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The Reconstruction of the Danubian Neolithic House and the Scientific Importance of Architectural Studies

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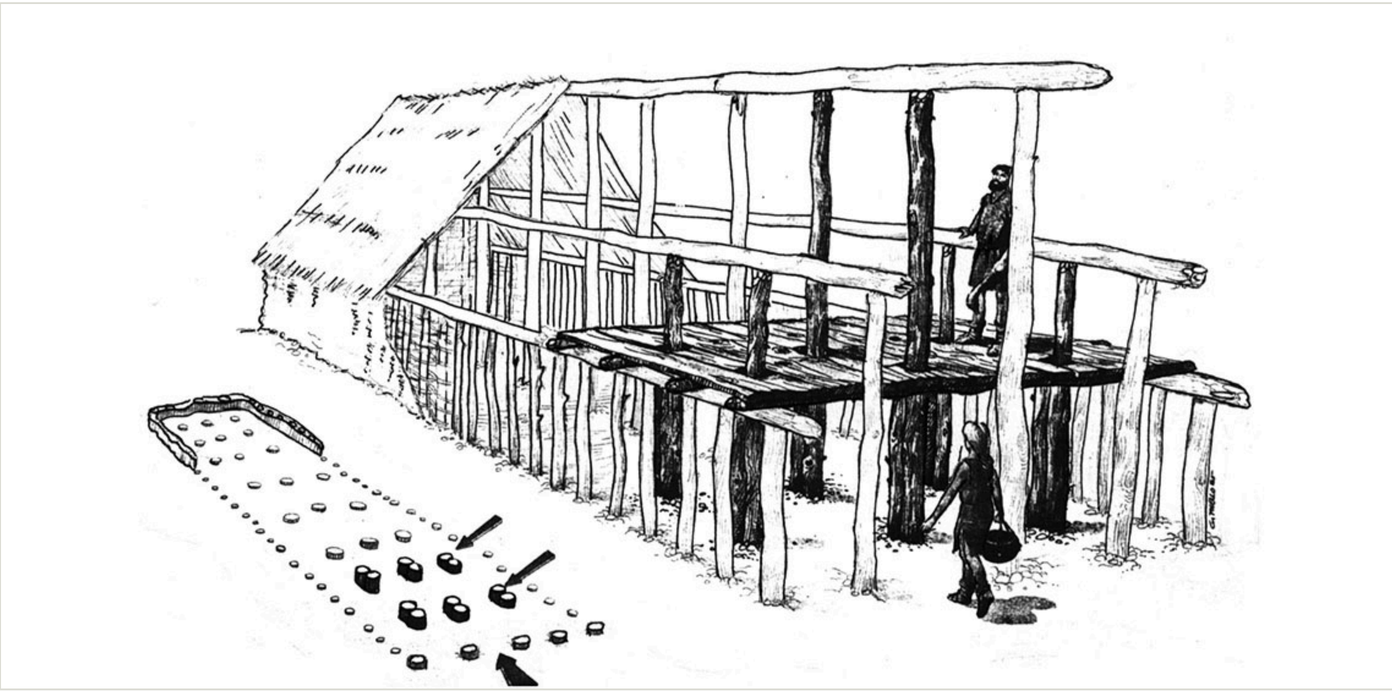

It has been 30 years, but it is still relevant

In May 1987, the subcommittee on Archaeology of the European Science Foundation (ESF) organised a workshop on "the reconstruction of wooden buildings from the prehistoric and early historic period". (...) The 1980s was the beginning of a boom in the construction of

archaeologically inspired buildings inside and outside archaeological open-air centres. In their proposal to the ESF, they wrote of the problems of constructing at a 1:1 size. Some of the problems addressed are still valid today.

> For neither of the periods discussed (Bandkeramik and post-Bandkeramik) is there any relationship between labour efficiency in building a house and type of ground-plan.

Un objet de recherche [...] à la fois particulièrement fertile et contraignant, en ce qu'il impose de ne jamais - sauf de façon provisoire - disjoindre le matériel du social et du mental. [A topic of research both particularly fertile and constraining because it demands the one never - except provisionally - separates the material from the social and the mental] Isac Chiva 1987 - La maison: le noyau du fruit, l'arbre, l'avenir. Terrain - Habiter la maison, 9: 5-9.

The importance of architectural studies

The social-anthropological study of 'egalitarian' societies allows us to posit the following concerning architecture (see for example: Rapoport 1969, Guidoni 1980, Preston-Blier 1987, Oliver 1987 or Nabokov and Easton 1989):

- Once a form of domestic architecture has been adopted, it strongly resists change. Indeed, in an egalitarian society, this form substantiates a value system, a worldview and a conception shared by all members of the group who adopted it. This shared worldview limits the field of possible expressions considerably and manifests itself in a high degree of conformity to one architectural model, both with regard to building style and with respect to the function attributed to spatial organization.
- If inhabited space (the house, for example) is partly ruled by material constraints, it is also ruled by mental ones, or rather by idéel onesIn this paper, the French word idéel corresponds to the concept used by Godelier (1984. Le Matériel et l'idéel. Paris: Fayard). In the English version - The mental and the material. Thought, economy and society. 1986. London: Verso - his publisher notes: "We have translated - for lack of a better alternative - the word 'idéel' as 'mental' but we are aware that this partly distorts what Maurice Godelier intended by using the word 'idéel' [...]. Godelier's intention was to take into account thought in all its forms and processes, conscious and unconscious, cognitive and non-cognitive. 'Mental' tends to underplay the unconscious aspects of thought and to reduce its conscious aspects to abstract and intellectual representations alone". In view of these distortions, I prefer to use the French word. (taboos, male/female oppositions, reception of visitors, etc.). The role of domestic architecture among egalitarian societies is thus to create a substantive structure which serves to control a physical environment (protection against the elements) as much as to create order in a social environment (relations between men and women, privacy, et cetera).
- The fact that there is no real differentiation between individual buildings corresponds to the fact that there is no fundamental social differentiation between individuals.

As a result, house building in Danubian societies - as manifested in its architectural style and the function of its spatial organization - conforms to a traditional architectural model, accepted and shared by all members of the group. It is a response to both material and *idéel* constraints. All change in the implementation of this object, which is constructed for those in the group and which is deemed to remain unchanged, will betray, much better than pottery or stone tools could do, any transformation within the group. Such changes reflect one or several transformations among the various factors that are of influence on the formation of the group (climate, sources of raw materials, techniques, economy, social structure, family organization, gender relationships, relationships between the internal and the external world, et cetera). In these respects, architecture is of fundamental significance for the study of prehistoric societies. Although the study of construction materials and techniques is necessary, it is perhaps more important that architecture be seen as a social indicator. Therefore it is of little use scientifically if archaeology focuses on reducing architecture to building materials and construction techniques alone.

Geography, chronological framework and social context of the Danubian Neolithic groups

The cultural 'groups' that are here brought together under the heading of 'Danubian*'* constitute the first sedentary agricultural population of temperate Europe. Raising cattle, ovicaprines, and pigs, and cultivating cereals, as well as hunting and gathering, these groups, which came from the region of the middle Danube (Alföld plain, Transylvania, eastern Slovakia, Moravia and Transdanubia) colonized and occupied an immense territory during several centuries (from the second half of the sixth to the second half of the fifth millennium BC[1]), which was bounded by the Vistula in the east and the Seine in the west, and by the Danube in the south and a line between the Lower Vistula and the Scheldt estuary in the north (See Figure 1). In order to be able to distinguish in this paper chronological evolution on the one hand and phenomena of 'peripheralization' on the other, it has been necessary to divide the area into geographical zones and the Bandkeramik era into 'homogenized' chronological stages (See Coudart 1990).

It is on the basis of natural boundaries, archaeologically 'empty' zones and slight differences of a stylistic nature that 'Bandkeramik Europe' has here been divided into four zones, comprising the following regions[2] : the *eastern zone* (Little Poland, Slovakia, Moravia and Silesia), the *central zone* (Bohemia, Saxony, Lower Saxony, Bavaria and Franconia), the *western zone* (Swabia, the Ruhr area, the Mosel area, the Rhine and Meuse basins), and the *western frontier* (the Hainaut, the Marne, the Aisne and the Yonne basins). Finally, Kujavia (Poland) has been included in this study because of the cultural affiliation of the Lengyel groups with the Danubian, but its isolation, its chronological position (Chalcolithic according to Lichardus et al. 1985) and the very considerable cultural differences which distinguish it from the other groups would be arguments to keep it apart.

According to a pan-European chronology (Lichardus et al. 1985), the first set of these cultural groups is a middle Neolithic one (Bandkeramik; c.5600-4900 calBC), and the second is late Neolithic in date (post-Bandkeramik: Lengyel I, II, and III, Stichbandkeramik, Grössgartach, Rössen, Blicquy / Villeneuve-Saint-Germain and Cerny groups; 4900-4400 calBC)[3] .

Analysis of the archaeological data allows us to conceive of Bandkeramik villages as consisting of three to eight buildings[4] . A regression analysis executed on ethnographic data allows us to predict that the number of inhabitants per house could vary between five and seventy, so that the population of a village may have fluctuated between a hundred and fifty and two hundred and fifty people without any need to build additional houses or to change the architectural precepts. This result presupposes that each house sheltered an extended family.

We consider Bandkeramik society to be egalitarian and acephalous, a society in which individual and personal power are negated in favour of collective identity, and which may well illustrate a form of economic and social organization which would have to be placed on a *theoretical continuum* between egalitarian hunter-gatherer societies and egalitarian societies with *big men* (Coudart 1991, 1993). Indeed, one sees differences in (social) position between age and sex groups (cf. grave inventories) and between houses (a very long, collectively supervised, storage area may be present or absent). The stylistic variations seen during the post-Bandkeramik period show local differentiation, which may correspond to the existence of inter-group competition. Similarly, organizational variation between houses of the same village suggests the emergence of some differentiation among individuals that was not present before.

Architectural reconstitution of the Bandkeramik house

More than 2000 ground plans of Bandkeramik dwellings having been excavated, their characteristics are well-known, all the more because they conform to a model that is universally shared among their builders and users. The Bandkeramik ‘standard’ did not emerge instantly - but neither did Gothic or Romano-Byzantine architecture. It co-evolved with the development of Bandkeramik culture. It is therefore normal that we do not find all its constituent elements on plans of the oldest dwellings. But once the Bandkeramik architectural model was adopted, it seems never to have been revised.

The Bandkeramik house is a longhouse - between ten and forty metres long - with pits dug along its long sides. Its load-bearing structure consists of uprights, grouped in cross-rows of three, perpendicular to the longitudinal axis of the house. In the majority of cases, the space in the building is divided into three sections, namely a front, a middle and a rear section, separated from each other by corridors which consist of two cross-rows close together (see below).

Reconstructions of Bandkeramik architecture have already been undertaken several times (See Figure 2), as can be seen from papers by Zippelius (1957), Soudsky (1969), Modderman (1973), Meyer-Christian (1976), Unité de recherche archéologique n° 12 (1977), Startin (1978), von Brandt (1980) and Masuch and Ziessow (1983; 1985). But insofar as some of these interpretations are unsatisfactory (particularly the last, which can be classed in the category "why make it simple if it can be difficult") and even contradictory, some new proposals will be advanced here which - in the light of ethnographic knowledge - appear more logical without being particularly original.

But above all, the prehistorian should dispel completely the prejudice that, in the absence of sophisticated instruments and metal tools, pre- and protohistoric people were incapable of resolving difficult technological problems. Wherever it is a part of their daily lives, people find easy and quick ways to put up scaffolding, erect a wooden post at a given height, make a ladder, make a row of uprights align at the same level, determine a roof's angle, all without recourse to our modern tools, using proportion and regularity. Using 'simple' techniques does not imply the absence of *savoir-faire* and imagination. I have found my fieldwork in the Highlands of Papua New Guinea (among the Anga tribes) perfectly illustrative in this respect. The archaeologist must also be aware that the physical structure of a house - or at least of what one finds - is not just dictated by material constraints, but is also influenced by *idéel* and cultural constraints, which - in archaeology - can often not be identified, but which are nonetheless fundamental to the product.

Ground plans and Orientation

At ground level, the Bandkeramik house plan is a rectangle or an isosceles trapezium of which the longest of the short sides is the house's façade; a third type (a 'sub-rectangle') combines characteristics of the first two: rectangular in front and 'trapezium-shaped' at the back (See Figure 3). In the two last options, the front wall is wider than the rear one.

As often as possible Bandkeramik people have used a plan that was not strictly rectangular (58,5% of the cases). In order to keep the pitch of the roof the same all along the house, the rear wall would be lower than the front wall (See Figure 4). The higher front part faced the region of origin of the Bandkeramik culture, the middle Danube (Mattheusser 1991). This orientation had probably nothing to do with the prevailing continental European winds, as archaeologists thought for several decades (See Figure 5). Apart from very rare exceptions (all cases in which the ground-plan is poorly preserved), the width of the rear wall is never greater than that of the front wall or the wall of the central section. The isosceles trapezium and the third type of ground-plan causes the façade and the entrance - in other words, the element facing the geographic Bandkeramik origin, and the transition between internal (private) space and external (public) space - to be the higher and wider architectural elements of the house; this entirely respects the Bandkeramik architectural norms.

Construction Materials

The conservation of architectural remains rarely permits the recovery of construction materials used in Danubian Neolithic houses. Nevertheless, palynology, charcoal analysis and fragments of burnt daub provide us with information concerning the materials that might have been used (see Bakels 1978, 79-92).

Carbonised wood collected from post-holes allows us to identify the species employed, but it cannot be proven that only these were used for house construction. Palynological studies suggest a well-forested environment where wood for building could have been easily felled. Furthermore, in dense forests trees tend to grow uniformly in trunk height and diameter, a condition favourable to Bandkeramik architecture.

The dark stains one finds in holes that served to hold the posts provide information on the diameter of the latter. Scholars suggest a wall height of two metres (Zippelius 1957; Soudsky 1969; Unité de recherche archéologique n°12 1977), while the posts that held up the ridge-pole measured between four and a half to five metres in height. But the walls were in all probability lower and the interior uprights shorter. The longest span of the longitudinal beams must on average have been three and a half to five and a half metres. Oak seems to have been the most common species used, but it is also the one with the best preserved carbonized remains. Other species were suitable, like maple, elm, wild cherry and sometimes pine (at Hienheim or at Olszanica for example). Finally, alder, ash, lime, poplar and willow may also have produced trunks of sufficient length. However, the durability varies considerably from one wood species to another. Bakels (1978, Table 6) gives the following figures:

Species	**Durability in damp soil**	**Durability in dry soil**	**Destruction by insects**
Oak	10-25 years	25-50 years	nearly zero
Cherry	10-15 years	25-40 years	moderate
Maple			
Elm	5-10 years	12-25 years	moderate
Pine			
Alder			
Ash			
Lime	5 years	6-12 years	considerable
Poplar			
Willow			

NOTE: THE LAST FIVE SPECIES ARE THEREFORE UNSUITABLE AS STRUCTURAL BEAMS, BUT MAY HAVE BEEN USED.

The daub used for the walls was easily made from the loess or silt rich soils on which the Bandkeramik people lived. Many plant remains have been discovered in daub fragments; it is not possible to determine whether these were purposely added as temper or not. But temper was a necessary ingredient; chopped straw (after harvests) or chopped hay (probably rare in the absence of true meadows) could also have been used. The supporting wattle may have been woven from hazel, willow and sometimes lime. These species have sufficiently supple branches for this sort of work; they were also easily available in the environment of the time.

Finally the rope used to bond the joints was easy to make with fibres from cherry, willow or elm, like those used to reconstruct the Neolithic houses at Allerslev, in Denmark (Hansen 1962).

The frame

Ceramic models (younger than the Bandkeramik period) and foundation remains (post-holes clearly identified by their darker coloration in the subsoil directly beneath the actual soil surface: Figure 6) are all we have to reconstruct the general structure of the building. And ethnographic analogies can provide various hypotheses on how to execute the woodwork for a building, using only stone implements (See Figure 7).

Most of the load-bearing parts of the frame appear to have been made of round timbers. Post-hole stains suggest an average trunk diameter of between twenty and forty centimetres - sometimes even fifty centimetres. From ethnographic observations in New Guinea, it is known that the felling of a tree using a stone adze could, depending on the kind of wood and the diameter of the trunk, take between one and three quarters of an hour (Cranstone 1971; Godelier 1973; Saraydar and Shimada 1971). At Stein, tree trunks at least eighteen metres long and seventy-five centimetres in diameter were cleaved into twelve pieces and used for house walls (Bakels 1978, 85). This result is relatively easily obtained by using a sledgehammer and wooden wedges, as demonstrated by R. Darat at West-Stow (England): in a few minutes, it is possible to cleave an oak trunk into four parts.

The oldest traces of pegging found (at Aichbühl in particular: Schmidt 1936, fig. 77) are quite late and from the late sub-Rössen, that is to say the period immediately after the post-Bandkeramik as defined here. The joints therefore must have required slotted beams, while the structural unity is maintained with the help of vegetal bonds. These procedures are still used today. For the posts that carry the beams, natural forks were certainly used as often as possible, as still is the case, for example, in traditional house construction in Melanesia, Andalusia or among the Pawnee of North America.

Inside the house, the layout of uprights makes the use of transverse linkage (a roof truss or a transverse tie beam with two crossbowman) unlikely. Indeed, if a cross-row of three posts bears the roof, as in this case, a truss is not necessary. In addition, the cross-rows are not always rectilinear, and in such a case a transverse tie-beam seems difficult to put in. Buttler suggested the use of a longitudinal connection (Buttler and Haberey 1936, pl. 34, 1). This seems a logical hypothesis and has since been taken up by a number of different scholars working on the question. Indeed, the posts in the transverse rows are also aligned longitudinally. This configuration can only be justified if the connecting beams of the frame are placed in the longer axis of the building (See Figures 2, 4). On the other hand, in the absence of pegging, tenons and mortises, this procedure is probably most suited to the architectural constraints. The pressures and tractions involved in this system are nearly all vertical, whilst the use of a transverse tie-beam introduces tractions and pressures in all directions. Even without these, the horizontal wind pressures to be withstood by Bandkeramik architecture were quite sufficient!

But such a construction is so alien to the thinking of the industrialized world that transverse tie-beam reconstructions of such buildings continue to be on public display, such as those in the open-air museum of Beaune in France (Archéodrome) or at Ansparn in Austria. Nevertheless, the longitudinal linkage is found in a large number of traditional Melanesian constructions or in some barns in the Mediterranean world.

Several kinds of longitudinal linkage have been proposed for Bandkeramik architecture. The simplest one is a system where the ends of two longitudinal beams meet at the head of a post. Soudsky (1969, fig. 13) suggested the existence of a π configuration: a beam placed on the top of two vertical posts would have had its two ends protruding (See Figure 8). Unfortunately, this arrangement is not always compatible with the layout and the number of internal cross-rows. These are indeed often too numerous and too close to one another for this kind of construction to be rational and stable. Actually, the number of cross-rows does not follow from a technical constraint, but is instead a response to an *idéel* necessity. As a matter of fact, the longer the house, the greater length of the longest span between the cross-rows. If the Bandkeramik people could resolve this problem for the big houses, why not for the smallest? On the other hand, the close spacing between rows is always observed in the same locations in the house (See Figure 9). This is particularly the case in what we identify as the separation corridors between the front and middle sections, and between the middle and rear sections of the house. In the middle section, after the first corridor, one also finds two cross-rows quite close to one another. Thus, it was probably the ratios of the distances between cross-rows that were important, rather than the absolute distances themselves. The particular rhythm of this arrangement (• •• ••• •) seems thus to have been important in the universe of mental representations, at least insofar as the house was concerned (See Figure 9.1e). It would probably not have been retained for so long if it had only been present for technical reasons.

Among a number of houses in the Rhine-Meuse region the middle section has a four-post design instead of two classic cross-rows: two uprights are aligned along the transverse axis (as in the case of a cross-row) but the third is missing; two posts take its place on both sides of the transverse axis to create an 'Y' layout (See Figure 10). Contrary to what one might think, this does not appear to be a very early element. Indeed it is only found in a zone of recent colonisation, and appears to be one of the rare - maybe the only - observed local innovations introduced by the Bandkeramik builders.

There are numerous hypotheses on what might have brought about such a 'Y' structure. It probably is not a response to a solely technical problem. Elsewhere, this configuration generally coexists with the two parallel cross-rows. That this particular layout carried a different frame is quite probable, but the frame is not the reason for it; that reason has disappeared long ago, together with the Bandkeramik people. Meyer-Christian suggested a practical solution, involving a lateral door (See Figure 11.1). But this is incompatible with the fact that the wall at this point often does not have an opening and, moreover, were such an opening to exist, supplementary stakes would have been a real hindrance (as at Elsloo, house 55) and, most of the time, such a door would have opened onto a rubbish pit. Masuch and Ziessow (1983, fig. 12) suppose that the 'Y' layout carries numerous sticks, and many other uprights to replace the missing posts of the other cross-rows. This hypothesis appears to be very complicated, even if three rafters could substitute for a roofing transverse linkage, as has been observed on some Inca buildings (Bouchard 1983, fig. 16-17 and pl. X), (See Figure 11.2).

There is another configuration of posts that brings the 'Y' to mind. This is a construction of three posts in which the post located closest to the north-eastern wall - or the northern wall - is displaced towards the rear section (See Figure 10.4).

The roof

The buildings were probably crowned by a ridge-roof, as suggested by small ceramic models of a later era, found on some Central European sites. The archaeological information is not incompatible with the hypothesis that the walls were not load-bearing: the interior post-holes are much deeper and of a much larger diameter than those of the wall posts. The interior uprights therefore constitute the structure bearing the roof's weight, particularly the row in the longitudinal axis that carried the ridgepole. In these climes, the pitch of a vegetal roof must necessarily be between thirty and forty-five degrees if it is to be watertight. At less than thirty degrees, the roof is insufficiently steep to ensure the flow of rainwater, and a pitch steeper than forty-five degrees aggravates roofing slippage. In the absence of transverse tie-beams, the most feasible answer to the problems posed by water-flow and by the tangential forces acting on joints appears to be a thirty-five degree pitch.

The experimental reconstruction undertaken at Cuiry-lès-Chaudardes, in France, by the Équipe de recherche archéologique n°12 from the Centre de recherches archéologiques of the CNRS demonstrated a number of things. First of all, that simple bonds were sufficient to attach rafters to the beams. Because of pressures and tractions, it also proved easier to use two-part rafters rather than one-part ones. Actually, as the slopes of the roof were not very straight, a long rafter was more difficult to use. Meyer-Christian (1970, fig. 1) believes that this problem was also inherent in the construction of the Bandkeramik houses. But the majority of traditional rectangular houses, built with essentially the same techniques (in particular in Papua New Guinea), have only one-part rafters: the load-bearing posts are topped after attaching trial rafters.

For some dwellings, one could imagine that the rear section was covered by a hipped roof and not gabled (Meyer-Christian 1976: fig. 11 and 12). Besides the fact that such a construction better protects the wall most exposed to the rain, there is archaeological evidence that points to this system: the posts of the last cross-row are very often less deeply sunk into the soil than the others. This more superficial anchoring is only conceivable in the case of a hipped roof, which would have exerted much less pressure. Yet, because this solution would require a transverse beam placed on the free ends of the two longitudinal beams situated on both sides of the ridgepole it would jeopardise the structure's solidity, and we have had to reject this reconstruction.

The roof cover

Several types of material may have covered the roof: straw, reed, wood shingle, birch bark and even animal skin has been proposed (Modderman 1973). The first two seem the most likely; the second has a longer life expectancy but is very difficult to cut with a stone blade (Pétrequin, personal communication). However, a thatched roof of straw is generally penetrated by the rain to a depth of twelve centimetres; the actual cover needed with this material is between twenty-five and sixty centimetres thick. In these conditions, the necessary quantities of raw material may be greater than what is naturally available nearby. However, soot deposited on the inner roof surface in this chimney-less construction will render the roof more watertight.

The reed or straw bundles are easily fixed with vegetal cords to rods attached to the rafters. The rods serve as a ladder for those tying the thatch on the exterior. An independent scaffolding is necessary for those who weave the cords around the rods from the inside.

The walls

The posts that make up the frame of the long walls are fifteen to twenty centimetres thick on average and are placed at intervals of thirty centimetres to one metre. Between two posts, remains of intermediary stakes have sometimes been found: ties are indispensable for holding up the wattle between the posts. Some houses in the Rhine-Meuse region had their posts set into foundation trenches. Sometimes, as at Stein (houses 29 and 23), traces of planks are found but usually only the remains of round posts are recovered, placed at intervals similar to those noted between the posts (or planks) of a wall without a foundation trench. These probably do not represent the remains of a wall of contiguous vertical planks. The West Stow (England) experiments revealed a lack of wall cohesion in the absence of roof trusses, and the fragility of a frame made by joining planks.

Another problem involves interpreting the foundation trench of the houses rear walls. As in the case of the trench dug around the buildings perimeter, traces of split, or more often complete round posts are found in it, spaced in such a way that they could not really have formed a different kind of wall than that elsewhere in the construction. It is possible that the infill between two posts was not always of wattle and daub, but we have no tangible evidence of any alternative. Clearly, this trench was systematically dug around the rear of the house, from the separating corridor between the middle and rear sections of the house. It appears that this correlation was not necessarily a technical one.

Considering the ethnographic evidence, it appears that the height (two metres) generally suggested for the long walls may be a bit too high. It corresponds to modern criteria rather than those prevalent in primitive societies. It is probable that, during the continental winters, low walls were preferable since a considerable amount of heat was lost in the higher part of the house. On the other hand, in the absence of a chimney, smoke can rise towards the rafters and allow non-polluted air in at ground level.

Some later houses in Saxony, Bavaria and the Ruhr have their long walls doubled by a supplementary row of posts; a very early example exists at Brezno but this is an exception. The internal and external posts of the wall are coupled two by two with an evident concern for symmetry. Numerous hypotheses have been suggested, including that of a load-bearing wall. Actually, the internal load-bearing structure of the construction does not seem to have changed: the number of posts is the same as before and the ratio between the depths to which the posts of the wall have been dug in the soil and the depths of the interior post-holes remains the same. If the load-bearing structure remained the same, why this supplementary investment?

As a matter of fact, the doubling serves to protect the wall better. This construction may constitute a rare - if not the only - technical improvement that the Bandkeramik builders made over the centuries. In such a configuration, the external, shorter posts sustained a purlin on which the extremities of the rafters sat, which would allow the latter to go as low as possible. Thus, the roof gives maximum protection to the walls against the rain. The wall itself cannot play this role because too short a wall would involve a loss of interior volume or an increase in the height of the central post and, in that case, a risk of roofing slippage. One could have remedied this inconvenience by displacing the wall towards the exterior but, in that case, the distance between the wall and the inner bearing posts would have become too great, and the construction less stable. Adding supplementary posts parallel to the wall is therefore an efficient solution. In addition, this system provides an ideal location for firewood storage.

Such a solution assumes, however, that the wall be is tied to the roof because, in our windy climate, a screen wall without any shear wall would have been contrary to the fundamental principle of Bandkeramik architecture: total cohesion between all the elements of the construction. Actually, the cohesion provided by wattle-work replaces the shear wall. This is an efficient solution because it allows flexibility, where the whole absorbs the distortion of any part. Indeed any disjointed element would constitute a point of fragility.

The door and the entrance

Like the rest of the superstructure, the door is difficult to reconstruct. Nevertheless, indications of its location have been found (See Figure 12). Apparently, it is always situated in the front section of the house, faces the region of origin of the Bandkeramik culture (the Middle Danube), between the two southernmost posts of the front gable. Moreover, the largest quantities of rubbish are found concentrated in the lateral front pit (Ilett et al.1982, fig. 6), as it was the most accessible outside location and nearest to the exit. Modderman and Meyer-Christian nevertheless suggest the existence of lateral doors; the latter based his conclusion on the 'Y' lay-out of the interior posts or on the separating corridors. But there are too many cases where a lateral door is quite incompatible with the continuity of the walls and the presence of pits dug along the house.

When lateral pits occur all along the house, a concentration of rubbish found towards the rear could also indicate a lateral south or south-west opening (Ilett et al. 1982). But continuity of the wall at this point - especially when it is placed in a foundation trench - indicates that we might be dealing with a window.

As the majority of constructions do not seem to have had lateral openings and as the adherence of the Bandkeramik population to their architectural model appears total (a fundamental characteristic of an acephalous egalitarian society), it seems that in the few houses where such a lateral door was actually possible, its existence was nevertheless highly improbable. We must reiterate that in this kind of society the location of a house's entrance is never insignificant.

The interior of the house

As we have already seen, in the majority of cases the interior of the house is divided into three sections (See Figure 9), each separated from the other by a corridor made up of two closely spaced cross-rows: the first one between the front and the central section, the second between the central and the rear section, at about two thirds of the total length of the house. It is improbable - and it would have been especially inconvenient for the Bandkeramik people themselves - if every cross-row of the house implied a screen. But such a screen may nevertheless have been constructed along the cross-rows of the separating corridors.

There is general agreement in interpreting the duplication of post-holes found in the front section as remains of the base of a raised floor (See Figure 13) that may have served as a storage area. This hypothesis is corroborated by wheat grains or weeds found in the rubbish pits of those houses that had such a platform (in particular in the Aldenhovener Platte sites, Lüning 1982a and 1982b).

The area around the house

Identifying the outside area which goes with a house is important because it played an important role in the chronological and spatial relationships which every construction or excavation around it had with the house itself. In the external lateral area of the house (four metres on both sides of the house) pits were dug that can be described as 'construction pits'. Obviously, these pits served as 'clay quarries'. The Bandkeramik people's preference for loess or silt rich soils permitted them to use local soil for their daub walls and for pottery making. Assuming that in the Bandkeramik past the soil was at the same level as at present, Milisauskas (1972, 1977) calculated that the volume of the lateral pits was generally sufficient for constructing a wall ten centimetres thick. This thickness is probably insufficient to ensure the complete protection of the house, but suitable additional sediment was amply available on site to make thicker walls.

Daub was probably also prepared in the pits: straw or chopped hay and water were added to the earth. Adequate plasticity and homogeneity were probably obtained by treading in the quarry-pits themselves. The pits were then re-used as rubbish pits. All household kinds of remains are found here: potsherds, broken or lost tools, remains of meals, etc. The pits are like a true ship's log, from which the daily life of the inhabitants can be reconstructed.

Finally, between the wall and the construction pits belonging with it, some houses have a large and regular trench strictly parallel to the long wall of the house. Some would prefer to see this as a typically early feature, but this phenomenon also occurs along many recent or late buildings (in particular at Rosdorf and at Straubing). Was it an additional line of external posts, as proposed by Modderman and Lüning (1982, fig. 7)? These trenches do not reveal the remains of posts, and are better interpreted as a natural phenomenon, resulting from rain water running off the roof - an option I observed on stilted houses in New Guinea. But such trenches may also have been dug in order to direct the runoff towards an appropriate pit.

House construction and repairs

It seems that the Bandkeramik house was built in two stages: one for the front and the middle sections, and another for the rear section. Actually, in most of the houses the walls as well as the internal longitudinal rows of posts of the rear section show a slight deviation in orientation. Thus it is probable that the posts of the front and middle sections were aligned independently of those placed in the rear. Moreover, in several houses that seem to have remained unfinished - including the walls - the rear section is often missing. This is the case with house 320 in Cuiry-lès-Chaudardes. Thus it is probable that, in Cuiry, house construction began with the front part, and was to end with erection of the rear section. But this was probably not a rule: the stages of the construction were easy to reverse. The necessity for these two stages is as likely to have been dictated by technical constraints as by *idéel* and cultural practices, or by both. It must not be forgotten that the rear section is very often characterised by walls set in a foundation trench, and could to have been the most private part of the house.

One may try to estimate the lifespan of this sort of construction. In these climes, a building made of wood and earth may easily survive for over a century. It all depends on the attitude of the inhabitants, and the attention they have devoted to its upkeep (replacing the daub, or parts of the framework attacked by insects or humidity, for example). Traces of repair or consolidation are archaeologically found: in Sturovo, for example, two or three replacement posts were almost always systematically set in the original holes, by enlarging them. This practice tends to indicate that the posts must have been replaced as they wore out. Such repair or consolidation can be found at Bedburg-Kaster (Frimmerdorf) or at Elsloo (houses 13, 25, 27, 32, 37, 48, 51, 55, 59, 67, 76, 78, 87, 88, 89, 93 and 94): where new posts or supplementary sticks were placed in the house interior or along the walls.

House construction and labour efficiency

I originally proposed (Coudart 1990) a *labour efficiency index I* (the ratio of surface area to number of internal posts) in order to compare the houses of the different Bandkeramik stages. But there are several reasons why it is not very interesting for that purpose. First of all, the large houses have relatively fewer posts than the small ones. Moreover, over time the length and the width of the rear section tend to decrease , and the width of the façade to increase, so that between the beginning and the end of the Bandkeramik the total surface is fairly stable, decreasing very only slightly. Thirdly, the number of posts is only reduced over time in the very large houses. As there is therefore very little difference in the 'labour efficiency I' index through time. On the other hand, this calculation is useful when one wants to compare the 'labour efficiency' of Bandkeramik houses to that of post-Bandkeramik ones.

The *labour efficiency index II* (the ratio of the surface area to the surface of the ' skin' of the house), an indicator of the control over the interface between the interior and the exterior environment, confirms the same tendency which has been observed for the *labour efficiency index I*: there is no real change; in numerical terms, the index is stable. Finally, the *labour efficiency index III* (the product of the index I and the index II) which reflects the ratio between the work involved in having the smallest exterior surface exposed to bad weather and the work involved in having the most spacious habitable surface - is also almost constant.

An archaeological reconstruction of Danubian Post-Bandkeramik houses

Discontinuity, but with certain cultural rules retained

Without entirely breaking with the preceding period, post-Bandkeramik architecture nevertheless manifests a radical change, both with respect to the architectural model and the techniques used.From a 'universally' accepted format there is a development towards regionally different kinds of architecture which are better able to resist the winds, and which vary more widely in volume and length. Nevertheless, certain cultural traits persist in the architecture, even though they are in contradiction with the new ways of doing things. In particular the different ways of keeping the cross-rows in the interior space of the house, is technically in contradiction to the fact that the long walls become load-bearing.

One cannot believe that the Danubian Neolithic people would have kept to a system of cross-rows because they were incapable of finding an improved technical solution. Once the cross-girder tie is in place, and the walls bear a substantive part of the weight of the roof, one or two of the three posts in the cross-rows inside the house have become redundant. This is corroborated by the fact that certain cross-rows in the rear section are reduced to one or two posts. Why then do we find cross-rows in some very late and very well preserved constructions such as house 3 in Zwenkau-Harth or in the houses at Krusza-Kamkowa? Why is there such an irregular arrangement and such a decrease in the number of cross-rows, which probably made them architecturally useless? Why did people put three posts in a position where one or two would have been sufficient?

Labour efficiency, improvements and technical changes

The 'labour efficiency I' index, with a mode situated between 5 and 11, marks a clear improvement in efficiency with respect to the Bandkeramik period. Clearly, the Lengyel houses in Kujavia have the highest index because they hardly have any posts inside the house (mean = 16.83; SD of å= 3.37). The 'labour efficiency II' also increases to values between .40 and .60. As the indices of 'labour efficiency I and II' rise, the index of 'labour efficiency III' also rises in comparison with the preceding period, to a mean of 5.04 (SD of å= 2.24).

For neither of the periods discussed (Bandkeramik and post-Bandkeramik) is there any relationship between labour efficiency in building a house and type of ground-plan. Most of the post-Bandkeramik houses were constructed on a trapezium or boat-shaped ground-plan (See Figure 3.4-5-6). These kinds of ground-plans probably made the construction more resistant. An aerodynamic shape (See Figures 4, 14) in particular was better adapted to climatic conditions if we assume that the rear section faced the strongest winds

Actually, other aspects of architectural design take the winds into account. Similar features are found among more traditional architectural constructs and among modern ones. Present-day examples are seen in Melanesia and Scandinavia. While modern Scandinavian architecture is specifically designed to withstand the dominant winds, Melanesian houses, on the contrary, often try to take advantage of the slightest breeze (in this case the opening would face towards the dominant wind), to improve the ventilation of the house The smoke from the fire in the middle section, for example, is blown towards the rear part of the house, thus creating a volume of non-polluted air at floor level, where the beds are located (Marshall 1979:, fig. 4; 1981; Coiffier 1984 and personal communication). However, because in Melanesia the houses' orientation is independent of the prevailing wind (Coiffier 1984, vol. 2), such constructions may there involve symbolic aspects (the need for a monumental façade, for example) rather than an improvement of internal ventilation, as was probably the case for the Bandkeramik house.

Several indices have been proposed to evaluate the degree of aerodynamic efficiency and stability of post-Bandkeramik houses. Soudsky (1969) suggested calculating the *small width / large width* ratio. In order to take house length into account, it has been suggested to use the tangent of the angle (*x*) formed by the extension of the long walls towards the rear (Marshall 1981; Coudart 1982). Actually, the two calculations are of little help. Aerodynamics and stability are much more complex phenomena and cannot be estimated solely on the bases of house wall obliqueness and the relation between the apse and the façade dimensions. In view of the cost of experiments and simulations proposed to obtain a mathematical control of an obvious proposition grounded in common sense, it seems sufficient to admit that a house with a slightly trapezium-shaped or trapezium-shaped ground-plan resists wind better, and above all shows a more dramatic façade than a rectangular house. That said, the observed angle *x* is always acute. For the Bandkeramik period, it is between one and nineteen degrees (mean = 5; SD of ∑ = 4). For the post-Bandkeramik period this angle is between two and a half and seventeen and a half degrees (mean = 10; SD of ∑ = 10)[5] .

For an efficient design, the angle *x* cannot be too small, but it cannot be very large without threatening the construction's stability itself. The Danubian people were aware of this limit and took it into account, playing with the permissible margin of the angle *x*, and thus choosing between the different types of ground-plan, so as on the one hand not to exceed the maximum width permitted by construction techniques, and on the other to have a wide enough range of lengths at their disposal.

Initially, at Zwenkau-Harth, at Dresden-Prohlis and at Hambach 260, the double walls appearing at the very end of the Bandkeramik period were simply improved. The number of additional posts was reduced: one single post-hole is found where, in the external line of posts, two posts used to face two wall posts (See Figure 15.2). Still a simple support for the heel of the rafter, the single post may be qualified as a 'pseudo-buttress'. The depth of wall post-holes and that of the additional line of posts is not very different. But above all, they remain clearly shallower than those of the internal rows of posts. In this sense, the basic construction was simplified and reduced but its conception and architectural structure remained the same as during the Bandkeramik period. Actually, one must remember that the external posts - now fewer in number - carried heavier loads than in the former period when they had been twice as numerous: their holes were therefore of a larger diameter than those of the wall posts. When the walls were not doubled, their posts were often fewer than they used to be, and therefore, as in the preceding case, their diameters were slightly larger (Bochum-Laer, Hienheim 2, Libenice, Mseno). At the same time, the number of interior cross-rows diminished; the arrangement of the latter is less dense and the house wider (up to 8 metres).

Later, actual changes appeared which sometimes affected the architecture's conceptual model: modification of the internal cross-rows, for example. The holes of the wall-posts are now also a little deeper, or even much deeper, than the interior posts. The pseudo-buttress disappeared but smaller posts (or actual buttresses) were often attached to the walls (See Figure 15.4and 15.5). At this point, one may speak of load-bearing walls. The ratio between the average depth of inner post-holes and of wall post-holes allows us to identify three main categories of load-bearing function: weak, moderate and important. The archaeological data do not allow a closer approximation, but it is enough to know that some walls withstood greater pressure and traction than others.

It seems logical to associate these observations and these hypotheses with the introduction of a transverse tie-beam and the use of pegging and, perhaps, the mortise-and-tenon technique. This association is all the more logical because the cross-rows become irregular and rare - even absent as in Kujavia - as though their symbolic presence were enough.

Beyond reconstruction: an architectural typology

With respect to Bandkeramik houses, the distinction proposed by Modderman 1970 (see Figure 16) between tripartite houses with a storage area (*Grossbauten* or type 1) and houses which comprise two sections and do not have a storage area (*Bauten* or type 2) is economically and socially highly relevant, and was probably significant during the Neolithic. The small buildings (*Kleinbauten*- or type 3) which consist of only one section without storage area or rear part, are all too often not well understood, because they are poorly preserved or partly destroyed by other habitations. Elsewhere, the layout and the dimensions of the houses are altogether too varied. This diversity does not permit the presence or the absence of a storage area to be considered a factor distinctive enough to allow houses with a storage area to be classified in a category called *Grossbauten*, and those without a storage area in a single other category (*Bauten*). This makes the Modderman typology relatively ineffective. Apart from the fact that we consider the great majority of buildings as tripartite houses (Coudart 1990), the diversity of the combinations possible between different parts is such that specific types of house cannot be established, even if the architectural model chosen is very strictly applied.

Based on a study of some five hundred houses, I have therefore proposed a division into three sections of the building: a *front*, a *middle* and a *rear* section (See Figure 9), which each may show a different spatial organization. Each type of a certain section may combine with several - and often all - types distinguished for other sections. It is a typology for house sections rather than a typology for houses in their entirety.

The internal division of space

The corridor of two cross-rows separating the front section (or at least the section we regard as such) from the remainder of the Bandkeramik house occurs in 89% of the sample, and the rear corridor (separating the middle from the rear section) has been observed in 93% of the studied cases. The Bandkeramik houses are thus divided into three sections (91% of the sample) - the presence of the front corridor is considered a sufficient indication for the assumption that a front section existed. Using this definition, only 4.5% of the sample do not possess a front section, so that one may speak of bipartite houses. The separating corridor between the central and the rear sections is absent in only 2% of the observed cases. This definition of partition allows us to classify 89.85% of the houses that were considered bipartite by Modderman as houses with three spatial units. The remaining bipartite houses - and the few monopartite houses, if we accept their existence - generally occur in the later periods.

Several buildings of the post-Bandkeramik periods have internal divisions which are specifically marked by one big cross-row, or by a foundation trench. In particular, this is so in the regions of the Rhine and Meuse (Aldenhoven, Hambach 260 and 471, Inden), the Ruhr (Deiringsen-Ruploh, Bochum-Hiltrop, Bochum-Kirchharpen) and Bohemia (Postoloprty). In these cases we sometimes find the usual corridor, as in the Neckar region (Schwäbisch-Hall). It is probably a case of continuity in the significance that is socially attributed to that space. In most cases, the way in which the separation is marked remains very irregular and it may well occur in the front section without being used to demarcate the rear section, or vice versa.

The ground-plans

We have not yet encountered the 'sub-rectangular' plan in the eastern zone, but the three types exist everywhere in both the other zones, and in all periods from which we know Bandkeramik houses. The first kind of ground-plan is dominant during the middle and recent Bandkeramik periods; the 'slightly trapezium-shaped' plan is present from the earliest period onwards (Miskovice for example). Finally, the three types all appear in more or less equal proportions in the later Bandkeramik period. Although it is possible to divide the different kinds of house ground-plans in two general categories (rectangular for the Bandkeramik period, and trapezium-shaped for the post-Bandkeramik period), there is no break between the two chronological sets. Both the 'trapezium-shaped' ground-plan and the 'boat-shaped' ground-plan are used in the late periods of the Bandkeramik, but in very small numbers. Similarly, the slightly trapezium-shaped ground-plan still occurs in the post-Bandkeramik period, although it is rare.

The location of the cross-rows

As in the house plan types, we observe two sets of cross-rows arrangements: types A, B, C, D; and types E, F, G, H, I (See Figure 17):

- for the Bandkeramik period (in which type D dominates): types A (dense regular pattern); B (dense amorphous pattern); C (intermediate pattern: between A and B); and D (widely spaced 'rhythmic' pattern).
- for the post-Bandkeramik period (in which type G is the most frequent): types E (spaced monotonous pattern); F (spaced amorphous pattern); G (very widely spaced monotonous pattern); H (very widely spaced amorphous pattern); and I (without visible cross-row).

But there is no real break between the two groups because the types E, F and G appear at the end of the Bandkeramik period, and type D continues to be used during the post-Bandkeramik period. Type D is in effect a type that occurs from the very beginning of the Bandkeramik period and becomes more and more dominant as time goes on. Thus, the western zone and the western frontier - the most recently colonised zones of the Bandkeramik area - are characterized by the systematic use of type D (96.57%). It seems that, after a period of hesitation, this type proved to correspond best to the cultural requirements of the Bandkeramik people, as this kind of spatial organization does not present any architectonic advantages over the other types.

Preferences for one type or another in the post-Bandkeramik period seem to develop with regionalization. In Kujavia, type I is most frequent. In Saxony and the Ruhr area, one sees more often type G. In the Rhine-Meuse region there is a lot of variability, including occurrences of types G, H and F, as well as ongoing use of the Bandkeramik types (B and D). In Bavaria, in general, we find type D. It is important to note that this regional differentiation is closely matched by the cultural variability in ceramic production.

The different sections of the house

We are here solely concerned with Bandkeramik houses because, even if those of the following period sometimes show a clear partition of space, the irregularity that we have observed for the post-Bandkeramik period foils any attempt to find patterning in the spatial organization of the building.

The front section

In the majority (45%) of cases in the sample, the front section (See Figure 18.1) has either a *storage area* (types a and b) or a *pseudo-storage area* (or*working area*): type c. Where we do not find anything in front of the separation (33%), there is what might be called a *reduced front section* (type d). But because we nevertheless find a separation, space must have been structured, and the central section must have been separated from that which stood in front of it. The main other types - the *simple front section* (type e) and the *no front section* (type f) - are even rarer (11% and 5.5% respectively). Every kind of front section exists everywhere and for all periods of the Bandkeramik, with two exceptions: (1) the presence of the 'pseudo-storage area', and (2) the absence of a separating corridor between the front and middle sections. Neither occurs in the older periods - but here our sample is too scanty.

In fact, each kind of front section corresponds to a different total length of the building and to a different number of posts. This link between the type of front section and the house's dimensions becomes clear in the correspondence analysis[6] (See Figure 19): on the horizontal axis, the rather short categories, the types 'reduced' and 'absent', contrast with the longer categories and with the type 'storage area'. The difference between the various kinds of front section is thus both qualitative and quantitative.

The central section

Distinction between the various types of central section, on the other hand, seems qualitative rather than quantitative. For example, it does not show up as a horseshoe-shaped curve in the correspondence analysis (see below and Figure 18.2). We might even say that this distinction expresses a characteristic that has to do with *idéel* function rather than with material function (even if the latter aspect is never totally excluded, and their mean lengths distinguish the *one unit* from the *four unit* type). Primarily, it is in this section that we find the'Y'-shaped pattern of posts, a configuration that does not in any way seem tied to architectonic constraints. In fact, there is no difference in size between the middle section of those houses that have a 'Y'-shaped configuration and the corresponding section of the other houses. Moreover, we find both kinds side by side on the same site. Finally, this pattern occurs probably only in the west - or is at least regional (essentially in the Rhine-Meuse area)[7] . On the other hand, it does not seem that one can truly contrast the two most frequent types of middle section, those of *two units* and those of *three units*, by size, except in extreme cases.

It is interesting to point out that if the 'Y'-shaped pattern seems to exist only in the Rhine-Meuse area and in 20.50% of the sample, the *inverse J* configuration occurs in more than 12% of the sample, in all geographical zones and in all periods.

The rear section

The rear section of the house is, even more explicitly than the front section, variable in a quantitative sense. Each type comprises a series of spatial units (between one and five) separated from each other by a cross-row (See Figure 18.3). We find that there is indeed a very strong correlation between the number of cross-rows and the length of the rear section: R = .85, and of course the mean lengths of the rear section vary with the number of units making up the rear section, which in turn might be linked to the number of occupants.

The most prominent are *one unit*, *two unit* and *three unit* types. The fact that the first one occurs relatively frequently in the later periods contrasts with the occurrence of large numbers of the third category during the early periods.

Correlations between length and types of each house section

Given that certain kinds of variables are linked to the dimensions of the house, and in order to arrive at a general overview of the relationships between qualitative aspects (types) and quantitative ones (different length categories), a correspondence analysis (See Figure 19) has been executed on the following variables: types of front (Av), central (Ct) and rear (Fd) sections, length categories of the front (Lg Av) and rear (Lg Fd) sections, total length (Lg T), Modderman's typology (Mod) and the internal partition (Part).

We find that the various types of central section are much less tied to size than types of other sections of the house. In contrast to the types of front and rear section of the house, the types of central section do not show up as a horse shoe-shaped curve - the form which in correspondence analysis characterises a relationship tied to differences in size between the variables.

Deductions from the typology about house use, and the structure and evolution of society

It is only by going far beyond the first level of hypotheses (material reconstructions of the house) but without leaving the first level of description and classification (typology) that one is able to consider the societies which built and used the architectural features dug up by archaeologists. It is here that archaeological studies of architecture find their justification.

Deductions from the inside of the Bandkeramik house

In spite of the fact that some houses are longer than others, or without a pit or with a very small isolated one, the function of each Bandkeramik building seems to be the same. This is potentially an aspect of the collective identity of the Bandkeramik people, which is especially prominent at the level of the constructionswhich are the concrete expression of the passage from one section of the house to another: these two corridors exist in almost all houses (90% of the ground-plans studied). But as we have observed, each section could be laid out in different ways. We must therefore try to see what each section might have been used for, and to what the different kinds of spatial organization might correspond.

The front section

The front section of a building contains the entrance and thus marks a transition between the external world and the internal one. This section is the locus of transition between the public and the private domains and probably accessible to all; the social anthropology of primitive societies makes clear that this transition is always emphasised. By means of very discreet (for example the orientation of the door) to very ostentatious (monumental façade, decoration, presence of ritual objects) markers, the *idéel* function of the construction is made public or, in case of a domestic building, the *origin*, the *place* or the *role* of the household in the group. It is a special place where one may stress one's resemblances or differences in relation to others. In each village, the front section of the Bandkeramik houses shows systematic variability in the arrangement of its cross-rows. The indexes of variability are different from one village to another, and more or less the same in the four geographical zones - irrespective of whether such zones were colonised early or later in the Bandkeramik expansion. Hence, we may consider this variability as tied to the socio-economic functions necessary for the maintenance and the reproduction of the group (Coudart 1990, Coudart 1991, 1993).

The front part of the house seems to have had an economic function, as is attested by the storage area. We do find a larger quantity of grain and remains of weeds in the rubbish pits of certain houses with a storage area (Langweiler 8) than in other houses, even though the number of cereal grains and querns is - in proportion to the length of the building - about the same in all houses (Luning 1982a and b: fig. 18). If the processing of cereals (pounding, storing, etc., and possibly redistribution) was the business of the inhabitants of houses with a storage area, the cereals were nevertheless consumed by the whole village. The fact that certain houses (45%) were distinguishable from others by their economic function might seem in contradiction with the fact that in an acephalous egalitarian society, in which there is no production of 'wealth', there is very little room for individual manifestations or personal power. In fact, when we consider the location allotted to the storage area (in a visible place, which can therefore be controlled by the community), we have to admit that the household units that managed these houses with a storage area probably remained under the control of those who did not possess one.

The central section

Separated from the front section by a corridor, the middle section was probably a domestic area. As the arrangement of cross-rows is not correlated to the surface, we can say that the diversity of the spatial organization of this section does not reflect variations of a demographic nature or differences in requirements for habitable space. We therefore do not consider the middle section as the area reserved for sleeping or where privacy was ensured. Moreover, this section was sometimes in direct contact with the outside - as seen above, the front corridor sometimes does not exist - and ample ethnographic evidence suggests that it may well have been a reception area for visitors. If one accepts this hypothesis, the layout of this middle section could be used to express certain preoccupations of the inhabitants of the house in relation to the other members of the community. It served this purpose much better than the front section, which was heavily constrained by its economic function. In a given period, certain households even have an entirely original pattern for the posts in this section, in the form of a Y.

In fact, on certain sites it has been established that the configuration of posts in the middle section is the same for all houses; on other sites variability is the rule, although that is less so in the western zone and on the western frontier. It seems as if uniformity is prevalent on small sites (Miskovice and Missy-sur-Aisne, for example) or on sites isolated from other important ones (Cuiry-les-Chaudardes and Hienheim), and variability occurs when the villages form part of a network of important sites (later periods in Langweiler and Bylany, Figure 20). In some cases (isolated or small sites), each household unit has attempted to stress its resemblance to the other members of the village. But in other situations (such as a large network of social and exchange relationships), each household of a village may express in the middle section of its house such differences as are recognised and accepted by all the members of the community of sites - and more markedly in the geographical zones of the early phases of the Bandkeramik expansion. At this point, everything happens as ifa sense of security or certainty about the future, associated with the presence of exchange partners and a good knowledge of the natural environment permitted the rules of social integration to be relaxed.

The rear section

Situated at the other end of the building, and separated from the middle section by another corridor, the rear section is doubtless the most withdrawn part of the Bandkeramik house; it is the least directly accessible, and it is probable that visitors were not admitted. Apart from the separating corridor, several other observations lead to this hypothesis. In the first place, the straightforwardness and the repetitive character of its spatial organization (a simple succession of cross-rows without any elaboration) do not suggest that it was a public area. This is no proof, but it seems logical that the Bandkeramik people would not, by stylistic means or by a specific configuration of posts, express similarities or differences with respect to other members of the group if only the inhabitants of the house itself had access to this stylistic message. Indeed, its inhabitants are the people for whom the resemblance is obvious - they belong to the same domestic unit - and for whom differences have no significance.

As we have seen for the front part, the rear section of the Bandkeramik house differs with varying degree of variability from one village to another, and in the same way in the four geographical zones. As far as the variability in the rear section is concerned, it is tied to the number of units present, and is thus essentially of a quantitative nature. It must be a response to different spatial needs rather than anything else. We may even suggest that the length depended on the number of occupants. In this case, the rear section could be the area reserved for sleeping and the locus of greatest intimacy.

It would be interesting if we could establish that the values of the index were proportional to the dimensions of the site. Everything seems to indicate that the probability of encountering households of various sizes increases with the importance of the village.

Uniformity and variability: two contradictory principles for one and the same socio-cultural system

From the relationship 'uniformity-diversity' or, if one prefers, from the diversity (of the arrangements) embedded in the uniformity (of the model) which characterised Bandkeramik architecture (as well as the social structure; see Coudart 1991), one may come to understand how the model of the house, and - beyond it - the cultural and social Bandkeramik system which produced this model, were maintained over centuries.

The fact that every variation of the architectural model was used in all four geo-cultural zones throughout the Bandkeramik period points to one and the same internal logic: it is a matter of unifying the Bandkeramik system while allowing it to diversify. In other words, it is a matter of creating, maintaining and expanding the Bandkermik cultural identity. This requires simultaneously a mimetic adoption of the model (uniformity) and a structuring system with differentiation among its constituent parts. Thus, a kind of 'uniform variability' is produced that compensates for the increasing entropy resulting from the uniformity of the Bandkeramik system. This is a very useful process, which allows the system to survive (i.e. with respect to its cultural identity) in the very long term without calling into question - or at least as little as possible - its inertia and the equilibrium of its traditions.

Individualisation and regionalization in the post-Bandkeramik period

The post-Bandkeramik period is marked by the progressive disappearance of theoriginal architecture, and we can no longer identify the partitioning of the house so clearly.

After identifying the characteristic variables of the post-Bandkeramik houses that do or do not co-occur, we have executed a correspondence analysis that presents the following results. Along the horizontal axis, these variables cluster by site and, even better, by geographic zone (See Figure 21). The western zone and the western frontier (negative values) are opposed to the central and eastern zones (positive values). We might say that the horizontal axis is that of the geographic division - from east to west, seen from right to left. The correspondence analysis contrasts the regional assemblages of 'Rhine-Ruhr-Neckar', 'Saxony-Bohemia' and 'Kujavia'. On the vertical axis, there is clear evidence of the survival of ancient characteristics which, dating from Bandkeramik times, still exist in certain areas in the central-eastern zone (Zwenkau, Libenice, Dresden-Prohlis, Mseno) during this later period.

Chronologically, the sites of Hienheim in Bavaria, Schwanfeld in Franconia, and Hambach 260 in the Rhineland would therefore be situated in an intermediate period. And, finally, the sites of Kujavia are indeed the most recent.

During the post-Bandkeramik period, we see the 'universal' character of the cultural traditions - which were once shared by the peoples that occupied most of temperate Europe - disappear. We might propose the hypothesis that this is the result of the diversification of the natural environments exploited, and this for two reasons. On the one hand, we might say that once the entirety of an area has been colonized, it is progressively transformed to the point where it develops characteristics that are ecologically incompatible with the technological traditions of the group. On the other hand, in the absence of a sufficient quantity of virgin land that fulfilled the environmental conditions to which the Bandkeramik people were used, they were forced to adapt to particular econiches. Regional differentiation and, in the long run, specializations could result from this diversity of environments and the techniques which were developed to exploit them. To sum up, the unity of the Bandkeramik culture is broken and there is no longer such a high degree of similarity between the houses of the eastern and western zones and the western frontier. But this does not mean either that there is no longer any homogeneity at all. We can discern some degree of regionalization, of which the most prominent aspect is the architecture, but which is also to be observed in the pottery. The cultural identity of the post-Bandkeramik groups is no longer universal, it is 'regional'. As a matter of fact, one should not speak of post-Bandkeramik groups but of 'Lengyel', of 'Stichbandkeramik', of 'Hinkelstein', of 'Grossgartach', of 'Rössen', 'Blicquy / Villeneuve-Saint-Germain' and 'Cerny'. One sees regional assemblages, such as those of the 'Rhine-Ruhr-Neckar', of 'Saxony-Bohemia', of 'Kujavia' and of the 'Paris basin', taking shape.

Across the whole of the Bandkeramik territory, the original architectural model is only preserved as far as the very great length of the houses, their orientation and their completely or partially trapezium-shaped ground-plan are concerned. The fact that the Bandkeramik model disappeared without being replaced - the absence of a model signifies non-conformity to a model - probably favoured a degree of individual expression that did not exist before. To mark one's belonging to a group - within and outside of it - no longer seems so fundamental: the architectural canon is less strict.

But if the architecture allowed the expression of differences within the group itself, it does not seem to be the case that true social stratification was generated, even if these first differentiations between households established a basis favourable for the development of social inequality.

Conclusion

It is in this respect that studying the architecture is of fundamental importance for our knowledge of the sedentary prehistoric societies.

1 Calibrated dates

2 The regions which do not figure in this summing up are those in which no remains of habitations have been found—or of which the data had not yet been published when this paper were written (1986).

3 To facilitate or allow the various calculations in this study to be done, it has been necessary to harmonize the different regional periodisations of the Bandkeramik by subdividing the Bandkeramik into four major periods: the ancient, middle, recent and late periods. Notwithstanding the terminology which is familiar to specialists, the division proposed here does not correspond to the 'periodisations' commonly used by prehistorians.

4 We must point out that a village is never composed of small houses only.

5 With an unrealistic value of twenty-eight degrees, the plan of house 3 at Hienheim is definitively doubtful.

6 A correspondence analysis is a multivariate statistical procedure applied to categorical rather than continuous data. It provides a graphical plan generated by two axes, which translates the correlations between n variables in a space of n dimensions; these correlations would be otherwise imperceptible even by imagination. Most of the statistical analysis of the present work made by the author, while the correspondence analyses were done by C. Chataignier on the computer of the Centre inter-regional de calcul électronique's (CIRCE) computer at Orsay, France with the SAS system.

7 It seems that Bandkeramik houses with a 'Y'-shape configuration have also been discovered in the Bodensee area.

Keywords (re)construction
construction of building

Country Austria
Hungary
Romania
Slovakia

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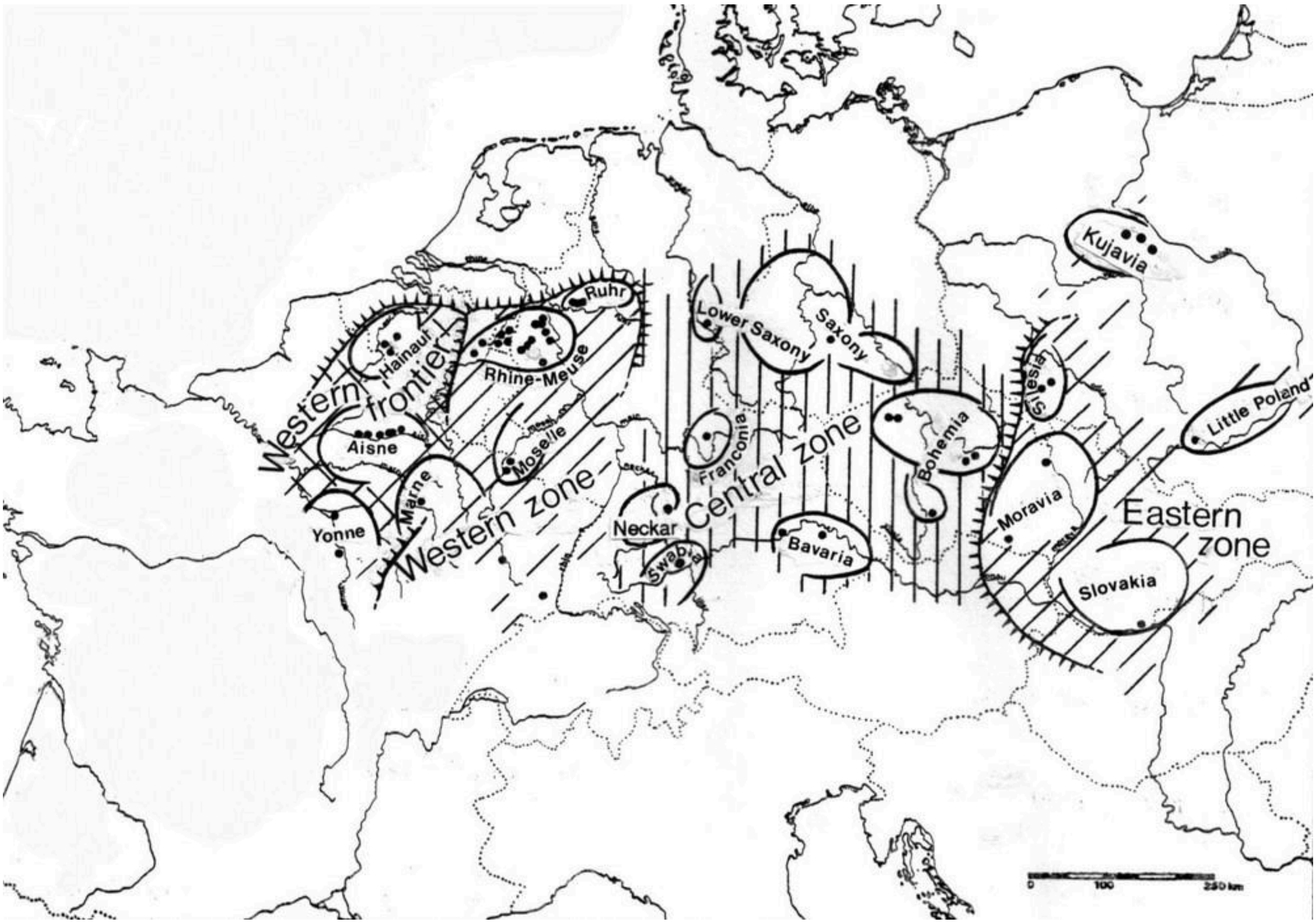

FIG 1. AREA OCCUPIED BY THE DANUBIAN (BANDKERAMIK AND POST-BANDKERAMIK) GROUPS: GEOGRAPHIC ZONES, CULTURAL REGIONS AND SITES WHERE HOUSES HAVE BEEN FOUND.

FIG 2. AN EARLY STAGE IN THE RECONSTRUCTION OF A BANDKERAMIK HOUSE, CUIRY-LÈS-CHAUDARDES, PARIS BASIN, FRANCE BY THE ÉQUIPE DE RECHERCHE ARCHÉOLOGIQUE N°12—CRA-CNRS (© COUDART, CNRS).

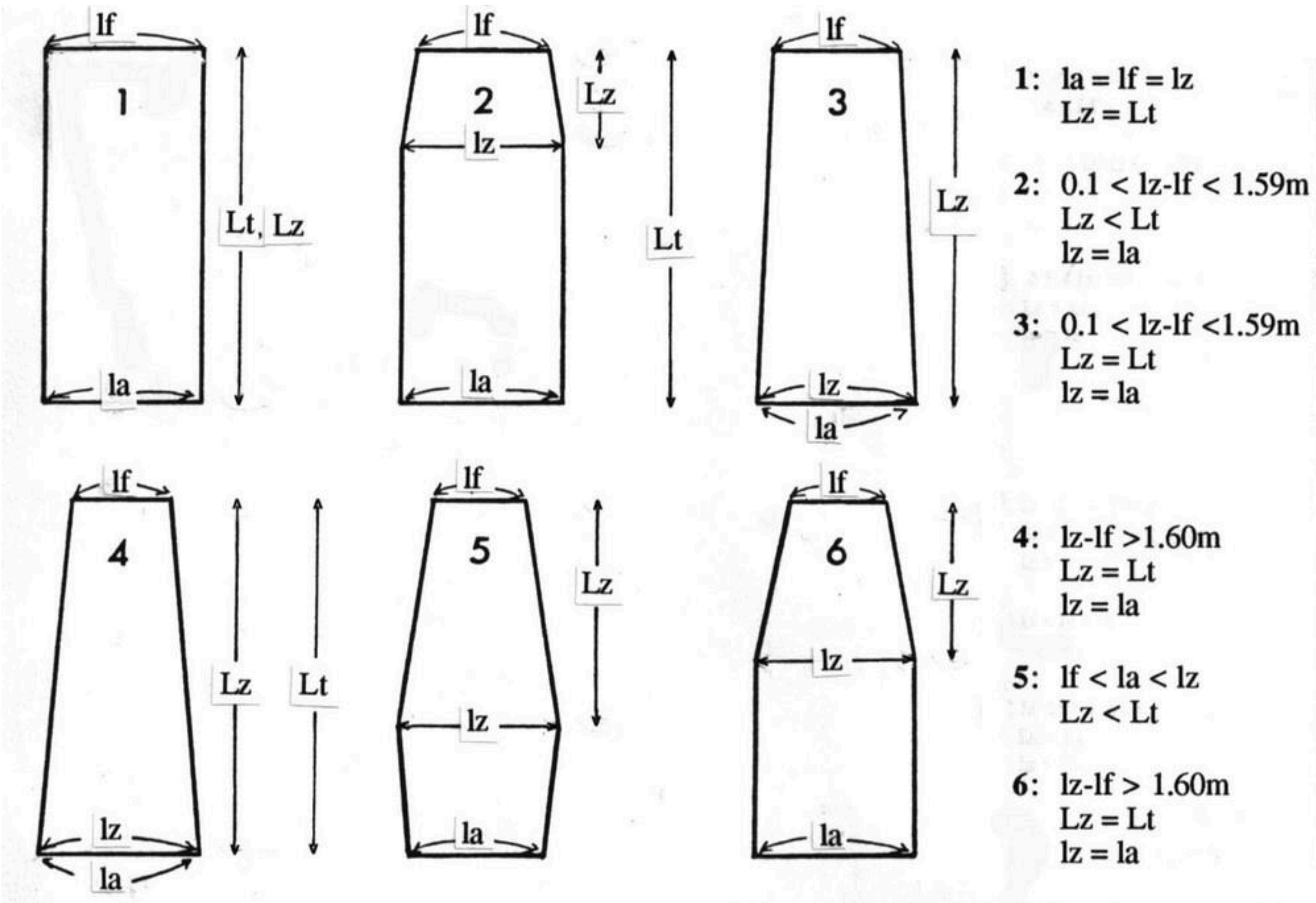

FIG 3. TYPES OF GROUND-PLANS:1, 2, AND 3 BANDKERAMIK (RECTANGULAR, SUB-RECTANGULAR AND SLIGHTLY TRAPEZIUM-SHAPED); 4, 5 AND 6 POST-BANDKERAMIK (TRAPEZIUM-SHAPED, BOAT-SHAPED AND PSEUDO-

TRAPEZIUM-SHAPED).

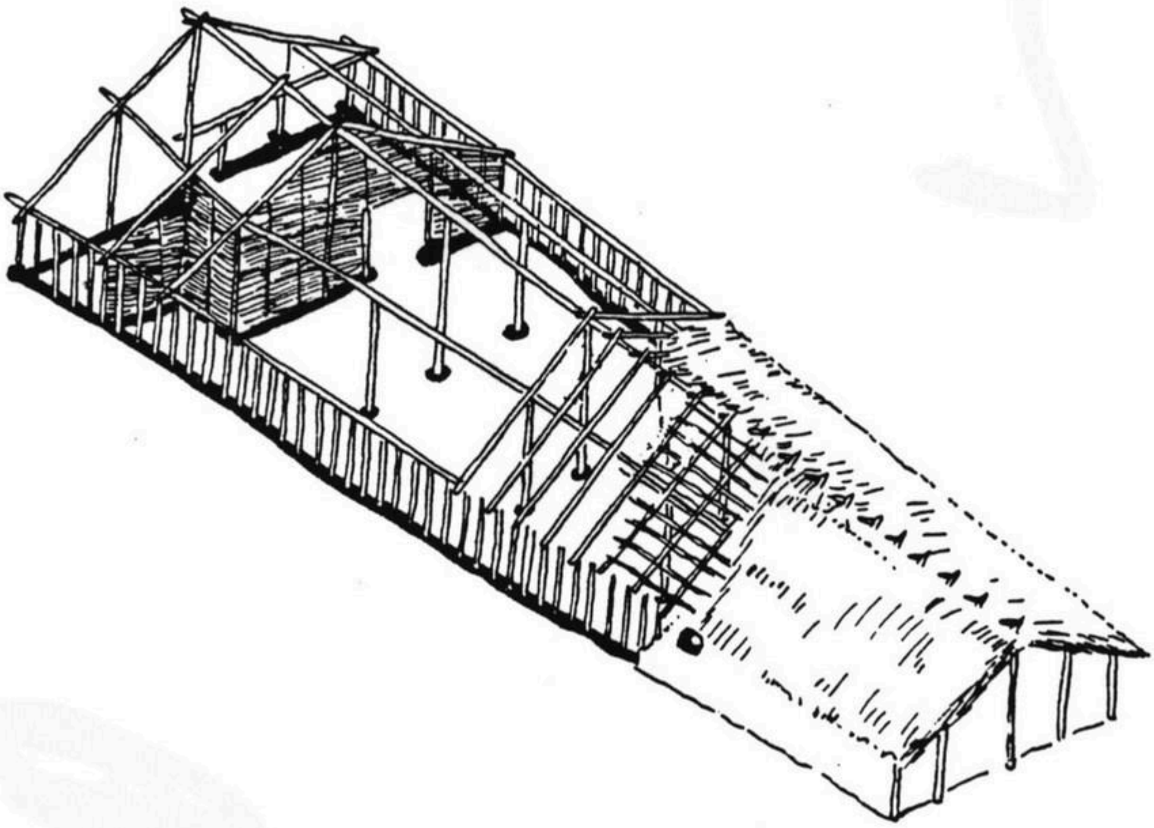

FIG 4. RECONSTRUCTION OF A TRAPEZIUM-SHAPED HOUSE (POSTOLOPRTY), AFTER SOUDSKY (1969).

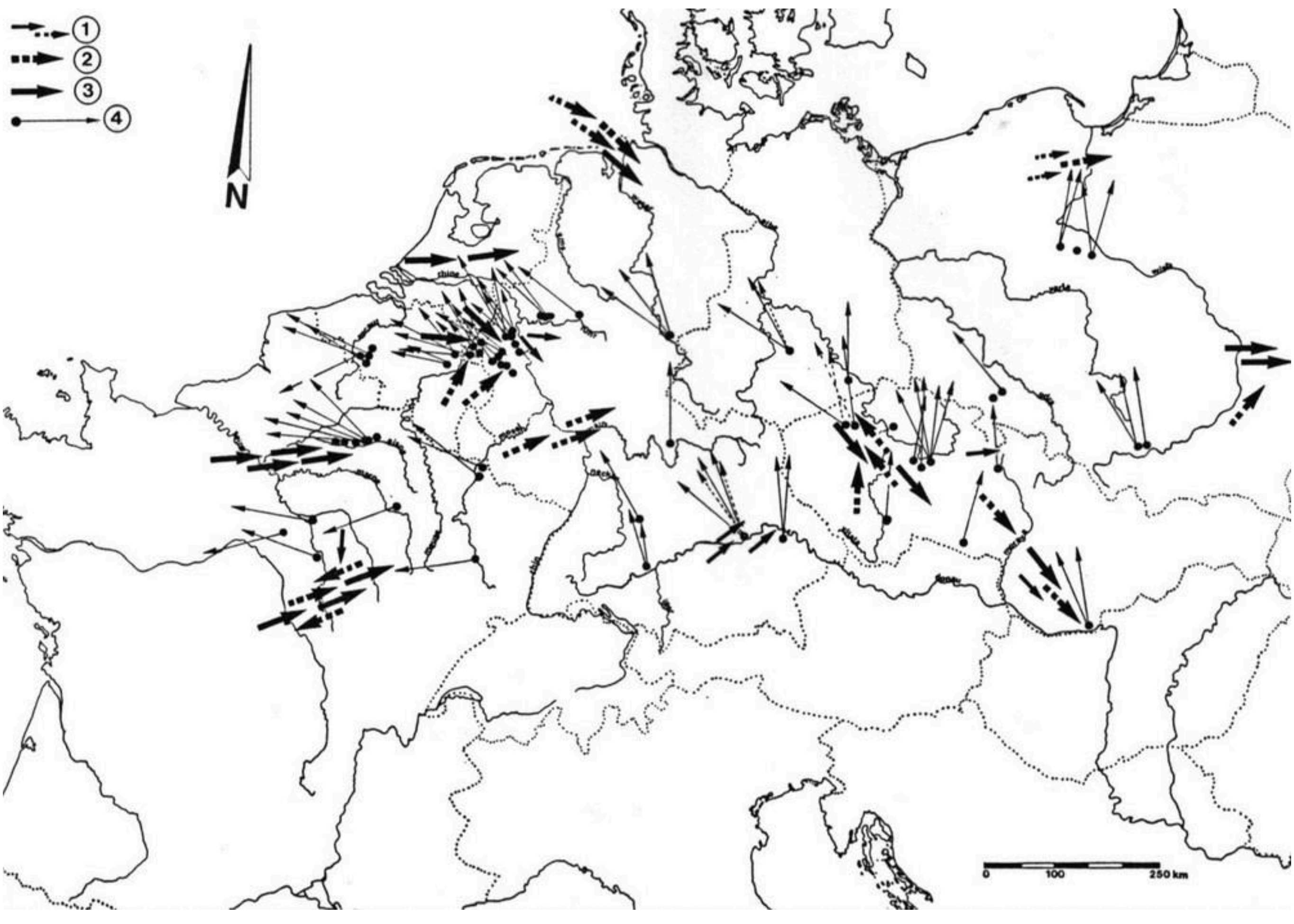

FIG 5. ORIENTATIONS OF THE DANUBIAN HOUSES AND THE DIRECTIONS OF THE PREVAILING EUROPEAN WINDS (1- SECONDARY WINDS; 2- PREVAILING WINTER WINDS; 3- PREVAILING SUMMER WINDS; 4- HOUSE): IT SEEMS THAT THE HOUSES' ORIENTATION HAD NOTHING TO DO WITH THE PREVAILING WINDS.

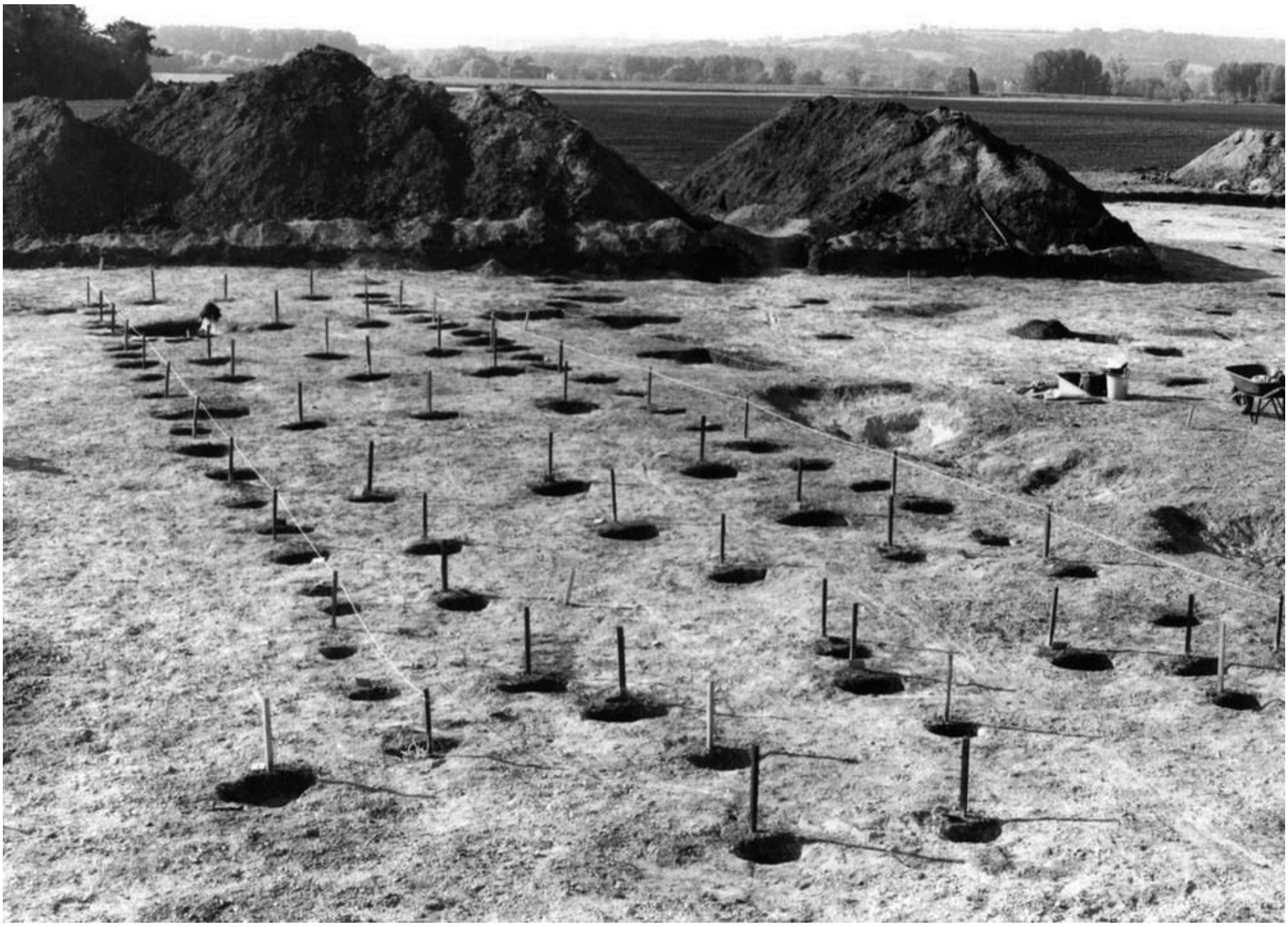

FIG 6. REMAINS OF A BANDKERAMIK HOUSE IN CUIRY-LÈS-CHAUDARDES (AISNE VALLEY, FRANCE).

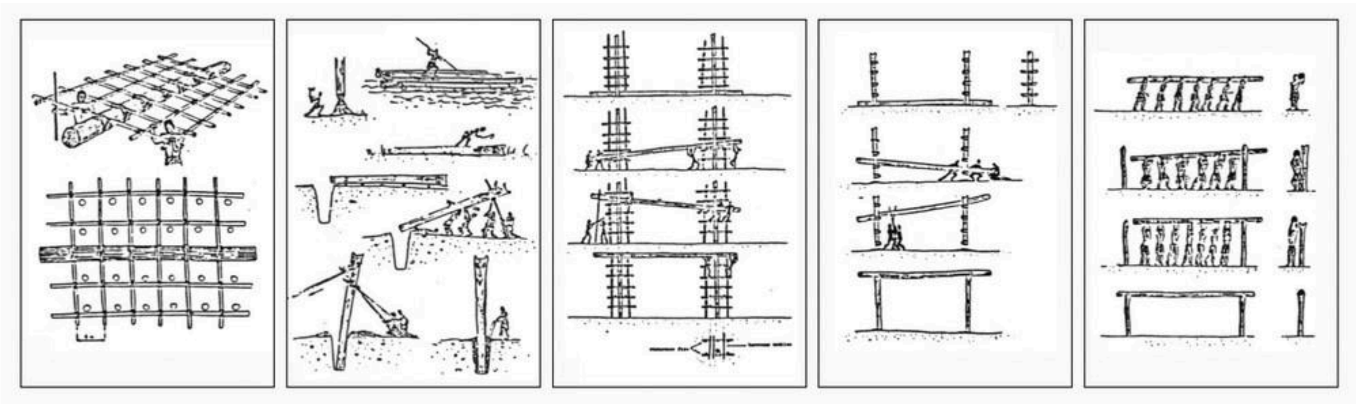

FIG 7. DIFFERENT WAYS TO PUT A BEAM IN PLACE AT PALIMBEI (IATMUL TRIBE, SEPIK, PAPUA NEW-GUINEA) (AFTER COIFFIER 1984, PL. 440, 441, AND 442).

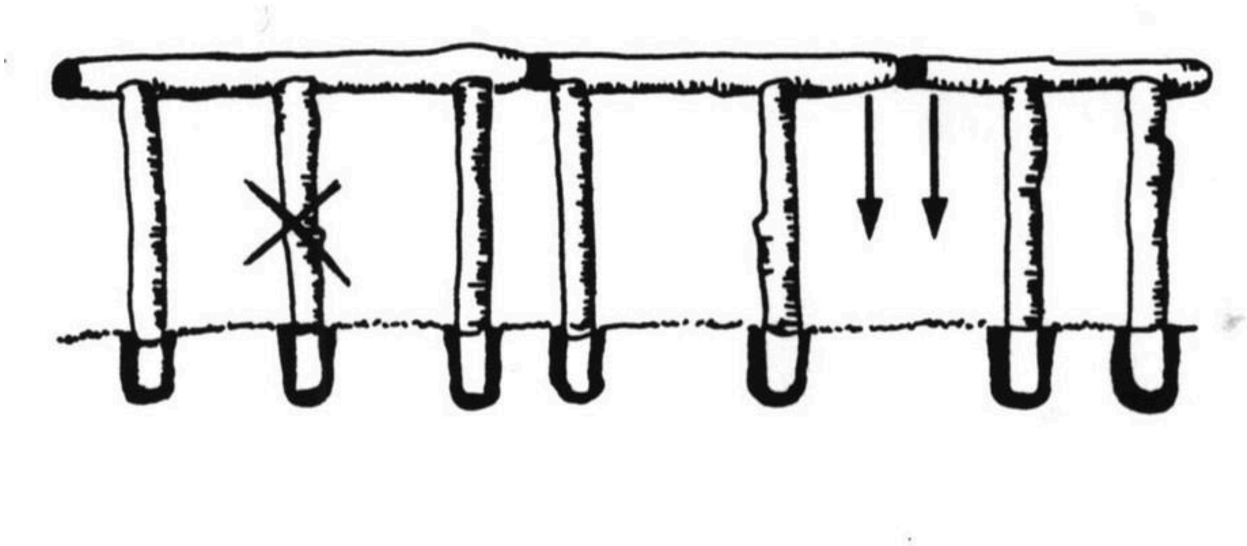

FIG 8. THE Π LONGITUDINAL LINKAGE: A BEAM PLACED ON THE TOP OF TWO VERTICAL POSTS WOULD HAVE HAD ITS TWO ENDS PROJECTING (AFTER SOUDKY 1969).

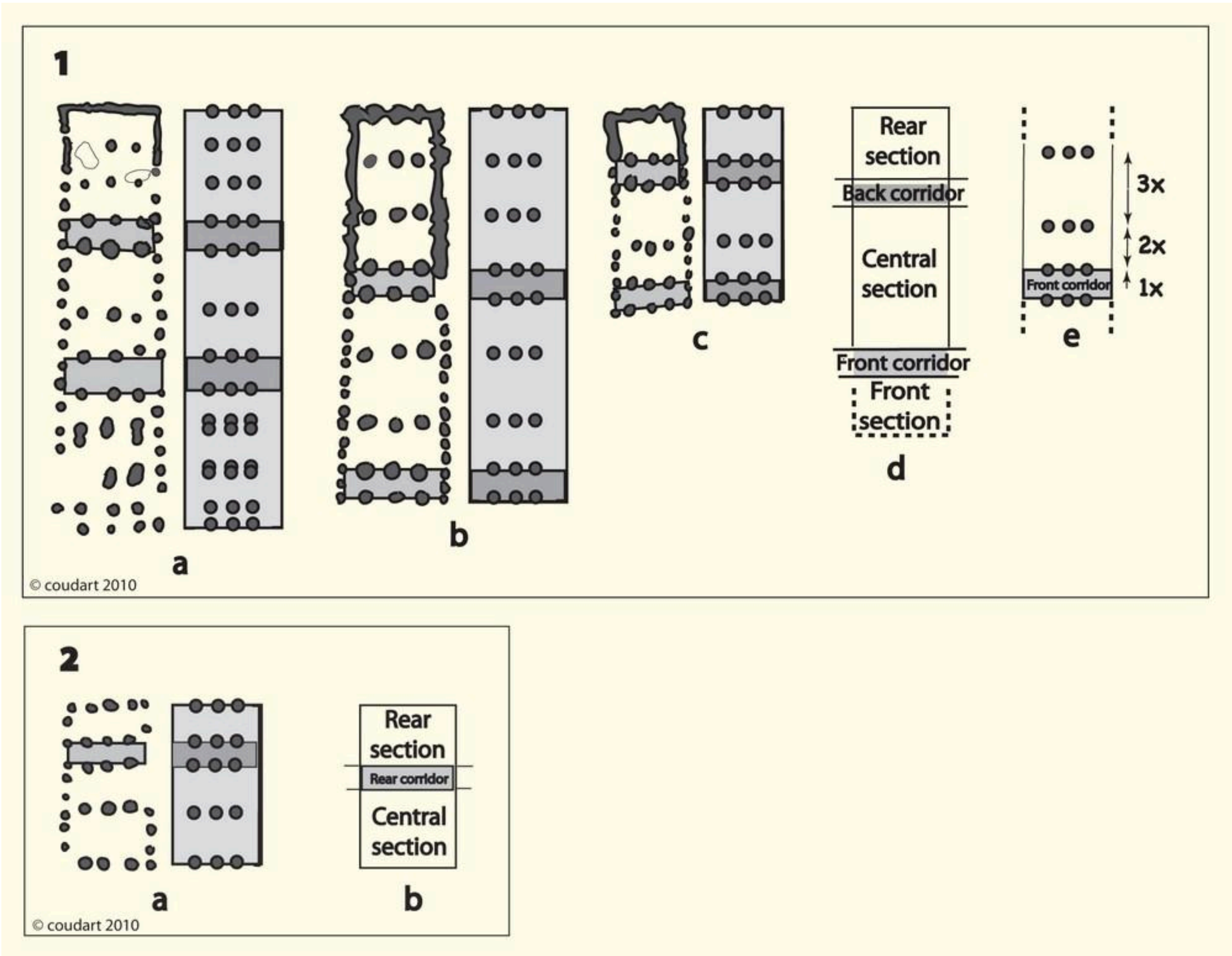

FIG 9. 1 – TRIPARTITE BANDKERAMIK HOUSE (96% OF CASES); 1A) HOUSE 32 AT MISKOVICE, BOHEMIA, CZECH REPUBLIC; 1B) HOUSE 245 AT CUIRY-LÈS-CHAUDARDES, PARIS BASIN, FRANCE; 1C) HOUSE 57 AT ELSLOO, LIMBURG, THE NETHERLANDS; 1D) THE ORGANISATION OF THE TRIPARTITE BANDKERAMIK HOUSE; 1E) THE MOST COMMON PATTERN (81%) OF SPATIAL ORGANIZATION IN THE CENTRAL SECTION OF THE BANDKERAMIK HOUSE. 2 – BIPARTITE HOUSE (4,5% OF CASES); 2A) HOUSE 425 AT CUIRY-LÈS-CHAUDARDES, PARIS BASIN, FRANCE; 2B) THE PATTERN OF THE BIPARTITE BANDKERAMIK HOUSE.

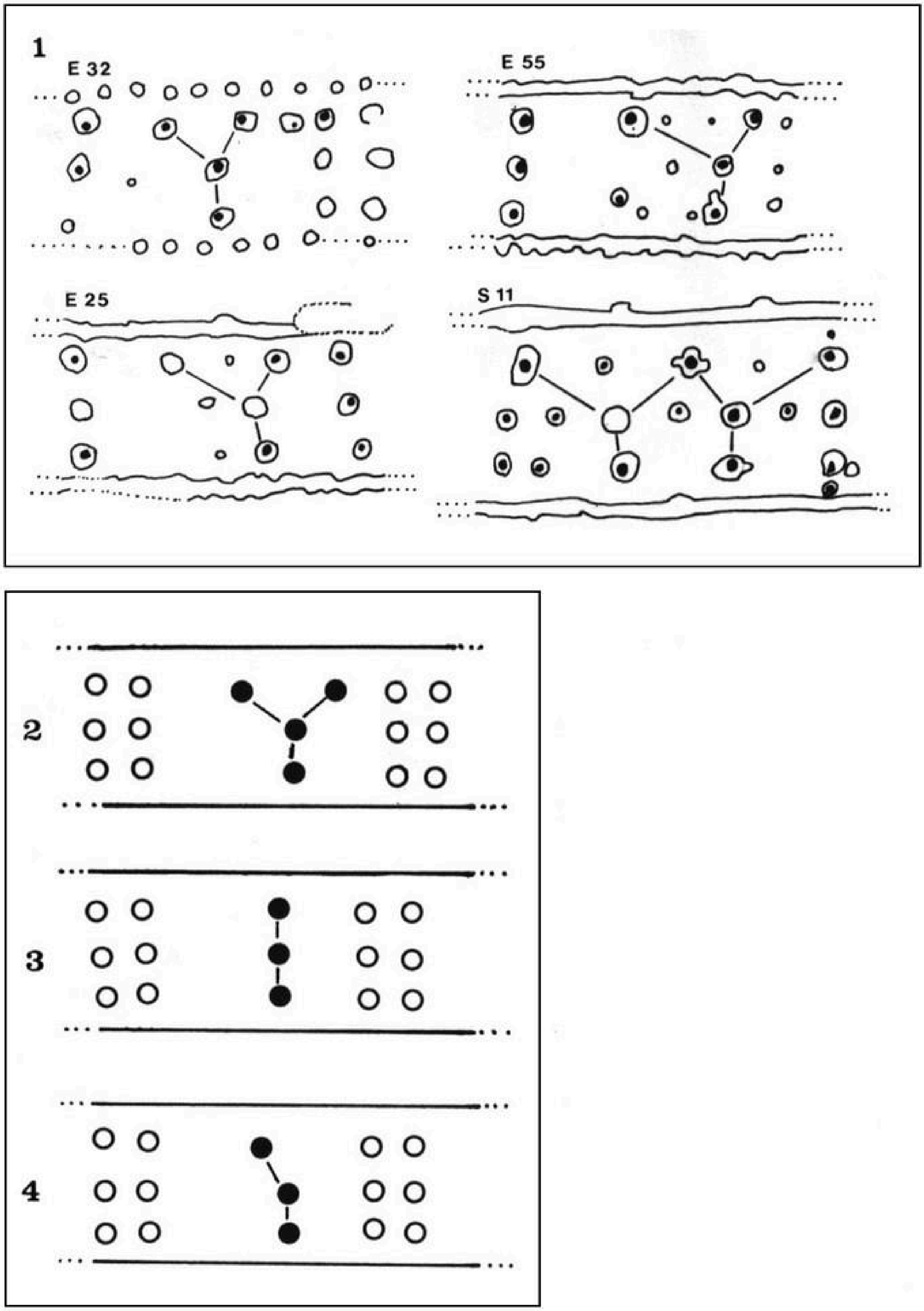

FIG 10. DIFFERENT CROSS-ROW CONFIGURATIONS. 1- 'Y' CONFIGURATION FOUND IN ELSLOO AND STEIN; 2- 'Y' CONFIGURATION; 3- RECTILINEAR CROSS-ROW OF THREE POSTS; 4- INVERSE J (OR PSEUDO-Y) CONFIGURATION.

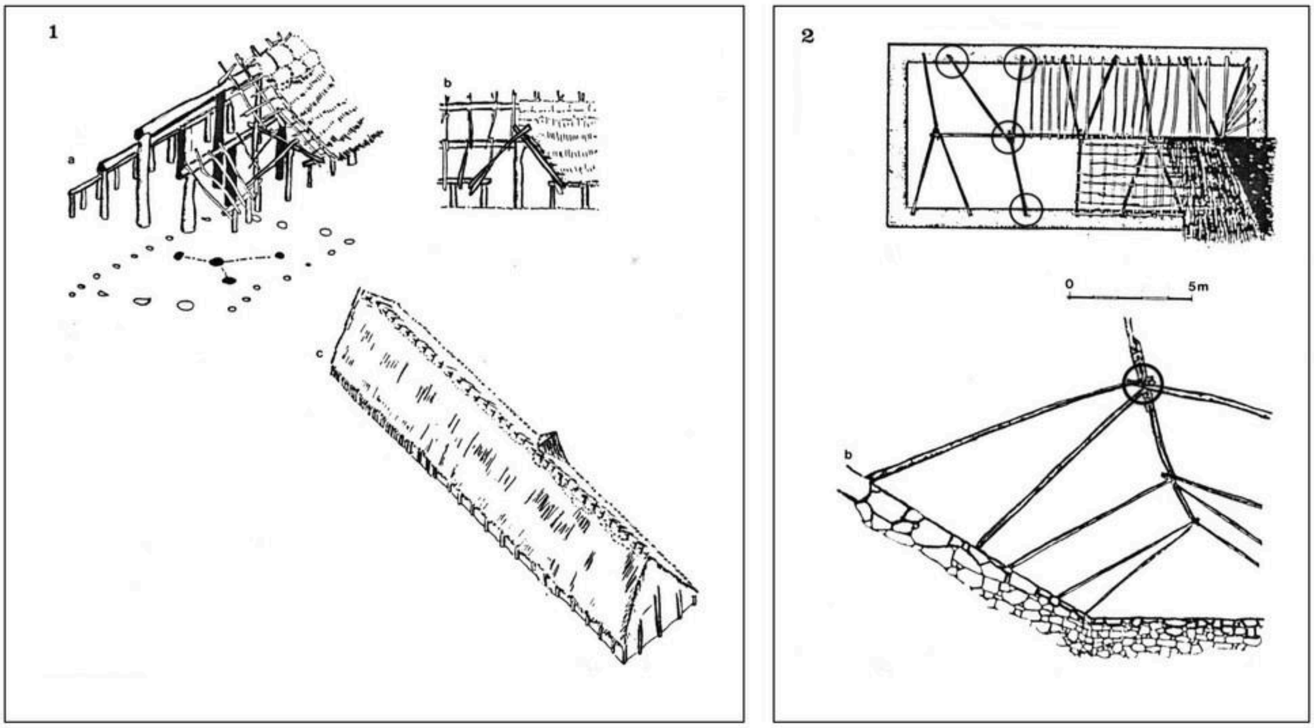

FIG 11. SPECULATIVE INTERPRETATIONS OF THE 'Y' CONFIGURATION OF POSTS. 1- UNCONVINCING INTERPRETATION (AFTER MEYER-CHRISTIAN 1976, FIG. 16 AND 17); 2- INCA CONSTRUCTION WITH A ROOF FRAME RESTING ON POINTS OF A SUPPORT IN A 'Y' CONFIGURATION (BOUCHARD 1983, FIG. 16).

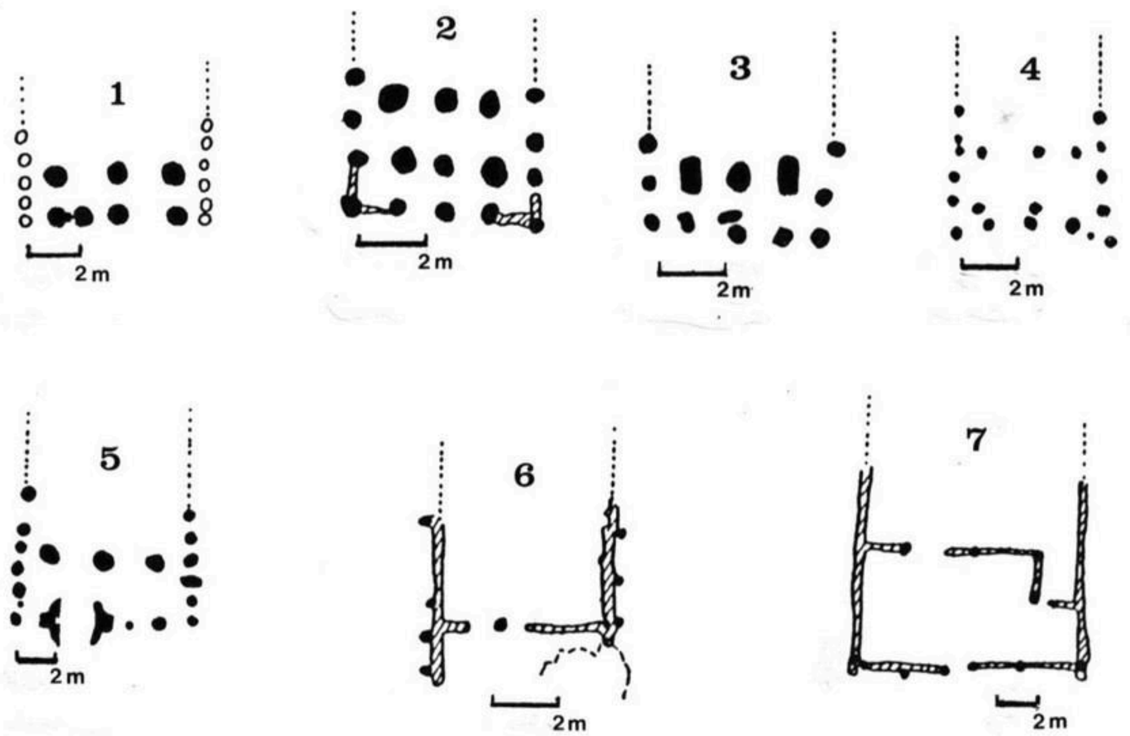

FIG 12. DIFFERENT ENTRANCES RECORDED FOR DANUBIAN HOUSES. 1- MENNEVILLE 10 (AISNE VALLEY); 2- SITTARD 34 (LIMBURG); 3- ELSLOO 76 (LIMBURG); 4- CUIRY-LÈS-CHAUDARDES 280 (AISNE VALLEY); 5- CHARMOY (YONNE AREA); 6- INDEN-LAMERSDORF 1 (RHINE-MEUSE AREA); 7- POSTOLOPRTY 15 (BOHEMIA).

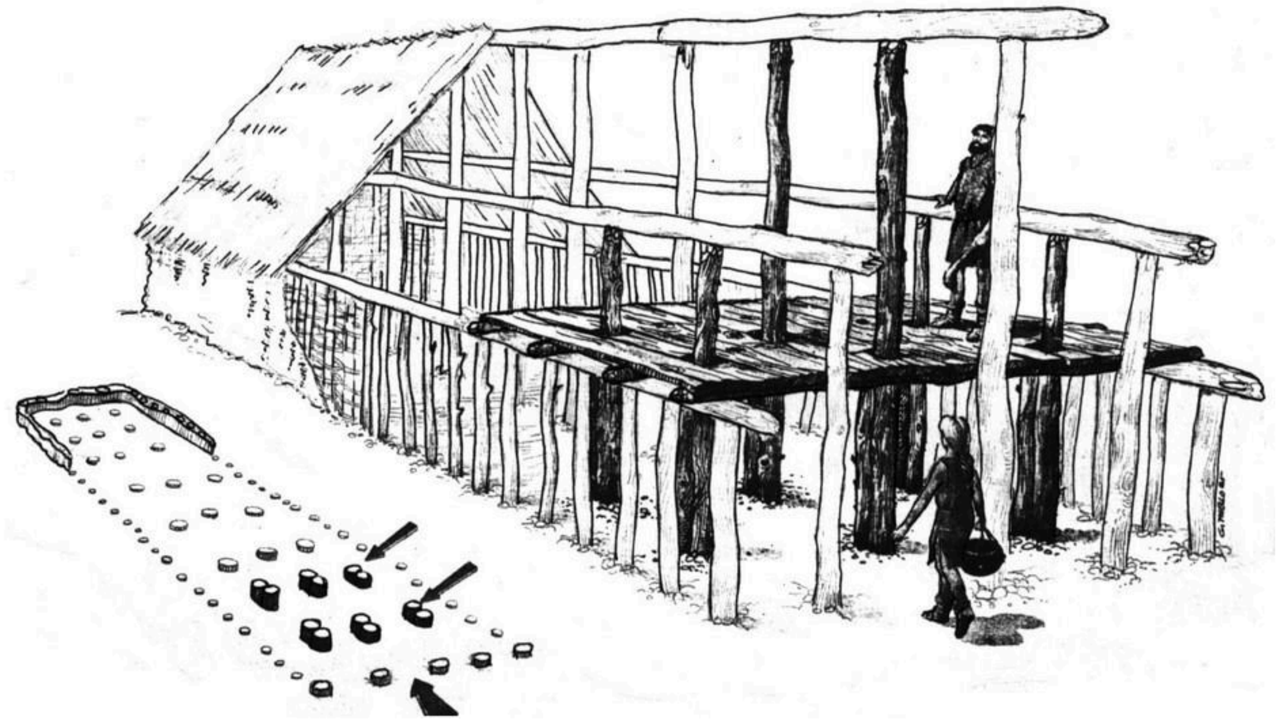

FIG 13. RAISED PLATFORM (OR GRANARY?) IN THE FRONT PART OF THE BANDKERAMIK HOUSE (AFTER GILLES TOSELLO).

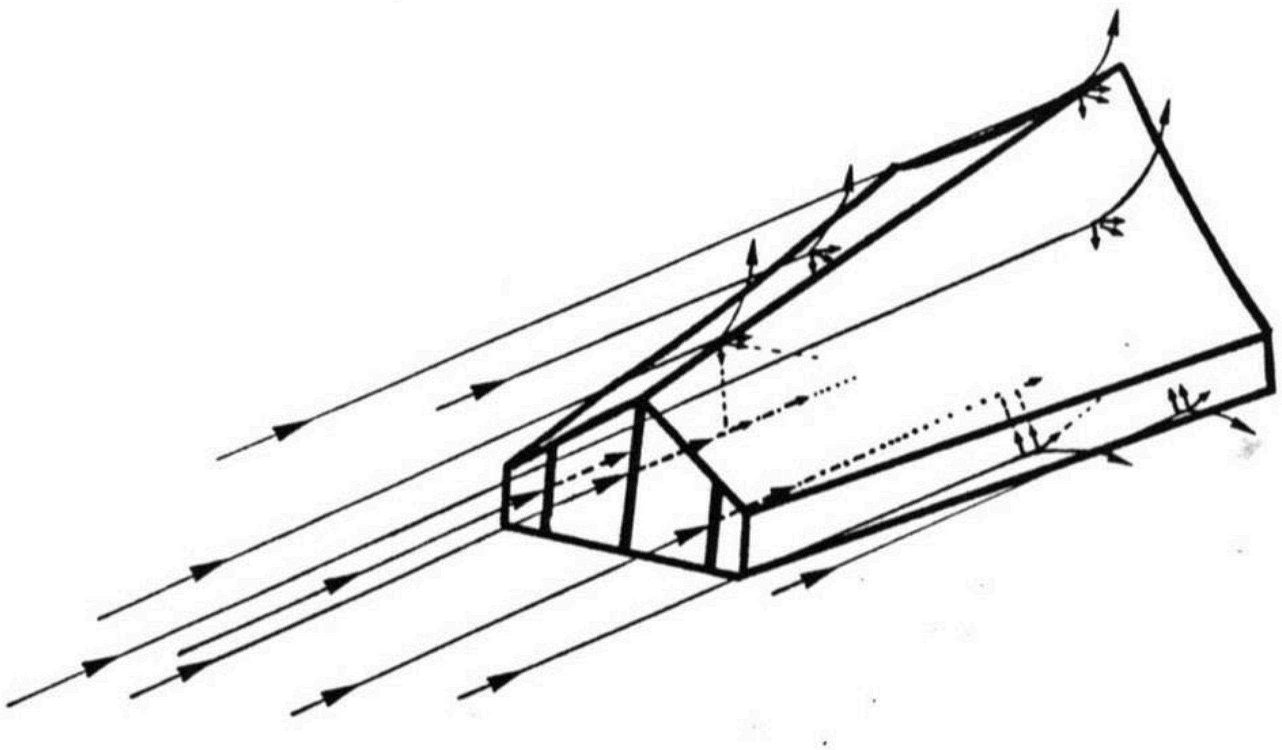

FIG 14. WIND PRESSURES ON A TRAPEZIUM-SHAPED HOUSE.

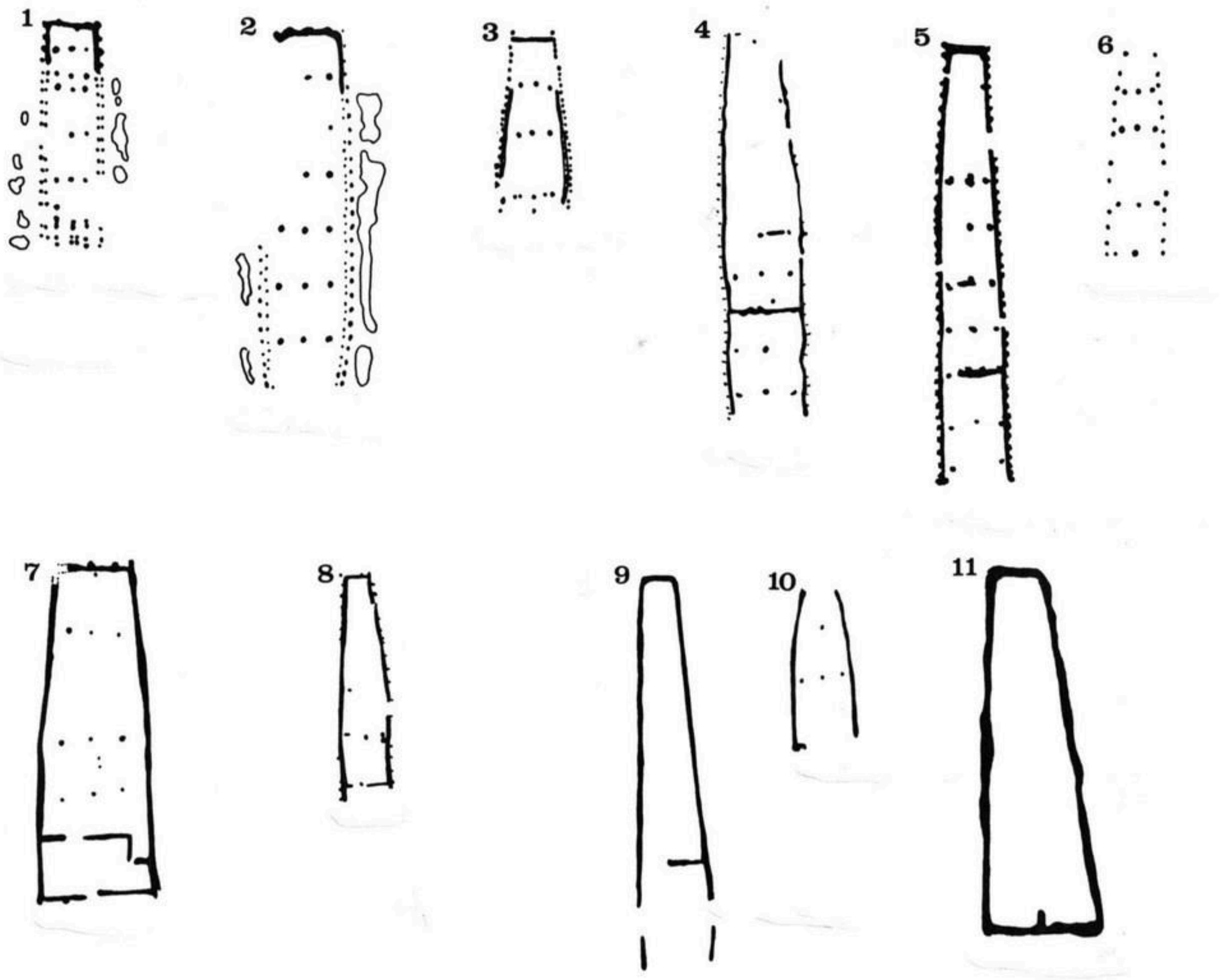

FIG 15. DIFFERENT FUNCTIONS OF WALLS MADE OF A DOUBLE LINE OF POSTS. 1, 2 AND 3: NON LOAD-BEARING FUNCTION (BUCHUM-HILTROP ZC, ZWENKAU-HARTH AND HAMBACH 260); 4, 5 AND 6: SLIGHT LOAD-BEARING FUNCTION (INDEN 2, DEIRINGSEN-RUPLOH 2 AND DEIRINGSEN-RUPLOH 3); 7 AND 8: MODERATE LOAD-BEARING FUNCTION (POSTOLOPRTY AND INDEN); 9, 10 AND 11: IMPORTANT LOAD-BEARING FUNCTION (BISKUPIN, ZWENKAU AND BRZESC-KUJAWSKI).

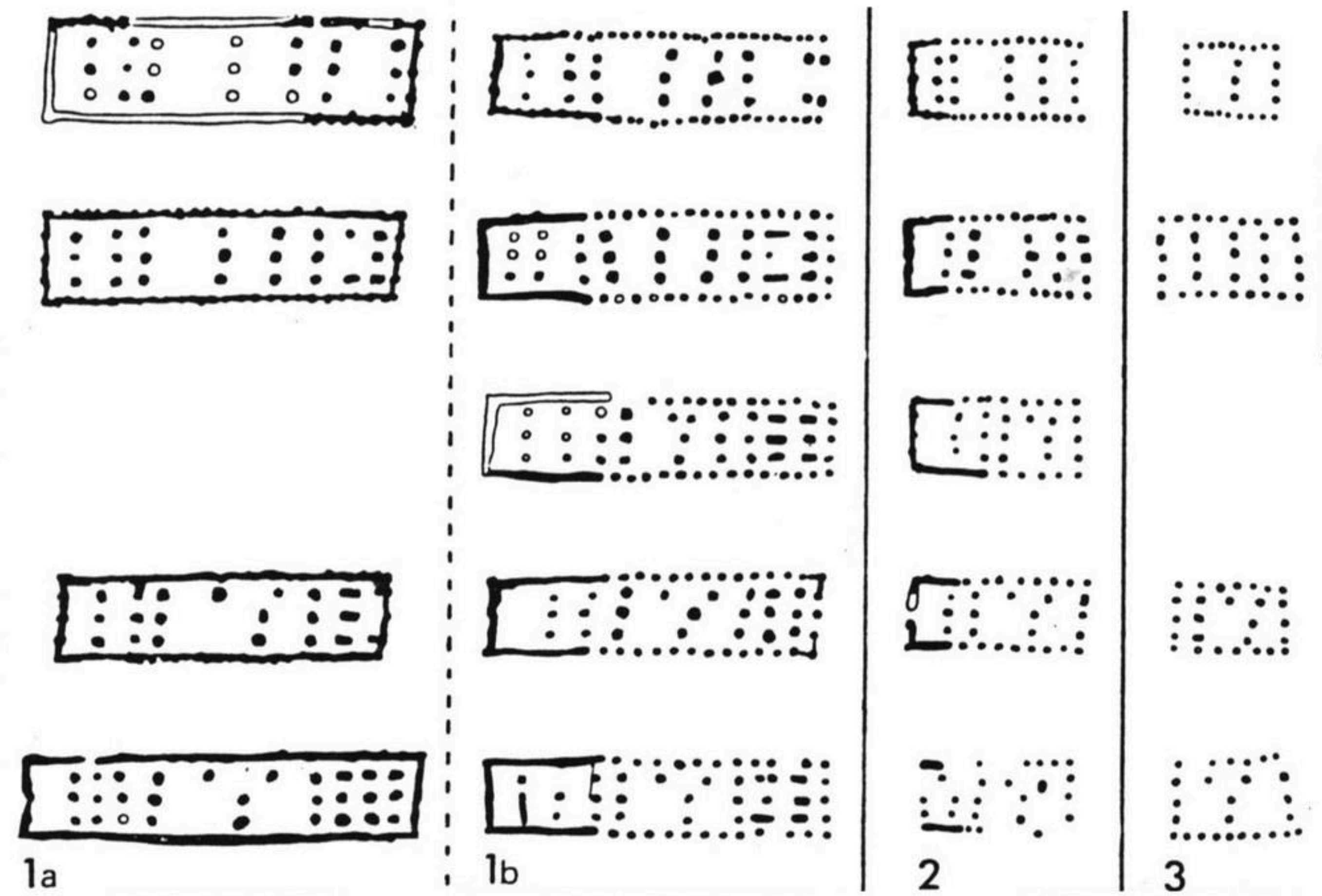

FIG 16. TYPES OF BANDKERAMIK HOUSE, AFTER MODDERMAN (1970, FIG. 12).

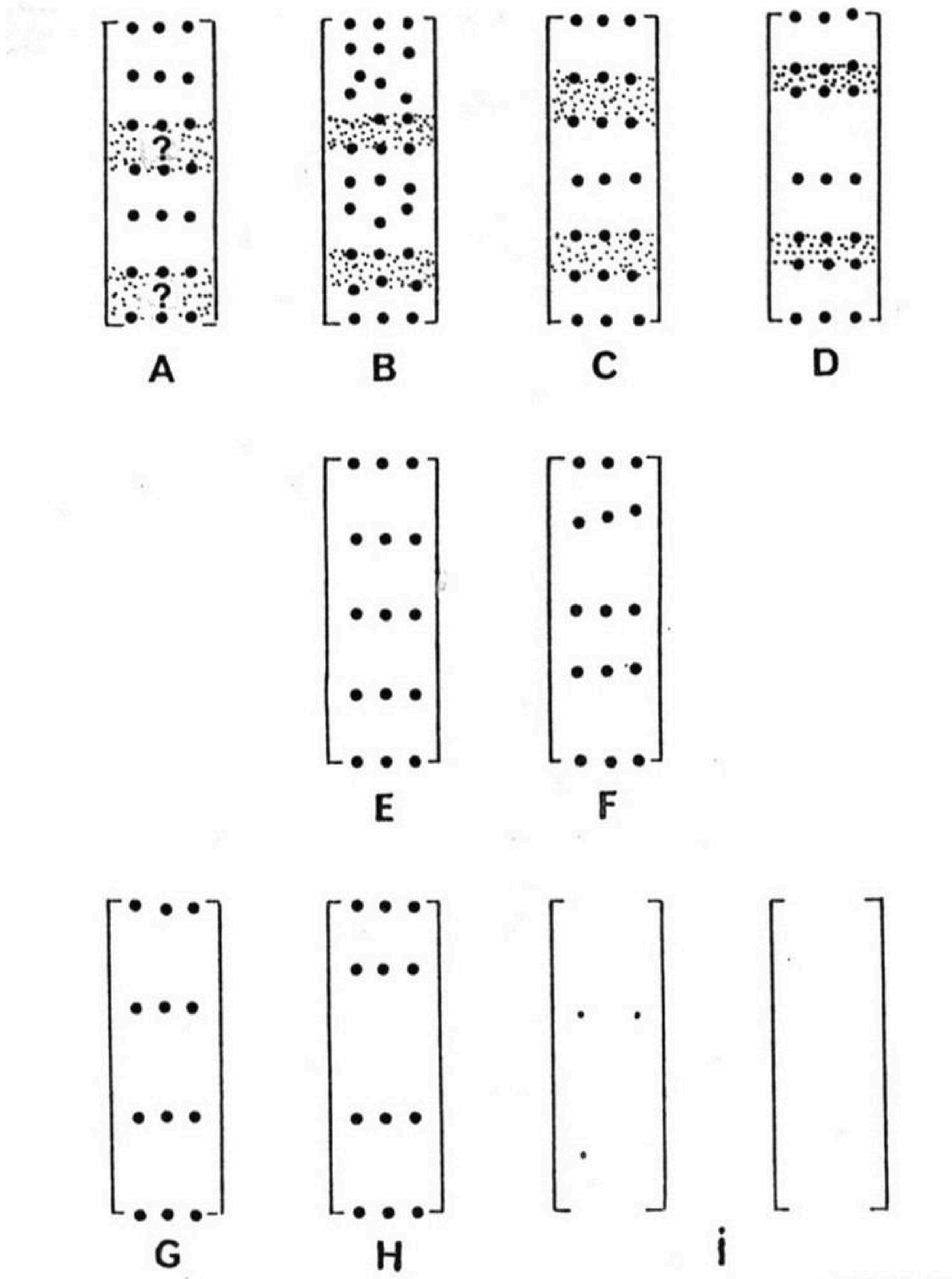

FIG 17. TYPES OF CROSS-ROW SPACING.

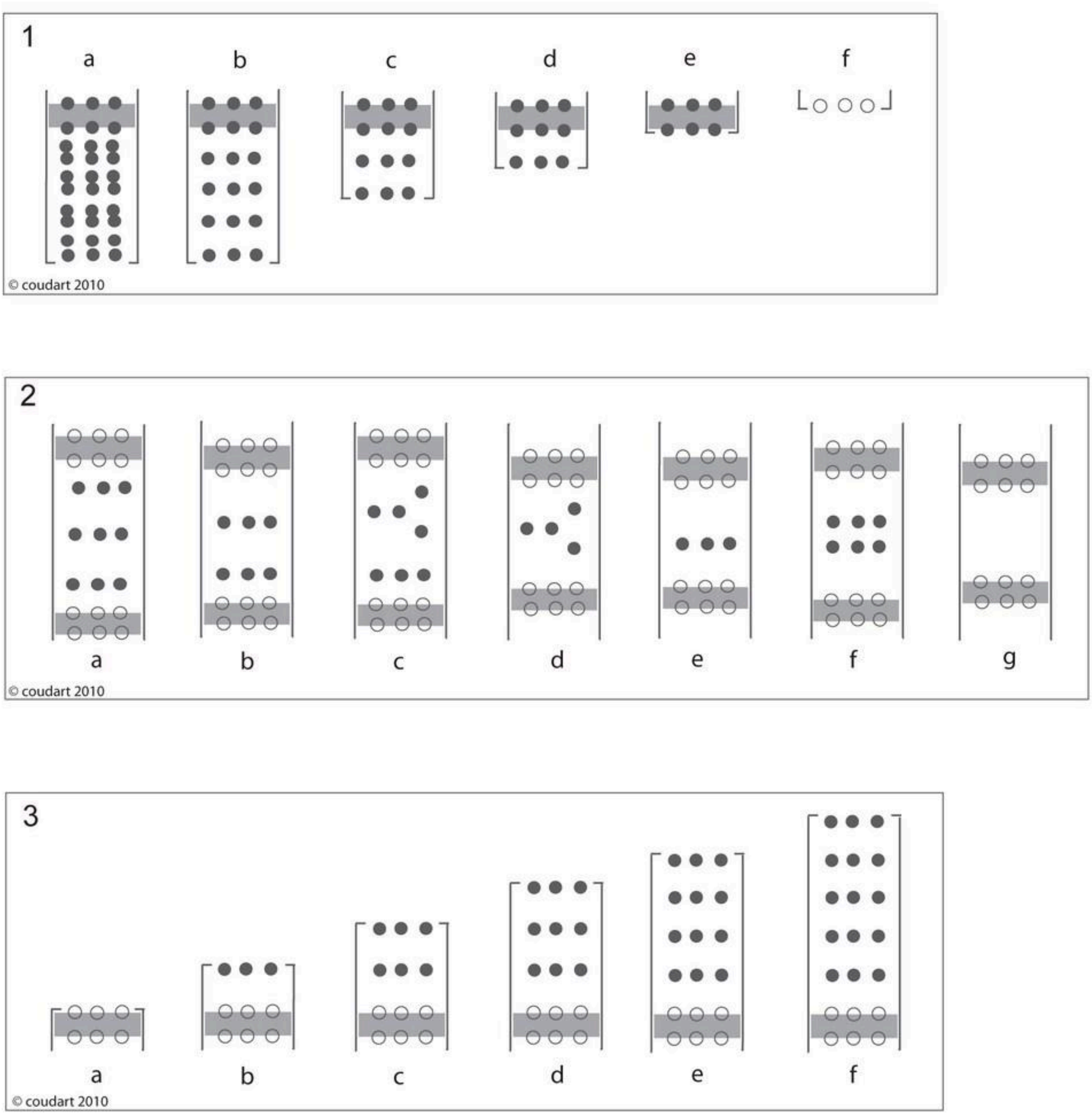

FIG 18. 1 – OPTIONS FOR THE FRONT SECTION: A & B ARE STORAGE PLATFORMS; C: A PSEUDO-STORAGE AREA (OR WORKING AREA); D: REDUCED FRONT SECTION; E: SIMPLE FRONT SECTION; F CORRESPONDS TO THE ABSENCE OF A FRONT SECTION. 2 – OPTIONS FOR THE CENTRAL SECTION. 3 – OPTIONS FOR THE REAR SECTION

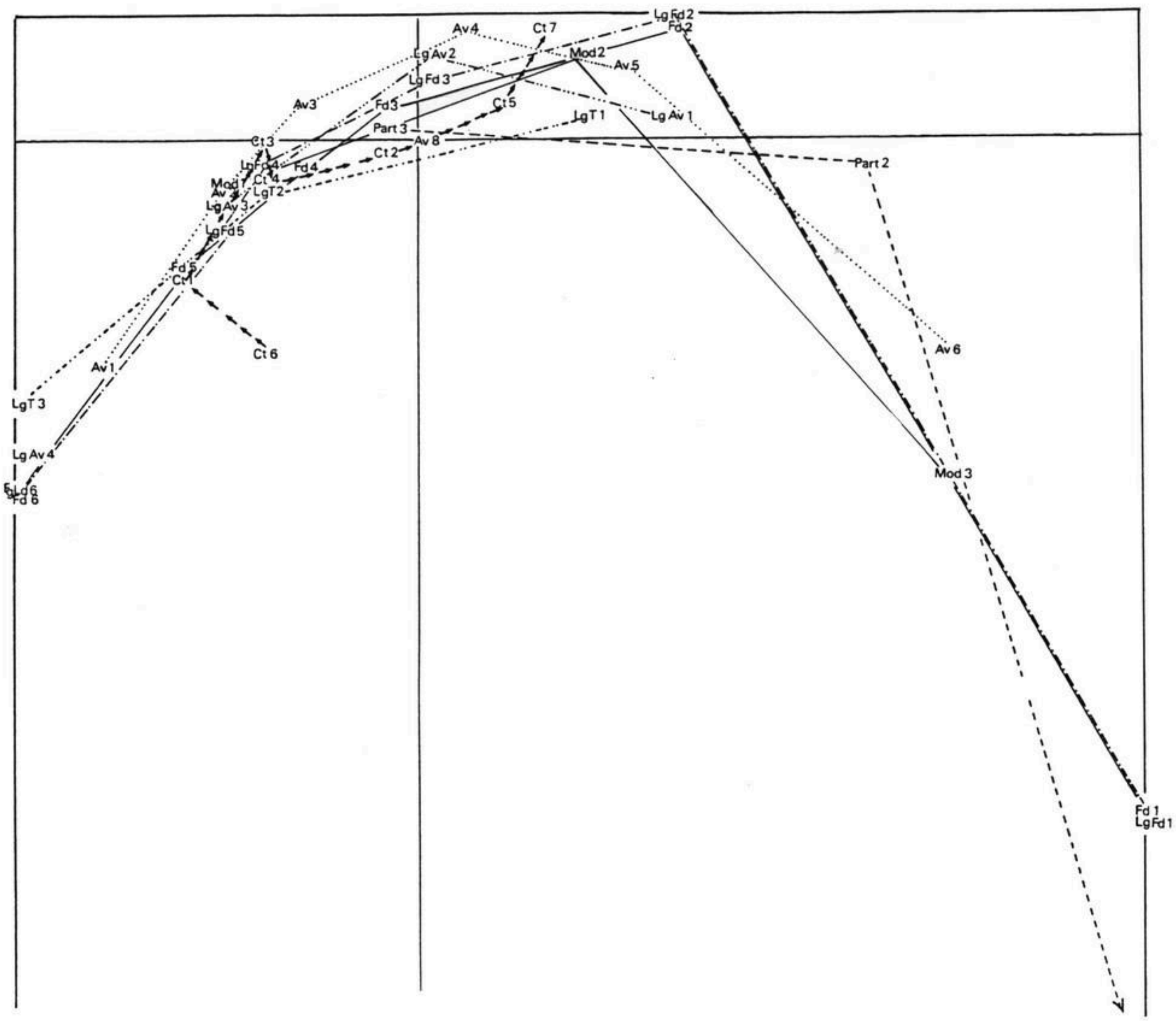

FIG 19. CORRESPONDENCE ANALYSIS OF THE DESCRIPTIVE VARIABLES OF BANDKERAMIK HOUSES. ON THE HORIZONTAL AXIS: THE RATHER SHORT CATEGORIES, THE TYPES 'REDUCED' AND 'ABSENT', CONTRAST WITH THE LONGER CATEGORIES AND WITH THE TYPE 'STORAGE AREA'. TYPES OF FRONT (AV), MIDDLE (CT) AND REAR (FD) PARTS, LENGTH CATEGORIES (LG AND LGT), TYPES OF INTERNAL DIVISION (PART), AND HOUSE-TYPES ACCORDING TO MODDERMAN (MOD), (SAS, ADDAD, C. CHATAIGNIER, FEBRUARY 1987).

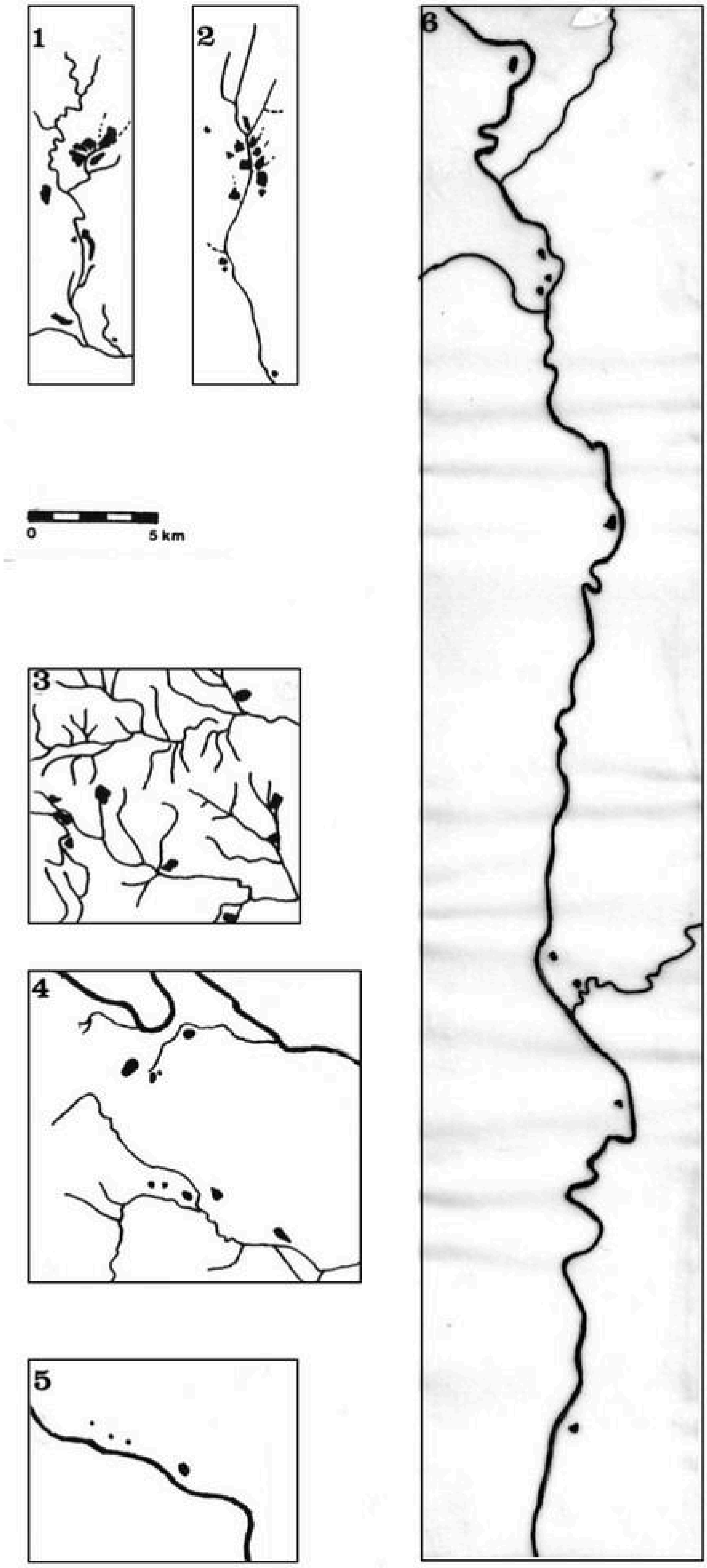

FIG 20. TYPES OF RELATIONSHIPS BETWEEN SITES. 1 AND 2- DENSE NETWORK (VRCHLICE AND BYLANKA VALLEY IN CZECHOSLOVAKIA, AFTER PAVLU 1977; MERZBACH VALLEY IN GERMANY, AFTER LÜNING 1982). 3 AND 4- LOOSE NETWORK (SLEZA REGION IN POLAND, AFTER KULCZYCKA-LECIEJEWICZOWA; SOUTH LIMBURG IN HOLLAND, AFTER BAKELS 1978). 5 AND 6- LARGE ISOLATED SITES (HIENHEIM REGION IN GERMANY, AFTER BAKELS 1978; AISNE VALLEY IN FRANCE).

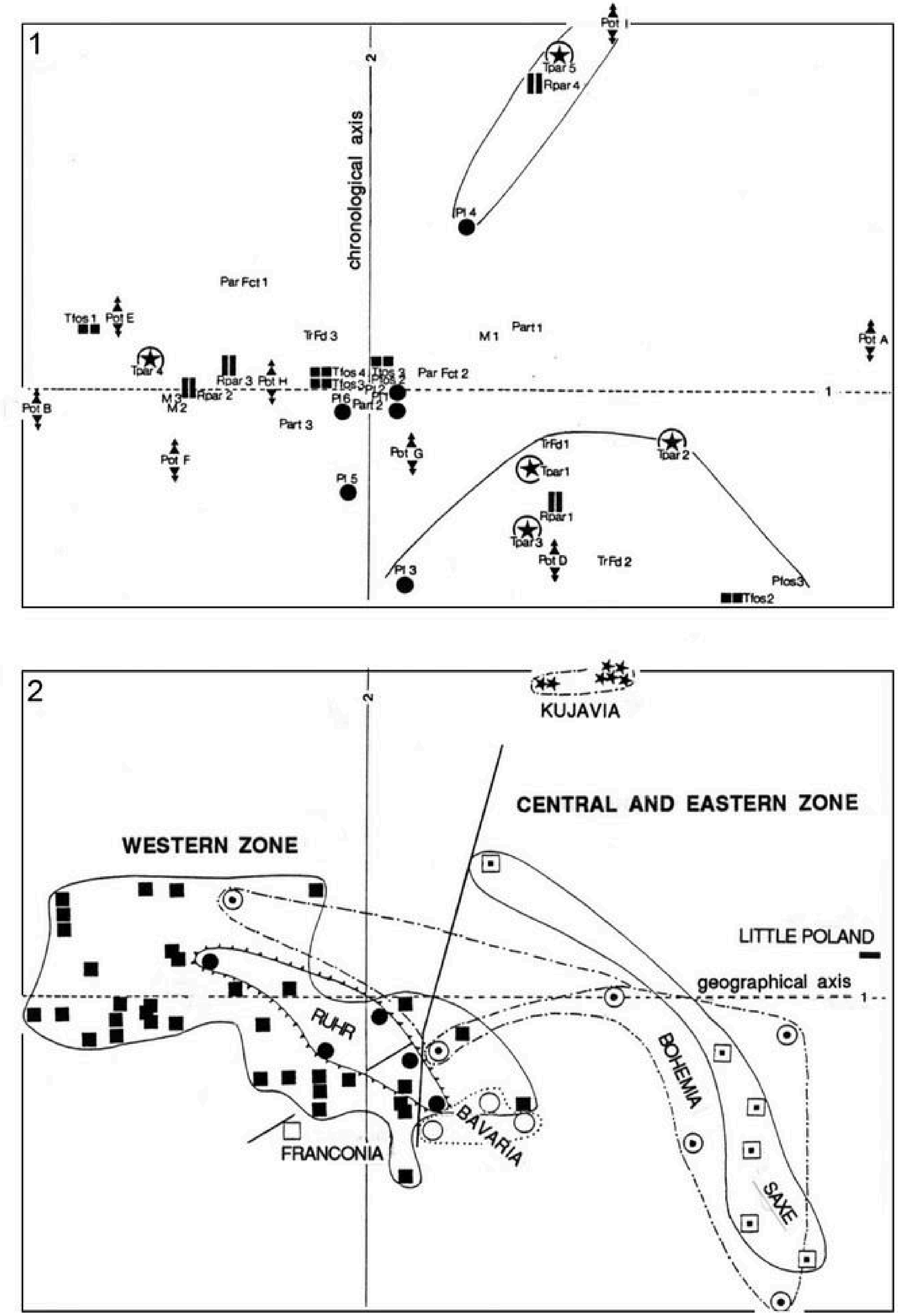

FIG 21. CORRESPONDENCE ANALYSIS OF THE DESCRIPTIVE VARIABLES OF THE POST-BANDKERAMIK HOUSES; 2- THE DESCRIPTIVE VARIABLES PER REGION (SAS, ADDAD, C. CHATAIGNIER, FEBRUARY 1987). THE WESTERN ZONE AND THE WESTERN FRONTIER (NEGATIVE VALUES) ARE OPPOSED TO THE CENTRAL AND EASTERN ZONES (POSITIVE VALUES). WE MIGHT SAY THAT THE HORIZONTAL AXIS IS THAT OF THE GEOGRAPHIC DIVISION—FROM EAST TO WEST, SEEN FROM RIGHT TO LEFT. THE CORRESPONDENCE ANALYSIS CONTRASTS THE REGIONAL ASSEMBLAGES OF 'RHINE-RUHR-NECKAR', 'SAXONY-BOHEMIA' AND 'KUJAVIA'. ON THE VERTICAL AXIS, THERE IS

CLEAR EVIDENCE OF THE SURVIVAL OF ANCIENT CHARACTERISTICS THAT, DATING FROM BANDKERAMIK TIMES, STILL EXIST IN CERTAIN AREAS IN THE CENTRAL-EASTERN ZONE (ZWENKAU, LIBENICE, DRESDEN-PROHLIS, MSENO) DURING THIS LATER PERIOD. CHRONOLOGICALLY, THE SITES OF HIENHEIM IN BAVARIA, SCHWANFELD IN FRANCONIA, AND HAMBACH 260 IN THE RHINELAND WOULD THEREFORE BE SITUATED IN AN INTERMEDIATE PERIOD. AND, FINALLY, THE SITES OF KUJAVIA ARE INDEED THE MOST RECENT.