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14 On chronology: pot sherds, house ghosts, and carbonized seeds

Pieter van de Velde

Current practice of the seriation of LBK pottery is analysed in order to overcome the difficulties obtaining with the (seeming) stasis during the Flomborn period, generally resolved by recourse to stages in the development of the houses' construction. A finer resolution of the analytical categories of the pottery decoration allows further chronological differentiation, and that way house construction and pottery decoration become separate and mutually independent categories again. An important result is that the evolution of the central post configuration of the houses is not step-wise but gradual/battleship-like, like any other category of material culture. Also, a series of 8 AMS dates is presented, four of which can be pooled to provide a date of 6204±22 bp; on archaeological grounds the JKV village was established less than a generation earlier, so that 5220 BCE is suggested as the year of the LBK immigration into the Graetheide area and adjacent Siedlungskammer.

14.1 Introduction

The aim of the present chapter is to establish an internal settlement chronology and to relate this to the general, external chronological frame. As in other Bandkeramik villages, stratigraphic analysis is only marginally applicable here as houses and associated features almost consciously seem to avoid overlaps. Instead I will attempt an analysis of changes in the decoration of the fine ware to seriate the associated houses. Previous efforts to sequence Bandkeramik pottery decoration have met with partial success only because of the apparent stasis in the repertoire during the Flomborn or Older LBK period. Recourse has usually been sought in the evolution of the construction of the houses. In a way, apples (decorated pots) are compared with pears (house plans) — a methodologically suspect procedure. By chance, the present settlement was inhabited mainly in that early period so that this apple and pear problem will have to be tackled head on. A closer look at the current practice of pottery decoration analysis will reveal that it is not so much a stasis in the decoration's evolution that is at fault, but rather the coarse and un(der)theorized categories in the analyses. A sharper definition and analysis of the pottery decoration will allow the sequential ordering of the houses, even within the Flomborn period. Apart from this, the establishment of the absolute chronological position is (at least initially) quite straightforward from an archaeological point of view: a selection of carbon samples is sent to the laboratory, and out come the physical dates, if all goes well. However, even the methods of 'science' have their problems —in the present case the conversion of radiocarbon readings 'bp' to calendar dates is complicated by the presence of 'wiggles' in the relevant parts of the calibration.

First earlier classificatory schemes for decorated LBK ware will be dealt with as a basis for the study of pottery decoration, and then an analysis of the Janskamperveld decorated pottery and a relative chronology based on it will be presented. Next I shall discuss relative chronologies based on the changing configuration of the posts in the central parts of the houses; again followed by a similar attempt for the present settlement. Finally the outcomes of a set of radiocarbon determinations will be presented, with the aim of positioning the Janskamperveld settlement in the wider prehistoric and Bandkeramik contexts.

14.2 The analyses of LBK pot decoration: a short review

Analysis of Bandkeramik pottery decoration usually aims at establishing a relative chronology along with a regional differentiation: decorative preferences have evolved over time, regionally in slightly different directions. Similarities indicate synchronicity; recognition of regional styles allows perception of contacts between regions (after Montelius and Childe). These generalities were applied relatively early in Bandkeramik studies, and a vast body of texts on the subject has appeared since. Here ignoring the earliest attempts (e.g., Jenny 1928; Butschkow 1935) and also selectively shopping among recent authors, in Buttler/Haberey's report on the Lindenthal excavations a fair number of pages was devoted to the definition of types of pottery decoration (mainly based on the different fillings of the strips which make up the ornamentation on the pots, yet not neglecting rim decoration), which through careful examination of their mutual association in that long-inhabited site's pits could be assigned chronological significance. Regional origins were considered through archaeological and mineralogical comparison, too (Buttler/Haberey 1936, 92-121). Buttler

deduced that with time the empty decorative strips on early LBK pottery gradually became filled up with an extra line, small points and/or hatchings, and also that the motifs became more convoluted. He signalled some more elements of change and regional differentiation; the 14 authentic LBK strip types distinguished by him became standard tools for generations of scholars (e.g., Meier-Arendt 1966). When Modderman and Waterbolk published their excavations of Dutch LBK sites in the 1950s, they applied Buttler's typology to the finds from Geleen, Sittard and Elsloo, slightly amending two types only (Modderman/Waterbolk 1959). Important from a methodological point was their explicit recognition (all translations are mine, PvdV):

For the assessment of the decorated pottery we have employed the classification made for the finds from Köln-Lindenthal by Buttler. The classification is based upon the type of the decoration, which is most appropriate for the very fragmentary ceramic material from Bandkeramik settlements. The decoration's motifs are not useful as a starting-point, as they are rarely complete.
Modderman/Waterbolk 1959, 173

For his later, still more extensive excavations, Modderman developed this classificatory scheme into the one that was to become most influential in Bandkeramik studies, and which was purely a differentiation of 18 types of strip fillings (Modderman 1970, 121-140, especially the chart on p. 122); as in Buttler's accounts, in the accompanying text rim decoration and secondary motifs were not neglected. This typology was explicitly not intended as a chronological index[1]:

We have very consciously sought not to build a typological chronology… Modderman 1970, 121

but presumably as an aid to description only (my inference, as this is nowhere stated). Yet, in the chapter on relative and absolute dating in that same book (ibid., 192-201) a scheme was presented which had only one possible implication: a relative chronology based on a combination of characteristics of ceramic decoration and house plans — represented by 32 and 7 elements, respectively (ibid., 199).

On the other side of the border, several investigators aimed at refinement of Buttler's periodization of the northwestern LBK (Gabriel 1979; Dohrn-Ihmig 1974). They worked with punch cards on material from earlier excavations but it proved impossible to achieve their aims by hand. At about the same time Stehli was working on an analysis of the first finds to emerge from the Aldenhovener Platte Project (Stehli 1973, 86 n. 42). He left no doubt about his quantitative and statistical inclinations — after all, vast amounts of data were to be expected from that Project. He opened quite programmatically with:

The pottery will be analysed on its characteristics, for which the classification and count of the finds already articulate with storage in a planned database. Stehli 1973, 57

(Remember, this was just before computers became available to universities). And some lines later he added:

In this investigation, the pottery shall serve the purpose of ordering the pits and the houses [at Langweiler 2] chronologically as precisely as possible. ibid. 57

He intended to work with all commonly recognized properties of individual pots (ware, shape, and decoration), yet had to admit that most of the elements were either too laborious to observe on all sherds, or too large to be visible on settlement debris, as had been noted by Modderman and Waterbolk before. Hence, only a small part of the original scope was retained, the "elements of the motifs" (Stehli 1973, 60; I shall refer to this classificatory scheme and its derivatives as the 'Rhineland Model' below). He manually sequenced the pit counts from that settlement to a chronological series. In later publications, accounting for neighbouring settlements, the list of elements (or band types, *Bandtypen*) was slightly amended though not fundamentally so (e.g., Stehli 1988), and the results of the meanwhile computer-assisted analyses of pottery decoration combined with changing architectural characteristics finally allowed the recognition of fifteen house generations along the Merzbach, an impressive achievement. But again, the earlier *ceramic* phases (with their Flomborn/Older LBK attribution) showed so little stylistic variation that the changes in the post configuration of the central part of the houses had to be brought in to differentiate these phases (Stehli 1988, 458; Boelicke *et al*. 1988, 915) — an unacknowledged return to the Modderman scheme of 1970.

Whereas Stehli's work with the Rhineland Model was aimed at establishing a relative chronological sequence only (Stehli 1988, 453), other students have tried to extend the idea of stylistic variation to inter-settlement analyses (again, in a return to Buttler's studies):

Normally, in a seriation of the strip types the stylistic evolution (chronological sequence) is represented by the first Eigenvector [in a Correspondence Analysis]. … In a continuous development the distances between the units are small, whereas a discontinuous evolution is indicated by substantially larger distances on that vector. This rule of thumb is void when apart from stylistic development other factors like, e.g., social structure, have a strong influence on the composition of the units. Kneipp 1998, 93

In the last sentence of this quote, Kneipp hits the nail on the head, though from a wrong angle: social influences are all there is to 'stylistic variation'; there is nothing else — even chronology is but an effect of social change. Thus, there is no *a priori* reason why the time factor should account for the

largest part of the variation in the data as hinted at in his first sentence: that depends on the composition of the data, as correctly noted in the last sentence of the quote. Unless time is reified as a causal factor, every Eigenvector in the outcome of any multivariate analysis should be examined as to its constituents before positing its interpretation. Although Kneipp seems to hint at intra-settlement variation (my reading of his term *social structure*), in the remainder of the book he is concerned with the definition of stylistic groups with chronological content, and the determination of regional styles in the area between Rhine, Weser and Main. In Germany, several more analyses of the mixes of pottery characteristics in Bandkeramik settlements have been made, all with the same aim of defining stylistic groups and chronology; most notable is Frirdich (1994), who based on the same data came to very similar conclusions as Stehli, so providing a confirmation of that work. Also, Krahn (2003) and Claßen (2006) should be mentioned here; apart from the regular chronological concern with band types, they shifted attention to the secondary motifs to investigate communication and marriage patterns within and between the Rhineland LBK settlements.

One other development in this field should be noted here. In Czechoslovakia in 1956 Soudský started the investigations at Bylany, later directed by Pavlů, which with few interruptions continue up to the present. The first results were made public in 1960, and comprised a quantitative analysis of the decorated pottery for the purpose of a site chronology (see Pavlů 2000, 1-3 for the history of that project, and the references). Research interests gradually shifted towards wider pursuits, and in the most recent publication the chronology is hardly discussed, figuring merely as a backdrop for social and ideological inferences, more often than not grounded in distribution patterns in time and/or space of decorative characteristics. One example should suffice:

> *It would be more acceptable to explain the line shape and its symbolic value as an index of kin groups, as has been proposed for the central motifs … the order of these motifs is less chronological than sociological, and comprises a genealogy of the Bylany site's two lineages.* Pavlů 2000, 167

The text describing Bylany's pottery is replete with this kind of inferences, often quite specific, sometimes more general, providing well-founded explorations of what more can be read from pottery decoration than chronology alone.

14.3 The analyses of LBK pot decoration: on methods

The above discussion shows that several archaeologists have considered Bandkeramik pottery decoration as a venue into relative chronology and prehistoric social structure, although they differ in the scope of their aims. Most have been content with the definition of regional groups of pottery decoration presumably mirroring tribal affiliations or something of that sort, some have inquired into local structures, explicitly assuming group/socially conditioned preferences in the field of pottery decoration. From the substantial effort necessary to establish regional traditions (e.g., Dohrn-Ihmig 1974, Stehli 1994, or Kneipp 1998) it can be inferred that to arrive at the even more detailed intra-site level, intricate and probably quite extensive analyses are required.

Almost thirty years ago I proposed yet another, though conceptually quite different classificatory scheme for Bandkeramik pottery (Van de Velde 1976; slightly amended in Van de Velde 1979, 1-25). It started as a reaction to the obvious shortcomings of previous classificatory schemes, including that of Modderman discussed above. To me, an important flaw of those classifications is their 'open' (inductive) character (Claßen 2006, 189), which means that no conclusions are drawn from the logical relationships governing the design or structure of the decoration. Rather, the schemes are based on the local variation, adding 'classes' as new material is excavated which does not fit — as a consequence, one never knows whether all variation in the data has been incorporated (one recent application of the Rhineland Model defined eight hundred (!) characteristics, with coding instructions requiring a full 54 pages; Kneipp 1998, 215-269). Another major flaw has been the general avoidance of the question of the relationship between research interest and classification — most clearly illustrated by Modderman's explicit denial of chronological intentions while developing his scheme, and the subsequent, just as explicit, use of it for chronological ordering without acknowledging this methodological shift[2]. And although Stehli was quite programmatic about his chronological intentions, he has nowhere discussed (at least as far as I am aware) the reasons behind the incorporation of at first some thirty-plus traits, and later adding 150 traits — I mean: why specifically this set of elements, and why not another one? Even if it were true that it is impossible to know beforehand what is chronologically relevant (or relevant for the delimitation of style groups, or the relationships between social groups, or whatever), a pilot study would presumably clear the field substantially. To put it simply, previous studies could be used as pilots — e.g., the Lindenthal publication by Buttler is full of chronological conclusions (Buttler/Haberey 1936).

It is my considered opinion that the decoration on the pottery of a group has a logic that can be fleshed out and understood. Being a relatively bounded cultural field, a well-worn tradition like LBK pottery decoration is unlikely to be deficient in this respect. Still, I suspect that the Stehli classificatory scheme/Rhineland Model was designed fully aware of this problem without openly coming to grips with it:

… possible interdependencies of rim and strip motifs interfere with the gravity point calculation since two characteristics would be counted separately which in reality rest upon a common factor. When such stylistic or even functional dependencies can be excluded, nothing can be held against a joint ordering in a single matrix of different kinds of characteristics. The point is to catch temporal change through the changing combinations of characteristics which vary independently of one another.

Stehli 1973, 85

As a consequence, the Rhineland Model was fitted with as many different 'types' as intuited on the pottery at hand, although no definition of the concept 'type' was given. As can be demonstrated easily, this early Model and all its later derivatives (including Kneipp's scheme), are quite deficient as many more 'types' will turn up in further excavations. As an example, and restricting myself to Stehli's 1973 chart with types of rim decoration: that decoration is made up of either lines, small points, stab-and-drag small points, finger impressions or small hatchings (five alternatives); they come singly or paired (theoretically providing two alternatives); they occur in one, two, or three-or-more rows (three alternatives); their direction is undetermined, horizontal, oblique, or vertical (four alternatives); and they are either continuous around the rim, or metope-like partitioned (two alternatives). Together they make $5 \times 2 \times 3 \times 4 \times 2 = 240$ possible combinations, of which his 39 types (also including the undecorated rim) are but a partial sample (cf. Stehli 1973, 69). Four or five simple and mnemonic variables each with a small number of attributes instead of 240 separate 'types' would have described *all* possible alternatives.

Returning to my conviction that there is a logic behind LBK pottery decoration, I proposed a simple reduction of the decorative motifs on Bandkeramik pots to wave and spiral basic forms, developed according to reflection, rotation, translation and glide, together constituting an algebraic group (an *algebraic group* implies that *all* possibilities of variation are exhausted in it) (Shepard 1954, 266-276; Washburn/Crowe 1988, 44-51). So far, I have not found any LBK design outside this group[3]. For instance, in Pavlů's analytical scheme especially this dimension and its format have been adopted for the elucidation of social relationships (Pavlů 2000, 151/D, K). Similarly and as a further example, a motif is executed either in a rectilinear or curvilinear format — rectilinearity of course being restricted by the round form of the pot belly — no other possibility is conceivable.

The other major flaw in existing schemes is the relationship of the research question to the aspects or dimensions entered into the classification. If every imaginable dimension of pottery is to be incorporated in order to answer all possible questions, the required set of characteristics would be infinite: there is some real reason for selection here. In the present analysis I have two research questions: the relative chronology of the site, and the definition of and relationships between social groups in the Janskamperveld settlement. As for the first problem, already in Modderman 1970 a set of traits is indicated which are sensitive to chronology (or, rather, which are indexing change over time). Obviously, more or less change over time will be visible in all aspects of pottery decoration, stagnation is nowhere to be expected; yet some aspects vary directionally, while others behave haphazardly. Based mainly on Modderman's observations, obvious candidates in the Graetheide LBK for directional change are the dimensions of techniques of decoration, and complexity and contents of design.

Regarding the techniques of the decoration, I sought to define them exhaustively as there are only five logical possible ways to decorate a pot's surface (Shepard 1954, 69; Sinopoli 1991, 25-26) of which incision is by far the most frequent in Bandkeramik ceramics. Also, the incisive tools with which the surface has been modified had either one single or a multiple (comb-like) point, the latter being an addition rather late in the LBK era. Thus, the members of this class are sticks, simple and multidented spatula, plastic moulding with either finger imprints or an appliqué. The quantitative composition of the tool set shows variation over time, as does the complexity of the decoration. Still according to Modderman, the zonation of the decoration shows marked changes: early in the Dutch sequence only the belly zone of the pots is decorated, while towards the end of the older phase also rim zones gradually become decorated; at the end of the LBK these two zones are filled in on all decorated pots (Modderman 1970, 193). Another aspect of the complexity of design is the contents or density of the decoration; the (perhaps too simple) idea being that the strips change from simple lines to bands to filled-in strips. Rather it seems to be the case that in this northwestern LBK-region, different components go through different popularity cycles. Thus, excepting the very youngest pottery, lines are nearly always present in the decoration, almost exclusively so in the earliest sub-phase, dominant somewhere in between, and from present to virtually absent in the end. Apart from the lines, the relative number of small point impressions increases at first, and later falls off due to the introduction of hatching to fill in the strips (this same phenomenon of popularity cycles is called "stylistic phases" in German analyses, although combinations with other aspects of the designs are then also involved). Especially these "components" (as I called them in my 1979 publication) are easy to observe on even minute sherds, and also the tools with which they were applied, so together they constitute a dependable basis for inferences regarding relative chronology.

Several more variables/dimensions in the pottery decoration were defined in my text. In the accompanying table 14-1 their visibility in the present site is listed, i.e., the proportion

variables	valid	invalid	% valid	count
total reference	194	0	100	1597 pots
		GENERAL		
techniques	194	0	100	1934 motifs
numericity		n.a.		
zoning	130	64	67	544 pots
		BELLY ZONE		
structures	179	15	92	1405 motifs
basic motifs	34	160	18	87 motifs
developed motifs		n.a.		–
auxiliary lines	129	65	66	728 motifs
fillings	166	28	86	1065 motifs
angle of fillings	128	66	66	535 motifs
ends of strips	83	111	43	275 motifs
secondary motifs	91	103	47	309 motifs
components	194	0	100	12731 comps
		NECK ZONE		
neck decn. fillings	70	124	36	147 motifs
neck decn. components	78	116	41	1155 comps

table 14-1 visibility of attributes of pottery decoration in the Janskamperveld settlement debris
valid: the number of features; n.a.: no summary data available

of the finds or motifs that allowed observation of the individual variables. Whereas the original classification had been designed with an eye to the analysis of the generally complete pots from cemeteries, in settlement debris like that from the Janskamperveld, the recognition of most variables is difficult as shown by the table. For, although the column "% valid" suggests a reasonable quality of the data, these figures refer only to the features (units) which yielded *some* observations. A more appropriate index for the quality is provided by the final column, which shows the numbers of motifs (pots, sherds, components) that could be scored for the respective variables. For instance, 34 features (17% of all units) yielded data on the basic motifs; however, the number of identified basic motifs is only 87 out of a total of 1405 motifs registered: a little more than 6% (table 14-1). From the table it is shown that *techniques* of decoration, *structures* (recti- and curvilinearity of the designs), and *fillings* of the strips and the *components* of the decoration provide the best data. *Zonation* of the design and the occurrence of *auxiliary lines* are less visible, with the other variables faring even worse in this respect. The dimensions just mentioned have been used to establish a relative chronology, and as indexes of social structure.

14.4 The chronological analyses of LBK pot decoration: on statistical techniques

In LBK settlement analyses, most attention is generally paid to the finds from the long pits (German *Längsgruben*) adjacent to the houses, presumably directly connected with the habits of the inhabitants. It is supposed that these pits originated as loam quarries for the adjacent house when it was being built, and were subsequently used as refuse dumps by the household inhabiting it[4]. On empirical grounds the estimates of the use life of the pits and of the life span of the (wooden posts of the) houses are always equated with at least one human generation (e.g., Stehli 1973, fig. 14-55, p. 99). Most investigators turn to the contents of the long pits as units of analysis without much discussion of post-depositional processes (e.g., Modderman 1970, 121). It should be noted that mainly 'secondary' refuse has been assembled in these pits (i.e., waste produced not on the very spot but elsewhere and then deposited in the long pits). Moreover, nothing but waste is found in them, and no useful objects, suggesting 'curate behaviour' by the Bandkeramians (LaMotta/Schiffer 1999). Certainly the suggested relationship between the house's inhabitants and the contents of the long pits along the houses is less than one-to-one, and waste from elsewhere will also have been thrown into them. Finally, as long as the village site had not been abandoned, through the actions of LBK children, swine, mice, and moles post-habitation objects may have entered the long pits, even if these had been filled up already (Stäuble 1997). Which means on the one hand that the archaeological material from these pits cannot be fully representative of the household utensils, and on the other that noise can be expected obscuring whatever structure there is in the data. It appears though that on the Janskamperveld the pits associated with houses tend to contain about 30% more decorated sherds than the other pits (cf. the chapter on pottery) — which may at least be interpreted as a confirmation of a link between the household and that type of pits; noise and structure will be dealt with shortly.

Earlier investigations like those of Buttler and Haberey's or Modderman's have established relationships between chronology and pottery decoration: some strip types occur in a restricted number of sub-phases only, whereas others have wider references. Since most settlement analyses, including the present one, aim at an overview of the history of the site, perhaps the best way to achieve this is by arranging the contents of the different features on the site through what in German is called the *Schwerpunktverfahren* (sequencing the points of gravity). The central idea is that characteristics ('types', 'classes', and the like) are continuously distributed over time while in use; they start to be replaced gradually by alternatives somewhere during their life time. In Stehli's somewhat obscure words:

In the period in which a pit is filled, i.e. when the pit is open, there are popular and less popular strip types. Leaving aside non-chronological factors [SIC] then the rare types represent either trailings of earlier current types or the beginnings of types that will flourish in the future. The common strips get into the pits with a higher probability than the not so common ones, and therefore are more determinant for the position of the gravity point in the matrix. Common strips also get deposited more often, therefore the largest quantities should be found in the vicinity of the gravity point. The gravity point thus falls certainly in the time range that the pit's fillings were assembled. Stehli 1973, 89

Therefore, if the assemblages from an excavation could be arranged in the correct chronological order, the incidences of the characteristics should be concentrated in time (hence the English name of the technique: sequence dating). Originally the idea was developed at the end of the 19th century by Sir Flinders Petrie in his analysis of an Egyptian predynastic cemetery. While this was performed entirely by hand, in the 1960s a more formal, matrix-algebraic approach was elaborated by Goldmann and Kendall and appropriately coined "Petrie concentration principle" (Graham 1973 provides references). An early implementation in Bandkeramik studies has been given by Stehli and Graham for the analysis of the decorated pottery from the Langweiler 2 site (Stehli 1973, 87-88; Graham 1973). In both Graham's and Stehli's analyses the concentration points are calculated across all available characteristics / 'types', and thus depend critically on the non-theorized and undiscussed investigator's selection of them. As ever, the outcome is fully dependent upon the input, and addition or omission of characteristics in the analyses of the find complexes has consequences for the results: the algorithm duly produces an ordering of the finds, although it is not clear what is represented by the ordering (cp. Schwerdtner 2007 *s.v.* "Deutungen"). Simply stating that the ranking is a relative chronology (as in Stehli's and Graham's accounts) is not sufficient:

… successful diagonalisation of a contingency table is in itself no warranty for a chronological ordering… Ihm 1983, 8

Clearly, time is not an autonomous variable in the data; change/difference (the usual measure of time, but also of spatial separation) is predicated upon social and ideological factors[5]. Status differences, personal preferences, economic differentiation may each and all have been more important for the composition of the assemblages than change in either of them.

Certainly, social relationships are changing with time, *though not in a causal way*; but the 'looks' of things change with time, again not in a causal way: present houses differ from those built a few decades ago, as do houses built in poorer and wealthier districts, but they are houses all the same and the differences have nothing to do with time. Changing relationships, changing habits all cause differences, and only some of the differences are primarily indicators of chronologically consistent trends in social relationships while other differences are primarily indicators of spatially consistent trends in social relationships. Therefore, analyses which assume that all typological differences are interpretable as chronological differences (as in the *sequence dating* procedures described above) cannot fail to produce invalid results, yet even Baxter (2003) has no discussion on this topic. What is needed, therefore, is an analytical technique which allows an interpretable differentiation of the variation in the data on whatever dimension with sufficient observations, in this case in the pottery decoration.

Since early in the 20th century, statisticians have been working on the theory of multivariate analyses of data matrices; the Petrie concentration principle was but one of the first instances. As long as electronic computers were not available applications remained largely restricted to small data sets, only to explode after these contrivances became available (Harman 1967, 3-5). The basic idea of multivariate analysis is that in every more or less coherent set of empirical data co-varying patterns can be disclosed through matrix operations. These patterns, called 'factors' or 'axes' are nothing but mathematical / statistical constructs; their aim is to describe observed data as succinctly as possible (technically: 'data reduction'):

This aim should not be construed to mean that [multivariate] factor analysis necessarily attempts to discover the "fundamental" or "basic" categories in a given field of investigation … rather it represents a simple, straightforward problem of description in several dimensions of a definite group functioning in definite manners, and he who assumes to read more remote verities into the vectorial outcome is certainly doomed to disappointment. Harman 1967, 5-6

That is, a data set comprising 'many' variables is reduced to a much smaller set of 'underlying' factors; routinely computer output of any of the available techniques presents the correlations of the original variables with ('loadings on') the different newly derived factors. It is these loadings which are invoked to arrive at an interpretation of the several factors. Thus, in a Principal Components Analysis (one of the many multivariate techniques) of LBK pottery decoration, a factor may turn up with high loadings for variables we have learned to consider as related to chronology, such as presence/absence of rim decoration, simple or multidented spatula, and various basic components of decorative elements, etc. The other variables will show minimal affinities to this factor, while loading on other axes instead, begging other interpretations. It may thus be possible to propose sociologically relevant factors 'behind' the pottery decoration.

If the only interest is a relative chronological ordering of the data, it is important to enter chronologically relevant variables into the calculations while leaving out non-relevant ones as these obscure rather than clarify patterns. Most multivariate analyses allow such a heuristic use in that patterns in the data ('data structure') are revealed in the grouping of the variables (each group a 'factor'); they also provide the relative weight of the several factors, a measure of the part of the variation in the original data covered ('explained') by the individual factors (see also discussions in Pavlů 2000, 14-15, 22-23, 90-91, etc.). So, in one data set the time factor may account for over half of the variation, whereas in another its contribution may be small or negligible (such as when there are no chronologically relevant variables in the data set, or when status or gender differences are so important as to swamp all other variation). Once a sought for combination of variables has been identified (i.e., those contributing jointly and importantly to one factor), the analysis is repeated with only these variables, thus eliminating most of the contamination ('noise') by non-relevant variables. The resultant ordering of the units (according to their *scores* on that factor) should be a better approximation of the desired result than is the summed effects of all variables.

14.5 An analysis of the Janskamperveld LBK pot decoration: chronological implications

In the excavated part of the Janskamperveld settlement decorated pottery occurred in 192 features. The decoration was described by means of the above classificatory scheme with the pit as analytical unit, and entered into a database. Figure 1 shows the distribution of the numbers of motifs per pit, the basis of the analysis below. From the outset the informative content of small finds is uncertain, as 'noise' (by sherds lying about on the site and accidentally having been tossed into the pits) and 'signal' (purposively dumped household debris) cannot reliably be separated. In the case of larger finds the effects of the first are effectively dampened by a substantially larger amount of the latter. Pits with few motifs will be omitted from the analyses; as an illustration, in the figure the threshold value has been set to the median count of four motifs per unit.

The first problem to be dealt with is the determination of the attributes relevant to chronological ordering. Finds with less than the median value of four motifs were omitted for being possibly too noisy (in the sense discussed in the previous paragraph), and the remaining 96 units with 1747 motifs were subjected to a general principal components analysis. The main objective was heuristic (Baxter 2003, 17), i.e., to confirm the above ideas about the chronologically relevant attributes in this body of data. The computations suggested four principal components as underlying descriptors of the data, together accounting for 85.1% of the variation in this body, individually 52.5%, 14.5%, 11.7% and 6.5%, respectively. Figure 2 shows the relationships of 16 attributes to the first two components as derived from the calculations. On closer inspection, there is indeed an association of precisely those attributes already considered as

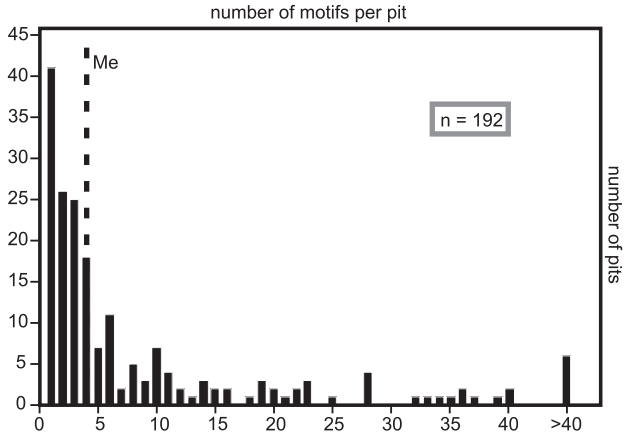


fig. 14-1 the number of motifs per feature
Me: median

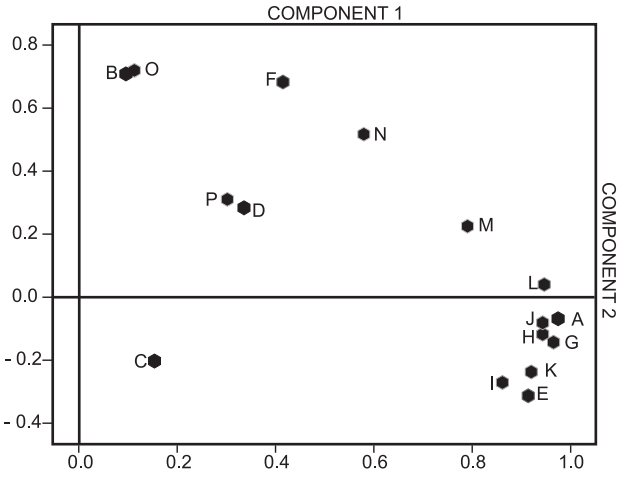


fig. 14-2 Component plot of general Principal Components Analysis
Component 1 accounts for 52.5% of the variance, Component 2 for 14.5%

A: simple spatula
B: multidented spatula
C: grooves
D: finger impressions
E: no neck decoration
F: with neck decoration
G: curvilinear motifs
H: rectilinear motifs
I: no auxiliary lines
J: with auxiliary lines
K: strips not filled
L: filled strips
M: log (no. of lines)
N: log (no. of pointlets)
O: log (no. of hatchings)
P: log (no. of finger imprints)

chronological candidates with multidented spatula (B), presence of neck decoration (F), and hatchings (O) situated close together, as are their logical counterparts simple spatula (A), absence of neck decoration (E), and the number of lines in the decoration (M), with the number of small points (N) neatly in between these two groups of attributes. The attributes just mentioned are roughly positioned on a line running obliquely from top left to bottom right, and thus indicative of association with *both* components in the graph[6]. The distribution of the other pairs of variables is rather clumped per set, and their interpretation should accordingly be different. It may therefore be concluded that in the Janskamperveld repertoire of pottery decoration no more (nor fewer) attributes are chronologically relevant than known from other sites in the Graetheide region.

Having established the chronologically relevant variables in this data set, I hoped that notwithstanding the Flomborn appearances of the larger part of the Janskamperveld pottery a quantitative statistical treatment would be more discriminating than a qualitative one like Modderman's scheme and that a relative chronology would result which is based *exclusively* on pottery decoration. A rereading of an early text of Lüning´s was my inspiration:

For the description of time slices combinations of characteristics and types should serve, [as] singly they cannot be ascribed to the finest subdivisions of … a chronological scheme. The sharpest subdivision is attained when not only presence or absence, but also the quantitative relation of attributes and types are analysed and changes in these relations can be interpreted as chronological after the elimination of other possibilities. Lüning 1972, 213

The scores of the 96 features on the first component, the chronological axis, then shows a dense cluster of closely packed units with a small number of outliers probably because of the remnant 'noise', but also because the second component played a (small) role in the chronological variation.

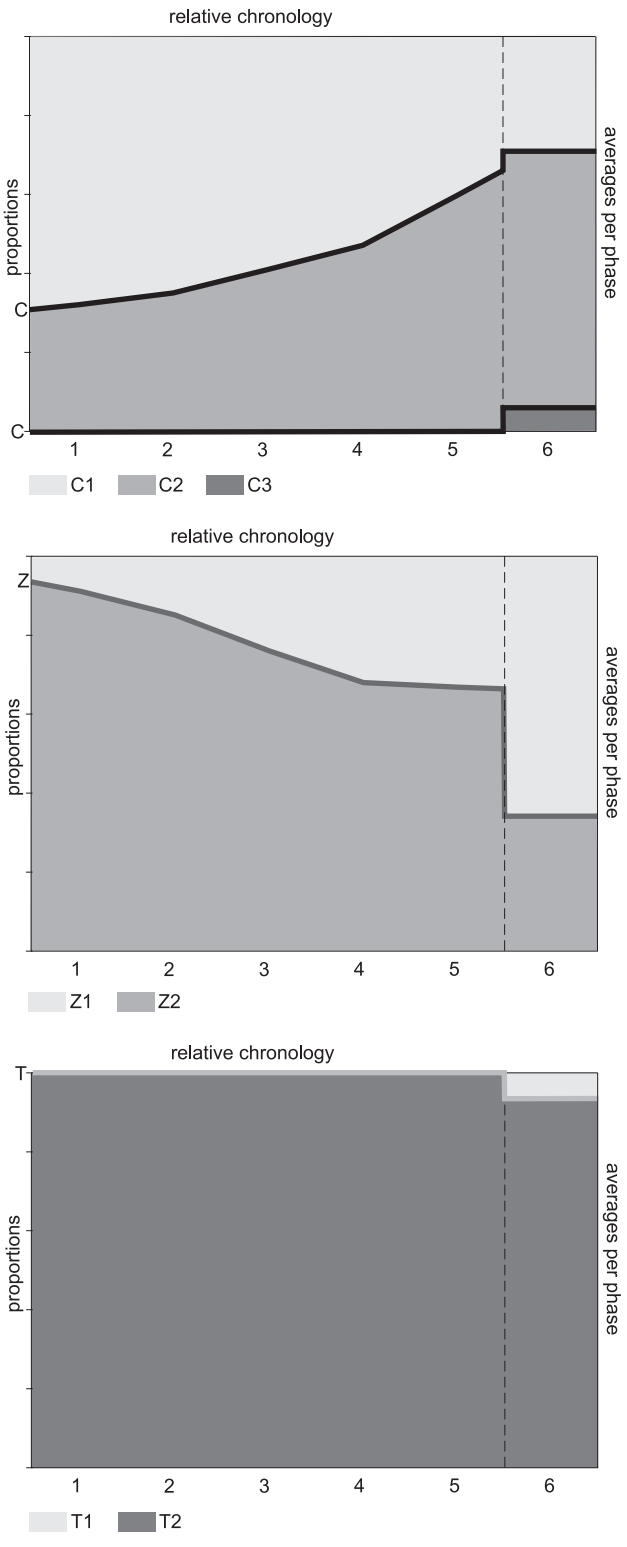
On closer inspection it appeared that the larger finds were rather evenly spread, and this suggested an analysis of only their chronological possibilities[7]. If a convincing ordering could be established for these larger units, then the smaller finds could hopefully be related to this grand picture afterward. Also, the raw counts were recoded to proportions per variable (thus: 2 pots without, and 4 pots with rim decoration in the same unit, were translated to 2/(2+4) = 0.3 and 4/(2+4) = 0.7 respectively) — which much enhances comparability. For statistical reasons, an absolute minimum was set of at least six observable *rims*; even then uncertainties about the proportions ranging from 0.1 to 0.35 have to be allowed at a 95% level of confidence. A higher threshold was impractical in this set of data as too few finds would be left to base generalisations on. Similarly, minimal counts of more than ten were set for the dimensions of *techniques* and *components*, which in practice proved redundant, as with six or more rims in a feature the other counts attained much better values than these thresholds. The sample of units thus defined contained 28 features (the very best in the lot, together numbering 2309 sherds from 947 pots), and this was the basis for a principal components analysis from which the chart of fig. 14-3, table 14-2, and the generalisations and specifications below have been derived. In this analysis, the time vector accounted for 58.3% of the variance in the relevant variables (the next two principal components took 18.4% and 12.5%, with no apparent relation with the chronological attributes).

From this component the passage over time of the different attributes of the decoration has been calculated, keeping to the ordering provided by the time factor, and grouping the finds to approximate equal numbers of pots per phase into six 'ceramic phases' (respectively numbering 1, 5, 6, 6, 5, and 5 units, in an attempt to equalize the numbers of pots between them).

The results of this computation initially suggest a *continuous* development, simply because it is a best ordering of the coded data. However, in the final, sixth, phase two innovations occur simultaneously (multidented spatula, and hatched decoration), while also the share of decorated rims nearly doubles; changes in the other variables are less impressive. Already during the excavation a discontinuity in the use of the site seemed likely, with many of the houses and finds pertaining to the Older Period, and there are also a few from the Younger Period, with nothing in between. Discontinuous development of pottery decoration

ceramic phase	techniques		rim decoration		components		
	singledent	multident	absent	present	lines	pointlets	hatchings
1	1.00	.00	.9	.1	.68	.32	.00
2	1.00	.00	.8	.2	.64	.36	.00
3	1.00	.00	.7	.3	.57	.43	.00
4	1.00	.00	.7	.3	.52	.48	.00
5	1.00	.00	.6	.4	.42	.58	.00
6	.95	.05	.3	.7	.29	.63	.08

table 14-2 changes in the proportions of chronologically sensitive elements of pottery decoration at the Janskamperveld settlement (cp. fig. 14-3)



(a necessary correlate of discontinuous habitation) should show up in larger and smaller *coincident jumps* in the values of the several variables (Van de Velde 1979, 42-45; Kneipp 1998, 93). Clearly, the calculated values can be depicted so as to show simultaneous jumps of most variables from the fifth to the sixth phase, especially marked by the appearance of multidented spatula and hatched components in the decoration and a doubling of the share of decorated rims, while the other variables show smaller changes (fig. 14-3).

Prior to that gap, the Older LBK decoration shows *gradual* changes: the preponderance of line components over small points shifts slowly to its reverse towards the fifth phase and although no innovations are introduced the percentage of decorated rims increases appreciably; while as a contrast the single-dented spatula remains a constant in the execution of the decoration. In these five phases, the evolution of the three chronological variables is almost model-like as if decorated pottery was deposited at this site without serious interruption. The data behind the plot in the figure are presented in table 14-2.

The main trends in pottery decoration in the Janskamperveld settlement are clear, as is demonstrated by the numbers in table 14-2. On the variable *techniques* the multidented spatula is a rare phenomenon in this data set, being introduced only late in the sequence, and even then a by far larger part of the decoration is executed by means of the simple single-dented spatula. The *components* of the decoration show some slight evolution in the early phases: in the beginning of the sequence up to two thirds consists of lines with only a few small points added; the latter component increases to well over half[8] over time; then hatchings appear on the site's pots, simultaneous with the introduction of the multidented spatula. Perhaps the most dramatic change in this repertoire is to be seen in the frequency of undecorated *rims*: from (almost) exclusivity in the earlier phase, dwindling to approximately two thirds in the fifth phase, and to jump to a third of the pots recorded here at the end of the scale. The attributes of the *techniques* variable contribute to a chronological differentiation only in the youngest phase, yet their observability and their numbers are sufficient to warrant specification in the table of up to two decimal figures, which is lamentably not the case for the variable with the steepest evolution, *zonation*. There, low numbers hamper attribution because of wide confidence limits; yet here, as ever the best guess is of course the observed value.

fig. 14-3 trends of pot decoration in the Janskamperveld LBK
(top diagram) C: components (1: lines; 2: pointlets; 3: hatchings)
(centre diagram) Z: zonation (1: with rim decoration; 2: no rim decoration)
(bottom diagram) T: techniques (1: simple spatula; 2: multidented spatula)

The figures listed in table 14-2 are based on the larger finds, and were meant to allow chronological attribution of the 166 other, smaller finds. The main problem then is that small samples have large confidence ranges, and mechanical attribution is therefore likely to be no better than simple guesswork (which was also the reason to omit small finds from the previous computations). Yet, the sheer quantity of these second-rate data is an invitation not to leave it at that as there may be some little or sometimes even considerable information hidden in it. As a matter of fact the attributes of the *components* variable exhibit considerable and directed change; moreover, these attributes always show the largest totals per find and they are always visible — if not, there is no decoration on the pot. That they come up with the largest totals implies that the confidence range is comparatively small around the observed value on this variable, so when the number of rims in a find is too low, the components may still point to a conclusion.

E.g., when a total of 15 lines and 5 small points has been counted in a unit, the proportion of small points in the sample is 5/(5+15) = 0.25. The 95% confidence limit can then be computed as ±0.18, which means that the sample has been drawn from a 'population' in which the proportion of small points is anywhere between (0.25 - 0.18) and (0.25 + 0.18), or 0.07 and 0.43; in 95 out of a hundred cases. Re ferring these proportions to table 14-2, it can be seen that the exemplary find belongs to any of the first three phases, with the first phase (being closest to the observed value of the sample) as best guess.

To apply the tendencies shown in the table to the smaller finds, scores on all three variables should be considered, weighted according to their respective total numbers. The total numbers should be referred to sampling theory, in order to estimate the confidence limits, which will provide an idea about the value of the determination; here I put my ambition rather high with a 95% level (a similar procedure was followed for hooking the finds from the Königshoven group of settlements, to the NW of Cologne, to the larger Rhineland sequence; Claßen 2006). For the Janskamperveld finds, a rating of the qualities similar to the one used in the chapter on houses was used; thus, whenever confidence limits soared to ±0.3 or more, the find was accorded a *w*-index of 1 or even 0; between ±0.2 and ±0.3, $w = 2$; from ±0.15 to ±0.2, $w = 3$; and better ranges were given an evaluation of 4. When one of the variables had not been scored (no rims in the find, for instance), rates were lowered one point on this scale. On the other hand, given that sample values are always the best available estimate of the population, small counts coinciding with a phase spectrum have been rated higher. A summary is presented in table 14-3.

As could be expected, most (smaller) units have been assigned to the two extreme phases; these are the finds with entries for either line or small points decoration only. As noted earlier the components of decoration are generally best preserved and visible in the archaeological record, and since thin-walled pottery tends to break on incised lines, their over-representation (leading to an attribution to the first phase) is an annoying artefact of this procedure. Conceivably, these (50 or 60) lowly classed units should be re-distributed over all phases as small finds occurred throughout the sequence — since it cannot be specified which of these units should go where in the sequence, it serves to put into perspective the low-valued chronologically extreme attributions by means of the decorated pottery.

	w-index					
phase	0	1	2	3	4	totals
1	56	14	2	8	1	81
2	3	2	0	6	4	15
3	1	4	1	3	6	15
4	8	3	1	4	6	22
5	3	3	0	6	5	17
6	12	6	14	9	3	44
totals	83	32	18	36	25	194

table 14-3 summary of the quality of the chronological attribution of all features with decorated pottery

It is here that I have to add another cautionary remark. The finds from this excavation were collected without regard to the stratigraphy — which in most cases was difficult to perceive, if at all. In a number of instances, however, secondary (and later) fillings have been noted on the section drawings, and sometimes problems with the ceramic dates (as when apparently old type houses are seemingly associated with younger phase finds) can thus be explained. For instance, decorated sherds from kettle pit 13100 yield a sixth ceramic phase indication. This pit probably belongs to house 12 which shows a clear Y-configuration and should therefore have a much earlier attribution (as also indicated by several other pits around this house). An AMS measurement on grain from the second layer in the pit similarly yielded a quite early date. In this case the complications can be spelled out, in most others not.

14.6 Addendum: from five ceramic phases to four house generations

In the chapter analysing the settlement, a sequence of four house generations ('HG') is derived for the first habitation period, coincident with the first five ceramic phases from the previous section. Ceramic phases 1 and 2 in the Janskamperveld settlement equate approximately with HG I and HG II, respectively, while ceramic phases 3 and 4 pertain jointly to the third house generation, or HG III; and ceramic phase 5 is equivalent to HG IV. A quick comparison showed that the

decorated pottery from the earliest phase at Elsloo-Koolweg (Van de Velde 1979) is chronologically almost identical with that from the Janskamperveld; moreover, as far as can be judged from its publication by quantifying the depicted decoration[9] Geleen-De Kluis (Waterbolk 1959) is just as old. Similarly the oldest decorated pottery from Langweiler-8 on the Aldenhovener Platte (Stehli 1994) has the same characteristics. Together these data suggest simultaneous migration of several LBK groups towards these regions. That way at least the first house generations in both areas may be synchronous. The second LBK occupation of the Janskamperveld site (above, 'ceramic phase 6') should have been more or less contemporaneous with HG XIII in the Rhineland. In this chapter I shall continue to use ceramic phases unless otherwise stated. However, as recent practice in LBK studies tends to substitute HG-reckoning for the older schemes (LBK I-V, LBK 1b-2d, etc.), in the other chapters of the present publication HG is employed, rather than ceramic phases or similar other rankings.

14.7 House plans and house chronologies

One of the major points of interest in the results of the excavation at Geleen Janskamperveld has been the occurrence of quite a number of Flomborn period houses, those of the so-called Geleen type. As described in the appropriate chapter, with time the configuration of the large posts in the central part of the houses changed notably, gradually evolving from the Geleen type into the Elsloo type. This evolution has been an argument in the chronological interpretation of the plan of excavated settlements (e.g. Louwe Kooijmans *et al*. 2002). Although this trend is clear and unquestioned[10], it does not mean that the Bandkeramik carpenters reconstructed the interiors of standing houses, for which there is no archaeological indication whatsoever neither here nor in any other northwestern LBK excavation. Apparently the pros and cons were not considered that important, yet newly erected houses showed small differences with the earlier ones — perhaps a subtle example of *distinction* (Bourdieu). That is, in a living Bandkeramik settlement, houses of slightly different constructions have stood side by side, depending upon their foundation date, just as pottery decorated in the older style was still used while a newer fashion was tried on newly built vessels. This simultaneous occupation of differently constructed houses — perhaps even simultaneous building according to different constructions — necessarily results in rather wide confidence intervals for their foundation. Therefore, both Modderman's and Stehli's turns toward the evolving central post configurations of the houses to define sub-phases within the Flomborn period, are methodologically weak. Even more so as in most settlements the number of different constructions is quite small. The Janskamperveld settlement, while relatively well provided with early houses, will nevertheless not fare much better in this respect: here, too, the sample of 40 houses with legible central structures is statistically quite small (cf. the chapter on houses), especially as 16 of them belong to the regular R-type. Moreover, not all houses are clearly associated with decorated pottery, as can be inferred from table 14-4.

	probable	possible	none	total
Y	1.1.1.1.2.4	1.1	9.9	10
dY	2.2.4	1.1.6	–	6
J	2	–	–	1
iY,Yi	3.3.5.5	1.1	9	7
R	3.3.4.5.5.5.6.6.6	1.2.5.6	9.9.9	16
count:	n = 23	n = 11	n = 6	40

table 14-4 central post configurations of houses *vs.* ceramic phases
'probable': clear association and good quality finds ($w \geq 3$)
'possible': possible association or bad quality finds ($w \leq 2$)
'none': no decorated ceramic finds associated

In that table the distribution of the houses over the ceramic phases is listed according to their central configurations. For example, among the ten houses with identifiable Y-configuration, the associated finds suggest that four of them belong to the first ceramic phase, one to phase 2 and 1 to phase 4 (second column, 'probable'); there are two houses of this type with either a shaky association or with small finds (third column, 'possible': both houses in phase 1), and two other houses with this pattern have no associated decorated pottery and therefore cannot be placed chronologically (fourth column, 'none').

Another way to look at these very data is presented in table 14-5, where the spectrum of the construction types is crossed with the ceramic phases. Thus, in ceramic phase 2 (at least[11]) one house with central Y-structure stood (H 49) together with three houses (at least) with a degenerate central Y-configuration (H 42, 57, 58). The distribution over time of the finds with decorated ceramics has been added for comparison. These numbers are minima for this settlement: six houses with recognizable central configurations could not be assigned to a ceramic phase for lack of associated decorated sherds, and another 29 houses had eroded too much to allow identification of their central configurations. Given the discussion on the ceramic phases in a previous section, the discontinuous sixth phase should perhaps be disregarded, leaving only 46 houses (of which 30 recognizable) in this analysis. Yet the table's patterns are so fully in accord with the probable evolution of the central post configuration of the houses as described by Modderman (see

ceramic phases	houses				features	
	Y	dY, J	iY, Yi	Rn	*w*≥3	(*w*≤2)
1	03,07,24,59,(12,22)	(01,05)-	(31,35)	(40)	9	(72)
2	49	42,57,58	–	(18)	10	(5)
3	–	–	02,17	04,06	9	(6)
4	13	28	–	25	10	(12)
5	–	(53)	09,45	14,19,41,(65)	11	(6)
6	–	–	–	08,10,62,(11)	12	(32)
x	38,54	–	48	15,26,27		

table 14-5 ceramic phases *versus* central post configurations of houses (catalogue numbers) and counts of features with decorated pottery (numbers in parentheses) uncertain ceramic phase

the chapter on houses), that a random background can safely be rejected — thus providing a confirmation of the relative ceramic chronology established in the earlier sections of this chapter. The table also shows that facile attributions (like R-type = late; or Y-configuration, so earliest) are grossly misleading: here too, change is gradual, not in jumps. It is also clear that the Elsloo type house (with its regular DPR configuration) made its appearance well before the onset of the Younger LBK (i.e., before phase IIa, Dutch chronology; or HG IX), contrary to present understandings. For a methodologically sound view of the development of the village plans, a similar approach to the central post configurations should be attempted as has been done for the pottery decoration.

A few short remarks on the out-of-range entries are appropriate here, being more or less at odds with the expected distributions over time.
Firstly, the iY-construction of the 1a-type house 35 has been tentatively attributed to phase 1 because of a pit next to the rear part of this building (34046, w = 0). A possible remnant of its Längsgrube (32112, w = 0) is similarly dated to the first phase. The very low w values render this 'date' questionable. Then one pit from the sixth phase cuts into another part of the Längsgrube (pit 24026, w = 2), which provides a not very impressive terminus ante quem for the present house. The pit complex to the right of the front part of this house (32100, dated to phase 6, w = 2) may or may not be related to this building at all.
Secondly, the rather eerie Yi-setup of the central section of house 31 is post-dated by a pit with some decorated pottery (24097, phase 1, w = 1) which cuts into the right-hand Längsgrube of this house. As in the previous case, with such a small find there seems to be no reason to trust this date, though there are no clear grounds to reject it either.
And finally, according to the present dataset the earliest occurrence of the R-construction is the outlying house 40 in the NW part of the settlement; the association with pit 57052 (phase 1, w = 0) is questionable and its value practically nil. More to the point seems the in many respects extraordinary house 18: its right-hand Längsgrube (52051) held a few decorated sherds suggesting a dating to the 2nd ceramic phase (although w = 1 only). There are no other pits with decorated pottery which might be associated with this house.
To sum up: the exceptions or outliers in table 14-5 are either due to uncertain associations or to very small samples of pottery decoration. I suggest, therefore, that the outlying entries be disregarded, and only the continuous ranges be accepted.

The data in tables 14-4 and -5, crossing ceramic relative datings with the evolution of house constructions, accord fully with what might be expected: with the ceramic 'dates' predicated upon battleship-like frequency distributions of several variables of decoration over time, the resulting developments of the house constructions similarly prove to be battleship-like. An important implication is that pottery decoration can indeed be used for relative chronological purposes even WITHIN the Flomborn period, given sufficient attention to logical consistency and detail of the classificatory scheme. The analysis of the Elsloo data that I presented in 1979 (Van de Velde 1979) implied the same, although much less emphatically. Yet practice elsewhere has persisted in combining the Rhineland Model for the Younger LBK with house typology for the Older LBK. Only recently a successful attempt has been made at the Cologne Institute to break down some of the early 'types' of pottery decoration into elements rather similar to those employed here, and through them define ceramic evolution within the Flomborn period (Münch 2005).

If tables 14-4 and -5 represent the distribution over time of the varieties in the central post setup, then the houses which have to do without sufficient decorated ceramics for the relative chronology should be distributed over the phases in a similar way. This as a preliminary to the study of the development of the settlement as a conglomerate of houses (dealt with in a separate chapter), but also in order to prepare the way for a check of the few overlapping house plans in the excavation. Their number is very small; indeed, notwithstanding its 69 houses, the Janskamperveld settlement

would qualify as "not dense" on Coudart's scale. The relevant houses are: H 08 cutting into the H 06 plan, H 13 into H 01, H 26 into H 27, H 56 and H 68, H 64 together with H 52 and H 69. The first pair of houses, H 06 and H 08 have decorated sherds associated, assigning them to phases 3 and 6 respectively; central constructions are of the R-kind in both houses, not discretionary therefore. Also H 01 and H 13 are associated with decorated ware which puts them into phases 1 and 2 respectively; their central configurations are a degenerated Y and a regular (perhaps slightly degenerate) Y, providing a retro-reaction against the general trend of table 14-5. Houses 26 and 27 cannot be connected to decorated pottery; their central alignment consists of R-type DPRs in both cases, so again there are no conclusions to be drawn here. Of the H 56 - H 68 pair only the first is associated with a few decorated sherds, resulting in an assignment to the first ceramic phase; in both plans the central post arrangement is no longer recognizable; hence no conclusion following. H 64 can be relatively dated by ceramic means and belongs to the very first phase of the settlement; the two adjacent or overlying houses have no pottery to help out; all three houses no longer give clues as to their inner configurations. Nothing here that was not implied already in table 14-5 therefore.

14.8 The ^{14}C (AMS-) datings

A few years ago a justifiable reproach to the excavators of this site was printed which read:

Referring to the radiocarbon datings regarding the Bandkeramik in southern Limburg, nothing has changed since the Lanting & Mook (1977) article. In spite of new excavations such as at Geleen-Janskamperveld (Louwe Kooijmans et al., 2002)… no new determinations have been carried out. This is especially lamentable in the case of Geleen-Janskamperveld. That settlement was mainly inhabited in phases 1b and 1c…

Lanting/Van der Plicht 2002, 45

In the meantime, this complaint has been acted upon; table 14-6 presents the results of eight determinations on features from this site. Readings (five by the Groningen laboratory, three by Oxford) have been taken on samples with negligible own age: peas and grain pellets. The results should therefore reflect the true ages. The carbonized wood samples used previously are prone to an average off-age effect of some one hundred years *too early* (as extensively discussed in Lanting/Van der Plicht 2002). Dates in print for the oldest Dutch Bandkeramik were all taken on such carbonized wood from post holes: 6370 ± 60 bp (Geleen-De Kluis), 6320 ± 90 (Elsloo), and 6270 ± 85 (Elsloo) are all older than the oldest determination of 6260 ± 50 bp in table 14-6 (references and details in Lanting/Van der Plicht 2002). Obviously series on wood and series on grain pellets

sample no	feature no	house	bp years	1 sigma BCE	lab no
1	20027	49	6260±50	5308-5207	GrA 27838
2	13100	12?	6240±70	5303-5202 5165-5113 5103-5076	GrA 27836
3	31021	12	6204±35	5215-5201 5167-5110 5107-5074	OxA 15542
4	31075	13	6208±38	5217-5199 5169-5072	OxA 15600
5	31075	13	6180±50	5210-5189 5177-5062	GrA 27842
6	15005	56	6170±45	5206-5187 5178-5143 5139-5061	GrA 27837
7	32100	35	6120±38	5201-5167 5109-5108 5074-4988	OxA 15601
8	32100	35	6110±45	5197-5172 5069-4954	GrA 27839

table 14-6 AMS-readings from the Janskamperveld excavation

cannot profitably be compared as the range of uncertainties caused by the age of the wood samples is undetermined; consequently, little attention is presently paid to them (e.g. Jadin *et al*. 2003, Lanting and Van der Plicht 2002, Lüning 2005, Whittle 1996). Given the early character of the site, the main aim of this series of AMS datings was to establish the chronological brackets of its settlement. At the same time the lower readings should shed more direct light on the first arrival of the Bandkeramians in this region, which has been estimated as 5230 BCE (through extrapolation and wiggle-matching from German dates; Lanting/Van der Plicht 2002).

Preliminary to further discussion[12], it should be noted that the INTCAL 04 calibration curve is characterized by two plateaux in the Bandkeramik age (fig. 14-4); an older one between 6300 and 6250 bp (which translates to 5300-5220 BCE approximately), and a younger plateau from 6200 to 6140 (5210-5060 BCE). Determinations within these ranges cannot 'simply' be converted but rather equate with a range of BCE equivalents. Taking this into account, the samples listed in the table have been calibrated; they derive from and are part of:

1. Feature no. 20027; from the bottom, first fill of the left-hand *Längsgrube* associated with house 49. Conversion yields a range of 5310-5205 BCE, which equates with the older plateau in the calibration curve; the house has a central Y-post construction, and an associated ceramic date in the second ceramic phase.

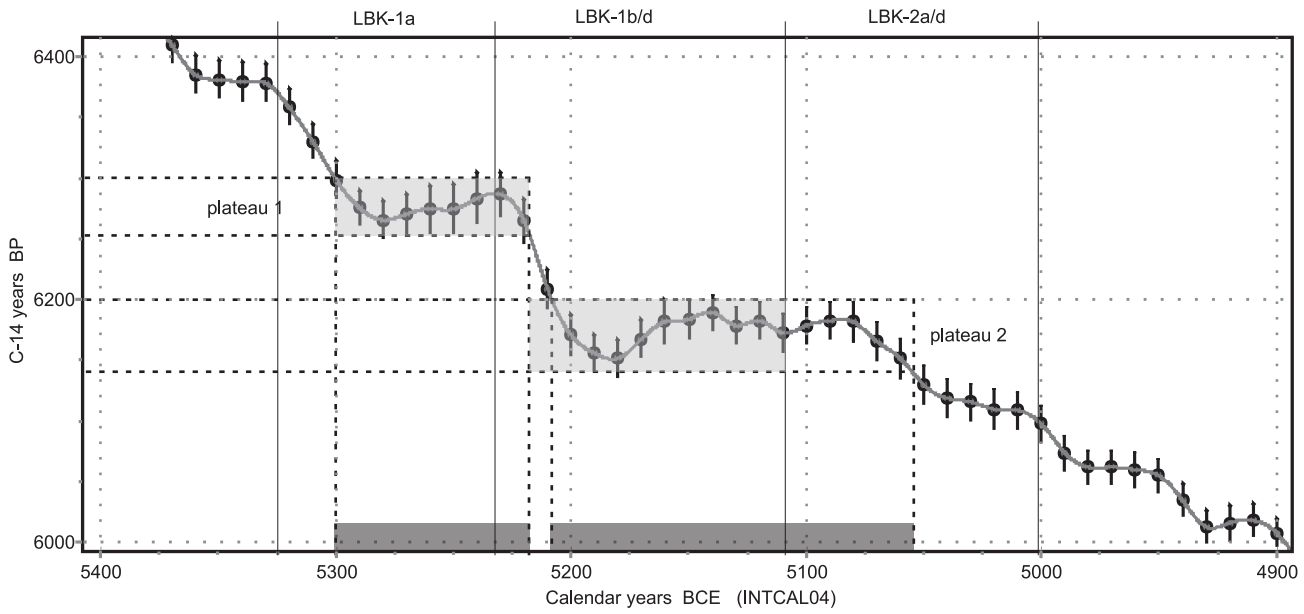


fig. 14-4 The INTCAL04 calibration curve for the LBK age
LBK-ranges (top) according to Lanting & Van der Plicht 2002

2. Feature no. 13100; second filling of a kettle pit behind house 12; association with that house is uncertain though not unlikely. The measurement equates with a calendar date of 5215 BCE (neatly in between the two plateaux), yet it converts to a range of just as likely dates between 5305 and 5205 BCE.
3. Feature no. 31021; from the right-hand *Längsgrube* of house 12. If an association of kettle pit 13100 (previous paragraph) with this house is assumed, the two datings are mutually supportive, and confirm the early dating of house 12, which is fitted out with a central Y-post construction, and has a ceramic phase 1 attribution.
4. Feature no. 31075; from the upper layer of the fillings of the right-hand *Längsgrube* or pit complex next to house 13, with many chunks of burnt loam immediately below. Therefore this sample is younger than the founding of the house by perhaps 15 years, one generation or more. Probable conversions of the reading: 5210-5190, and 5175-5060 BCE. Given the central Y-post configuration and attribution to ceramic phase 2, the earliest range or slightly before it, seems the best fit.
5. Feature no. 31075, as previous entry, being a sample from the same find.
6. Feature no. 15005; second filling of the right-hand *Längsgrube* along house 56. Best conversion: 5180-5060 BCE, coincident with the second calibration plateau. House 56 associated by its *Längsgrube* with this feature shows an R-type (regular) configuration of its central *Dreipfostenreihen*, in accordance with the expectations; the associated ceramics are poor.
7. Feature no. 32100; from the lowest fills of a silo bin or pit complex to the right of house 35, sealed by a massive layer of chunks of burnt loam, charcoal and carbonized grain pellets on top. Best conversion estimates 5195-5170 and 5070-4955 BCE. With a central iY-post configuration and very small samples of decorated ceramics associated, the younger range is much less probable than the older one.
8. Feature no. 32100, as previous entry, being a sample from the same find.

Because they relate to the same or very similar archaeological events, six of the readings in table 14-6 can be paired: nos. 2 and 3, nos. 4 and 5, and nos. 7 and 8. Of every pair one sample has been taken to Groningen, the other to Oxford; as was to be expected, pair wise differences are small, and therefore the readings can be pooled in order to tighten the uncertainty ranges (all weighted to their variances):

= House 12 (nos. 2 and 3) obtains an average date of 6211 ± 31 bp, which converts to 5217-5202 BCE (in between the two calibration plateaux), and 5166-5113 or 5104-5075 on the younger plateau.

= House 13 (nos. 4 and 5) then has a date of 6198 ± 30 bp, suggestive of 5212-5202 BCE (again, in between the two plateaux), and 5166-5113 or 5104-5075 on the younger shoulder of the curve. As noted above, being from the top layer of the *Längsgrube* this dating is somewhat later (at least fifteen years?) than the founding of the house.

= House 35 (nos. 7 and 8) is calculated to 6116 ± 29 bp, or 5187-5179 BCE on the younger plateau or 5061-4993 BCE after it. This provides the youngest date for this settlement: the sample was sealed off by a thick destruction layer which may be testimony of the end of the house when not of the second occupation. It is, on ceramic grounds, a few generations earlier than the definitive demise of the LBK from the Graetheide region. Lanting and Van der Plicht (2002) propose a closing date for the Dutch LBK of *c*. 5005 BCE which would tally best with the second, youngest range.

A statistical test does not reveal important dissimilarities between the readings on the four samples on which the datings of the HH 12 and 13 have been established, and therefore the four can be pooled to obtain an even better estimate for the earliest events on the site. Their weighted average is 6204 ± 22 bp which translates to 5214-5203 BCE (between the two obnoxious plateaux), and 5163-5131, 5127-5116, and 5099-5078 in the range of the younger calibration plateau (adding the first reading, the average becomes 6213 ± 20 bp, or 5216-5204 BCE; other ranges: 5161-5133, 5124-5118, 5096-5079). Reading no. 2 being a few years younger than the opening of the pit it is taken from, and samples nos. 4 and 5 perhaps fifteen or more years later than the associated house, this average could be some ten to fifteen years younger than the beginnings of the two houses. If it is accepted that they belong to the first generation, then the coming of the Bandkeramians to the Graetheide is fixed to the decennium around 5220 BCE. Then, on the other side of the local occupation, on ceramic grounds the second habitation on the Janskaperveld was set to LBK-2c, which equates with HG XIII in the Rhineland; the pooled date for House 35 of between 5060 and 5000 BCE (above) compares well with the dendrochronologically obtained 5057 ± 5 for the second well at Kückhoven, constructed in that very House Generation (Weiner 1998: 106).

These dates pose problems for current Neolithic chronologies, since it is generally assumed that the Flomborn phase starts *c*. 5300 BCE. It should be noted, though, that in final analysis that date is based upon the second well at Kückhoven constructed in HG XIII of the Aldenhovener Platte; that phase of the well has yielded a dendrochronological date of 5057 ± 5 BCE (Weiner 1998: 106). Then extrapolating, it is assumed that House Generations last on average about 20 years, so that 12½ × 20 ≈ 250 years should be added to arrive at the beginnings of HG I, which defines that of the Flomborn phase, *i.e*., 5057 + 250 ≈ 5300 BCE (Whittle 1996, Jadin *et al*. 2003, Lüning 2005). However, as noted above already in 2002 Lanting and Van der Plicht proposed 5230 for that event on the basis of the well's date and wiggle-matching of substantially the same determinations for the *älteste* LBK used elsewhere to estimate the length of the oldest LBK period (though, as they complained in the quote above, *without* direct evidence). That estimate accords very well with the Janskamperveld AMS date of 5220 BCE, but if this latter date were to be accepted —based as it is on direct evidence— then one of the consequences is that the average length of a LBK house generation is to be reduced from *c*. 20 years to (5220 - 5055) / 12½ = 165 / 12½ ≈ 13.3 y/HG if no overlapping is to be assumed. Also, the long contemporaneity of the Bruchenbrücken phase (or *älteste LBK-II*) with Flomborn should then be halved from 5300-5150 (Lüning 2005: 71) to 5220-5150, its 70 years still representing five house generations (as proposed here) instead of the original six (proposed by Lüning).

14.9 Some conclusions

Analysis of the decorated pottery to obtain a relative chronology for the Janskamperveld settlement proceeded along several steps beginning with a discussion of its basis: the classification of the motifs. A few alternative classifications were first compared on their versatility and logical consistency, and found to be lacking in either or both aspects; instead (and possibly not surprisingly) the classification that I had developed earlier (most extensively in Van de Velde 1976, 1979) was preferred as being both easily and widely applicable and methodologically well founded. As a computational method to derive the chronological ordering of the ceramic complexes, principal components analysis was selected which allows the efficient separation of relevant and irrelevant variables, a procedure with one exception (Pavlů 2000) not explicated elsewhere in applied Bandkeramik archaeology.

With this classification, the twenty-eight largest assemblages of decorated sherds were analysed, yielding a coherent and clear picture of the changes over time, even within this Flomborn period assemblage. These were arbitrarily divided up into six ceramic phases with strong indications of a discontinuity from the 5th to the 6th phase (table 14-2 and fig. 14-3 above). Then the 166 finds with less decorated pottery were fitted to this master frame assigning a quality value each on a scale from 0 ('bad') to 4 ('excellent') based on their size (table 14-3). The resultant distribution is weighted towards the extremes, where the smallest finds tend to of necessity. In the chapter on the settlement's development, it is found that there are four house generations in the first occupation —with the ceramic phases 3 and 4 jointly making up the third generation, and the other ceramic

phases approximately equal to one generation each. The first house generation here equates with HG I of the Aldenhovener Platte, and also with the first LBK activities at Elsloo-Koolweg and Geleen-De Kluis.

Next, attention was turned towards differences in the house plans, more specifically to the evolution of the configuration of the roof posts in the central section of the houses going from a single, simple Y-plan in the beginning, via degenerate derivations towards two or more regular DPRs per house in the end. Different types do not define separate house generations, though; replacement occurs rather gradually, with newer constructions alongside older types. As with pottery decoration, at any moment in time there was a *spectrum* of central configurations. Therefore a definition of house phases based on this central configuration as companion to ceramic phases is methodologically nonsense. Instead, the distribution of house types over the ceramic phases (table 14-5) was found to confirm the latter, as the post configurations were neatly arranged according to their (supposed) evolution.

Finally, eight AMS-radiocarbon dates from this excavation were presented, all read from samples with negligible age; yet the two plateaux in the calibration curve for this era have the effect of 'smudging' the results. Four dates suggest a founding of this village in the second half of the 53rd century BCE, right at the beginning of the LBK presence in the Netherlands, thus establishing a pioneer status for the settlement's earliest inhabitants. Two other dates confirmed the late re-occupation of the village area, also deduced from the decorated pottery ('ceramic phase 6'), close to the end of the LBK in this region in the first decade of the 5th millennium.

Thus, the beginning of the village can be estimated at about 5220 BCE, the end of its first occupation in ceramic phase 5 / HG IV (fifty or sixty years later, probably), while the village area was re-occupied by Bandkeramians in the next-to-youngest LBK (2c, Dutch chronology; HG XIII, Rhineland chronology), with a suggested date of around 5050 BCE obtained from well beneath a destruction layer. Apparently, the site has been witness to the Bandkeramians' arrival on the Graetheide; but probably not to their departure.

Notes

1 For which purpose the evolution of the central posts' configuration of the houses was recommended; cf. in the present publication the chapter on houses.

2 Recently, attitudes are changing: Krahn 2003 is very explicit on this topic, as is Claßen 2006; but cp. Schwerdtner 2007.

3 For instance., the individual pots illustrated in Jadin *et al*. 2003, the generalized motifs in Hauzeur 2006: figs. 93-97, 163-164, 199-200, or the analytical schema in Pavlů 2000: fig. 14-5.03; respectively illustrating the Belgian Omalien, the Gallo-Luxemburgian Moselle group, and the Czech LBK.

4 This is contested by Stäuble 1997: 19 who holds that the long pits were filled right after the end of their quarrying function.

5 One simulation study suggested that only one in ten runs of a seriation produces a reliable, or rather, stable outcome (Graham et al. 1976). However the problem appears to have been not so much with the seriation *per se*, as with the auxiliary programmes intended to "polish" the input data (Djindjian 1985).

6 *Rotation* did not improve matters.

7 Note that in seriations well-filled units tend to the centre of the distribution, and therefore are preferably left out.

8 The proportions for the Components variable have been computed from natural counts (regular numbers), which takes no account of the visual differences of, e.g., a line and a pointlet.

9 The sherds have disappeared since.

10 But cf. Coudart 1998: 39 and 57, note 14, who rightly observes that in some cases circular reasoning may be involved.

11 "At least" is added as a reminder that non-pottery or illegible houses (including those that could not be excavated) should be considered, too.

12 I am much obliged to Professor Van der Plicht who kindly discussed with me some of the pitfalls of 14C-calender date conversions.

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