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# Analysis of spatial patterns in buildings (access analysis) as an insight into social structure: examples from the Scottish Atlantic Iron Age

SALLY M. FOSTER\*

*Clearly the pattern of space in buildings can be expected to relate to the way that buildings are used to structure and reproduce social relations. As an archaeologist, wishing to infer social structure by its reflection in the building pattern, one may hope the relation may be reasonably direct. Here the formal geometrical method of access analysis is used to elucidate the pattern in a distinctive kind of prehistoric settlement form, and thence to elucidate the social structure which both produced it and was structured by it.*

The aim of this paper is to describe an archaeological application of access analysis, a means of investigating the relationship between spatial order and society. As presented below this is a technique based on the gamma analysis of Hillier & Hanson (1984), which looks at the patterns of relations between inhabitants and between inhabitants and strangers as they are reflected in the use of interior space, in terms of the patterns created by boundaries and entrances. This approach has received much criticism (see particularly Leach 1978) because of its extreme belief that spatial organization is a function of the form of social structure. The present writer believes that without taking the full Hillier & Hanson line, but by adopting more modest horizons, this formal and vigorous technique can be demonstrated to be of some value to others who believe that spatial order does carry some social information.

There continues to be an increasing trend towards the interpretation of the archaeological remains of buildings, erstwhile architecture, in a social context, by analysis of their interior space (such as Smith 1978; Boast & Yiannouli 1986; Gilchrist 1988). To a certain extent this

follows movements in architectural circles (e.g. Glassie 1975; Markus 1982: 4 for brief summary), and the work of geographers and social theorists (e.g. Gregory & Urry 1985). Two common themes, ultimately derived from *Structuration Theory* (Giddens 1984), seem to lie behind much of this work:

- 1 The belief that space is both produced by, and in turn produces and reproduces social relations. Thus architecture is seen as culturally meaningful, and not just as a response to certain environmental needs. However, wide differences of opinion exist as to if, how, or to what degree social relations might be gauged from archaeological remains. Leach (1978: 400) has argued that the chasm between basic space syntax and real life sociology is wider than Hillier and his colleagues suppose. Yet others using the techniques of Hillier & Hanson have demonstrated that observed spatial patterns are not coincidental, and can be explained in social terms on the basis of historic and ethnographic evidence (Yiannouli & Mithen 1986). A similar relationship has been noted on the basis of observed similarities between the

\* Department of Archaeology, The University, Glasgow G12 8QQ.

plans of 'villas' in Britain and Gaul (Smith 1978). Total sceptics about the social relevance of spatial organization are not so vociferous.

- 2 It is recognized that all social interaction is situated within both time and space, thus time is emphasized as an essential component in all social analysis. Barrett (1988) has recently suggested an archaeological means of applying Structuration Theory, and taking into account the factors of time and space, which he calls *Fields of Discourse*.

This note will discuss the theory and technique of access analysis, and the relevance, if any, of this technique to the elucidation of social structure through a medium of analysis such as *Fields of Discourse*. The archaeological application of this technique, with appropriate modifications, is described using examples from the Iron Age of Orkney.

**The theory and technique**

A building is made up of walls which define a series of enclosed spaces, the boundaries between which may be broken by doorways allowing access from one area to another. The importance of doors is not only that they open, but more importantly that they can close, effectively segregating spaces and controlling the means of access to any particular point.

Access analysis is based on syntactic relations, and considers the arrangement of different spaces as a pattern of permeabilities, that is in terms of the interconnections between spaces. There will never be agreement between disciplines as to what constitutes social space (e.g. compare Fletcher 1977; Piaget & Inhelder 1956; Gregory 1978; Norberg-Schulz 1971), but this technique is important because of its descriptive autonomy, unambiguous rules of application, and its clear exposition of how these relate at the very lowest level to relations between inhabitants, and between inhabitants and strangers. Societies which might vary in their type of physical configuration and degree to which the ordering of space appears as a conspicuous dimension of culture can all be compared on a similar basis.

The technique is best explained with the use of the example of a small modern house, where only the ground floor has been taken into consideration (FIGURE 1A). Each unit of space, including transitional spaces such as a hallway, has been represented as a dot with lines between them where there is permeability, giving access between spaces (FIGURE 1B). The network of dots and connecting lines forms an unjustified access map. This map can be justified, in this case from an outside perspective (the carrier), the stance of the stranger (FIGURE 1C), although it could have been from any point

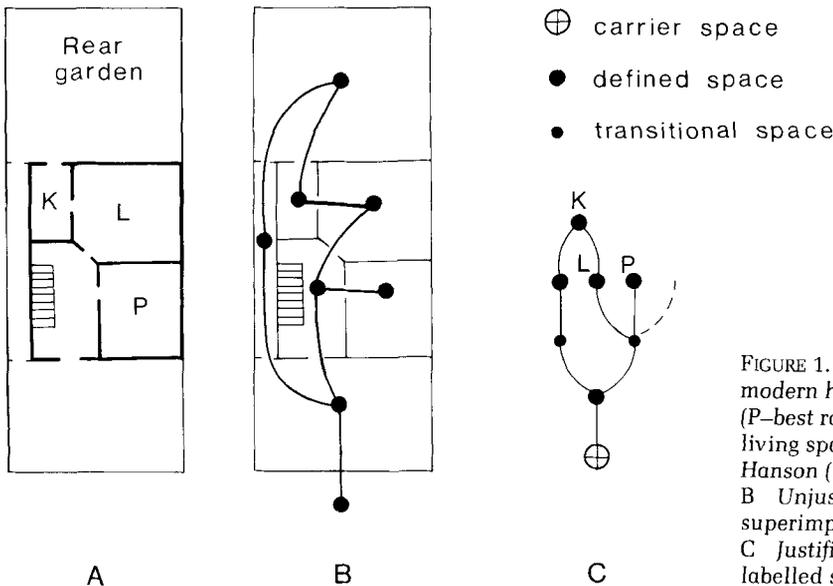


FIGURE 1. A Plan of a small modern house, ground floor only (P—best room, K—kitchen, L—main living space). (After Hillier & Hanson (1984): figure 99.)  
 B Unjustified access (gamma) map superimposed.  
 C Justified access map with labelled spaces.

in the building. By justification it is meant that all points of a certain depth, that is the minimum number of steps taken to reach them from the carrier, have been positioned on the same horizontal line, subsequent depth values on lines parallel to the first. Given the rules of construction any line will either connect with points on the same level of depth, or two levels separated by only one level of depth. The resultant map is both an aid to visual decipherment of the pattern, and could in theory be combined with quantification procedures (an aspect which is not pursued here).

Buildings are easier to study than settlements because open spaces cannot be so readily separated into analytical elements (Hillier & Hanson 1984: 16), and the richness in differentiation of interior structures means that they carry more social information than exterior relations (Hillier & Hanson 1984: 154). So, once spaces are defined, the spatial order of a structure can be represented in part by a diagram showing the interconnections of the enclosed spaces. A prerequisite for analysis is therefore an accurate map with all access points marked. *Form* (the formal properties of space and the boundaries which define it – its style) and *function* (the purpose of buildings) must also be embraced. In practice it is virtually impossible to make a distinction between these attributes (Markus 1982: 4–6). Hillier & Hanson (1984) minimize the interactive nature of these because of their apparent belief in the analytical autonomy of the spatial dimension. However, these other architectural dimensions have to be brought into consideration if the full archaeological value of access analysis is to be appreciated.

The primary data demands of access analysis create some problems for most archaeologists. The success of illuminating and stimulating studies such as those edited by Markus (1982) on the period of the Scottish Enlightenment, or by Graves (forthcoming) on the English medieval church, is in no small measure due to the fact that the buildings which they are studying either still stand (albeit possibly with alterations), or full architectural plans exist for those which have been demolished or whose construction was planned but never realized. In addition these are periods for which some of the ideas of society, and the nature of values and relationships are known because of documentary sources. One of the main criticisms

levelled at Hillier & Hanson is that their technique cannot work fully unless something is already known of the relevant social structure, when it can be seen in retrospect how the observed patterns in the spatial arrangement relate to the known social structure (Leach 1978). Prehistorians do not have historical accounts, nor can they make ethnographic studies of the populations they are studying, but they do possess a body of primary archaeological data which may provide non-spatial evidence for other aspects of social structure. It will never be possible to 'test' prehistoric social inference derived from the spatial; one can only explore its promptings from within a clearly defined understanding of the way material culture and social structure are related.

### Social inference from access analysis

It is suggested that examination of access maps and the application of the techniques of Hillier & Hanson (1984), in combination with other evidence for architectural form and social function, may impart social information at three general scales, the first two of which are considered appropriate here.

#### 1

The variations in spatial arrangements impart social information about the realities of living in, or visiting, that particular building: where and how frequently physical encounters might be made between occupants and/or between occupants and strangers, and how these encounters might be controlled. The inhabitant-inhabitant and stranger-inhabitant interfaces can be observed in terms of relations of *symmetry/asymmetry* and patterns of *distributedness/nondistributedness* (FIGURE 2) because distribution articulates relations of boundary (the means of access to a space) whilst asymmetry reflects the importance of a space in terms of its degree of segregation or integration (Hillier & Hanson 1984: 148):

In gamma two spaces *a* and *b* will be: symmetric if *a* is to *b* as *b* is to *a* with respect to *c*, meaning that neither *a* nor *b* controls permeability to each other; asymmetric if *a* is not to *b* as *b* is to *a*, in the sense that one controls permeability to the other from some third space *c*; distributed if there is more than one independent route from *a* to *b* including passing through a third space *c* (i.e.

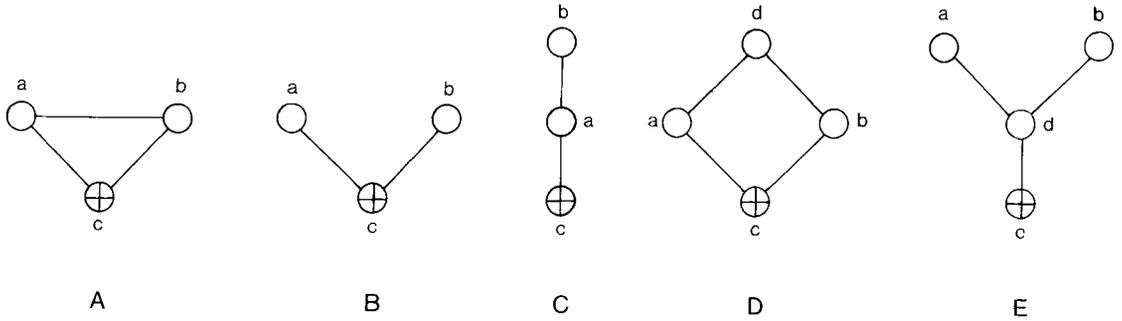


FIGURE 2. A a and b are in a symmetric and distributed relationship with respect to c.  
 B a and b are in a symmetric and nondistributed relationship with respect to c.  
 C a and b are in a nondistributed and asymmetric relationship with respect to c.  
 D a and b are symmetric to each other with respect to c, but d is in an asymmetric relation to both with respect to c.  
 E d is in a nondistributed and symmetric relation to a and b, which still remain symmetric to each other with respect to d, or to c.  
 (After Hillier & Hanson 1984: figures 88–92.).

if a space has more than one locus of control with respect to another); and nondistributed if there is some space c, through which any route from a to b must pass.

This spatial network suggests patterns which need investigating. As a result of labelling space in terms of use or form it is possible to observe whether particular labels correspond to particular syntactic positions and to investigate these patterns further.

Interior spaces constitute one of the the most common *locales* for activity and social interaction, the places where discourse can be sustained. Social analysis should therefore consider the way architecture, and the spatial organization of a settlement, intervene to structure some part of the cycle of social reproduction (Barrett forthcoming). Access analysis articulates an understanding of this, as knowledge of where, how frequently, and under what architectural circumstances, physical encounters occur. The information on access maps may be static, and cannot take the temporal frequency of discourse into account in its construction, but yet is of value in the consideration of potential time-space paths occupied by human beings.

2

The study of the spatial configuration of a number of patterns may reveal variant proper-

ties, a set of which may be thought to constitute the generic rule underlying the space in question, and which can be referred to as the *genotype* (each example will undoubtedly have a different *phenotype*, or actual physical realization of these rules). Some of the invariant properties which constitute the generic rule are observable and/or measurable in terms of relations of *symmetry/asymmetry* and patterns of *distributedness/nondistributedness* (see above).

The challenge is to explain how these observed topological patterns may relate to social factors as there is unlikely to be a one-to-one relationship between spatial organization and society. For example, might these expressions of boundary and control of space be reflecting the relations of physical autonomy and dependence between different sectors of a community? What type of social relations (gender, age or social status) might induce this spatial order and are these the social relations on which society is organized? Might the repetitive occurrence of patterns represent the acknowledgement of a code whereby authority was sustained? If an increased investment of formality into the ordering of the landscape (cf. Boast & Evans 1986) has been detected, this must be explained.

3

Finally, Hillier & Hanson believe that by recog-

nizing the basic syntactic *generator*, or organizing principle, behind a human spatial complex then different forms of social organization can be recognized (Hillier & Hanson 1984: 82). This is because they argue that although there are many different manifestations of spatial relations, there are only a finite number of organizing principles (Hillier & Hanson 1984: 54; summary in figure 23). Their rules reflect the notion of social order as suggested by Durkheim (1984), who envisaged two types of social solidarity and located their cause in different spatial variables: an *organic solidarity* which works best when the system is large and integrated; and a *mechanical solidarity* which works best when segments are small and isolated.

This is the aspect of Hillier & Hanson's work which has received most criticism (Leach 1978; Batty 1985), and is of no relevance to a social interpretation involving the use of Structuration, because it treats space as a totally independent discourse. It is not considered in further discussion.

### Archaeological application of access analysis

Examples from the Iron Age of Orkney can be used to give an example of the application of access analysis and to discuss its feasibility for archaeological remains. Here, despite subsequent robbing and other vagaries of time, the wide availability of natural building blocks has resulted in the unprecedented survival of structures, often to several storeys. In a few cases it is possible to walk through doors and up stairs, lie down in bed-neuks, and collect water from the wells. Remains are always only partial, and each site is the product of centuries of site-formation, most recently selective destruction and presentation by archaeologists. Any analysis has therefore to evaluate carefully the state of the site at any one period. It is not possible to measure symbolic divisions of space (although artefactual distribution may sometimes be suggestive). Nor is it possible to recognize when major features, such as earthworks, which may have acted as a frame for later activity (see e.g. Boast and Evans 1986), ceased to be maintained conceptually (Haselgrove 1984). Nevertheless this quality of data, and the fact that in several cases the sites can be examined on the ground, is particularly significant because the definition of relevant units of

space may vary from area to area, period to period, in prehistoric structures where the concept of an entrance or division between functional spaces may need to be liberally interpreted. Thus the constitution of an archaeological space is not necessarily defined by the theory, but is dependent on the nature of the available evidence. Provided rules are carefully formulated and consistently applied to the data in question, then analysis may proceed.

In this study the designation of a space depends on the physical presence of a doorway, a low kerb or ramparts (or being aware of their existence). It also depends, to a large measure, on the ascribed function of an area; it is obviously important to distinguish an enclosed area where sleeping rather than storage might have taken place. The recognition of functional zones, even if only defined by what in another period might have been described as furniture, is an obvious archaeological progression on a technique evolved for upstanding 'historic' structures. For example, areas with hearths are especially important. All of these criteria are subjective, which is why the method can best be applied to upstanding structures, preferably with a 'full' archaeological data-set, and which have been fully recorded to modern standards.

If we take as an example the recently excavated Early Iron Age house at Bu (Hedges 1987(1)) then some of the archaeological peculiarities of this technique can be seen more clearly. In FIGURE 3A we see the permeabilities suggested by the excavator; in FIGURES 3B-C exactly the same process as adopted for the modern building in FIGURE 1, and described above, is run through. Each space is usually an area which is enclosed by orthostats, with access either through doorways (as in the case of FIGURE 3B x), or over low kerbs (v) where the access lines may therefore appear to be jumping walls. The central 'service area' (y) is defined by a low kerb and gives access to the hearth (z); it is divided into two areas because the smaller north section is partly paved and the distribution of artefacts (Hedges 1987(1); figure 1.57) may suggest that the southern half had a different function to the northern half. Area w is treated as a single space because the central orthostat was not designed to break the space into two distinct components, and because of the extent of floor deposits which are more or less specific to this area (Hedges 1987(1)).

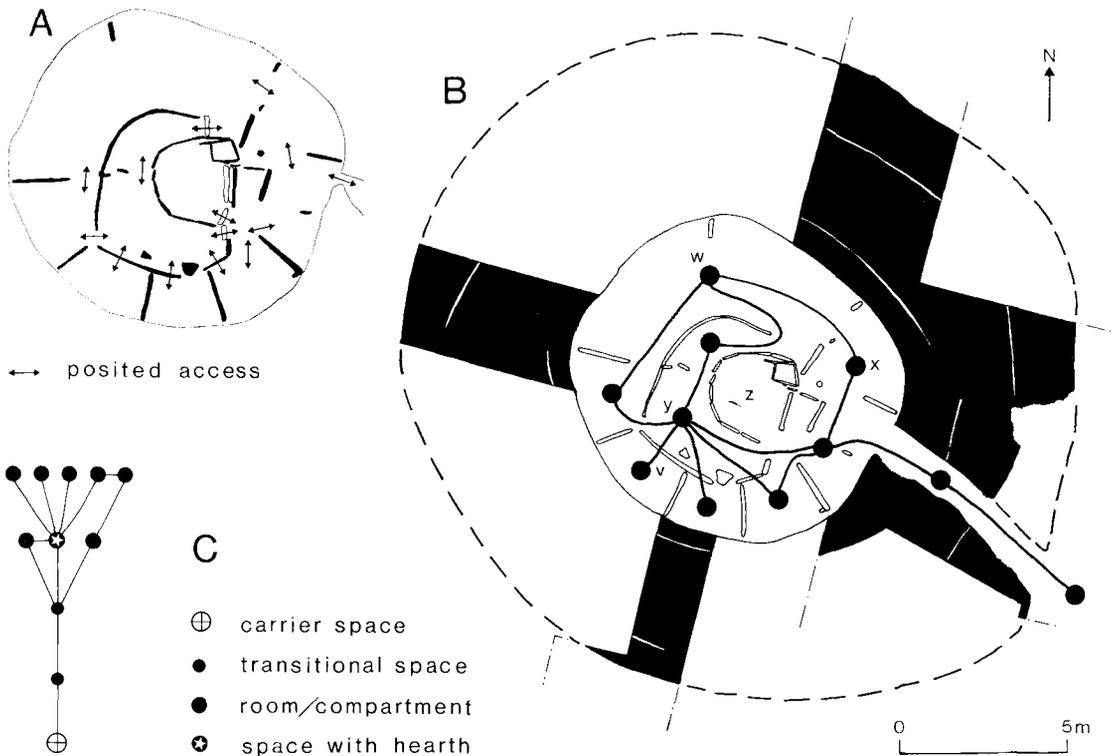


FIGURE 3. A Plan of Bu indicating points of access. (After Hedges 1987(1): figure 1.10.)  
 B Bu with unjustified access (gamma) map superimposed.  
 C Justified access map with labelled spaces.

As there may be some uncertainty about whether or not a space was enclosed, the degree to which it was socially relevant, or when access points were valid, there will inevitably be phases in the complex history of even a well recorded site when it is impossible to produce a totally accurate analysis (or any form of analysis). Yet there will be phases when a clear pattern does emerge, notably when buildings are first laid out on a virgin site. When comparisons are made of these major changes then patterns begin to emerge. In the study of Iron Age and Early Medieval Orkney four or five major phases can be identified, one of which, the Middle Iron Age, the period when brochs were prevalent, is the subject of discussion here.

**Specific example**

In the Middle Atlantic Iron Age, around 100 BC, brochs first appear – thick-walled circular

buildings, many of which had at least one upper storey or gallery. This study is specific to brochs in Orkney, but its implications are significant for the Atlantic Province as a whole, especially in areas where outbuildings are associated with the brochs (primarily Caithness, northeast Sutherland and to a certain extent Shetland). The outbuildings can roughly be divided into two forms, radial and non-radial. The radial examples (FIGURE 4) encircle the broch in a regular fashion, a passage leading through them to the broch, which is usually surrounded by a narrow encircling passage; there is a very full use of all available space between the broch and its surrounding outworks, where these exist. The non-radial form may be very early in the development of brochs (as at Crosskirk in Caithness: Fairhurst 1984) and may in some cases precede radial outbuildings (as possibly in phase 6 at Howe: Carter et al. 1984). A question hangs over the relative

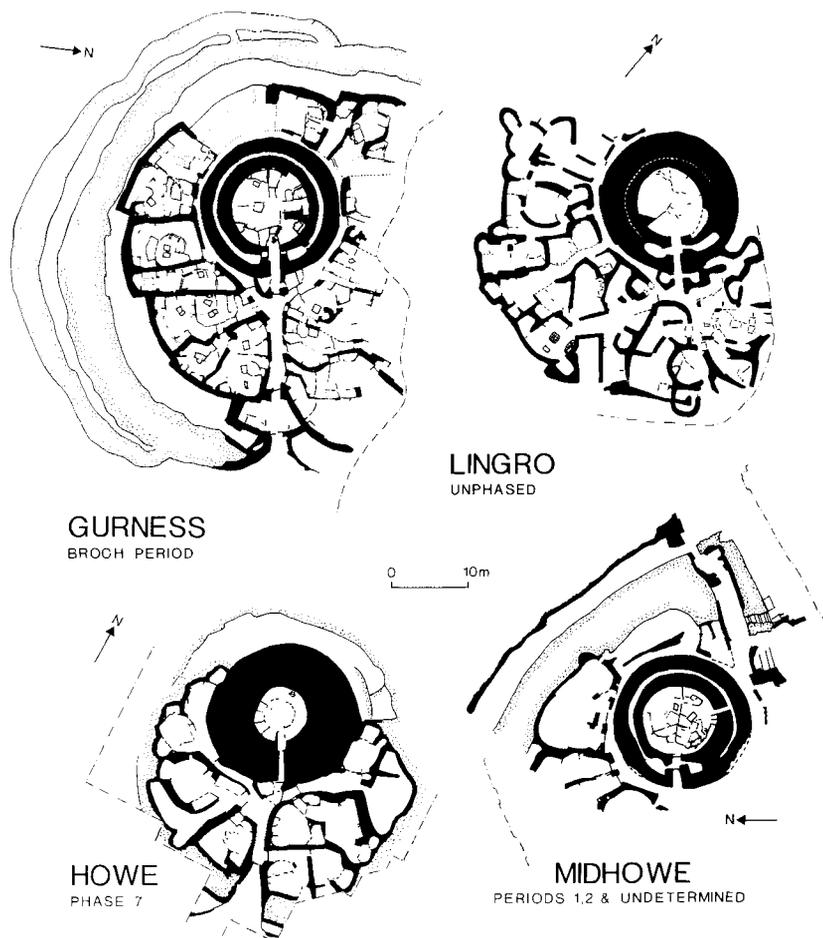


FIGURE 4. Plans of brochs with nucleated settlements. (After Hedges 1987(2); RCAMS 1946(2); Carter et al. 1984; Callander & Grant 1934).

chronology of the brochs and both types of outbuildings. This note is essentially concerned with the radial examples, where the dating evidence rests almost exclusively on the evidence from Howe, Gurness and Midhowe. These are the best understood examples, although similar plans are suggested elsewhere in Orkney (Hedges 1987(3): 14; e.g. Lingro, FIGURE 4) and northeast Sutherland. On the basis of present evidence, outbuildings elsewhere tend to be of the non-radial type. Hedges' work suggests that some of the outbuildings associated with these brochs in Orkney have been built in the same phase of construction as the broch, or are near contemporary afterthoughts, because the layout of some of the outbuildings and the broch is by and large systematic, and their floor areas, fittings, and furnishings are comparable (1987(2-3)). At

Howe the phase 7 outbuildings are contemporary with the broch, at Gurness they may be primary although little is known of what, if anything, underlies them, and at Midhowe the outbuildings are of several phases, of which the earliest may be contemporary with the broch. Whatever one's stance in this debate, it cannot be disputed that the broch and outbuildings co-existed at one point, functioning as a unity, in this writer's opinion probably early in the development of the sites.

In FIGURE 5 the nucleated settlements of Gurness, Midhowe and Howe have been treated as a single set of premises, drawn as justified gamma maps with an extended vocabulary of symbols to represent the different types of space and means of access. These access maps therefore incorporate information about the spatial properties of the

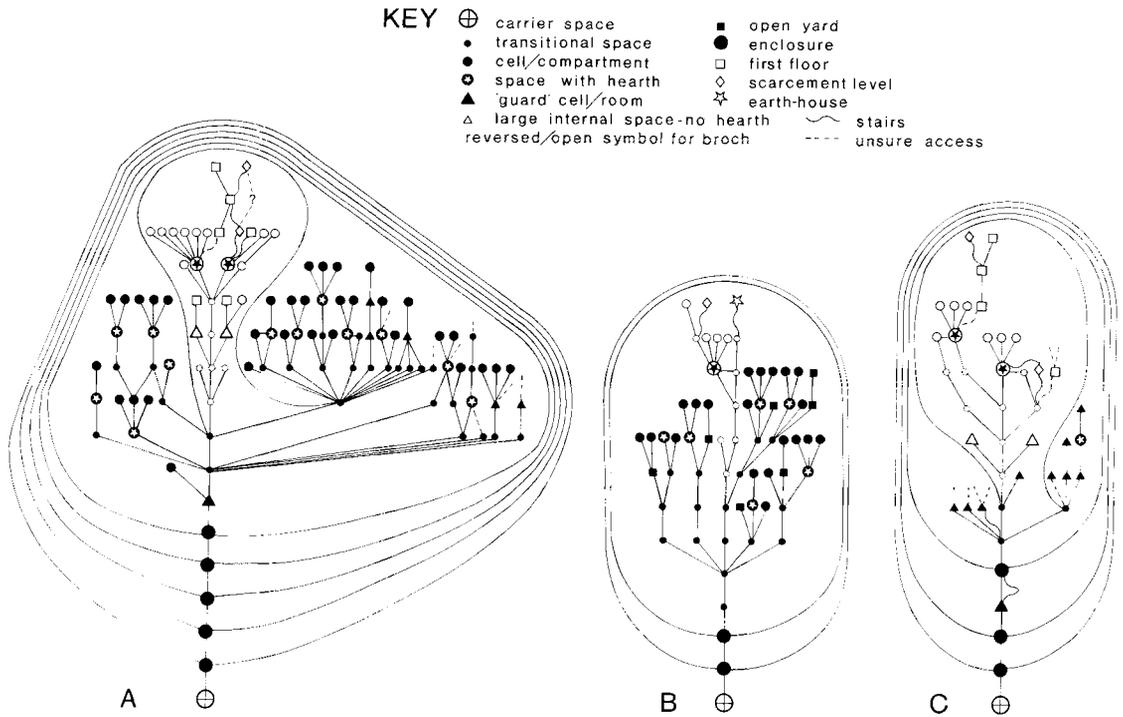


FIGURE 5. Justified access (*gamma*) maps for Middle Iron Age nucleated settlements (reversed/open symbols distinguish the broch from other structures).

- A Gurness.
- B Howe.
- C Midhowe.

brochs and the potential functions of some areas. Moreover by the use of open and closed symbols the differing architectural types have also been indicated. The result is an all-embracing consideration of the architecture presented in convenient diagrammatic form.

Some general trends can be observed, and will be briefly described at the different scales of inference outlined above:

1

At the immediate visual level, the development from Early Iron Age single, agricultural and domestic units (such as Bu, FIGURE 3) to Middle Iron Age nucleated settlements reveals the introduction of a staggering hierarchical use of space. The maps become considerably deeper (more asymmetric), and the deepest, most segregated area is always the set of spaces which constitute the broch. Upper galleries and upper storeys, features not found in the

outbuildings, are the very deepest, least accessible spaces. Their usage may have included storage, extra sleeping facilities and wallheads from which surveillance might be made. Unfortunately these are the parts of the structure about which least is known as they were always the first to collapse or be dismantled, and the total number of original floors is not known. If the majority of activities and functions was in the upper storeys then obviously their exact nature can never be assessed and the ground plans tell us less (although it seems most probable that the ground floor was the main domestic forum).

The larger the access maps, then the more abstract and complicated they become to analyse, and it is helpful to break them down, for instance by dividing them into distributed ('ringy') and nondistributed ('tree-like') sub-systems (FIGURE 6 for Gurness as an example). On the very outside, globally governing the

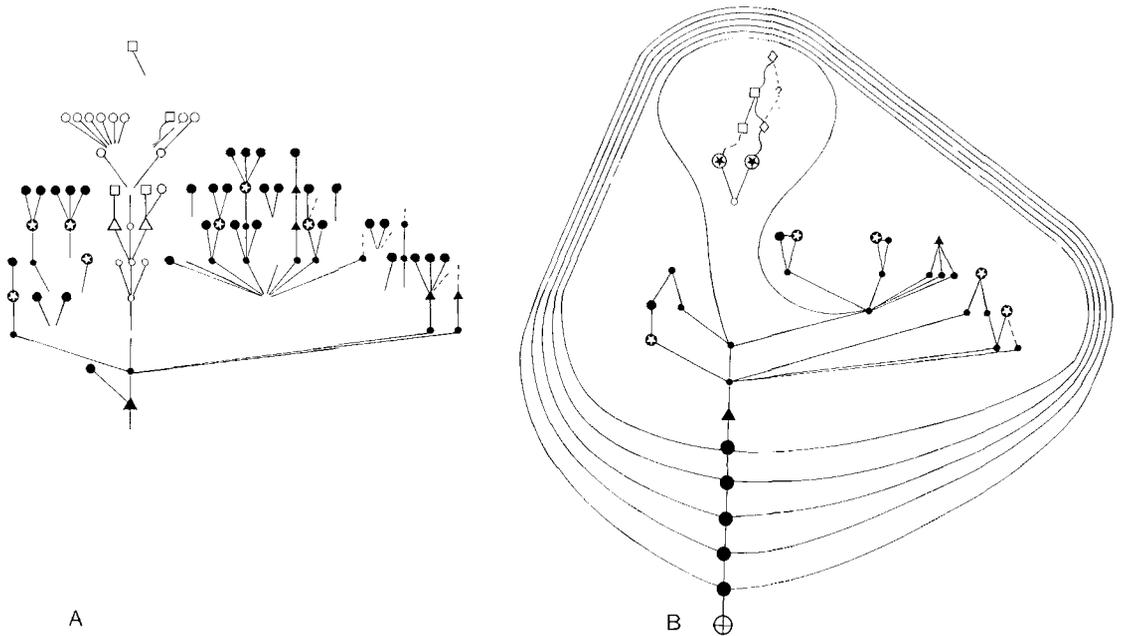


FIGURE 6. *Justified access (gamma) maps for Gurness.*  
 A *the nondistributed sub-system.*  
 B *the distributed sub-system.*

interior, are earthworks which extend the depth between the inside and outside worlds, even if in some cases they only create abstract rather than real rings. Access to the interior proper has to be via the 'guardhouse' or forecourt, a relatively convex space; this is where the transition from the outside world to an inner environment is sanctioned. From here ingress is made into a long thin passage from which access to both outbuildings and broch can be made. In the cases of Gurness, Howe and Lingro (as suggested by an early section of walling: RCAMS 1946(2), figure 230) the entrance into the settlement and the broch entrance are aligned, which must have enhanced the processional-like qualities of these passages. From here the outbuildings constitute a local, large and almost totally nondistributed area of settlement, spaces in which strangers cannot freely circulate and into which they must be invited. Such branching off thus creates the maximum segregation of spaces with the least expenditure of depth, both between and within domestic units. Entrance to and between the outbuildings is mainly by means of this passage,

therefore most movement can be monitored by control of its various sections.

From this first narrow passage access is gained to the next ring, a passageway which encircles the broch (except at Howe). This ring is at the point where ingress can be gained to further nondistributed spaces at a slightly deeper level. Ringy structures interconnect some apartments and outbuildings. Access to the broch interior is from the initial passage, at about the same level as some of the outbuildings, but is deepened by guard cells, an elaborate doorway into a long tunnel, and a series of vestibules. The form of the architecture is particularly relevant; the monumentality of the broch tower and its elaborate entrance contrast starkly with the less substantial outbuildings, all of which appear very similar in form, serving to heighten the discrepancy between these spaces. Once inside the broch, the final ringy structure is encountered, which is separated from all the others by several depth levels. This is quite complex in the case of the double domestic units at Midhowe and the later levels at Gurness. The rings connect the main domestic foci (the hearth areas) and the upper

levels. Cells and compartments are arranged in non-distributed fashion from these rings, in similar fashion to the outbuildings.

From the point of view of strangers, the overall hierarchical layout and the differences in architectural form have done nothing to encourage their admission to the broch. Therefore, its interior ringy system is unlikely to have had a major rôle in articulating immediate stranger-inhabitant relations, but was probably a means of articulating the relationships between the different domestic units, where they existed. The ringy sub-systems in the outbuildings would have played a similar role, but here there is a greater emphasis on the non-distributed component.

From the point of view of social structure a number of observations can be made on the basis of this information. Despite some similarities with the outbuildings, the broch obviously stands out as the most important area in the settlement complex because of its spatial importance, its prime location and its monumentality. This, in combination with the degree of controlled access to the outbuildings and their apartments, which are almost exclusively segregated, may suggest that the social structure on which these new relations were founded required strict control in order to be both established and maintained.

## 2

Taking an overview, the observed systems serve to emphasize the social inequalities existing between the broch and outbuilding occupants, and the settlement and the outside, the latter distinction being the strongest. Local relations between the internal cells are basically the same except for the broch; the factor of *non-interchangeability* has been introduced between the broch and all its surrounding units. Thus this is more of a transpatial than spatial system. In other words the emphasis is on spatial relations which have been determined by genotypic rules and produce the required restrictions of encounter, even though each physical manifestation of these rules is different. What is more, the genotypic-model is global, because it recurs, and as a result transpatial relations and integration can exist between arrangements (settlement complexes) because similarities in layout and comparable positioning may foster a conceptual form of

identification (Hillier & Hanson 1984: 238). In addition the inhabitants of a single settlement may feel a strong sense of identity with each other because they share a structured whole with others. Furthermore, the repetitive nature of these patterns may be representing the acknowledgement of a code of symbols, in this case spatially determined, by which those in the broch sustained their authority over the inhabitants of the outbuildings. The ordered layout of the outbuildings and the comprehensive use of space further suggests that these were laid out as a unity under the authority of the broch inhabitants, rather than being the result of the cumulative construction of outbuildings to a basic structuring principle.

### Social interpretation

These social inferences fit a model of ranked society where Midhowe, most probably Lingro and definitely Gurness and Howe can be interpreted as planned nucleated villages in the 'centre' of which lived the pre-eminent family or personages, surrounding whom were those who payed tribute and in return received protection or patronage (non-nucleated settlements can probably be seen as dependent settlements; this is not to exclude the possibility of other unrecognized elements in the settlement pattern for which a place could be found in this scheme). Similarities in the formal layout of these settlements and the social relations they structured, suggests that these settlements should all be seen as part of a wider society with similar values.

A clientship scheme has also been suggested by MacKie (1987). Besides the different routes of inference, the major difference between our two schemes rests upon interpretation of the primary archaeological evidence, specifically the chronological relationship between the brochs and the outbuildings. Undoubtedly some brochs, particularly early examples, did stand alone, but others aggregated settlement around them, sometimes in very formal conditions where radiated settlements were the result, on other occasions less formally, and on a lesser scale, when the non-radial outbuildings may have been the result. MacKie's scheme has a tribal aristocracy living in the brochs with about 100–300 people living in 'fragile settlements' around the broch, in structures which are as yet unrecognized in the

archaeological record. Granted that a large proportion of Iron Age settlement may exist totally unrecorded, the present scheme proposes that a large element of the non-broch population came to live in broch outbuildings.

### Conclusions

In the absence of examining the broch period in the context of the Early and Late Iron Ages, and considering all the evidence for discourse in which the architecture may have been relevant (the subject of a future paper), the true impact and significance of these spatial arrangements have been minimized. Nevertheless, it is hoped that some of the archaeological potential of the technique of access analysis has been successfully demonstrated. One can find fault in the tenets behind the gamma analysis of Hillier & Hanson, but the formal

approach is one which can be adapted and modified for archaeological purposes. Social inferences can be derived from the spatial order by circumspect consideration of the assumptions behind every appropriate step of the technique, and a clear understanding of the relationship between material culture and social reproduction. All discourse has a spatial element; access analysis is a useful tool for articulating an understanding of the part space plays in structuring social relations, and the part social relations have in structuring space.

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