl darum handelt. Eine Serie von Mikroskopanalysen der Tonwaren soll dieses Problem erhellen.

Ich habe die Ausführungen des amerikanischen Archäologen Binford (1968, 269) zu den archäologischen Beweisen früherer Untersuchungen in Beziehung zu bringen versucht; eine Erklärung des Ganzen wollte und konnte ich nicht geben. Das Problem, ob man die Glockenbecher als von Hirtenleuten getragen oder als Statusgegenstände in einem weitverzweigten Netz betrachtet, ist noch zu klären; auch wenn die jeweilige Antwort zu jedem dieser Fälle offensichtlich sehr unterschiedlich sein wird. Bisher ist diesem Problem keine Beachtung geschenkt worden. Es ist zu fragen, warum sich diese Umstände so oder anders gebildet haben. Meiner Meinung nach ist diese Frage viel wichtiger als das Forschen nach der Entstehung der Glockenbecher, wenn auch diese beiden Probleme anerkanntermassen aufs engste miteinander verbunden sind. Es wird sicherlich noch vieler Arbeit bedürfen, eine Erklärung dafür zu finden; doch zu entdecken, was wir zu erklären haben, ist der erste wichtige Schritt.

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STEVE J. SHENNAN

Społeczna interpretacja kultury pucharów dzwonowatych  
w Europie Środkowej

**Streszczenie.** W niniejszym artykule przedstawiono sugestie, że dotychczasowa interpretacja charakteru kultury pucharów dzwonowatych była niewłaściwa. Problem ten w odniesieniu do Europy środkowej i wschodniej poddano weryfikacji na podstawie koncepcji tzw. „sfery wzajemnego przenikania” (Interaction sphere), po raz pierwszy rozwiniętej w archeologii amerykańskiej. Wzrastająca wciąż liczba odkrytych osad kultury pucharów dzwonowatych wydaje się wskazywać, że dotychczasowe wyobrażenia o znacznej ruchliwości ludności omawianej kultury są błędne. Badania osad ujawniły materiały zróżnicowane regionalnie, w których zabytki uznawane za charakterystyczne dla kultury pucharów dzwonowatych ukazują nam się jako niezbyt istotny dodatek, używane były bowiem głównie w charakterze darów grobowych. Dotychczasowa interpretacja zróżnicowania materiałów, zakładająca starszeństwo klasycznych pucharów dzwonowatych w porównaniu z ceramiką towarzyszącą, nie dawała możliwości postępu w badaniach tego problemu. Jednakże badania ostatnich lat na terenie Węgier udowodniły współczesność obu tych rodzajów ceramiki, co zmusza do poszukiwania nowych możliwości interpretacyjnych. I tak jest np. możliwe, że małe cmentarzyska z grobami zawierającymi ornamentowane puchary dzwonowate odpowiadają nielicznej grupie społecznej, podczas gdy reszta ludności grzebała swoich zmarłych w innych miejscach i wyposażała ich tylko w tzw. ceramikę towarzyszącą. Tak więc jedynie ta ostatnia byłaby właściwym elementem charakterystycznym miejscowych populacji, podczas gdy rozprzestrzenione szeroko w całej Europie puchary dzwonowate, płytki ochronne itp. uznać trzeba za przedmioty o funkcji specjalnej rozpowszechnione dzięki wymianie dalekosiężnej.

*Tłumaczył Andrzej Szymański*

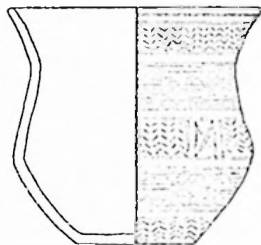
# SHAPE AND STYLE VARIATION IN CENTRAL GERMAN BELL BEAKERS:

## A COMPUTER-ASSISTED STUDY

S.J.Shennan and J.D.Wilcock  
University of Cambridge North Staffordshire  
Polytechnic

### ABSTRACT

The paper describes the analysis of Bell Beaker pottery from Central Germany, in terms of shape and decoration. Two main computer techniques (the 'elided' and 'mosaic' methods) are given for the objective description of pottery shapes, and illustrations are given of clustering and multi-dimensional scaling applied to collections of pottery types from widely-differing archaeological contexts. The Bell Beaker pottery is analysed using these techniques, and the results compared with Principal Components Analysis carried out on the automatically-determined width/height ratios at several positions along the profiles of the pots. It is deduced that the uncertainty which arises in automatic shape measurement can be a problem and that, for the Beaker pottery under study, Principal Components Analysis suffices to explain the shape variation in terms of the two simple ratios height/maximum width and base width/maximum width. By examination of the clusters it is further deduced that shape and decoration are related in the Central German Bell Beakers.



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### Acknowledgments

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### 1. Introduction

The so-called 'Bell Beaker culture' is one of the best-known phenomena in European prehistory, and its existence has been recognised since the beginning of this century. It has always attracted attention because of its extremely wide distribution and the rather striking character of the objects which characterise it - the tanged copper dagger, the stone archer's wrist guard, and the fine quality pottery which is the subject of this paper. Until recently the main centre of interest has been the origin of this 'culture', and particularly of the Bell Beaker itself, as the significance of its distribution has always been assumed to be known - it was supposed to represent an expansion of pastoralists and/or metal-prospector, most probably from somewhere in Spain. In the last few years, however, in the climate of new developments in archaeology, this idea has come to be regarded as unsatisfactory: Lanting, Mook and van der Waals (1973) have suggested an origin in the Netherlands, while Harrison (1974) has argued for multiple independent origins, thereby removing the need for any long-range transmission. Unfortunately, little can be said about any of these hypotheses in the face of a lack of data with which to test them: some of the main areas have remained largely unknown apart from one or two famous (and exceptional) finds. At the present time, therefore, the most pressing need is for detailed regional study, to understand the relations of the Bell Beakers to their local context, before returning again to the larger scale.

The pottery itself is one of the main sources of evidence. It has mainly been used in the past for the construction of typological chronologies, based on assumed schemes of typological development, and occasionally backed up by <sup>14</sup>C dating, as in Holland. Sometimes, however, these schemes are confounded, for example at the Abri de Font-Juvenal in southern France (Guilaine, 1974), where typologically 'early' and 'late' types are found together in the same layer, which has given two early <sup>14</sup>C dates. This brings home the dangers of the usual assumptions and emphasises how little is really known about the nature and significance of variation in pottery. It is proposed, therefore, to outline briefly the types of variation which occur, and their potential significance in answering both old and new questions, as it is only in this light that the present study makes sense.

The problem of pottery classification is not as simple as it might seem, because pottery has at least two main spheres of variation: shape and decoration. The conventionally recognised types used in establishing chronologies are generally combinations of these, and it is necessary to ask whether we are justified in combining them in this way. The decoration of a vessel will be related to socio-symbolic, religious, aesthetic, and fashion considerations, although even here function may be important (cf. van der Leeuw, in press). A vessel's shape will first of all be determined by its function, but, given that we are concerned with vessels of a single functional type, it will relate to a variety of factors, including the type of clay and its moisture content, variations in the technique of manufacture, and the vessel size. There is thus no *a priori* reason why shape should covary with decoration. This is not to deny that particular shape types can be especially appropriate for particular modes of decoration, as Clarke (1970) has shown for the British Beakers.



What it does mean is that, at least initially, it is very important to treat shape and decoration separately and to investigate the degree of covariation between the two. A corollary of this argument is that while variation in decoration can often be regarded as relating to variation in human interaction, this is not necessarily the case with shape. A situation in which they might be expected to covary especially closely is when there are specialist potters. Obviously a particular shape and form of decoration are combined in a given vessel, so it is the variation between vessels which matters. If a large number of vessels is being made and distributed by a (semi-) specialist, technical reasons for shape variation are likely to be at a minimum and decoration is likely to vary within fairly narrow limits, thus there will be an invariant relationship between the two properties, both of which are likely to be more or less constant over an unknown number of pots. The problem about recognising this, of course, is that only a minute sample of the vessels will remain.

The above discussion has been largely in terms of the space dimension, but the problem of covariation through time is similar. Both shape and decoration will change stochastically with time; whether such change in either shape, or decoration, or both, will be directional is another question - a matter for investigation rather than assumption.

With all this in mind, it is now necessary to turn back to the concrete problems of the Bell Beaker 'culture'. The area of the present study has been Central Europe, which has one of the densest concentrations of Bell Beaker material, and to which not a great deal of attention has been paid, at least by British archaeologists. The vessels on which this paper is based come from only one part of the area - the Saale valley, in what is now the German Democratic Republic. This is the first part of an analysis which will eventually cover the Bell Beakers from Czechoslovakia, Hungary and Bavaria as well. The aim of the study is to make suggestions about the sort of human behaviour which might have produced the variations in shape and decoration visible in the data, and is therefore likely to be relevant to a more general understanding of the Bell Beaker 'culture'. These suggestions will then form hypotheses to be further tested. The first stage, however, is to reduce the material to some sort of order, in this case by grouping together those pots most similar to one another. We have already seen that this should be done separately for different criteria, or we are likely to emerge with a confused and meaningless picture. The method chosen for the part of the analysis described here is appropriate since only shape is considered, and the shape groupings can then be compared with those produced on the basis of decoration; moreover, by including undecorated vessels of the same type, it is possible to find out whether or not the ornamented pots form a subset of the total range of shape variation.

## 2. Computer techniques for pottery profile analysis

### 2.1. The problem of pottery classification, and some previous attempts to solve it

Pottery has been studied in a systematic manner for almost twenty years. The classification of pottery styles has traditionally been by subjective judgment, using word descriptions of 'form', body, glaze, decoration and ware name, and drawings of predominant types for reference purposes, e.g. Dragendorff or Gillam types. Body, glaze, decoration and ware names have all in the past been defined by specialists and

the consistent use of these specialist terms leads to little ambiguity. However, the description of form has been much less closely defined. Perhaps the biggest curse which plagues the archaeologist is the proliferation of terms which have been introduced; many are vague and show unsatisfactory overlaps with other terms (see Kim, 1969; Hardy-Smith, 1974). If a form classification is well-known, e.g. Drag.37, it can be quoted directly; otherwise the confusion of terms leads to unsatisfactory definitions. An attempt is made below to group similar forms. Each commonly-used term within a group shows unsatisfactory overlaps with other terms in the group:

plate/platter/pancheon/charger  
dish/saucer  
bowl/basin/porringer  
cup/goblet  
mug/tankard/tyg/"Beaker"  
chamber pot/posset pot/pipkin  
jug/pitcher/ewer/flagon  
jar/albarelllo/galley pot/vase/olla  
"Urn"  
"Food Vessel"  
amphora  
mortarium

Accordingly, some archaeologists have decided that the only really satisfactory way to describe a profile is as a numerical code which actually embodies the form of the pot; this has inevitably involved use of the computer.

One of the first workers to consider the systematic geometric description of pottery shapes was Shepard (1957). This procedure, an elaboration of the 'aesthetic measure' of Birkhoff (1933), considered corner points (carinations), inflection points and orifice diameters. Unfortunately the system as proposed did not provide a continuous transition between types in all cases, which is a prime requirement for an acceptable scheme of nomenclature. Shepard's treatment did not use computers, although there was a brief mention of the application of computers in the foreword to the fifth printing.

Freeman (1961) discussed the encoding of arbitrary geometric configurations. Although pottery profiles were not mentioned, most of the techniques proposed are applicable to them.

Gardin et al. (1962, 1967) have coded pottery forms on punched cards, but it is now generally accepted that the computer must be used to analyse large bodies of data. Poulsen (1972) developed Gardin's system, commenting that the detailed observations proposed by Gardin were too time-consuming. Instead a series of codes for rim types, wall thickness and decoration were suggested.

Clarke (1962, 1970) classified British Beaker pottery using various ratios of dimensions (rim diameter/waist diameter, belly diameter/waist diameter, foot diameter/waist diameter, rim height/waist height, and rim height/waist diameter) and codes for decorative motifs, position of decoration, paste and firing. The numerical range of each ratio was subdivided into a number of sub-ranges according to the distribution of the pots, and then

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the occurrence of a particular sub-range of each ratio was recorded on a presence/absence basis for each pot. It should be noted that this transformation of a continuously-variable number into several discrete sub-ranges is arbitrary, and can lead to intrusion of subjective judgments into what should be objective analysis. The variables were cross-correlated in a square matrix and submitted to matrix analysis, where the computer reorders the rows and columns of the matrix until high values of correlation appear on the central diagonal. Clarke took the groupings of attributes which emerged in this way to define various groups of Beaker pottery types. This work is of direct applicability to the present study, and is mentioned further below. The method has, however, been severely criticised by Matthews (1963).

McGimsey and Green (1965) presented a coding scheme for pottery which was designed to be analysed by computer.

In a series of papers (Rottländer, 1966, 1967, 1969; Holzhausen and Rottländer, 1970) Rottländer investigated provincial Roman pottery using statistical techniques on the form of the pots.

Ankel (1966, 1967) used the computer to analyse prehistoric pottery. A grid was used to record vessels in three planes. The positions where the profile crossed the grid lines were noted, and using this system it was found possible to store and reproduce on demand visual representations approximating to the actual shapes of the pottery. This work is of direct relevance to the 'mosaic' method of pottery profile analysis used in the PLUTARCH System described below.

McPherron (1967) used attribute clustering to study the variability in pottery style.

Freeman (1968) described computer methods for the classifying and matching of profiles and other irregular curves, a technique which potentially enables whole vessels to be reconstructed from a pile of potsherds.

Powlett (1968) described the work of Berard (1883-1918) which included a classificatory system for early La Tène Marnian ceramics.

Gaines (1970) discussed the description and analysis of ceramics by computer, finding that the general problems encountered are lack of standardisation of terms and concepts.

Orton (1970, 1971, 1973) has described pottery forms in a statistical manner, working on a collection of pottery from a kiln site in Highgate Wood, London.

Wagner (1971a, 1971b, 1971c) and Hurley and Wagner (1972) have performed several pottery analyses using the computer. The clustering results were illustrated with models constructed with coloured pins.

Lischka (1972) has defined a set of vessel types based on shape, dimensions, surface finish, decoration and wear, using cluster analysis by computer.

Whallon (1972) discussed the suitability of various statistical methods for pottery classification.

Ericson and Stickel (1973) have proposed a geometric classification system based on simple solid

shapes such as the sphere, cylinder and cone. A pottery shape may be described in terms of conjunctions of these solids, plus radius, thickness, height, etc. If complex forms are described using this scheme, systems of brackets become necessary, and it seems unlikely that such an excessively coded nomenclature which also requires a knowledge of solid geometry will find favour among archaeologists.

## 2.2. Methods of pottery classification in the PLUTARCH System

The PLUTARCH System has been described by Wilcock (1974). The computer programs interlink information retrieval, statistics and graphics facilities, providing a comprehensive system for recording, analysing and publishing archaeological information. For the analysis of pottery the system provides information retrieval files, profile statistics, weighted pair-group agglomerative clustering, and graphics capabilities for dendrograms, skyline plots (see the companion paper 'An algorithm for the skyline plot' in this publication), scalograms with group sizes and/or minimum spanning tree, pottery diagrams and pottery volume histograms.

The profile of the pot is first digitised by following (with crosswires) the outline of the left-hand section of a pot drawing mounted on a digitising table, such as the d-Mac Pencil Follower. The original diagram may be quite crude, perhaps produced by drawing round a pin template previously pressed against the pot. The inner and outer profiles are read and rotated numerically by the computer, so that the centre line is truly vertical, then they are smoothed (to remove the original crudity of the diagram and to eliminate hand-shake during digitising) and scaled to standard height with compensation of the scale factor. The profile code and the volume of the pot are determined from the outer and inner profiles respectively, and the pot is displayed in conventional left-hand section and right-hand elevation on the screen of a line-drawing display unit, where it may be accepted or rejected by the archaeologist. If accepted, the name of the pot, the scale factor, profile code and volume are recorded, and are later available with other pots for statistical analysis and display by means of dendrograms, skyline plots, scalograms and histograms (see below).

Two main types of profile code are available: the 'sliced' and 'mosaic' methods, each of which inherently expresses the form of the pot. The main difference between these codes is that the sliced method only records the outer profile from the footring or base to the rim, while the mosaic method records the whole outer profile from the centre of the base to the rim.

Figure 1 shows the 'sliced' method, where an arbitrary number of horizontal 'slices' of equal thickness are taken. The radii of the outer profile readings at the leftmost point of the footring (or lowest point of the outer profile, as appropriate), at the highest point of the outer profile (top of the rim) and at equal vertical intervals in between are expressed as percentages of the height of the pot. The profile code, which is independent of the size of the pot, is thus expressed as a calculated string of percentages, and similarities between pots may then be defined in terms of the inverse differences between corresponding percentages. The method is good at



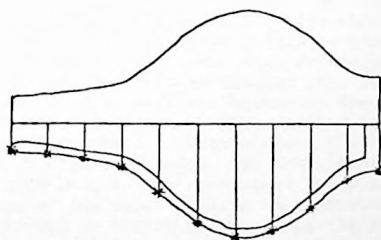


Figure 1. Illustration of the readings taken along the profile of a pit during the operation of the sliced method. The first reading is taken at the furthest point of the footing, or at the lowest point on the outer profile. The second reading is taken at the lowest point on the noise profile (line of the rim) and the remaining readings are spaced at equal vertical intervals up the outer profile.

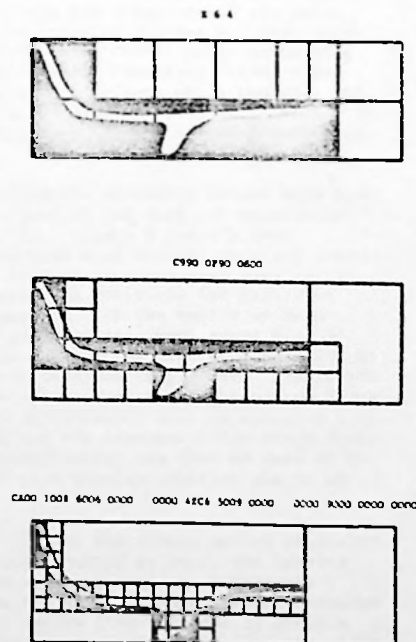


Figure 4. Illustration of the mosaic method for Smolian form Dragenduff 15, emphasizing the improved resolution and coverage right up to the centre line of the pit.

Smolian DRAG. 37

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detecting gross differences in the profile of pots, as may be expected, but less good at detecting fine differences, which tend to be swamped by other gross differences. Unfortunately, it is the fine differences which are often diagnostic of the typology of pottery, and the important features may be near the rim or near the base of the pots. Because the equal-interval sliced method is insensitive to fine differences just below the rim and just above the lowermost point of the pot, the method may have to be improved by increasing the number of readings near the rim and near the base of the pot, or by a system of differential weighting of readings. The problem is especially severe when it is necessary to derive a typology of very similar pots such as the Bell Beakers, and this is discussed further in the Results section below.

Figure 2 shows a typical computer printout for the sliced method. For each pot, the name of the item is followed by the scale factor (which has been recalculated during the height standardisation phase), the radii from the base to the rim expressed as percentages of the height, an indication of whether the height is greater ('TALL TYPE') or smaller ('DISH TYPE') than the maximum radius, and the volume of the pot expressed in various units. The lower half of Figure 2 shows a comparison run for a representative collection of Samian ware, in which the pot under study, form Dragendorff 37, is compared with all other forms on record. The profile, scale, volume and overall similarity coefficients between each pot and form Drag.37 are given as percentages in the first, third, fifth and sixth columns of figures respectively. Finally the four most similar forms have been requested. Naturally, the form Drag.37 on record is selected as being 100% similar, while Drag.29, Drag.45 and Drag.38 are all deep bowl types of decreasing overall similarity (see the first column of figures). The other two columns give the scale and volume similarities for the selected items.

Figure 3 shows the 'mosaic' method, taking again form Drag.37, and Figure 4 shows the 'DISH TYPE' form Drag.18 in order to emphasize the improved resolution and coverage right up to the centre line of the pot. The method is based on a rectangular grid superimposed on the profile, and extended to the right from the leftmost point of the profile in unit squares of side equal to the height of the pot, until the centre line is overlapped. Only one unit square is required for Drag.37 (Figure 3), but Drag.18 (Figure 4) requires three such unit squares, since its maximum radius is more than twice but does not exceed three times its height. The unit squares are then subdivided into four sub-units of side equal to half the height of the pot, and the subdivision continues further until sufficient resolution is obtained. Three stages of subdivision are shown in Figures 3 and 4, but the computer performs four such stages. At each stage the presence or absence of the outer profile in each current sub-unit is recorded in binary fashion, and the binary string may be expressed for mnemonic purposes as hexadecimal codes, illustrated on the left of Figure 3. The adjacency properties of the two-variable Karnaugh map have been used in their description. Thus at the first level of resolution Drag.37 may be described as a 'Type E' pot, and Drag.18 as a 'Type E64' pot. The extended codes for the second and third levels of forms Drag.37 and Drag.18 are given on the second and third lines of Figures 3 and 4 respectively. The idea is capable of indefinite expansion.

Figure 5 shows a typical computer printout for

the mosaic method. For each pot, the name of the item is followed by the recalculated scale factor, an indication of whether the height is greater ('TALL TYPE') or smaller ('DISH TYPE') than the maximum radius, the volume of the pot expressed in various units, and the mosaic codes for the fourth, third, second and first levels respectively. Note that for every single code digit at level 1 there are four digits at level 2, 16 at level 3 and 64 at level 4. The similarity between pots is calculated by binary correspondence between profiles.

### 2.3. A typical pottery classification by computer: the common Samian ware forms

As illustration of the method the Roman Samian ware forms have been chosen, because they exhibit a wide range of profiles and because the forms, being industrially-made, are both well-defined and well-known by most archaeologists. The methods themselves are, of course, applicable to pottery of any period, with the single proviso that cylindrical symmetry is assumed in the volume calculation (hence for wheel-made pots there will be no error, but the irregularities of hand-made pots are not taken into account).

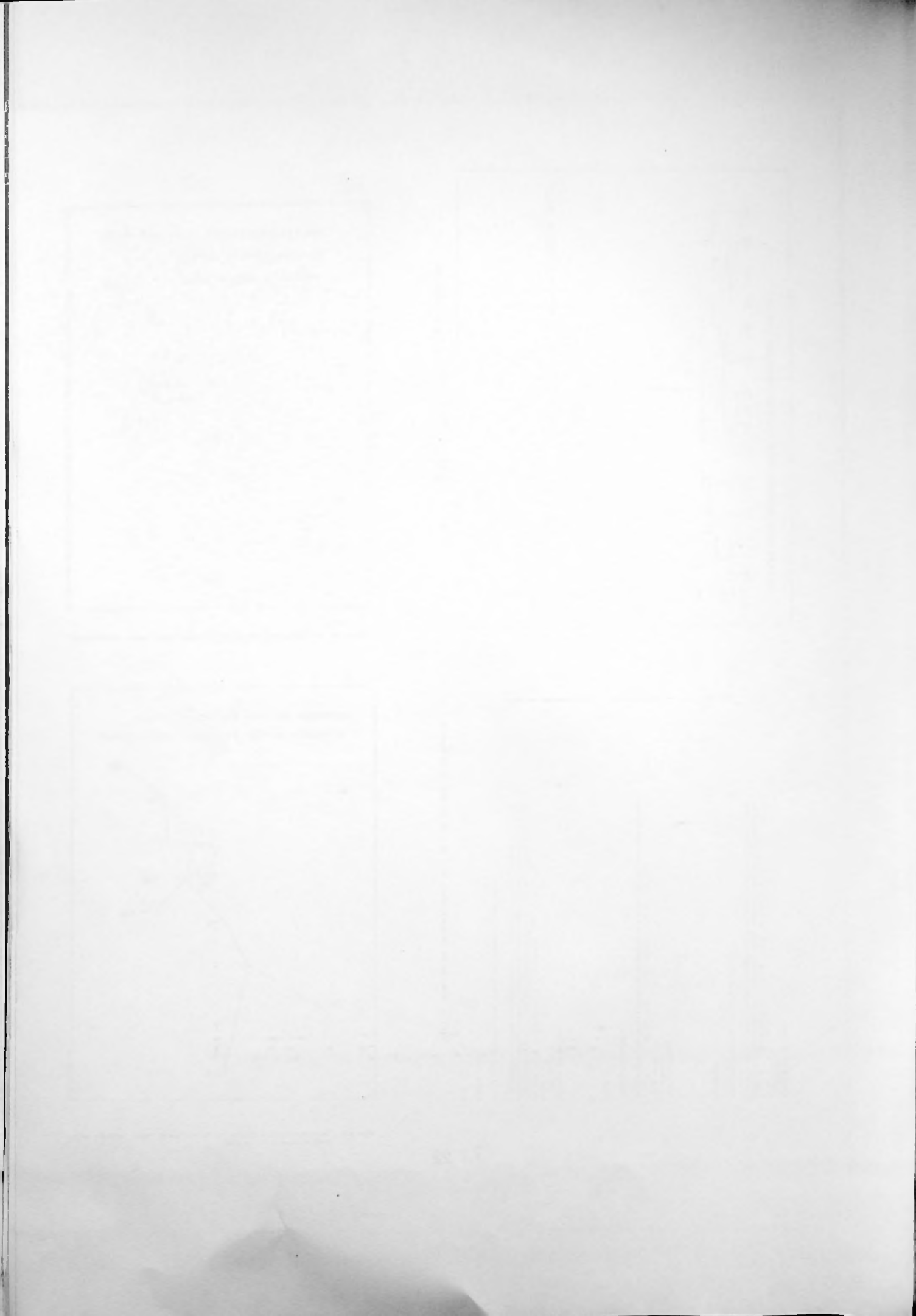
Figure 6 shows a dendrogram for the classification of common Samian types taking profile, but not size of the pots into account. This should be interpreted in conjunction with Figure 7 which shows a two-dimensional scalogram (product of multidimensional scaling) for the same data, and Figure 8 which is the same with the minimum spanning tree added. Points representing the pottery forms are positioned in two-dimensional space in the scalograms, and are close together if the corresponding forms are similar, far apart if the corresponding forms are dissimilar. The minimum spanning tree joins each item to its most similar items, and indicates the structure of the data. It can be seen by studying Figures 6-8 that there is a broad division into 'tall' pots (forms Drag. 29, 37, 30 and 68) and the remaining 'dish' type pots. A sub-group can be seen which contains the evolutionary platter sequence Drag.18 - 18/31 - 31 and another which contains the drinking cups Drag. 27 and 33.

The classification divisions become more pronounced if both profile and size are considered (Figures 9 and 10). Figure 9 shows a two-dimensional scalogram with minimum spanning tree, and the actual pottery diagrams have been introduced in corresponding positions for reference purposes in Figure 10. In the centre of both Figures is the group of deep bowl types Drag.37-29-45-38, at the top are the platter types, and at the bottom anomalous types Drag.30-68. Within the platter cluster can be seen the drinking cup group Drag.27-33, the evolutionary platter sequence Drag. 18 - 18/31 - 31 and the ornamental-rim group Drag. 35-36. The classification can thus be said to be successful when such diverse profiles are to be analysed.

Figures 6-10 used the sliced method of analysis. If the mosaic method is used, the results are broadly the same, with minor differences attributable to the higher resolution and coverage right up to the centre line. Figure 11 shows a skyline plot for mosaic profile and size classification of the same set of common Samian types. The same information is carried in the diagram as would appear on a dendrogram, with the difference that groups now stand out as 'skyscraper blocks'







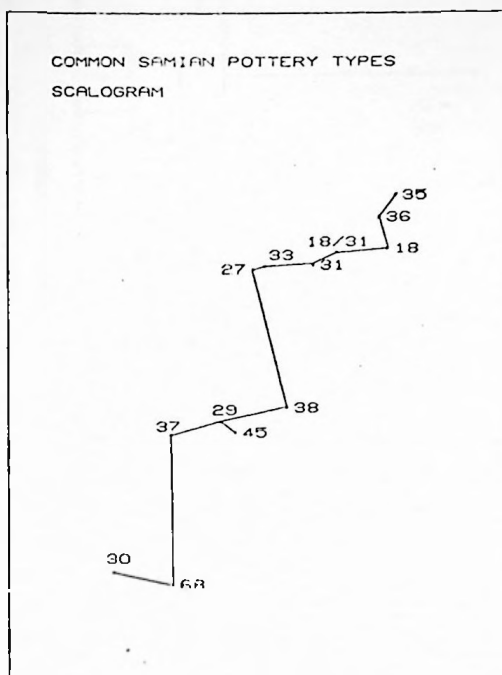


Figure 9. Two-dimensional scalogram for common Samian types - profile and size, with minimum spanning tree.

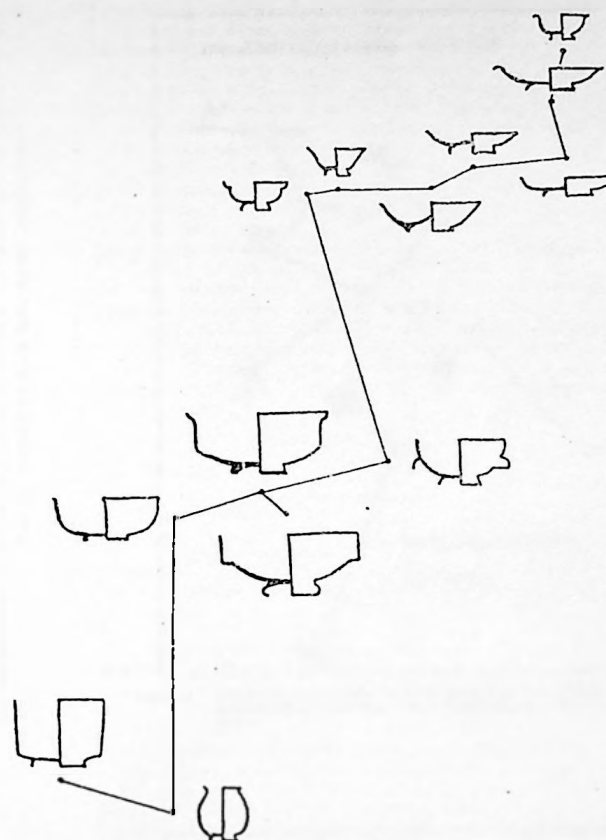


Figure 10. Two-dimensional scalogram for common Samian types - profile and size, with pottery diagrams.

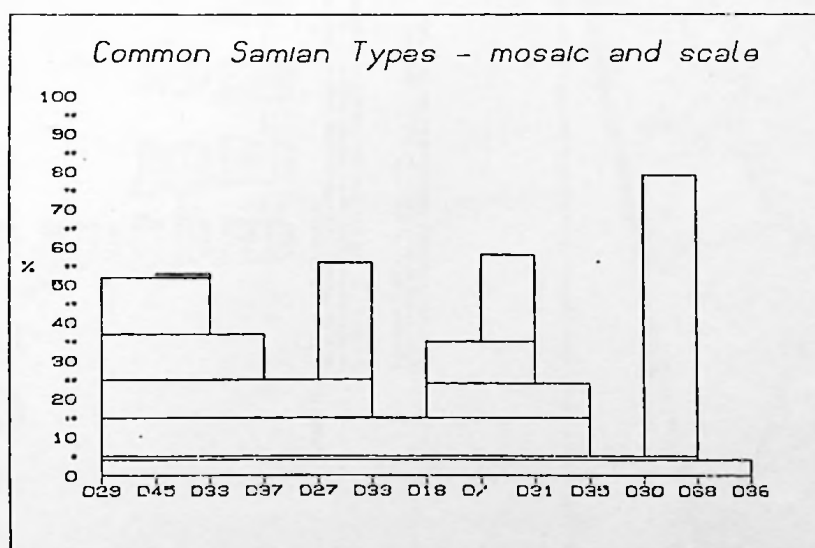


Figure 11. Skyline plot for common Samian types - profile and size, using the mosaic method.

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10



DENDROGRAM FOR BRITISH BEAKER POTTERY

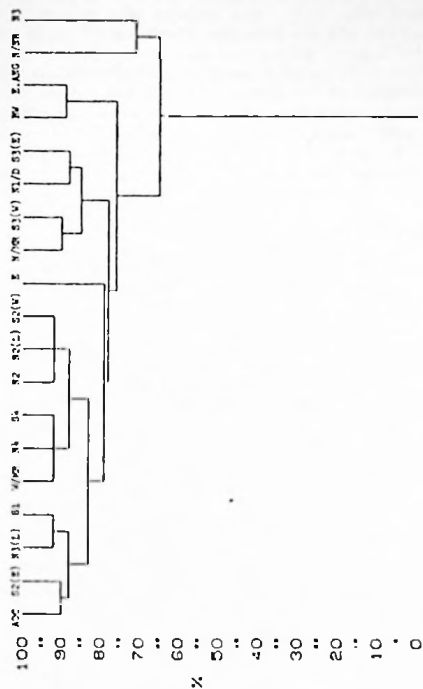


Figure 13. Dendrogram for British Beaker pottery - profile and size.

MULTIDIMENSIONAL SCALING

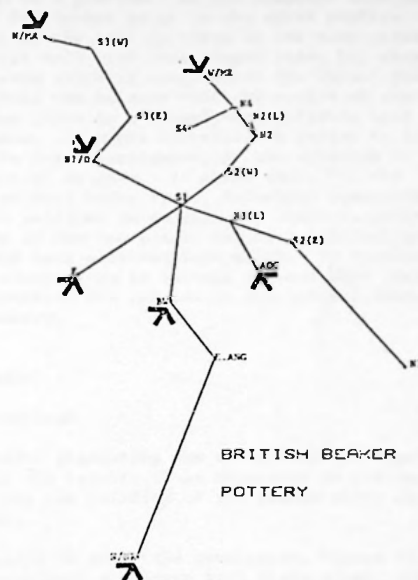


Figure 14. Two-dimensional scaling for British Beaker pottery - profile and size, with minimum spanning tree. Heavy arrows indicate Clarke's intrusive groups.

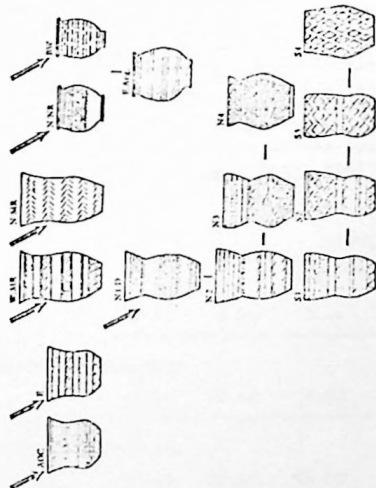


Figure 12. Typology of British Beakers. The arrows indicate the intrusive groups, while the dashed line the three insular traditions (G. Anglian, Northern 1-4) and Southern 1-4). The time-scale runs diagonally from top left to bottom right.

Reproduced from Clarke, D.L., 1970  
Beaker Pottery of Great Britain and Ireland, Figure VII  
by courtesy of Cambridge University Press and the author.

MULTIDIMENSIONAL SCALING

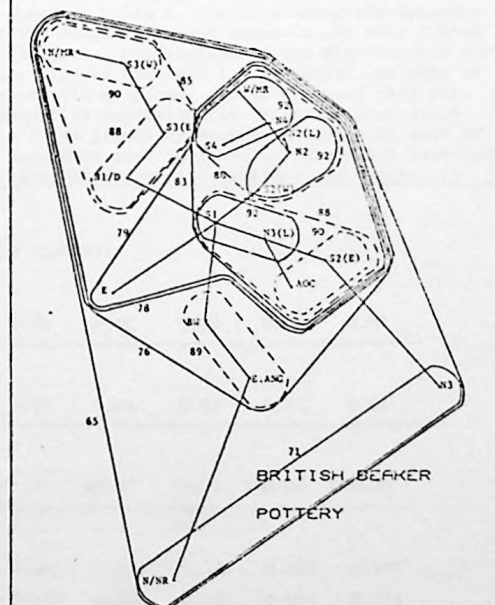


Figure 15. Two-dimensional scaling for British Beaker pottery - profile and size, with minimum spanning tree and contour plot using phenon isopleths to show group formation.



and the depth of the troughs between blocks indicates how different the groups are. The same group of deep bowls Drag.29-45-38-37 appears on the left, joined now by the drinking cup sub-group Drag.27-33. The evolutionary platter sequence Drag.18 - 18/31 - 31 occurs next, and finally there is the anomalous group Drag.30-68, shown to be very different from the rest by the depth of the adjoining trough. The ornamental-rim types Drag.35 and 36 have now been split up, since the mosaic method is far more sensitive to the curved rims than the sliced method.

#### 2.4 Application of the methods to British Beaker pottery

Clarke (1970) in his classic study of British Beaker pottery derived a typology of beakers and indicated the occurrence of intrusive types. His typological sequence is illustrated in Figure 12, with heavy arrows indicating the intrusive groups. On submission to computer analysis based on profile and size using the sliced method, representative beakers of each of Clarke's groups gave results shown in Figures 13-15.

Heavy arrows corresponding to Clarke's groups have been added to the scalogram with minimum spanning tree shown in Figure 14, and it can be seen that in general there is good correspondence, most intrusive groups appearing either at the end of branches (AOC, E, W/MR, N/MR, N/NP) or at marked angles in the minimum spanning tree, showing a lack of smooth evolutionary change (BW, N1/D). The formation of groups is shown by the dendrogram (Figure 13) and the contour plot (Figure 15), which has phenon isopleths to show the level at which groups come together. The computer classification shows that Clarke's intrusive groups can mostly be explained by shape differences alone. The exception is type N3, which in terms of shape is an intrusive type, but placed by Clarke in the Northern sequence on grounds of decoration and other features. Moreover, the Northern and Southern sequences are quite diverse in shape, as is shown by the diffuse scatter of these types across the scalogram.

#### 2.5 Analysis of the Central German Bell Beakers

In the analysis of Central German Bell Beakers in this study the 'sliced' method of profile comparison unmodified by scale or volume has been used. The computer-produced width/height percentages at several positions along the profiles of the pots were also submitted to Principal Components Analysis. By

comparing the results of the two methods, which are further discussed in section 3 below, it is deduced that the uncertainty which arises (for methodological reasons) in automatic base measurement can be a problem. In the computer scan of the profile the lowest point on the outer profile furthest to the left is taken as the base width. This works well with foot-ringed pots, but when the pot is even slightly round-based the lowest point on the base may be very near the centre of the base, even when there is a clearly-recognizable base of some width. It might therefore be better to discount the base measurement, or use a system of differential weights. It seems that, for the Beaker pottery under study, Principal Components Analysis suffices to explain the shape variation in terms of the two simple ratios height/maximum width and base width/maximum width. By examination of the clusters it is further deduced that shape and decoration are related in the Central German Bell Beakers.

### 3. Results

#### 3.1 Methods

Before discussing the archaeological significance of the results it is necessary to discuss the method and the validity of the groups which it produces.

Figure 16 gives the dendrogram, Figure 17 the two-dimensional scalogram with group sizes, and Figure 18 the scalogram with minimum spanning tree. On examination, some of the larger groups seemed rather heterogeneous (e.g. group FG 9 which contains 15 vessels, 3 of which are illustrated in Figure 19). In order to find out the reasons for this, and to obtain a deeper understanding of the criteria on which clustering was based, a Principal Components Analysis was carried out on the descriptive ratios produced by the PLUTARCH sliced method from the digitised vessel outlines. The eigenvalues, eigenvectors, and variance accounted for are shown in Table 1. It is immediately apparent that the first component accounts for over 80% of the variance. Examination of the eigenvectors for Vector 1 shows that all the variables are more or less equally weighted, and it is clear that this component is basically the height/maximum width ratio (as a glance at vessels at opposite ends of the component soon confirms). The second component accounts for 10% of the variance and represents

TABLE 1.

#### RESULTS OF PRINCIPAL COMPONENTS ANALYSIS

EIGENVALUES	8.93	1.14	0.44	0.30	0.09	0.03	0.01	0.00	0.00	0.00	0.00
PERCENTAGE VARIANCE	81.64	10.41	4.03	2.73	0.80	0.24	0.11	0.04	0.03	0.02	0.01
CUMULATIVE VARIANCE	81.64	92.05	96.08	98.80	99.60	99.83	99.93	99.97	99.99	100.00	100.00
EIGENVECTORS - BY ROWS (only first 3 vectors given)											
VECTOR 1.	0.023	0.281	0.311	0.324	0.323	0.319	0.321	0.326	0.326	0.319	0.309
VECTOR 2.	0.898	0.310	0.151	0.022	-0.105	-0.163	-0.154	-0.100	-0.029	0.014	0.034
VECTOR 3.	0.316	-0.565	-0.464	-0.248	-0.030	0.065	0.119	0.172	0.215	0.286	0.355

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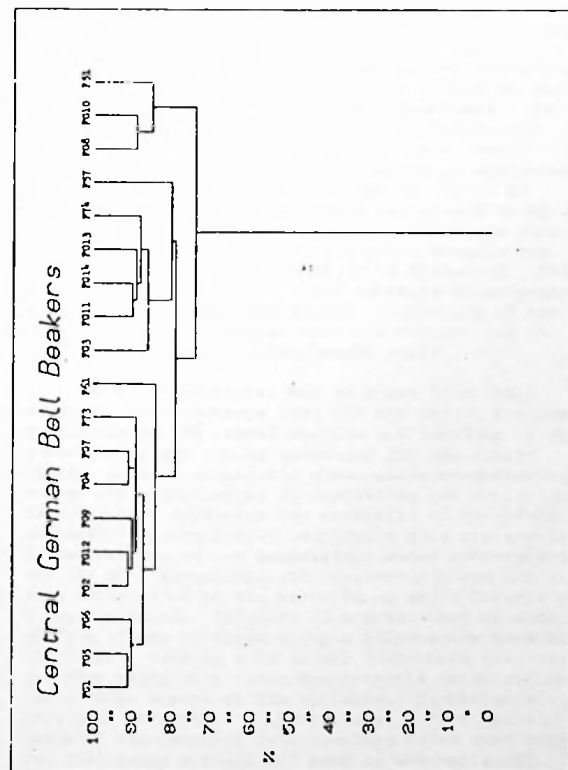


Figure 16. Dendrogram produced by average-link cluster analysis for the Central German Bell Beakers, based on shape alone.

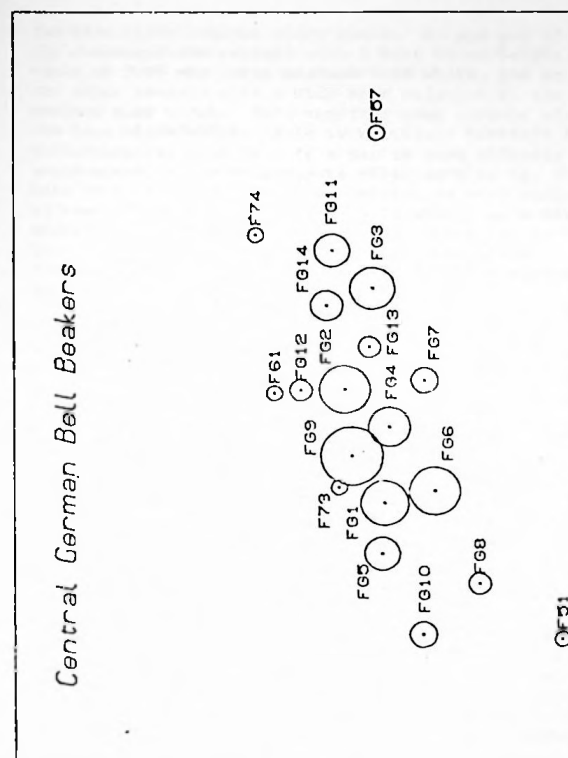


Figure 17. Scattergram for the Central German Bell Beakers with group alone.

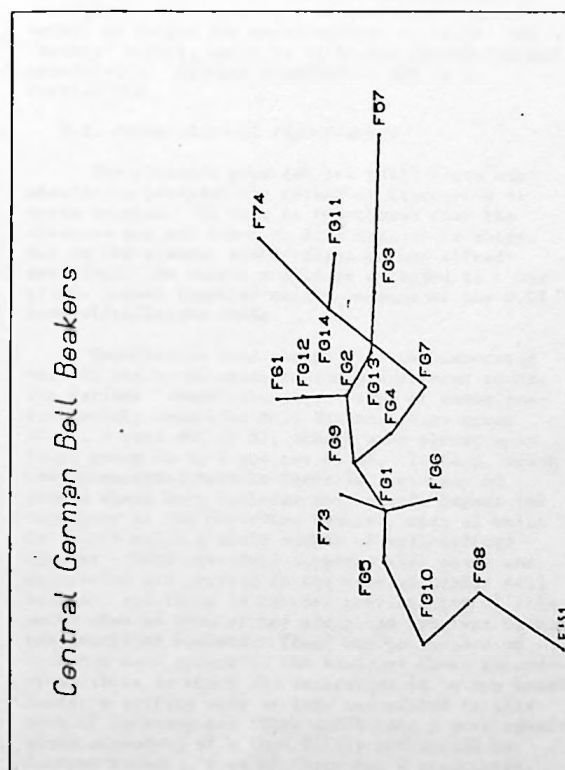


Figure 18. Scattergram for the Central German Bell Beakers with minimum spanning tree.



the base width/maximum width ratio. At one end of the component are vessels with a base width/height ratio of 0.0% and large maximum body width, and at the other vessels with a wide base relative to the maximum body width. This requires some comment since the base width/height ratio is extremely variable for methodological reasons. If a pot is even slightly round-based, as hand-made pots often tend to be, the base will be recorded by the computer as very narrow or even non-existent, and this will appear as a base width/height ratio of 0.0% even when there is, in fact, a clearly recognisable base of some width. Foot-ringed vessels, on the other hand, will always have a meaningful base measurement.

To avoid the problem of the 0.0% base width/height ratios, a second Principal Components Analysis was executed leaving out the base measurement. The main effect that this had was to increase the amount of variance accounted for by the first component to 89.76%. The second component remained the lowermost measurement/maximum body width ratio, but now only accounting for 5.46% of the variance.

The most important fact to notice in both cases is that over 90% of the variance was accounted for by two ratios: height/maximum width and base width/maximum width. It might be objected that this is not relevant to the cluster analysis which was carried out, but this is not the case. Figure 20 is a scattergram showing each of the 90 Beakers analysed plotted against the first two principal components and identified by the number of the cluster to which it was assigned by the PLUTARCH average-link cluster analysis. It may be seen that there is an extremely high degree of correspondence between cluster membership and position on the scattergram. The implication of this is that the cluster analysis has grouped the Beakers more or less entirely on the basis of the two very basic ratios represented by the first two principal components. This is confirmed if we compare the multi-dimensional scalogram (Figure 17) and the principal components scattergram, for which the configurations are very similar (the scalogram should be rotated by 180° to obtain correspondence). The scattergram from the second Principal Components Analysis (Figure 21), with the base measurement omitted, no longer represents a very good approximation to the clusters; this, of course, is to be expected since the clusters were calculated using a Euclidean distance measure which included the base measurement. The groupings are still broadly the same, except for group FG9 which is dispersed. This is very satisfactory as it was markedly heterogeneous, a fact already mentioned above. Inspection of the original ratios suggested that its members had in common the 0.0% base width/height ratio.

Several inferences may be drawn from these results. They indicate that all the detail included by digitising the vessel outline and sampling it at intervals is not really necessary for the Beaker pottery studied since only about three measurements are of any significance in explaining the variation. Secondly they emphasise the potential of Principal Components Analysis when continuous data are available. It enables one to see immediately which measurements are the most important, and consequently one has a much better idea of the criteria on which objects are being clustered. If there is a great deal of data to analyse it may be worth doing a pilot study with all the detail, running a Principal Components Analysis, and then using only those measurements which account for a large amount of the variance. Furthermore, a principal components scattergram is a very useful means of representing relationships given that only two components account for most of the variance,

a fact which can, of course, be established by studying the percentage and cumulative variance part of the print-out. In the scattergram one can look at the variation between individual objects without the abstraction into clusters. If a cluster analysis is carried out, it is possible to see how it relates to the scattergram and to consider different groupings; moreover, distinctions can be made between more and less coherent clusters, and between core and peripheral members of a single cluster.

The scattergram is preferable to the multi-dimensional scalogram (given continuous data) because it can cope with larger amounts of data and thus shows all the individuals and not just a small number of clusters. We have already seen that in this case the two are more or less identical. It is clear that the low stress in the two-dimensional scalogram occurs because only two components account for most of the variance and a two-dimensional representation is therefore appropriate: the greater the number of variables accounting for significant amounts of variability, the greater the stress. This being so, it seems that multi-dimensional scaling is of greatest use when three or more main components are present, or when the data is of a qualitative nature.

In summary then, although overall shape (expressed as a series of width/height ratios) was used by the cluster analysis, the significant factors appear to be measurements at the belly and base only. This is unfortunate because, as everybody knows, it is often small idiosyncracies which are important in recognising similarities and differences between pots, but in the 'sliced' method they are completely swamped by the gross variation. Answers to this problem might be to incorporate idiosyncracies as qualitative attributes, to weight the measurements, or to use the 'mosaic' method, which is of higher resolution and sensitivity. Further experiments are to be carried out.

### 3.2. Archaeological significance

The clusters produced are still worth consideration provided the method of clustering is borne in mind. It must be remembered that the clusters are not based on fine details in shape, but on the several width/height ratios already described. No weight should be attached to those groups joined together mainly because of the 0.0% base width/height ratio.

Examination soon showed that the decorated vessels are by no means randomly scattered across the various 'shape' clusters - some of these contain mainly decorated Bell Beakers (e.g. group FG 11, 4 pots out of 5), others have almost none (e.g. group FG 3, 1 pot out of 8). In fact, among the undecorated vessels there is a variety of shapes which both includes and extends beyond the repertory of the decorated Beakers, most of which fall into quite a small number of well-defined classes. This certainly suggests that shape and decoration are related in the Central German Bell Beakers, and there is further confirmation of this point when we look at the groupings apparent within the decorated vessels. These may be divided up into two main groups on the basis of their decoration: those in which the decoration is in two broad bands, a variety more or less restricted to this area of Germany; and those which have a more equalized ornament, of a type fairly widespread in Central Europe. Each of these has a restricted,



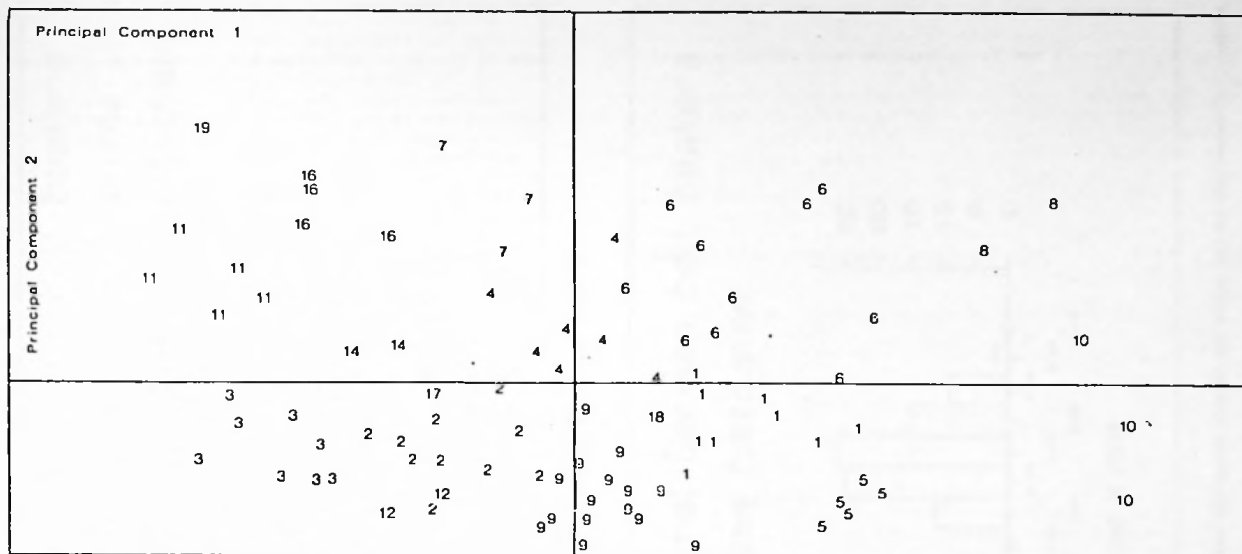


Figure 20. Scattergram showing the 90 Beavers plotted against the first two principal components, each Beaver identified by the number of the cluster to which it was assigned by the PLUTARCH average-link cluster analysis.

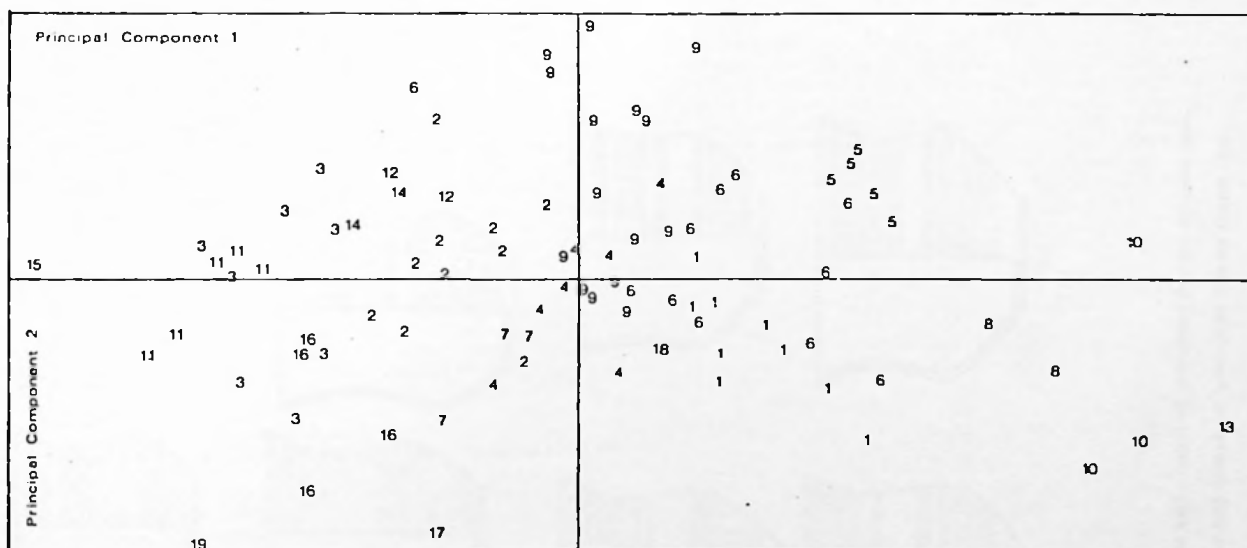
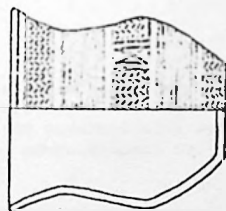
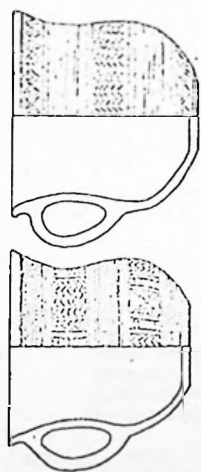
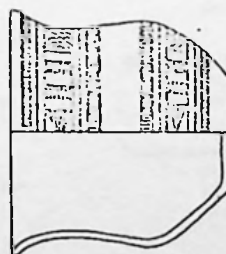


Figure 21. Scattergram showing the 90 Beavers plotted against the first two principal components, each Beaver identified by the number of the cluster to which it was assigned by the PLUTARCH average-link cluster analysis. The base ratio has been omitted in the principal components analysis.





a)



b)

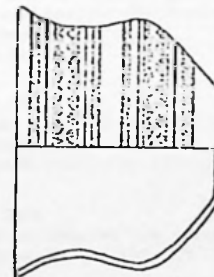
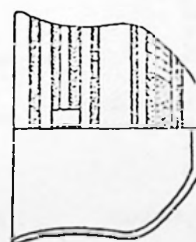


Figure 22. a) Decorated Bell Beakers of widespread Central European type.

b) Decorated Bell Beakers of restricted Central German type.

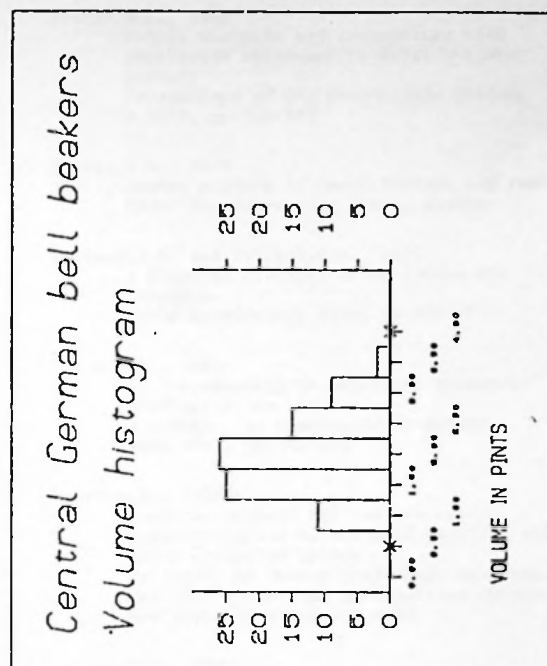
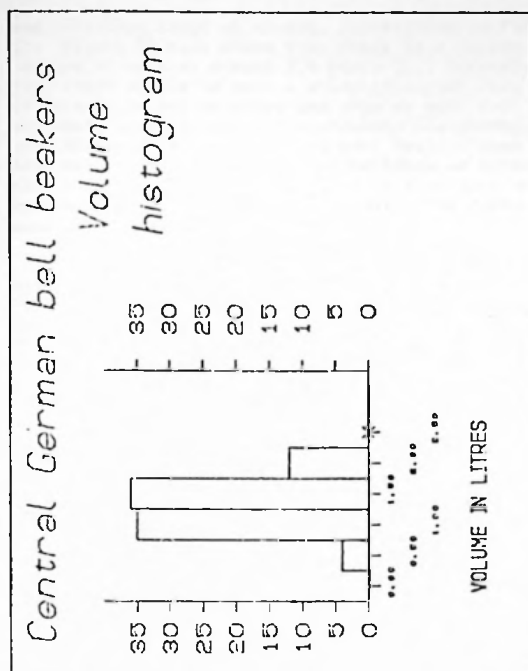


Figure 23. Volume histograms (litres and pints) for Central German Bell Beakers.

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and different range of shapes, illustrated in Figure 22. Figure 23 also shows that there is a concentration of volumes around 2.0 pints (1.1 litres). That there should be such a standardisation, not just of decoration but of shape and size as well is extremely interesting, and emphasizes the strong constraints under which decorated Bell Beakers seem to have been made. It may perhaps be taken as evidence that they were being manufactured by some sort of specialist, although this would have to be tested by such methods as thin-section analysis.

A point which has not yet been considered is to what extent these groups are micro-regional variants. This does not seem to be the case with the groups of decorated vessels, which come from all parts of the Saale valley area. If there were not specialists involved, this suggests a considerable uniformity of interaction over the whole region, although sampling factors may be involved - if there were more vessels available, detailed differences might appear. At present the only sign of such differences is from Schafstädt, a Bell Beaker cemetery of about 20 graves in the middle of the area. Four vessels from this site are clustered in group FG 1; three of these are undecorated, while the fourth is decorated in a way which is also peculiar to this particular site. Although the evidence is slight, it is tempting to hypothesise that there may have been a two-tier pottery system in which decorated Bell Beakers generally followed rigid area-wide conventions, quite possibly being made by specialists, whereas the other vessels were made locally, in locally idiosyncratic shapes which do not vary systematically over space, for reasons outlined above. Such a conclusion, if it can be shown to be valid by further testing, has considerable implications for our understanding of the Bell Beaker 'culture' and its significance; moreover, it fits in with results obtained from work on other aspects of the 'culture', particularly the burial (Shennan, in press).

Here, however, is not the place to get involved in these more general problems. This paper has merely aimed to show the potential which such computer techniques as cluster analysis, carefully used, have for bringing order to large quantities of complex data, and thus developing fruitful hypotheses for future testing.

**ACKNOWLEDGMENTS:** I would like to thank Dr H. Behrens, director of the Halle Landesmuseum, for permission to study and draw material in the museum, and to use his own drawings and card index (SJS).

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