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THE REAL AND RANDOM ARCHITECTURE OF SIPHNOS: ANALYSING HOUSE PLANS USING SIMULATION

Eugenia Yiannouli and Steven J. Mithen

Over the last fifteen years, there has been a growing diversity of theoretical and methodological perspectives in the archaeological literature. Marxist, structuralist, ecological, middle-range, ethnoarchaeological, experimental, systemic, post-processual, social or simulating form a rather poor sample of the terminology fairly recently coined, in an effort to rescue archaeological reasoning from the so-called pitfalls of traditional archaeology.

If this is the case with archaeology in general, it is even more so with spatial archaeology in particular: for "spatial studies" is a convenient term under which a number of rather diverse approaches to the meaning of space have found refuge.

This divergence in the conception of space varies from notions of site formation processes (Schiffer 1976, 1978), to notions of social reconstruction (for example Naroll 1962, Clarke 1972, Kramer 1982, Kent 1984), of conceptual, cosmological or symbolic qualities (Fritz 1978, Bourdieu 1979, Hodder 1982 and others), of locationally adaptive behaviour (Fletcher 1977) and finally of semantic (Preziosi 1979, 1983) or "grammar" systems (Glassie 1975) that relate to different social conventions.

A number of these approaches rely on different systems of metrics, whereas the rest have studied a variety of ways that different types of artefacts are distributed in space: so that types of artefact distribution have been treated as the bearers of the notion of spatiality.

It is true that different kinds of distribution plots are spatial by virtue of being in space. Such a definition however is redundant since whatever has to do with material reality is spatial from the same viewpoint. Moreover, being in space as a unit in a system of measurement and being in space as an artefact in a distribution plot are apparently two different ways of being in the same medium. In other words, being in space as an entity, for example as an artefact, and being in space as part of it, such as the enclosed space of architecture, are two different ways of being in space (since the former is somehow "contained" by the latter), that one may be justified to ask to what extent, and in what ways, are the variables of these studies spatial at all.

The tendency, therefore, to visualise and even to identify spatial aspects of society by means of metrical units or artefact distributions

has resulted in a relative disregard of the notion of space per se from the archaeological literature: that is of space as a three-dimensional relational entity in the way that has been socially arranged by the physical configuration of solid buildings.

This brief discussion, and the problems that have been hinted at, point to the fact that archaeology lacks an epistemological framework within which these disparate issues could be fitted in a way that would clarify their relative validity, their interpretative range as well as their methodological suitability to different sets of theoretical problems.

It is believed, therefore, that the formulation of an epistemology of archaeological methodologies in general and of spatial methodologies in particular is a valid and urgent task. It would have to express, to say the least, the concern to rescue archaeological reasoning from the pitfalls that may lie latent in the new methods of archaeology.

One way of dealing with the issue is to study the nature of premises in theories, of initial conditions in arguments and of assumptions in methods. This paper aims therefore at discussing some methodological aspects of a relatively recent conception of space and its social implications as they have been developed by the work of Hillier and Hanson in the Bartlett school of architecture and planning at the University College, London.

This work has been chosen because it is believed that it provides spatial archaeology with a theoretical and methodological device that gives space the status of an autonomous social and therefore archaeological category. The following presentation is based on the ideas developed in Hillier and Hanson's (1984) analysis of the notion of space.

The premises of such a conception are briefly and generally the following: firstly, spatial organisation is, in a sense, the product of social structure; this is congruent with recent developments in the fields of archaeology (Renfrew 1982, Fleming 1982, Hodder 1982), anthropology (Levi-Strauss 1963, Leach 1976) and sociology (Giddens 1979, 1981). Secondly, a social system has a certain logic in it and is therefore recoverable in spatial terms. Thirdly, space is thus conceived not as an area or a number of areas but as a three-dimensional relational entity, i.e. as a system of spatial relations, which conditions, by its very nature, a system of social relations.

These notions can be worked out on the basis of the so-called alpha analysis used for the study of settlement layout and gamma analysis employed for the study of buildings. In this paper, aspects of the latter type of analysis only are going to be considered.

Gamma analysis is a conventional term which refers to a number of interrelated notions that deal with the peculiarities in the nature of space in buildings and with the ways that these peculiarities can be

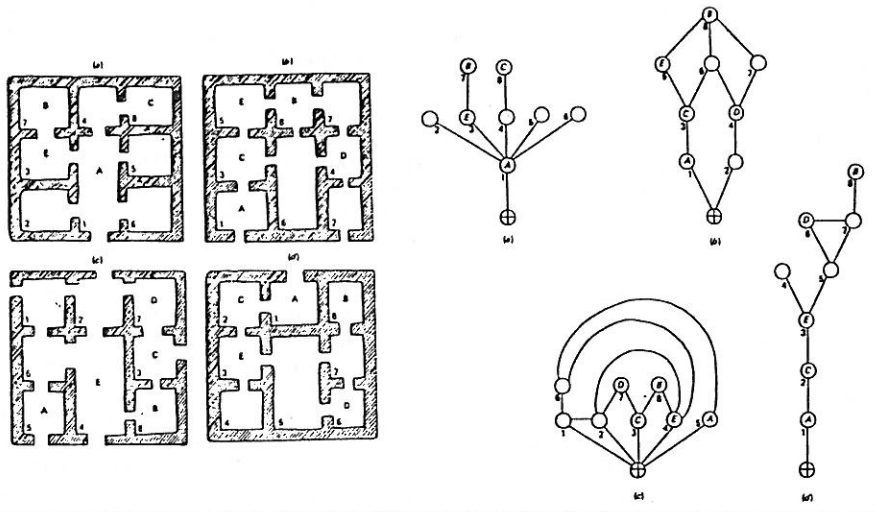

Figure 1: Four theoretical buildings and their permeability maps. After Hillier and Hanson 1984.

methodologically handled, so that the social meaning of the spatial arrangements may be eventually approached.

The space in buildings is peculiar by virtue of being an enclosed space and therefore cut off from the rest of the space that surrounds or "contains" it; the way that buildings demarcate space is not however absolute, since the notion of entrance makes the space of buildings permeable and thus related to the space within which buildings are contained. The notion of entrance is of crucial importance, since it is an inherent feature of all buildings and the differentiating feature between the enclosed space of buildings and the enclosed space of other artefacts. It is thus conceivable why entrances that make built space permeable and thus accessible should be a fundamental variable in the "social logic of space".

If this is the case with the notion of entrance, it should also be the case with the notion of many entrances and their comparative location in buildings; for the relative location of entrances and rooms in buildings arrange and control access and movement to and inside them. The way in which a building is thus permeable can be visualised with the help of "permeability maps" that have the ability to bring out essential similarities in apparently dissimilar ground plans and vice versa (Figure 1). Permeability maps are related to the notion of genotypes because it is on the basis of the latter (which are the abstract, elementary rules that underlie and thus yield spatial form) that permeability maps take concrete shape.

On the basis of such a device, two important aspects of the internal organisation of buildings can be worked out. One is the degree of relative integration/segregation of any room in a building, which is otherwise called depth or relative asymmetry (RA has a value between 0 and 1, with low values indicating a high degree of integration and vice versa).

The other aspect is the one of relative ringiness (RR). RR denotes whether patterned elements, such as all rooms in a building, acquire their final form as a result of the influence of a single or a plurality of factors (for example, whether a layout is built with reference to a central area or whether it is a result of an aggregate process).

These spatial aspects are considered to be of importance because they can be related to social aspects of the community that created them. It has been shown that, on many occasions, the notions of asymmetry and control are interrelated in such a way that segregated areas have been found to have a particular social importance (Hillier and Hanson 1984, 155-63); similarly the dichotomy of symmetry-asymmetry has been found to relate to types of egalitarian-ranked societies respectively (Renfrew 1982; Fleming 1982; Fritz 1978, 54; Levi-Strauss 1964, 179; Rapoport 1977, 278). It is therefore believed that the degree of control invested in a society can be traced in the way that the society in question manifests itself in spatial terms.

It seems, therefore, that the notions of entrances-rooms-RA-RR and their mean values are the variables on the basis of which permeability maps can be analysed, compared and even quantified. The importance of these variables would be indicated by the extent to which they are redundant; in this paper particular attention is going to be given to the significance of systems of entrances, rooms and RA values.

A set of permeability maps will have a particular distribution for the values of these variables. However, before we can use these values as significant characteristics of the maps, we need to know whether such a distribution could have arisen by chance. Simply by having a number of depths and rooms, maps will have a particular RA and MRA values; does the difference between the values arise by chance or relate to decisions taken by the architect or builder?

The requirement is therefore to create a set of "random" permeability maps from which distributions of RA and MRA can be derived and compared with those from real maps. To do this, we can use the real maps to provide minimal criteria for the basic form of the random map (i.e. frequency of depths, nodes=rooms, and links) and use simulation to generate a set of random maps.

As a data base, seventeen single and double storey modern houses from the Aegean island of Siphnos were used. These were built over a period of about two hundred years (Tzakou 1979). Although the house plans are irregular and difficult to compare, their permeability

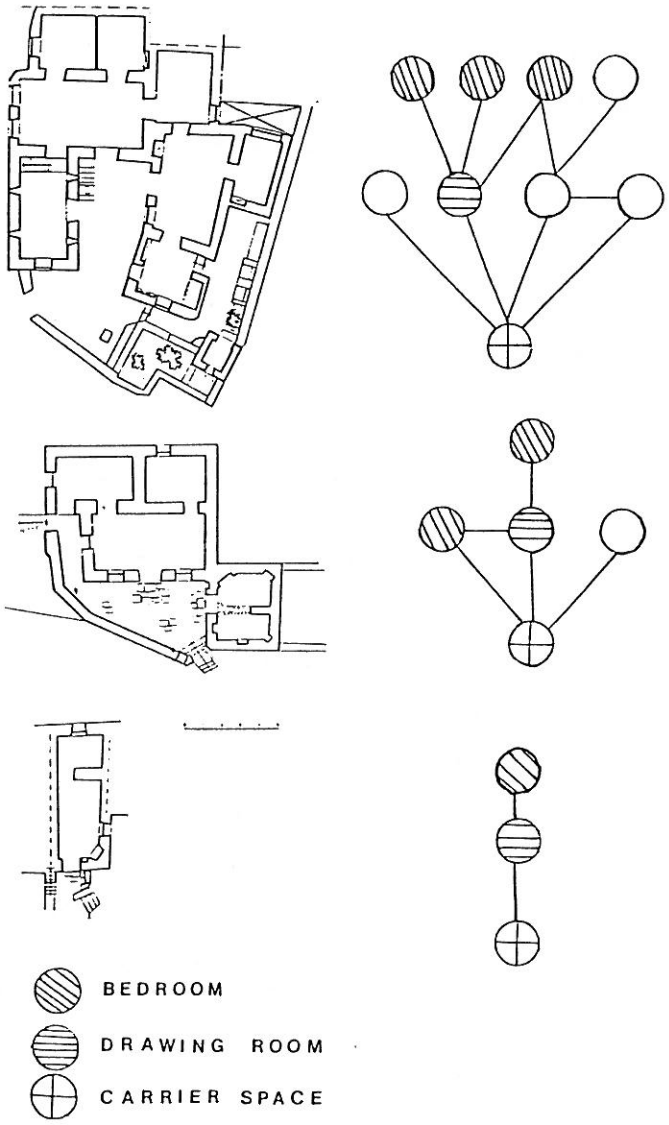

Figure 2: Examples of modern Siphnian houses. After Tzakou 1979.

structures point to the fact that there is a considerable number of consistently recurring features (Figure 2; see the discussion for further details).

Method

The aim of the simulation study is therefore to create a set of "random" maps using minimal criteria on their form derived from the analysis of real plans. Three sets of data were derived to use as such constraints on the simulated plans:

1. The probabilities that there would be 1, 2...N depths in any one map.

2. The probabilities that there would be 1, 2...M nodes at each of the N depths.

3. The probabilities that there would be 1, 2...K links between a node at depth n and those at depth n' (n'=n or n'>n).

These probabilities were derived from the data set of real maps and are given in Table 1.

It is clear that there are several likely characteristics of real maps not used to generate simulated maps. Two may be of particular importance. First, whether the number of nodes at depth n influences those at depth n' (n'>n or n'<n). Secondly, whether the number of links from one node at a particular depth affects the number of links from any other node, at that or other depths. Essentially we are not introducing any organisational characteristics into the simulated maps and consequently refer to them as "random".

To create these plans, a simulation program was written in the "Pascal" programming language and run on the University of Cambridge IBM computer. A data structure was designed to contain information about each map. A map was considered to be a set of nodes and each node was described by four characteristics. First it had a reference number to locate it on the map. Secondly it had a number defining the depth at which it lay. Thirdly, data defined the number of links from this node to each of the depths within the plan. Fourthly, it was also specified to which of the other nodes, recorded by their reference numbers, each node was linked. The information in these characteristics partly overlaps and was used to ensure that the program worked correctly.

A simulated plan was created in two discrete steps using the three sets of probabilities and a random number generator. The initial step was to create a set of unlinked nodes. The number of depths (n) and the number of nodes each depth (Mn) were determined. Each of the nodes was then given a reference number.

The second step was to link the nodes by using the following procedure. Each node was examined in turn, beginning with that at depth 1. The number of links from this node to nodes at the same and "higher" depths were determined using the third set of input probabilities and random numbers. If there were K1 links between the node at depth n and nodes at depth n+i, then there was an equal chance (ie 1/(Mn+i) that any node at depth n+i was the other end of the K^H link. A constraint was

a)

n	1	2	3
	0.0	0.296	0.704

b)

n	M=1	2	3	4	5
1	1.000	0.000	0.000	0.000	0.000
2	0.296	0.259	0.296	0.111	0.038
3	0.210	0.474	0.105	0.158	0.053

c)

n	n'	K=1	2	3	4	5
1	1	0.000	0.000	0.000	0.000	0.000
	2	0.000	0.000	0.000	0.000	0.000
	3	0.000	0.000	0.000	0.000	0.000
2	1	0.921	0.048	0.000	0.000	0.000
	2	0.238	0.000	0.000	0.000	0.000
	3	0.000	0.000	0.000	0.000	0.000
3	1	0.000	0.000	0.000	0.000	0.000
	2	0.841	0.114	0.000	0.000	0.000
	3	0.114	0.000	0.000	0.000	0.000

Table 1:
a) Probability of ith map having n depths (n=1,2,3).
b) Probability of nth depth in the ith map having M nodes (n=1, 2, 3 M=1,2...5).
c) Probability of node at nth depth having K links with nodes at n'th depth (n=1,2,3) (K=1,2...5).

added to this procedure, namely that there could be no more than one link between any two nodes. In a very few cases this resulted in insufficient nodes at depth n+i for the number of links from depth n. Such maps were discarded. In addition, certain finished maps had nodes which were unlinked to any other node. Since this is an impossibility in the real world these maps were also disregarded.

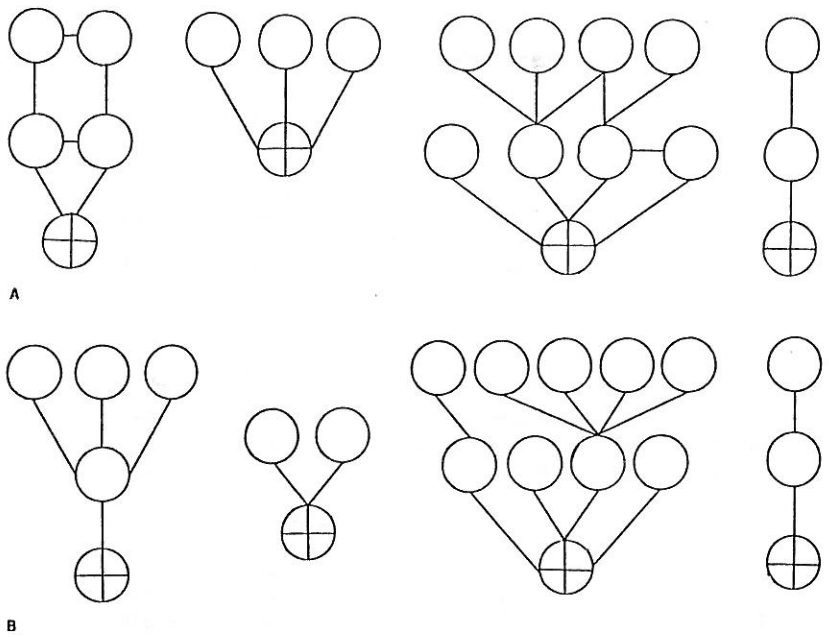

Figure 3: Examples of the permeability maps of a) real, and b) simulated houses.

By systematically examining each node at each depth, beginning with the single node at depth 1, the nodes were linked in this manner. This created a single "random" permeability map which was recorded. The procedure was then repeated to create a further example. By this method we created a sample of 30 random maps.

For each map the following characteristics were calculated:

1. Total number of nodes (T).

2. Relative asymmetry of the carrier space (ie the space within which a building is contained, symbolised by) 2(MD-1)/(T-2).

3. Mean relative asymmetry.

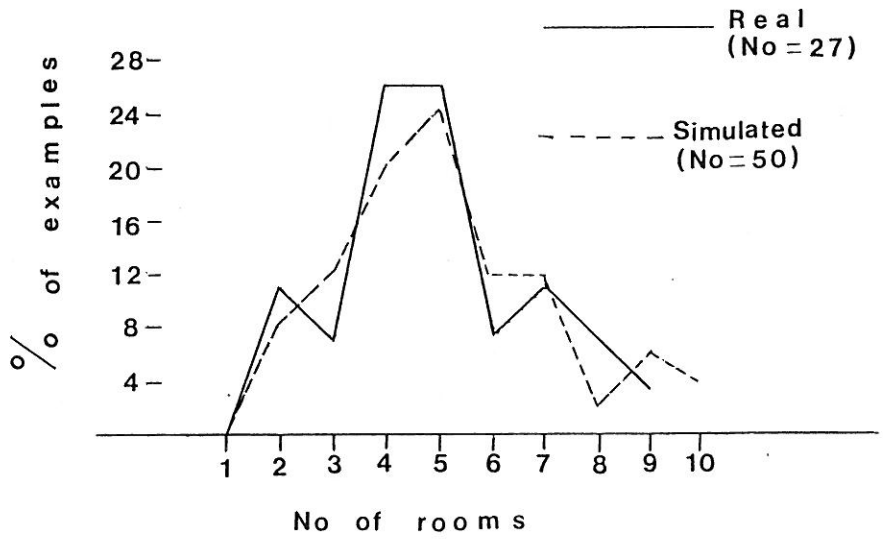

Figure 4: Distribution curves of the number of rooms in real and simulated houses.

Results

A sample of 50 simulated plans were created, some of which are illustrated in Figure 3. For each plan three measures were calculated -- the total number of nodes, the relative asymmetry of the carrier space, and the mean relative asymmetry. The distribution of these values in the simulated plans were compared with those of the real plans.

Figures 4 and 5 show that the distribution of the number of nodes and the relative asymmetry of the carrier space in the real and simulated plans are very similar. This is what we should expect since these values depend on the "minimal criteria"; the input probabilities into the simulation program adopted form the real plans.

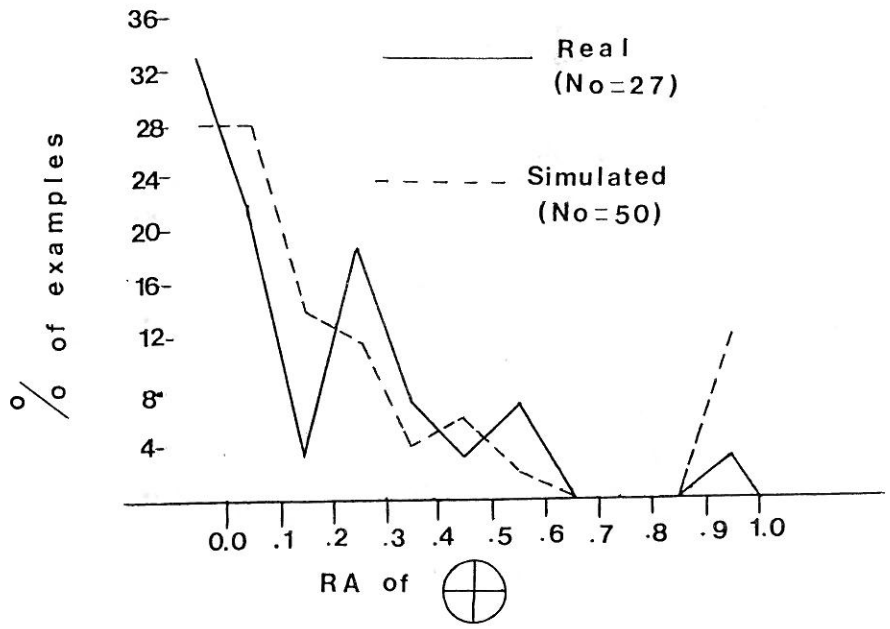

Figure 5: Distribution curves of the relative asymmetry of the houses from the carrier space, ⊕.

However, the mean relative asymmetry (MRA) depends on the patterning of connections between the nodes, in addition to these minimal criteria, and reflects, as we see in Figure 6, a significant difference in the real and simulated distributions. There is a much higher frequency of low MRA values in the real plans. That is, the house builders/designers were patterning the connections between nodes in a manner to create lower MRA values, and consequently more highly "integrated" houses than would exist if the same number of connections were made randomly.

Discussion

The significance of the results may be recapitulated in the following way. Firstly, the minimal criteria used for the generation of the simulated maps (frequency of depths, nodes and links) were where society would reproduce itself without accentuating its differences.

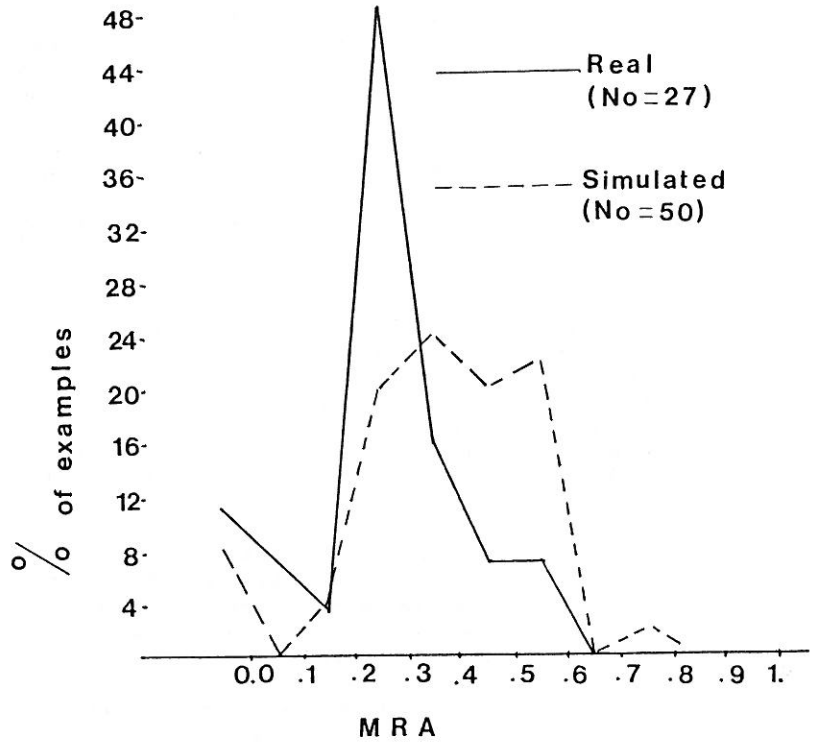

Figure 6: Distribution of mean relative asymmetry values of realand simulated houses.

established. We can be confident that the simulation runs correctly, since in Figure 4, the close fit of the distribution curves between the nodes of the real and the "randomly" simulated houses indicates that the latter were of the same size-category as the former, hence the similarity in the RA values of the carrier space (Figure 5). Then, we are confronted with the observation that there is a greater number of real houses with lower MRA values than we would expect by chance (Figure 6). In other words, there is a constant tendency to produce houses with low

degrees of segregation. Since, therefore, the MRA values of the real houses do not seem to have arisen by chance, these values must be of significance for they point towards the purposive and intentional character of house-building decision-making.

What, however, could be the social meaning of such values in more concrete terms? According to basic premises in Hillier and Hanson's conception of society and space, spatial patterning is a system that relates to forms of social patterning and that low RA values indicate a high degree of integration of sets of activities in the life of the social system in question. Consequently, the absence of segregation, ie. of strong differentiation among activities in terms of their comparative location within buildings should, in theory, correspond to a domain

The existence of such a domain is firstly indicated by the consistent recurrence of sets of features in the permeability maps of the Siohnian houses, as can be seen in the limited sample in Figure 2. The houses are of two depths, they have four entrances, and it is only the bedrooms that are found in the second depth which always open off the drawing room. The ultimate significance of these features cannot be illuminated without reference to the broader context within which the architecture is found, eg. ideology, religion etc., which may be inferred from the archaeological record. Further insight can be gained by attention to oral traditions, written records and the history of the island, which, being a full study in their own right, fall outside the scope of this paper.

Secondly, the attested homogeneity in the permeability maps and in the MRA values becomes interesting when we note that these houses were built over a span of about two centuries and belonged to families of different economic and occupational background (Tzakou 1979, 52). In other words, in spite of the differences that an economic type of analysis would reveal, such as variations in the number of rooms, non-local kinds of building material, wealth differences etc., the internal organisation of house space seems to act in this case in a way as to underplay the influence of contrasting social values.

That a socially differentiated group may unite and thus maintain itself in the level of the spatial structure of its vernacular architecture is further corroborated by other peculiarities in the life of this community.

It has been attested that at great religious feasts, all the inhabitants participate in such a way that status and class divisions become irrelevant issues (Tzakou 1979, 54). Similarly the distribution of high status family houses is based in kinship and friendship attachments and they do not have any privileged access to public resources and facilities (ibid. 77). Moreover bread ovens and oil presses found in the courtyards of big houses were commomly shared by the people of the surrounding neighbourhood (ibid. 79). This preference for high interaction among people is therefore evident in their "shallow" houses as well as in the high integration values (ie. low MRA values) of the rooms as a

whole, with the outside world. Structurally similar permeability maps can therefore indicate a level of unity in a society of differences.

This analysis and conclusion are of significant importance from an archaeological point of view because they verify the irresoluble interdependence between spatial organisation and social structure. More specifically, they attest that the notion of entrance and that of permeability maps are significant descriptive and interpretative variables, since RA values are not just methodological devices but heuristic means for reading social aspects into spatial structure. The application therefore of these ideas in a known ethnographic conctext has pointed to their significance in studying unknown archaeological cases.

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PAST PRACTICES IN THE RITUAL PRESENT: EXAMPLES FROM THE WELSH BRONZE AGE

Paul Lane

Introduction

The aim of this paper is to question the common archaeological conception of space and time as passive environments for action, by proposing instead that time and space are constituents of action, which take an active role in the reproduction and transformation of society. The perceived advantage of this perspective is that it redirects attention away from the search for material correlates of behaviour of a universal nature, towards the explication of the specificity of individual contexts.

More specifically, this paper will discuss problems of inference with special reference to the use of the terms 'ritual' and 'domestic' to describe various categories of archaeological entity. It will be argued that while both terms are a useful short-hand for defining the dominant characteristics of particular entities, their use introduces a set of largely ethnocentric, and frequently androcentric, assumptions, which serve to reinforce and reproduce an appearance of mutual exclusiveness and opposition between these two aspects of human action. That is, without wishing to deny the empirical existence of activities that can be described as ritual or domestic, I shall question the validity of the assumptions which underpin the division of social practice along such lines, and point to problems of inference that such a division introduces into the interpretation of archaeological deposits.

Archaeological inference: defining domestic and ritual contexts

At the heart of the ritual/domestic dichotomy lie particular conceptualisations of human action and of the relationships which pertain between action and the representation of notional phenomena, especially through the medium of material culture. However, there are initial definitional problems with the terms 'domestic' and 'ritual'. Within archaeology the term 'ritual' is conventionally used to refer to archaeological entities which cannot be adequately accomodated by technological or economic processes, and, in this sense, is employed to explain the unexplainable. This idea can be seen in Hawkes' "ladder of inference", which ranks inferences into a scale of ascending difficulty, from fairly straightforward ones about technology and economic subsistence through those concerning socio-political organisation to those relating to religious and spiritual life (Hawkes 1954, 161-2). These divisions are based on the assumption that the respective classes of activity are inherently different, and can be arranged along a continuum "leading up (sic) from the generically animal in man to the more specifically human" (Hawkes 1954, 162).

(Archaeological Review from Cambridge 5:2 [1986])