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Intrasite Spatial Analysis in Scandinavian Stone Age Research

A Discussion of Theory

By DEBORAH OLAUSSON

Abstract

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This paper is a discussion of theory and method used in intrasite spatial analysis – the analysis of "living floors". Processes in the formation of the archaeological record such as abandonment, discard, loss, and caching, are discussed. There is also some investigation into factors which may disturb or obscure patterning on an occupation site. Examples to illustrate the discussion are taken from analyses of settlement sites which date from the Mesolithic and Neolithic in primarily Denmark and Sweden.

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I. Introduction

As archaeologists, our primary interest lies in investigating past behavior. We cannot study this behavior directly, but are forced to infer it by analysing more indirect clues to behavior: material culture (artifacts), the exploitation of natural resources, settlement location, etc. The question with which we are always confronted is to what extent such clues reflect past behavior, and exactly what behavior they represent. It is possible to envision a hierarchy of inference, going from a high level of certainty on the one hand, to a high level of uncertainty on the other. For instance, the presence of a pot allows us to infer the behavior of ceramic manufacture with a high degree of certainty, while there is considerably more uncertainty involved in inferring descent rules on the basis of the location of potsherds at a site (e.g. Hill 1968; Longacre 1968; Stanislawski 1973).

The attempt to identify past behavior by means of the analysis of horizontal patterning of former settlement sites, often referred to as intrasite spatial analysis, is an example of an inferential level of some uncertainty. As is often the case when a new approach becomes popular, early examples of such analysis, applied to Paleolithic living floors, were characterised by a naive assumption that there is a direct relationship between patterning on sites and past behavior. It was thought that sufficiently precise excavation and analysis of a living floor should allow the archaeologist to reconstruct the behaviors which occurred there (e.g. Binford 1972, p. 136; Thompson & Longacre 1966 quoted in Wood & Johnson 1978; Whallon 1973, p. 117). Ethnographic, ethnoarchaeological, and experimental work carried out subsequent to these optimistic beginnings has somewhat dimmed the initial enthusiasm and has indicated that the picture is in fact exceedingly complex. While intrasite spatial analysis commonly is applied in the interpretation of settlement sites in Scandinavia, research here has at times failed to take into account many of the complicating factors pointed out in later studies. One exception is a seminar paper dealing with the Late Paleolithic site at Segebro (Thorsberg 1984). A large part of the paper deals with a thoughtful source-critical evaluation of settlement analysis and its problems as related to Segebro.

The aim of the present essay is to discuss a number of these complicating factors as they may apply to intrasite spatial analyses carried out on Swedish and Danish occupation sites. Only horizontal patterning will be discussed here. Most of the example come from sites of Mesolithic and Neolithic age, although there have been attempts to identify activity areas in the more permanent structures of the Bronze and Iron Ages as well (e.g. Boas 1980; Ramqvist 1983; Linderholm 1984).

II. Processes in the formation of the archaeological record

In his book *Behavioral Archeology* (1976), Schiffer distinguishes between an object's archaeological context and its systemic context. An object is said to be in archaeological context when it is no longer participating in a behavioral system, while materials within an ongoing behavioral system are said to be in a systemic context (Schiffer 1976, p. 28). Schiffer identifies four processes by which an object can be transformed from a systemic to an archaeological context (i.e., the object enters the archaeological record and can be recovered archaeologically): discard, disposal of the dead, loss, or abandonment (Schiffer 1976, pp. 30 ff.). Consideration of these categories reveals that they are not mutually exclusive when applied to occupation sites. Insted, all such processes can be subsumed under two headings: catastrophe and abandonment. (Of course this discussion applies only to sites where there has been a discontinuity. At locations where there have been several occupation episodes and/or continuity, the picture is much less clear. Intrasite spatial analysis usually is not attempted on such sites because of a lack of clarity.) It is very important to be able to identify which of these events characterizes the site one is studying, since each represents different degrees of correlation between spatial patterning and behavior. At an occupation site overtaken by a catastophe, where ongoing activities were instantly interrupted, one would expect many objects to have been left at their location of use (Schiffer 1972, p. 160). Of course the catastrophe itself may disturb the patterning, making it difficult for an archaeologist to recover. Thus we have at one extreme Pompeii, where behavior is truly "fossilized", and at the other a site overcome by a flood whose waters totally mix the settlement remains.

Site abandonment

The other process by which a living floor becomes part of the archaeological record is when an occupation site is abandoned. To be sure a catastrophe, such as a fire or warfare, can be the reason for the decision to abandon a site. The degree to which site patterning reflects ongoing behavior in such cases is partly dependent on how much time the inhabitants had to sort out which objects to take and which to leave, as well as on their judgements about transportation, the probability of return, etc. (Schiffer 1972, p. 160). As long as there is the possibility of objects having been removed from the site, intrasite analysis must proceed with caution. At the short-term sites reflecting little investment in time and labor which characterize nomadic groups, abandonment is of course a common phenomenon. However, there are even examples in which more permanent settlements representing a higher investment are abandoned (e.g. Carlsson 1977).

Abandoned sites represent conscious behavior on the part of their inhabitants: a decision to leave the location of settlement, either permanently or with the intention of returning at a later time. The degree to which eventual patterning on these sites reflects behavior depends on many factors: the degree to which the group curates its tools (see below), the duration of settlement, habits of discard, the social complexity of the group etc. The location of struc-

tures and/or objects on an abandoned site *could* represent the location of e.g. huts, activities, refuse areas, etc.; but it is important *not* to assume that there is a necessary, simple, one-to -one correspondence between such patterns and the behavior behind them. Only after we have been able to identify what processes stand behind the spatial distribution of artifacts at a settlement site can we hope to identify the behavior that led to their deposition. It is then possible to identify the processes of site formation at an abandoned site: discard, disposal of the dead, loss, and intentional deposition.

The extent to which the positions of artifacts and/or structures on an abandoned site reflect past activities depends on several factors, as noted above. Schiffer defines de facto refuse as ". . . the tools, facilities, and other cultural materials that, although still usable, are abandoned with an activity area." Thus de facto refuse found in an activity area may relate to what was in fact used there, but *also* to: the conditions under which abandonment took place, available means of transport, distance to the next occupied activity area, and whether or not return was anticipated (Schiffer 1976, p. 33). In order to be able to ascertain the exent to which the position of articles on an abandoned site reflects past activity, it is necessary to consider each of these factors in turn. Equally important as evidence of site activity is what is *not* present at the site. By making the distinction between unusable items (which are discarded and left at the site – see below), those which are still usable but are left behind, and those taken along when the site is abandoned, Schiffer alludes to the concept of curation.

Curated and expedient technology

The concept of curation is a useful one for intrasite spatial analysis. It was first discussed by Binford in his analysis of Mousterian variability (Binford 1973). By curation Binford means an investment in the maintenance and care of objects to increase their life expectancy. Curated items are transported and repaired and are used as long as possible before being discarded or reworked into some other form. Therefore, in a curated assemblage "important items are maintained and curated, thus their entry into the archaeological record, in terms of frequency, is inversely proportional to the level of maintenance and hence their technological importance" (Binford 1976, pp. 339 ff.).

This distinction obviously has far-reaching consequences for intrasite spatial analysis, since what remains at a site left by a group with a curated technology will relate to factors such as how easily a tool breaks or how difficult (time-consuming) it is to replace, rather than reflecting its context of use or its importance in the ongoing technology (Binford 1973, p. 242). Therefore

> Spatial patterning and mutual associations of tools in groups will be stronger, more common, be exhibited by more tool types, and represent the actual location of activities in which the tools were used to the degree that the technology is expedient as opposed to curating (Whallon 1973, p. 119).

Let us consider some examples from Scandinavian archaeology in which an awareness of this distinction could alter the interpretation of site activity.

In his study of Paleolithic scrapers from Borneck-Ost, Knutsson uses analogy with ethnographic examples and his own experiments with edge-wear analysis to study activity areas in this camp. On the basis of this evidence, he suggests that the main activity at the camp was working hard materials (Knutsson 1978, p. 54). The tools on which he bases his conclusion, scrapers and burins, are among the most expediently made stone tools (a scraper can be made on a flake in 2–3 minutes) and could therefore represent equipment it was not thought necessary or profitable to take when the inhabitants moved on. In fact if the site had been over-

come by a catastrophe, rather than abandoned during a seasonal round, the composition of the tool-kit might have been quite different and Knutsson's conclusions about the predominant activity here might also have differed. Nevertheless, Knutsson's study does afford a clue that the degree of curation here was low. In studying the unretouched flakes he found 130 more tools to add to the 80 retouched tools (p. 55). This may indicate a high degree of expediency, in which tools are quickly used and discarded. Also the 5 % ratio of tools to flakes (p. 54) is rather high and may be a basis for suggesting a primarily expedient technology.

Brinch Petersen's analysis of the Maglemose site of Sværdborg II (Brinch Petersen 1972) is also worth examining in the light of the present discussion. There are a few clues which might indicate that the inhabitants of this site used a more curative technology than was the case at Borneck-Ost. Brinch Petersen comments that the flint tools and bone artifacts found on the site are limited and monotonous, consisting mostly of microliths and barbed bone points (Brinch Petersen 1972, p. 74). However, he does not conclude from this that the site represents a specialized camp where only activities using such artifacts were involved. He thus is arguing (although implicitly) that the inhabitants took most of their possessions with them when they abandoned the site after one summer. Another clue that supports this interpretation is the low percentage of tools (less than 1 %) in relation to flint debitage and cores (Brinch Petersen 1972, p. 74). This figure is of course uncertain as the number of objects in the category "actual tools" would probably increase if the unretouched pieces had also been examined for use (Brinch Petersen 1972, p. 64).

It is significant that it is the small, easily made pieces such as microliths, notched and denticulated pieces, and burins, which predominate at Sværdborg II, while larger, more "costly" (in terms of manufacturing time and/or availability of raw material) items are scarce (Brinch Petersen 1972, p. 64). This also supports an argument for the curation of more costly tools and points up the fact that it is impossible to classify an entire technological complex as "expedient" or "curative", as Binford seems to try to do in his earlier essays. Decisions to discard or to repair are made for each tool or each type of tool and they can depend on a myriad of factors.

Larsson speculated about this factor at Segebro. There he found 753 proximal fragments of blades, but only 482 distal blade fragments, in layer 6. Even if the tools on distal blade fragments were included, the two totals did not match. Larsson concluded from this that certain parts of the blades had a special function and were therefore taken along when the site was abandoned (Larsson 1982, p. 83).

In light of the fact that we do not know which tools were removed from any given site or in what numbers, it seems dangerous to try to base chronology on comparisons of tool frequencies between sites. Brinch Petersen states "The small number of scrapers does not indicate that activities here have differed from those on other Maglemose sites, e.g. Mullerup–Sarauw's islet – as the number of scrapers in the Maglemose culture seems to be a chronological trait . . . The large number of microliths may likewise depend on the chronological phase" (Brinch Petersen 1972, p. 74). To the extent that the degree of curation is a chronological trait it may be possible to apply such an argument, but it must be used with caution. Vang Petersen tries to avoid this danger in his use of frequency seriation of oblique projectile points for dating Atlantic sites. He specifically states that he has chosen these because they are among the least susceptible to reworking (Vang Petersen 1979, p. 7). While it is true that the stone point itself is quickly made and therefore easily discarded, one could question why whole points are found at a settlement

site at all. Points mounted on an arrow shaft would no doubt have been subject to curation (Keeley 1982) and therefore removed from the site (Larsson 1982, p. 83). Of course, it is possible to speculate that cultural considerations account for the discard of apparently functionally usable tools. Perhaps an arrow point which killed a certain animal was considered unclean or unlucky and was discarded for this reason. Broken points however, could be explained as evidence for retooling (Keeley 1982; see below; Larsson 1984a, p. 102).

Arguments equating the density of artifacts with the duration or complexity of settlement are often put forward (e.g. Blankholm 1981, p. 401; Larsson 1978, p. 192; Andersen *et al.* 1982, p. 24). Another common assumption is that the frequency of certain artifacts at a site reflects the relative importance of the activity in which they were used (e.g. Andersen *et al.* 1982, p. 27; Larsson & Larsson 1984, p. 58). Binford notes on the contrary that for curated assemblages ". . . there is an *inverse* relationship between the importance of the item as measured by the frequency with which it is carried, and its occurrence as an item remaining in the field" (Binford 1976, p. 339; italics mine). Larsson and Larsson suggest that the dominance of discoid scrapers at Karlsfält may be evidence that animal husbandry was more important than cultivation there (Larsson & Larsson 1984, p. 58). While in the light of other lines of evidence this is probably true, in cases where supportive evidence is not available it is dangerous to base such conclusions on the relative tool frequencies at a site. If the tools left behind were in fact those considered *least* important by site inhabitants, while those taken along when the site was abandoned were the *most* important ones, such an interpretation would be incorrect. As should be obvious by now, it is not possible to establish a direct connection in such cases until the possibility of curation is explored.

Thus far we have been concerned only with the fate of stone tools. Ceramics, being more fragile and therefore less transportable, are probably subject to a different set of parameters. Nevertheless whole pots (or sherds which can be restored to whole pots) are rarely encountered on abandoned sites, perhaps indicating that these too were curated. Indeed one would expect them to be, given the labor invested in their manufacture. In his use of broken pots to calculate the duration of settlement at the Early Neolithic site of Mosegård, Madsen has assumed total expediency in the use of pottery – i.e., the inhabitants had no pots with them when they arrived, and took none with them when they left. The fact that only 83 flint tools, mostly smaller objects such as scrapers and knives, were found on the site (Madsen & Juel Jensen 1982, pp. 72 f.) suggests that at least the larger tools were taken along when the site was abandoned after its occupancy of an estimated 3–10 years. If pots were also taken, this would alter the numer of pots on which the duration of occupancy was calculated (unless of course the same number of pots had been introduced to the site when the inhabitants arrived).

As a final example of the impact this concept has on interpretations of intrasite spatial analysis in Scandinavian archaeology, I would like to discuss Broadbent's *Coastal Resources and Settlement Stability* (1979). Broadbent's approach is similar to Knutsson's (1978) and to Juel Jensen's (Madsen & Juel Jensen 1982); i.e., the use of edge-wear analysis to identify functional loci on occupation sites. In addition to evidence from stone tools, Broadbent examines the location of features, stone and bone waste and phosphate concentrations (Broadbent 1979, p. 152). By including the latter, Broadbent is able to strengthen greatly his conclusions and avoids some of the difficulties raised by the curation problem. Stone and bone waste products and phosphates are more likely to remain on the site at least, even if they are

not left at the location of activity (see the discussion of discard habits, below) and they may more accurately reflect activity than tools themselves do (cf. Whallon 1978, p. 29). In spite of this, Broadbent does employ an unproved assumption of tool expediency when he identifies subareas and percentages of working activities by the location of quartz artifacts (pp. 140–141). In fact the artifact-poor but stone and bone rich areas which he uses to define the extent of the sites may also be used as an argument for a more curative technology in which many tools were removed from the site by the inhabitants. Had they been present, Broadbent's conclusions about the main activities at each site, and about intrasite activity, might have been different.

Discard

Discard is a process by which unusable or unwanted materials are disposed of. Disposal can be at the location of use (termed primary refuse by Schiffer) or away from it (termed secondary refuse by Schiffer, 1976, p. 30). In this paper only discard in association with a settlement site will be considered, although primary refuse could arise at a butchering location, or a dump could be far removed from a location of occupation. The somewhat special case of knapping refuse will be discussed separately below. Primary refuse, by definition waste which remains where it was created, may provide clues about activity areas. Secondary waste, if waste from one activity is collected and dumped in one place, may also provide such information, but requires considerably more cautious analysis. For this reason Schiffer's distinction between primary and secondary refuse is necessary and helpful in settlement analysis. If refuse is to be used to make statements about activity at sites, it is necessary to be able to distinguish archaeologically between primary and secondary refuse.

We can propose two integrated factors which influence whether a group will discard at the location of use or away from it: the duration of occupation and the undesirability (as defined by site inhabitants) of the waste. To some extent the first factor controls the second, since settlement inhabitants may decide short-term discomfort "costs" less than the effort of moving waste.

This is the reasoning behind a hypothesis proposed by Schiffer: "with increasing site population (or perhaps site size) and increasing intensity of occupation, there will be a decreasing correspondence between the use and discard locations for all elements used in activities and discarded at a site" (Schiffer 1972, p. 162). Based on a study of the discard practices of 79 cultural groups listed in the Human Relations Area Files, Murray suggests a modification of the hypothesis. She notes that waste is not discarded at the location of use (secondary refuse) in family living spaces that are a) enclosed and either permanent or occupied for at least one season or b) enclosed and occupied for less than one season. Elements will be discarded at their location of use (primary refuse) within family living spaces that are a) not enclosed and b) occupied for less than one season (Murray 1980, p. 497). Thus, populations whose family living spaces are the interiors of shelters usually discard elements *outside* those areas (Murray 1980, p. 497). In fact, the situation is even more complex than this study would suggest, because notions of cleanliness and comfort are so intimately bound up in the cultural system of the inhabitants of a particular site. For example, in Hodder's ethnoarchaeological study of the Nuba, he found that the members of the Mesakin Qisar tribe discarded most of their refuse at the location of use in their courtyard, while keeping the area around the compound bondary clean. Activities in the courtyard were ritually or symbolically "cleaned" instead. The Moro tribe, on the other hand, relied less on symbolic purification and in-

stead removed much of their waste from their living spaces and discarded it as secondary refuse outside the compound (Hodder 1982, pp. 161 ff.) It is clearly impossible to arrive at any law-like generalizations for refuse disposal. Therefore, it is difficult for archaeologists to infer the locations of site activity from locations of waste concentrations. Former living shelters that are abandoned during the occupation of a site can also become dumps for secondary refuse, as was often the case in pueblos from the southwestern U.S. (Burgh 1959). Therefore if we are to infer site activities from patterns of discard, it is necessary to consider the duration of settlement and the permanency of shelters, and to try to distinguish between primary and secondary refuse. Of course even after abandonment a site will be subject to processes which can disturb patterning, such as animal activity and natural processes.

1. Archaeological examples of primary refuse

Two extreme examples in which location of discard was assumed to equal location of use are cited in Welinder (1971): Bare Mosse II and Linnebjär, both Mesolithic sites in Scania. Welinder seems to be aware of the danger of making this assumption when he notes that activities other than microlith manufacture can be difficult to identify at settlement sites, because tools need not lie where they were used (Welinder 1971, p. 181). Nevertheless, he takes the predominance of scrapers on the eastern half of the site of Bare Mosse II to indicate women's work, which in turn leads to a conclusion that women occupied this half of the site. By similar reasoning, men kept to the western half, where they used microliths, burins, and retouched flints (Welinder 1981, p. 183; cf. Fredsjö 1953, p. 58 for a similar interpretation at the site of Tosskärr A). Similarly, the presence of four discrete concentrations of a presumed knapping floor, accompanied by a concentration of scrapers, microliths, and debitage, is taken to mean four occasions of shortterm settlement by a small group at Linnebjär (Welinder 1971, p. 188; cf. Larsson 1982, p. 89; Grøn 1983). One would like to see a more source-critical evaluation of these finds, taking into account not only the question of primary vs. secondary refuse, but also the permanency of settlement and the question of curation, before accepting this interpretation of artifact scatter.

In their study of the Early Neolithic settlement site of Mosegård, Madsen and Juel Jensen also make an implicit distinction between what they assume to be discard at the location of use, and secondary discard, when they distinguish between activity areas and a dump area (Madsen & Juel Jensen 1982, p. 67). They identify the primary activity area by a high density of pottery and waste flints, while they identify the dump as an area containing large quantities of pottery, waste flints, and tools (p. 67). Interestingly, they also identify two secondary activity areas on the basis of soil coloration, although these areas were devoid of cultural material. One wonders if the inhabitants left waste around the hearth but removed it from the secondary activity areas, or if instead the activity at the latter created no tangible waste other than soil coloration.

Madsen and Juel Jensen use the location of sherds from single pots to indicate location of breakage, by which they in turn identify the primary area of pot-using activities such as the preparation and storage of food (pp. 69–70). It is necessary to eliminate the possibility of secondary use of potsherds (e.g. Stanislawski 1969) and to establish with certainty that the sherds represent primary refuse, before making this assumption. Larsson's suggestion of activity by three groups at Ageröd V is also based on an assumption of primary refuse (Larsson 1983, p. 103).

2. Archaeological examples of secondary refuse

There are numerous examples of what are interpreted as dump areas to be found in Scandinavian archaeological literature. Perhaps the most famous are the shell middens (e.g. Andersen 1960). However, in few cases does the author make explicit the criteria by which he/she has identified a dump. In most cases these seem to include criteria such as: a large quantity of material concentrated in one place, materials which are often broken or in some way unusable, a lack of stratigraphy, and/or functional heterogeneity. In the special case of pottery, sherds from dumps are often not restorable to complete vessels (Burgh 1959, p. 189) A good example of an attempt to distinguish between primary and secondary refuse can be found in Larsson's *Ageröd V* (1983). Examination of the weight of flint artifacts in the settlement area and that of flints in the refuse area showed that the percentage of heavier flints increases with distance from the shore. This Larsson interprets as showing that the light and small flints have been allowed to lie within the settlement area, while the heavier and therefore larger flints were in the way and were thrown in the refuse area (Larsson 1983, p. 93; cf. Larsson 1982, p. 89). Larsson also considers that the existence of collections of organic materials in the refuse area indicates secondary refuse (Larsson 1983, pp. 99 f.)

In this connection it is necessary to point out that all that is found in a refuse area need not be refuse. Lost objects (e.g. Andersen 1951, p. 75), caches of raw materials (Larsson 1983, pp. 79 ff.) or even caches of finished objects (Larsson 1978, pp. 67–70) may also be present and it is of course desirable to be able to distinguish these from waste.

3. A special kind of discard – knapping waste

Whereas little work has been done on determining means of distinguishing between primary and secondary refuse arising from most site activities, much has been done towards establishing means of identifying knapping locations. Indeed most authors attempt to identify possible knapping locations at an occupation site, even though they are unable to identify any other specific activity areas. Experimental and ethnographic studies have made clear what characteristics to expect of primary and secondary knapping debris.

For instance, Andersen attributes the unequal distribution of flint debitage (as cmpared to a more even spread for tools) at the Bro site to special areas set aside for flintknapping, while tools were left to lie where they were used (Andersen 1973, pp. 16 f.) Larsson applies his own knowledge of flintknapping and the results from the Lejre experiments (Fischer *et al.* 1979) to explain the distribution of handle cores and microblades at Ageröd V. The pattern conforms to one where the microblades were removed by pressure against a core held in a support. Larsson assumes here that both cores and unwanted microblades remained as primary refuse (Larsson 1983, pp. 91 f.). Grøn uses metric data on certain artifact types, in connection with spatial distribution of the artifacts, to identify two flintknappers of different ability at Svanemose 28 (Grøn 1983, p. 40).

Another approach to locating primary knapping refuse is advocated by Welinder. He notes that knapping locations can only be identified by the presence of debitage such as core rejuvenation flakes but not by cores or blades, since the latter could be used in other activities. By the same reasoning, he also suggests that the location of microburins (the presumably useless products of microlith manufacture) should show the location of microlith manufacture (Welinder 1971, p. 181). However, such a criterion is not sufficient for establishing where knapping took place because of the possibility that such waste was considered

undesirable (too sharp for bare feet?) by site inhabitants and was removed. An example of this can be seen at the Magdalenian site of Pincevant. Here a tight concentration of flakes was found about 20 meters from the living area. Karlin and Newcomer interpret this as secondary refuse from knapping, perhaps transported in a skin knapping pad and dumped. In support of their argument they note that many of the tiny, diagnostic – but useless – fragments which arise during knapping are not present in the scatter. They point out that this one occurrence of secondary refuse disposal is unusual for the site. Most flaking was done in less frequented areas where the knapping debris could be left where it fell (Karlin & Newcomer 1982, pp. 163 f.).

Broadbent devotes an entire chapter of his book to a description and analysis of primary locations of quartz quarrying and knapping (Broadbent 1979, pp. 99 ff.). While this is not an example of knapping in the context of an occupation site, it can be instructive to examine Broadbent's interpretation to look for clues which enable us to recognize knapping behavior on occupation sites. On the basis of traces of soot, hammerstones, and quartz tools and debitage, Broadbent located four loci for quarrying and knapping. At Feature A at Locus IV, a horseshoe-shaped configuration of quartz flakes, cores, and hammerstones had been covered by soil and vegetation and appeared to be in primary position after a knapping episode (p. 103). Such "pure" workshop areas, representing a single task and short occupation, are less likely to be subject to the human disturbance practices which can characterize settlement sites.

Broadbent also claims to have evidence for knapping on his settlement sites. For instance, he takes a small hearth, a work seat, upright anvils and quartz debitage to represent a smaller specialized work area. He interprets a concentration of gravers, platform cores and hammerstones as a heavy quartz-working area (Broadbent 1979, pp. 141 f.).

While experimental work has established what patterns of dispersal arise from the manufacture of certain tool types (e.g. Burton 1980; Fischer *et al.* 1979; Newcomer & Sieveking 1980; Vemming Hansen & Madsen 1983), it has been found that these patterns are also subject to factors of disturbance (Bowers *et al.* 1983) and can be misinterpreted. An analysis of the size ratio of flakes, as was alluded to in Karlin and Newcomer's (1982) reasoning and as suggested by Behm (1983) seems a more reliable means of identifying primary knapping locations. However even this approach is unreliable if flakes of a certain size range have been removed for some reason. Therefore the best method would seem to be the use of microdebitage analysis (Fladmark 1982), in which flaking debitage in the size range less than 1.0 mm is used to separate primary refuse from secondary refuse. Microdebitage is relatively immune to disturbing factors such as re-use, curation, cleaning activities, collecting procedures, children's activities, etc. (Fladmark 1982, p. 208). Since these particles can be blown laterally (Fladmark 1982, p. 214), they can even mark knapping locations under conditions such as those in an Ethiopian example where all knapping was done over a container and therefore even very small flakes (but not microdebitage) were removed as secondary refuse (Gallagher 1977).

4. Hut floors and find concentrations

A common theme in the intrasite spatial analysis of Mesolithic sites is the attempt to locate a shelter or shelters which housed the inhabitants. Where there are post-holes, stones, or other evidence of structure, attempts are made to trace some outline of a shelter. An additional line of evidence is the pattern of artifacts and waste. Oddly, the arguments here can be based on two diametrically opposed ideas – that huts are located where there is an *absence* of finds on

the site (e.g. Gallagher 1977, p. 413; Widholm 1980, pp. 43 f.); or conversely that they are located precisely where there is the *greatest* concentration of finds (e.g. Andersen 1951, p. 72; Brinch Petersen 1972, p. 48; Andersen 1973, p.17; Larsson 1978, pp. 192, 198; 1983, p. 102; Grøn 1983). Ethnographic examples have shown that the former circumstances often hold true (e.g. Knutsson 1978, p. 56; Gallagher 1977, p. 413; Yellen 1977, p. 92). The disparity between ethnographic evidence and the archaeological interpretations may be explainable by reference to the above discussion of primary and secondary refuse: in cases where a settlement is occupied for more than one season and where family living spaces are enclosed, discard location will be outside the shelter. One can therefore expect discard location to correspond to use location in family living spaces only when these are not enclosed and are occupied for less than one season (Murray 1980, p. 497). Discard behavior is therefore dependent on social and practical constraints – if waste is considered undesirable (e.g. too sharp or too smelly) by the inhabitants of a shelter, then they must make a decision whether to remove themselves or to remove the waste (Schiffer 1972, p. 161; Binford 1978, p. 348). The evaluation of these costs depends in turn on the duration of settlement. One may not bother to remove undesirable waste if he plans to vacate the shelter in the near future. For this reason, it is necessary to establish the permanency and degree of enclosure of a shelter *before* one can argue that it should be characterized by an absence of waste or by the opposite condition (see also the discussion of settlement complexity and duration, below).

Other factors having to do with comfort may also determine what activities will be carried out inside or outside a hut and can therefore influence where waste will lie. One important consideration is during what season a site was occupied. In warm weather most activities except sleeping probably took place outside the hut (Yellen 1977, p. 92) – unless of course shelter from pesky insects was sought (Knutsson 1978, p. 56)!

All of the archaeological examples in which a concentration of finds is used to argue for the presence of a hut are considered short-term sites inhabited by few people. Andersen suggests that the spread of tools and waste indicates two knapping locations in a hut 6×5 m at Bro (Andersen 1973, pp. 17 f.) In addition to other evidence, Larsson also uses the existence of three flint concentrations to argue for three huts at Ageröd V (Larsson 1983, p. 102). Several authors explain an abrupt limit to a flint distribution as being due to hut walls, with a more diffuse spread at one end indicating an opening (Andersen 1951, p. 72; Andersen *et al.* 1982, p. 12; Larsson 1978, p. 192). Becker interpreted a layer of bark as a hut floor at the site of Holmegaards mose. There was also a hearth and a flat stone in the "hut". Although there were bones and thousands of nutshells on the bark floor, there was little flint there. This Becker takes to mean that the inhabitants knapped outdoors (Becker 1945, p. 63). At Sværdborg II, also a Maglemose site, Brinch Petersen is forced to rely on the distribution of objects in the absence of hut remains or a fireplace. He cites a relativley large number of flint tools, much waste material, and bone scraps as evidence of the location of a hut (Brinch Petersen 1972, p. 48). Since this site is interpreted as being inhabited by one family for one summer season (Brinch Petersen 1972, p. 43), it is plausible that the inhabitants left such quantities of waste in their shelter when they abandoned the site. However, even temporary huts need not contain much waste, of course, as is the case among the !Kung bushmen. Here most activities are carried out outside the hut and there is little debris left inside (Yellen 1977, p. 92).

At the Ahrensburg site of Borneck-Ost, Rust interprets a ring of stones as the re-

mains of a tent. The majority of tools were found within this ring (Rust 1958, fig. 16). Knutsson suggests that the artifact-free area in the presumed tent was reserved for sleeping. In an argument based on assumptions of expedient technology and primary refuse, he suggests that the presence of scrapers whose wear corresponds to that which arises when scraping fat from hides, found in the middle of the "tent", means that this activity was carried out there (Knutsson 1978, p. 56).

At the other end of the spectrum is an interpretation in which a *lack* of debris is used to indicate a shelter. While this condition can obtain for more temporary shelters (such as among the !Kung bushmen), it is usually attributed to more permanent shelters where the inhabitants value their comfort enough to remove any waste which may be produced in the house. In the larger and more permanent structures from the Neolithic and later periods, curation and a desire for comfort are taken to mean that the area of the most intense activity is the area which is kept clear of refuse. For this reason Widholm suggests for instance findless areas in Late Bronze Age sites with "settlement pits" constitute the real remains of the settlement area (Widholm 1980, p. 44). Likewise Skaarup was forced to turn to other evidence than artifact patterning to look for activity areas in the Neolithic houses from Stengade (Skaarup 1975, p. 34), just as Ramqvist did when examining room division in the Iron Age houses at Gene (Ramqvist 1983, pp. 151 ff.).

Whether waste is discarded at the location of use or is moved also depends on whether a site is completely or partially abandoned (Schiffer 1972, p. 160). Huts which were kept clear of debris as long as they were occupied may serve as refuse dumps when they are abandoned, even though the site as a whole has not been abandoned (Burgh 1959). In such a case the last shelter(s) to be abandoned may be expected to contain the least amount of waste and the number of usuable tools present will depend on the degree of curation.

In short, due to problems of curation, secondary use, retooling (Keeley 1982), and disturbance factors, as well as the reasons for secondary refuse discussed above, the location of tools at a settlement site excavated archaeologically *cannot* be used as a reliable indicator of activity areas. However there are other types of waste which are less susceptible to these processes and therefore can better serve to locate activity areas. In the absence of stones or charcoal, burnt stones or a concentration of heated flints are often taken to indicate a hearth (e.g. Andersen 1973, p. 13; Welinder 1971, p. 181; Larsson 1983, p. 90; Fischer *et al.* 1979, p. 24; Knutsson 1978, p. 56; Thorsberg 1984, pp. 34 ff.). Whallon suggests that plant and animal remains, or the by-products of tool use such as resharpening spalls, will be better indicators of site activity than tools are (Whallon 1978, pp. 29, 34; Keeley 1982, p. 807). Even such indicators are not always present, however. In an ethnographic example from Ethiopia, for example, scrapers were resharpened directly over a waste container and deposited as secondary refuse away from the locus of activity (Gallagher 1977, p. 412). Animal and plant remains, when preserved, may also provide clues about activity areas on sites (e.g. Brinch Petersen 1972, p. 74 f; Broadbent 1979, pp. 136 ff; Ramqvist 1983, p. 151 ff.). Objects which are so common so as not to be subject to curation or are too heavy to be moved may provide indications of for example knapping (Broadbent 1979, p. 140; Fischer *et al.* 1979, p. 19), grinding (Lomborg 1977), or structures (Knutsson 1978; Becker 1945). Differences in soil composion were used in the absence of cultural materials by Madsen to suggest secondary activity areas at Mosegård (Madsen & Juel Jensen 1982, p. 67). Phosphate content is also frequently used to identity activity areas, as Broadbent did at Lundfors (Broadbent 1979, p. 142), or for determining room divi-

sions in more permanent houses (Skaarup 1975, p. 111; Ramqvist 1983, pp. 151 ff.). Naturally the more evidence which it is possible to bring to bear on the interpretation of an occupation floor, the greater are the chances that the interpretation is correct. However it seems safe to say that tools (because of curation, multiple functions and secondary use), and/or waste materials which are sharp, smelly, or in some other way might have been undesirable, are those materials *least* likely to have been discarded where they were used. Therefore, these should be the least reliable evidence upon which to base an interpretation of activity areas at a settlement site.

5. Retooling

A special problem concerning the use of stone tools for identifying activity areas is that of tool use-life and the replacement of worn-out tools. This is a very complex problem which has not yet received the attention it deserves (cf. Schiffer 1976, pp. 63 ff.). Keeley points out that many stone tools were hafted when used, and that usually the haft took longer to make and wore out less often than the stone point/blade. Therefore, hafts were curated, whereas stone tool blades wore out and were replaced by a new blade in the curated haft (Keeley 1982, p. 800). Keeley calls the act of replacing the hafted part of a tool in its haft "retooling". As a consequence of retooling, retouched stone artifacts found on settlement sites may represent hafted blades/points which were discarded in the process of replacement in a haft, rather than reflecting the activity in which the complete (haft+stone blade) tool was used.

> Therefore, we can expect that many tools recovered from almost any archaeological site will have been deposited there simply as a consequence of the retooling of hafted implements (Keeley 1982, p. 800).

Further, scarcities of lithic raw material, either immediate or anticipated, should be expected to result in the increased deposition of once-hafted tools (Keeley 1982, p. 804), where even slightly used tools are replaced by fresh ones, thus increasing the tool's use-life. Temporary repairs and the reworking of stone implements should be the rule at habitation sites where fresh raw material is in short supply (Gramly 1980, p. 829). Many tools at settlements not occupied year-round could represent seasonal repair, where tool use occurred at another site than where repair took place (Keeley 1982, p. 804).

Keeley suggests that retooling debris can accumulate at certain special locations on a site, such as around a hearth. "In the resulting lithic concentration, a variety of typologically and functionally distinct implements will be spatially associated" (Keeley 1982, p. 802). Is it not possible that the scrapers bearing skin-working wear found inside the "tent" at Borneck-Ost are a result of retooling, rather than an indication that the messy job of skin-working was carried out inide the tent (Knutsson 1978, p. 56; cf. Juel Jensen 1982, p. 104)? Similarly, the concentrations of scrapers and microliths used to denote a woman's and a man's half of Bare Mose II (Welinder 1971, p. 183) conceivably might be a result of the repair of these tools, rather than their use, in two distinct areas. Undoubtedly the butt fragments of flint axes which are so common on Neolithic settlement sites are to be explained by this activity (Olausson 1983, pp. 65 f.). As another example, Larsson attributes a high concentration of fragmentary projectile points at certain Late Paleolithic sites to retooling (Larsson 1984a, p. 102; cf. Fischer *et al.* 1984, pp. 42 f.). The pattern of used and unused tools evident at Mosegård may also be due to this phenomenon. The apparent randomness of used scrapers at Mosegård shows no pattern of activity but might instead be due to retooling, where the scrapers were discarded at the location where a new scraper was fit into the haft. It would be necessary to look for

hafting traces on the scrapers and on the denticulates before such an idea could be confirmed (Madsen & Juel Jensen 1982; Keeley 1982, p. 807; Odell 1978; Cahen *et al.* 1979, p. 682; Juel Jensen 1982, p. 104; Juel Jensen 1983, p. 149; Knutsson 1978, p. 50). The unused tools in the presumed dump area could reflect resharpening where the used edge was removed by retouch and the tool discarded before the new edge was used (because there was good access to raw material at the next settlement location?). In fact it is very important to know which tools were used hafted and which were hand-held, since the latter are more often expediently discarded where and when they wear out (i.e. at the location of activity), whereas the former may more often be discarded in the process of retooling. The lack of apparent patterning of tools which Broadbent found by edge-wear analysis to have been used (Broadbent 1979: Chap. VII) may be explained by this factor. Here again, an examination of tools for hafting traces could aid in the interpretation of activity loci. Thorsberg speculates that the Segebro site represents a repair station, and that the main activities here were flintknapping and retooling. The tools themselves were used at another location. He recommends conjoining waste flakes to try to determine what products were removed (i.e. curated) from the site (Thorsberg 1984, p. 96). I would like to conclude this section with a quote from Keeley, as I think the point he makes is a very important one:

> Once-hafted tools tend to accumulate in archaeological contexts when and where they are replaced in their hafts, which is neither necessarily when nor where they were last used. No archaeologist who finds a concentration of broken or impact-damaged projectile points around a hearth imagines that that was the location of their use. Most archaeologists would interpret such a concentration as the place where projectiles were repaired (that is, retooled). But a similar concentration of drills, end-scrapers, notches, or burins might be interpreted as the location of boring, scraping, shaving, or graving activity. If these borers, etc. were hafted tools, then this inconsistency is not only unjustified but may be the source of crucial errors in the interpretation of on-site activities (Keeley 1982, p. 802).

Loss

Objects can enter the archaeological record by being lost, as well as by conscious discard. In fact Whallon points out that in a highly curated technology, loss will be the most common form of disposal for certain kinds of tools (Whallon 1973, p. 119). On settlement sites (the only context we will discuss here), one might expect the number of lost objects to depend on the object's size and value and on the duration and complexity of the settlement. The loss of smaller objects can go undetected, or the effort of searching for them can be deemed too costly in relation to their worth (e.g. Thrane 1971, p. 159). I would expect that loss frequency for complex sites occupied for longer periods would be higher than on simpler sites, because there will be more objects in circulation and more opportunities for loss. In any event, the position of a lost object on a site need not reflect any conscious activity, and it is therefore necessary to try to separate the process of loss from that of conscious discard. One cannot assume that undamaged and potentially usable items have been lost, since as Schiffer points out such items can rather represent objects whose recycling costs are higher than their replacement costs (Schiffer 1972, p. 159). The easily manufactured and apparently unused stone scrapers and denticulates found scattered around Mosegård and in the dump may therefore represent discard rather than loss (Madsen & Juel Jensen 1982). The oar in perfect condition found in the dump at Ulkestrup Lyng (Andersen 1951, p. 75) is difficult to explain. Being made of wood it has taken some time to make and therefore may have been considered valuable and worth recovering, and it is difficult to imagine such a large object being lost. It may instead be an offering of some sort.

There are few other examples which have been interpreted as representing lost objects to be found in Scandinavian settlement analysis. There is need for a discussion of how much the factor of loss may have affected the make-up and placement of artifacts found on settlement sites. One must be able to single out lost objects and separate them from primary refuse, since the position of a lost object may have no relevance to site activity areas.

Caching/offering

Objects which have been deliberately cached and then for some reason not recovered also become part of the archaeological record. Caches are most often located isolated and apart from settlement sites, and there are few examples of caches containing two or more items whose position and/or contents suggests deliberate burial to be found on settlement sites. Gallagher notes in the Ethiopian example that obsidian flakes or blanks for scraper manufacture were stored in the house or in caches outside the house (Gallagher 1977, p. 410). Caching can provide confusion, in light of the curated/expedient distinction, since objects to be saved are temporarily removed from circulation (use at a settlement site) and cached with the intention of being reintroduced into the on-going system at a later date. Such objects only enter the archaeological record (are transformed from a systemic to an archaeological context, in Schiffer's terms), if they are not recovered – a special form of loss. Objects deposited as an offering, on the other hand, immediately become part of the archaeological record as there is no intention of re-using them (Stanislawski 1969, p. 15). The cache of quartz flakes found by Broadbent at one of the quarry sites probably represents the former case (Broadbent 1979, p. 103). A flint axe buried together with a clay pot at the Neolithic settlement site of Troldebjerg (Winter 1935, pp. 51 ff.), or a concentration of 33 microliths found in the refuse layer of Ageröd I:B (Larsson 1978, pp. 67 ff.), may exemplify the latter. Caches whose contents are intended for later use may be left at an abandoned site if the owners intend to return. The extent to which an object will be cached as opposed to being transported or discarded when a settlement site is abandoned should depend on several factors: the cost of transport, access to raw material, the "cost" of the item, and how useful it is at the next site (especially important for seasonal sites). Perhaps the existence of a cache on a site indicates that the site's abandonment was intended to be temporary – i.e. it formed part of a seasonal round of sites. In spite of the fact that most of the Mesolithic sites excavated in Scandinavia have been interpreted as short-term seasonal sites, of which several are considered to show evidence of two or more seasons of occupation (e.g. Andersen *et al.* 1982; Welinder 1971, p. 188; Becker 1945, p. 63), there is little evidence of find concentrations which could be interpreted as caches at any of these sites.

Schiffer discusses disposal of the dead as another process by which the archaeological record is made (Schiffer 1976, pp. 31 f.). While such activity can occur at settlement sites (e.g. Larsson 1984b; Wyszomirski 1979), this behavior is more properly discussed in the context of mortuary practices and will not be further discussed here.

III. Factors which may disturb or obscure patterning

The factors which can disturb or obscure possible patterning at a site fall into three main categories: disturbance caused by the site inhabitants or by other human beings prior to archaeological excavation, natural disturbance, and archaeological excavation techniques which fail to recover patterning. The subject of natural disturbances is an extensive one and it will be treated independently in another context. In the present essay we will concern ourselves only with disturbances due to man or to animals.

Settlement complexity and duration

Without good ethnographic data, it is difficult to determine what effect these two factors have on site patterning. The common assumption among archaeologists is that patterning will be obscured by long occupation and/or settlement complexity. However it could also be suggested that on the contrary activity areas will become more rigidly defined with longer occupancy or greater organization as the inhabitants fall into a habit of associating certain tasks with certain areas of a site (Binford 1978, p. 350; Odell 1980, p. 410; Schiffer 1972, p. 162).

As was evident in the discussion of discard habits above, it is very important to determine the duration of site occupancy in order to be able to interpret artifact patterning. This is because items discarded by a migratory population inhabiting a site for a short time are often primary refuse which can be used to identify activity areas, whereas at permanent settlements discard is nearly always away from the family living space rather than as primary refuse (Murray 1980, p. 495). Most intrasite spatial analyses try to determine settlement duration in order to evaluate the feasibility of performing intrasite spatial analysis (e.g. Welinder 1971, p. 181; Broadbent 1979, p. 136; Brinch Petersen 1972, p. 43). Occasionally, however, the clarity of patterning itself is used as an argument for short-term settlement (e.g. Knutsson 1978, p. 54; Welinder 1971, p. 183; Andersen 1973, p. 16; Madsen 1982, pp. 205 ff.; Juel Jensen 1983, p. 151). Authors seldom make explicit what length of time they consider would obscure patterning. Broadbent suggests that occupation of 30–36 years at Lundfors would have blurred sharper activity boundaries, although the material retained enough of its integrity for spatial analysis in simple terms (Broadbent 1979, pp. 136, 152, 154). Madsen suggests that an occupation lasting "several decades" would have reorganized Mosegården and displaced the dwellings (Madsen 1982, p. 206). Site occupation of 3–10 years by c. 15 people should not have been enough to disturb for instance the primary discard of broken pottery or an activity area around a hearth (Madsen & Juel Jensen 1982, pp. 69, 73).

Some efforts have been made towards making quantitative estimates of the the duration of site occupation and site complexity based on archaeological data. Madsen based his estimate on rates of pot breakage (Madsen & Juel Jensen 1982). Broadbent's estimate of time came from shoreline data, while he derived population estimates from analogies with ethnographic examples and site area (Broadbent 1979, pp. 152 ff.). Odell uses edge-wear data and experiment to estimate the number of tools employed in a subsistence-related activity. Then through models of seasonal exploitation by hunting and gathering groups he suggests one should be able to ascertain how many tools would be utilized per season and per year and thus estimate how long the group remained at the site (a model which assumes tool expediency) (Odell 1980, p. 416). Knutsson recommends using experiments to arrive at estimates of tool use-life and estimating site occupation on the basis of this factor (Knutsson 1978, pp. 40 ff.) More traditional archaeological methods, such as the thickness of the occupation layer (Brinch Petersen 1972, p. 74), indicators for seasonal occupation (Brinch Petersen 1972, p. 74; Andersen 1951, pp. 72 f.), tool typologies (Becker 1945, p. 63), or the size of the site are of course also used for estimating site duration.

The number of people who occupy a site will also have a bearing on the clarity of spatial patterning. Archaeologists often attempt to reach an estimate of population at a site, although they may not do so specifically in order to evaluate their interpretations of artifact patterning. Here again more work needs to be done to determine if increasing site population or complexity obscures patterning (Ascher 1968, p. 50), or on the contrary if it results in a coalesence of

discrete activity areas (Whallon 1973, p. 117; Schiffer 1972, p. 162). Such information would be of great help in interpreting artifact collections as either representing several groups in simultaneous occupation or as successive occupations by one group (e.g. Larsson 1983, p. 102; Broadbent 1979, p. 154; Welinder 1971, p. 188).

The activity of children and animals

Another factor which can disturb patterning is the activity of children playing or disturbance by animals, either while the site is occupied or following abandonment. These factors are discussed by Yellen for Bushmen camps (Yellen 1977, pp. 93, 103), but there are few references to such activity to be found in archaeological analyses. Andersen *et al.* suggest that the large number of cores in the dump at Ulkestrup Lyng is due to children throwing cores into the water (1982, p. 34). One wonders how much of the patterning seen on a site is due to children's play, and how much patterning left by adult activities has been disturbed by children (Hammond & Hammond 1981; Knutsson 1983). It is of course difficult for archaeologists to investigate this aspect, but surely it must be considered when intrasite analysis is undertaken.

Likewise the removal by animals of waste from primary discard locations must be taken into consideration when site subsistence activities are investigated. Bones which bear signs of knawing and animal activity cannot be assumed to be primary refuse (Bonnichsen 1973).

Secondary use and recycling

Another factor which can complicate the interpretation of activity areas on a site is recycling and secondary use. Recycling involves the use of refuse material (i.e. used-up objects or waste) as raw material for a new product. Secondary use means that an object is used another way than was originally intended but without further modification (Schiffer 1976, p. 38; Ascher 1968, p. 50). For instance, Welinder cautions against using the location of cores or blades to identify knapping locations, as these could be used in other activities (Welinder 1971, p. 181). For stone tools, microwear analysis and the high-power approach (Keeley 1980) should provide a useful means of identifying both primary and secondary tool use at a settlement site. Indeed such analyses are becoming an increasingly frequent part of current settlement analysis in Scandinavia (e.g. H. Knutsson 1982; Thorsberg 1984; Juel Jensen 1982, 1983; Madsen & Juel Jensen 1982; Jeppesen 1984).

In an ethnographic study of the use of pots and potsherds among the Hopi, Stanislawski points out that the frequency of recycling or secondary use is dependent on cost. In an area of meager resources, objects which are no longer usable are likely to be recycled as raw material rather than being discarded (Stanislawski 1969, p. 12; cf. Sundell 1978, p. 9). On Hopi sites, potsherds could be crushed for temper or used as chinking in house and oven constructions. Larger sherds were used when new pots were fired, or ancient sherds were collected so their designs could be copied (Stanislawski 1969, pp. 12 ff.). In light of this any assumption that the location of sherds represents the primary location of pot using on a site (e.g. Madsen & Juel Jensen 1982, p. 5) may be unwarrented.

Units of excavation

One final point which must be made when discussing intrasite analysis is what excavation techniques most effectively recover patterning which may exist. Whallon points out that the size of the grid unit used to observe a spatial distribution often has a direct effect on any analysis of concentration, correlation, or association in the data (Whallon 1973, p. 122). In a revealing study based on

a knapping experiment, Fischer *et al.* point out that excavation in units of 2 m^2 or even 1 m^2 obscures patterning and may lead to a false interpretation of a flint scatter as a hut (Fischer *et al.* 1979, p. 19). Excavation techniques used on Scandinavian Mesolithic sites vary from plotting each artifact by Cartesian coordinates (e.g. Broadbent 1979; Andersen 1973; Fischer & Mortensen 1978; Andersen *et al.* 1982), to registration by 0.25 m^2 (Larsson 1978; Vemming Hansen & Madsen 1983, p. 43) or by 1 m^2 (Welinder 1971; Brinch Petersen 1972). More attention must also be paid to even smaller units of analysis. If knapping locations are to be demonstrated, microdebitage analysis should be attempted (Fladmark 1982). Screening is also important for recovering objects not ordinarily seen during even the most careful excavation by hand (Larsson 1982, p. 83). As there now exists a means of calculating what unit of excavation will best recover patterning (as weighed against the costs involved) at any given site (Rogers 1982), future excavation with the aim of performing spatial analysis should be able to avoid mistakes such as those Fischer *et al.* (1979, p. 19) warn against.

IV. Summary and conclusions

The aim of this paper has been to explore some of the factors which can complicate efforts at interpreting behavior based on patterning on occupation sites. Some recent treatments of settlement analysis of primarily Mesolithic and early Neolithic sites in Sweden and Denmark were used as examples, where alternative explanations to patterning could sometimes be suggested. The intention here was not to criticize, but rather to point out areas in which more rigorous treatment may lead to a better understanding of transformation processes. On the basis of the discussion, it should be possible to offer some approaches for performing intrasite spatial analysis in the ideal case.

Prior to excavation, a decision about excavation strategy is made. Computations by Rogers (1982) and a consideration of what can be expected at the site, as well as practical and economic considerations, enable the excavator to decide on the most appropriate units of excavation for each particular site.

In attempting to interpret site activity, it is necessary to evaluate how much the site has been disturbed by post depositional processes. It is necessary to determine whether the site entered the archaeological record due to a catasprophe, or whether it was abandoned with the intention of returning or not. Further, one must determine site duration and complexity as early as possible in the analysis. Once these major characteristics are identified, the position of individual objects on the site must be critically examined, bearing in mind the various processes which might have caused them to lie where they are found.

In order to be able to say that the tools used on a site will be found on the site, it must be possible to rule out tool curation. This is not easy, since an archaeologist has no way of knowing what tools are missing from a site he or she excavates. One could postulate expediency if a wide range of tools is present, for instance. Evidence of resharpening in the form of resharpening flakes could suggest curation, especially if tool-specific flakes indicate tool types which are not present at the site (e.g. Thorsberg 1984, p. 95). A large proportion of tools in relation to knapping debris would suggest expediency, as would large numbers of non-retouched objects showing evidence of use. A discrepancy between the numbers of proximal and distal fragments of blades may indicate curation. Of course, loss outside the settlement can also account for some tool absence, but curation can be suspected if a systematic pattern among tool types emerges.

Primary refuse at a site can only be identified with certainty by items and indications which due to their size cannot be moved

(because they are too small or too large). Microdebitage or phosphate traces are examples of the former; large boulders or grinding stones the latter. Other waste and tools are too easily subject to movement by site inhabitants or natural processes and cannot be assumed to be in the location of use.

The criteria for identifying secondary refuse are more often applied by archaeologists and are dicussed above. Schiffer maintains that it may be possible to identify site activities by looking at waste concentrations in secondary refuse (Schiffer 1976, pp. 70 ff.). However the methods he advocates must be used with caution, since groupings in disposal areas can represent factors other than the discrete activity in which tools were used (Speth & Johnson 1976, p. 56).

It is also important to be able to recognize retooling behavior at a site. While handheld tools are likely to represent activity at the site, tools discarded in the process of retooling may only represent rehafting, not use on the site. Some ways to recognize this difference archaeologically include looking for hafting traces and examining resharpening waste.

Secondary use and recycling are factors that can also complicate interpretations of site activity. Edge-wear analysis and an investigation of raw material availability are necessary in evaluating this factor.

The effects of the factors of loss, caching, and children's activity on archaeologically-seen patterning are little understood and seldom discussed. However, it is necessary to be able to identify these processes as well when intrasite spatial analysis is attempted.

The examination of the position of remains on a settlement site is one of the most commonly-used means of extrapolating past behavior. However, it is necessary to conduct such an investigation with care and with a full awareness of the source-critical problems attached to such analysis. The approach has become increasingly sophisticated since the first simplistic beginnings in which virtually all patterning was assumed to represent "fossilized" behavior. It is important that such efforts at delineating what factors enhance or disturb the distribution of objects on sites be continued, in order to facilitate increasingly accurate interpretations of site activity.

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