INTRODUCTION

There is hardly a more romantic image in anthropology than that of a small band of hunter-gatherers setting off into the bush, their few belongings on their backs. Mobility, in fact, has long been considered a defining characteristic of hunter-gatherers. At the Man the Hunter conference, for example, Lee & DeVore (101:11) assumed that all hunter-gatherers "move around a lot." This is not entirely accurate, for many hunter-gatherers move infrequently—some less than many "sedentary" horticultural societies. Early concepts of mobility blinded us to the fact that mobility is universal, variable, and multi-dimensional.

Partly because of these concepts, and partly because we do not understand the relationships between movement and material culture, archaeologists have had difficulty identifying different forms and levels of mobility. This is especially true in defining and then detecting sedentism.

It is important that we learn to recognize the various forms of mobility archaeologically, because the ways people move exert strong influences on their culture and society. In his classic study, Mauss (105), for example, related the Inuit's seasonal mobility to their moral and religious life. Sahlin (136) saw mobility as conditioning cultural attitudes towards material goods. Currently, archaeologists focus attention on the sedentarization process because reduced mobility precipitates dramatic changes in food storage, trade, territoriality, social and gender inequality, male/female work patterns, subsis-
tence, and demography (44, 69, 71, 73, 89, 93, 124, 126, 152) as well as cultural notions of material wealth, privacy, individuality, cooperation, and competition (170).

Here I consider concepts of mobility/sedentism, archaeological measures of mobility, and the effects of reduced mobility, focusing on foraging and, secondarily, on horticultural societies. (Space prohibits discussion of nomadic pastoralists; for reviews see 36, 40, 98.)

CONCEPTS INVOLVED IN THE STUDY OF MOBILITY

While some archaeologists refer to a settlement continuum from mobile to sedentary, many in practice think of mobility in typological terms. One early scheme divided hunter-gatherers into four categories (11): free-wandering groups, with no territorial boundaries; restricted-wandering groups, constrained by territorial limitations; center-based wandering groups, who seasonally return to a central village; and semi-permanent sedentary groups, who occupy a village year-round but move it every few years. Murdock (111) modified these terms and categorized societies as fully nomadic, semi-nomadic, semi-sedentary, and fully sedentary. Many archaeologists still use a variant of this typology, or, more simply, distinguish only between mobile and sedentary societies (2).

These categories have analytic utility (e.g. 17, 21), but they collapse the several different dimensions of mobility and encourage us to think of it in terms of a single scale of group movement. However, mobility is a property of individuals (25, 47), who may move in many different ways: alone or in groups, frequently or infrequently, over long or short distances. Some sorts of individuals may move more than others (e.g. men vs women, parents vs nonparents, young vs old, good vs poor foragers), and movement also occurs on daily, seasonal, and annual scales.

Binford (17) began to unpack the concept of mobility by differentiating between residential mobility, movements of the entire band or local group from one camp to another, and logistical mobility, foraging movements of individuals or small task groups out from and back to the residential camp. Binford used these descriptions to categorize two ideal hunter-gatherer settlement systems. Collectors move residentially to key locations (e.g. water sources) and use long logistical forays to bring resources to camp. Foragers "map onto" a region's resource locations. In general, foragers do not store food; they make frequent residential moves and short logistical forays. Collectors store food; they make infrequent residential moves but long logistical forays. However, the main difference between foragers and collectors is not the frequency or length of movement, but the relationship between the placement of consumers and the tasks of individual foragers—that is, the organizational relations between movements of individuals as individuals and movements as a group. The Anbarra of northern Australia, for example, move
residentially only a few times each year (107) while the Aeta of the northern Philippines move residentially much more frequently (90). Both, however, are foragers since they move consumers to resources; the difference in the frequency of movement is related to the food density of their respective environments.

Binford did not intend that the concepts of foragers and collectors become types. Instead, he used them as conceptual tools that helped him to think about the organization of camp movement relative to foraging activities and thus to understand the role mobility plays in creating archaeological sites. Many have misunderstood this aspect of Binford’s original paper. The archaeological literature is replete with examples of “foragers” and “collectors,” along with efforts to critique the behavioral descriptions of the two concepts while ignoring the more important organizational differences they encompass (e.g. 6, 164).

Binford (18, 20) later added another dimension, what we might call territorial or long-term mobility, encompassing cyclical movements of a group among a set of territories. For example, the Nunamit’s specific annual range changes as caribou populations rose and fell, and as resources such as firewood became depleted at particular locations (3, 20). While the Nunamit change the location and size of their territory every decade or so, they eventually return to a previously used tract of land. Thus, they circulate through a series of territories. Long-term mobility is often seen as a conservation measure (51), but it is more likely a response to subsistence stress (65). In either case, the land required by a foraging (or horticultural) population over the long term is much larger than the area used during a single year. Constraints on the long-term territory rather than on the annual territory may be important in conditioning evolutionary change (133).

Finally, to residential, logistical, and long-term mobility we can add permanent migration from a former territory. Such migration can be intentional or unintentional, and it can result from movement of groups or from gradual abandonment by individuals or families. It is probably caused by population growth, but there may be other reasons as well. This aspect of mobility is poorly studied because modern foragers and horticulturalists are encapsulated and circumscribed by agricultural and industrial societies. However, because most of the world was initially populated by foraging peoples, migration must have been an important dimension of mobility in the past (for discussion of free-wandering, see 1).

As should be apparent, most definitions of mobility are behavioral. Mobility has, of course, a cultural component, in that cultural conceptions of the environment affect the way a locality is treated, as Steward pointed out many years ago (85, 148). Hunter-gatherers who leave a place physically and conceptually, for example, may treat it differently from those who leave a locale physically but who still think of it as a place on the landscape, perhaps because of facilities located there (20) or because of a cultural attachment to it. Some
researchers differentiate between hunter-gatherers and pastoralists, arguing that the former develop concepts of "relatedness" to land while the latter do not (40)—concepts that generate differences in mobility in addition to those associated with feeding livestock. Some prehistoric foragers may have had little attachment to land under some conditions and so could more easily migrate from one area to another. [The populations who colonized North America, for example, may fall into this category (94).] Thus, current behavioral descriptions may need to expand and include cultural and cognitive factors affecting mobility, such as cultural concepts of and knowledge of the environment.

Bettinger & Baumhoff (15, 14:100–3) offer an alternative to Binford’s forager-collector scheme. Their model proposes a continuum from travelers, who have high mobility (presumably residential and logistical) and take only high-return-rate food resources, especially large game, to processors, who are less mobile and use intensively a diversity of resources, especially plant foods. The difference in subsistence generates differences in demography as well, with high rates of female infanticide lowering the growth rate among travelers. According to these authors, such a model specifies precise relationships between population and resources, and settlement and subsistence. Both the forager/collector and traveler/processor models, however, collapse several dimensions of adaptation (primarily mobility, subsistence, and demography). Nevertheless, the detail of these models cannot help but encourage us to think less typologically and more theoretically about the issue of mobility.

Foraging and Mobility

Although many variables affect mobility, subsistence—and therefore foraging strategy—is certainly a primary one (17, 90). Since the introduction of optimal foraging theory to anthropology there have been numerous ethnographic studies of hunter-gatherer and horticultural foraging strategies (e.g. 66, 142, 143, 171). These studies focus on foraging time, location and group size, and diet breadth but are rarely related to residential movement because they are often conducted with foragers settled by government policy, or with trekking horticulturalists who move residentially only every few years. Thus, arguments relating daily foraging to group movement are largely theoretical.

As they consume food around their camp, foragers reach a point of diminishing returns, where "they may stay on only by absorbing an increase in real costs or a decline in real returns: rise in costs if the people choose to search farther and farther afield, decline in returns if they are satisfied to live on the shorter supplies or inferior foods in easier reach. The solution, of course, is to go elsewhere" (136:33). Many ethnographic cases demonstrate that foragers move not when all food has been consumed within reach of camp but when daily returns decline to an unacceptable level (72). Although the Tanzanian Hadza, for example, can forage for roots up to 8 km from camp, they generally do not go beyond 5 km, preferring instead to move camp (160). It is likely that
foragers move when the returns of logistical forays from the current camp drop below those to be expected from another camp, after allowing for the cost of moving (92).

We should point out that foragers do not always move as a group; forager social units, in fact, can have an extremely fluid composition. Relieving social tension is a reason often given for this fluidity, and subsistence can often be a source of this tension. Large families, for example, will reach the point of diminishing returns more quickly than small families, and may move on a different schedule. The degree to which everyone’s subsistence is tied to the same resource (e.g. fish runs, communal hunting) will also condition the degree to which families move together. Since many plant foods provide lower returns than large game, the point of diminishing returns will be reached at shorter distances for plant gathering than for hunting large game. Since large game is usually procured by men (with a few ethnographic exceptions), women’s foraging should by and large determine when camp is moved. This is important in considering the effect of reduced residential mobility on women’s and men’s activities (see below).

At the heart of the relationship between daily foraging and group movement is perceived “costs” of camp movement and foraging. While it is unclear what period (e.g. per hour, day, or week) should be used in assessing the cost and benefits of moving and foraging, we still might predict that as the cost of camp movement increases relative to the benefit of foraging in a new location, foragers will remain longer in the current camp (92). Several variables enter into the decision to move. One important variable is the return rate of the exploited foods. As resource return rates decline, foragers reach the point of diminishing returns at shorter and shorter distances and must move more frequently. Likewise, if a resource appearing elsewhere provides higher return rates than current foraging provides, the forager may also elect to move. (This, rather than “affluence,” probably explains why foragers pass up some resources; see 70.) Another variable is the “cost” of moving, determined not only by the distance to the next camp but also by what must be moved (e.g. housing material), the terrain to be covered (e.g. mountains versus prairie), and availability of transport technology (such as dogsleds or horses) to move housing, food, and/or people. If food has been stored, then the cost of moving it must be balanced against the next camp’s anticipated resources. Models predicting how far resources can be transported (87, 128) show that a resource’s return rate does not necessarily predict how far that resource can be carried.

Perceived costs of moving must include evaluations of the risk involved in transferring to a new location. “Risk” involves several components, such as the likelihood of an event’s occurring and the magnitude of that event. If foragers perceive the next camp’s resources to be more risky, they may elect to remain where they are and accept lower mean foraging rates. Some desert hunter-gatherers, called tethered nomads by Taylor (151), remain at a water
source at the expense of decreasing foraging return rates (moving only when water runs out) because they are uncertain of the status of other water holes. Some Australian Aborigines, for example, will consume only 800 kcal/day and forage up to 15 km from camp rather than move to an insecure water source (33).

Finally, the number of people who forage for each family, and their specific tasks, can affect mobility. The usual assumption is that adults forage, with women gathering plant food and men hunting. However, in some societies children forage and can provide much of their daily food needs (24); in others, women sometimes hunt (50). Understanding variability in age and sex division of labor is a prerequisite to understanding mobility.

**Non-Energetic Variables**

Foraging is an important variable, but by no means does it alone determine mobility. People also respond to religious, kinship, trade, artistic, and personal obligations. This does not negate the importance of foraging efficiency. In fact, if nonforaging activities are as important as we presume they are, then they require that one forage or garden as efficiently as possible (142). Nonetheless, not all residential movements are directly controlled by subsistence. People move to gain access to firewood or raw materials for tools, or because insects have become intolerable. Movements can be socially or politically motivated, as people seek spouses, allies, or shamans, or move in response to sorcery, death, and political forces (64, 159). Kent (96, 97), for example, found that Basarwa and Bakgalagadi gave political or social motives for 57% of their movements. However, some movements made for social/political reasons can ultimately be related to foraging concerns. For example, during a period of drought-induced food stress, /Xai/Xai Basarwa stated that they were going elsewhere to trade, but the decision followed two weeks of bickering over food (165).

Finally, residential mobility itself may be culturally valued. Formerly mobile hunter-gatherers often express a desire to move around in order to visit friends, to see what is happening elsewhere, or to relieve boredom (92). The Kaska, for example, did not like “sitting in one place all the time like white men” (81:92). On the other hand, the coastal Tlingit used dance to parody interior groups who, in their opinion, wandered about in a pathetic search for food (106:96). Cultural ideals valuing movement might encourage mobility even where sedentism is possible, although they are unlikely to account for large-scale evolutionary trends. They may, however, help perpetuate cultural and niche differences between populations of horticulturalists/agriculturalists and hunter-gatherers or pastoralists, since mobility can be a strategy to maintain cultural autonomy.
SEDENTISM

One of the most important topics in archaeology today is the question of the origins of sedentism, especially sedentism among hunter-gatherers. For many years, sedentism was thought to be incompatible with a foraging lifeway except in a few favored locations, North America’s Northwest Coast being the classic example. However, it is now clear from archaeological and ethnohistoric data that significant reductions in residential mobility occurred without benefit of agriculture (or with agriculture playing only a minor role) in a number of areas, including the Gulf Coast of Florida (163), the Levant (8–10, 30), the American Midwest (29, 28, but see 115), and perhaps coastal/highland Peru (1, 130). Recognition of these prehistoric cases has caused many archaeologists to reexamine the concept of sedentism.

What Does “Sedentism” Mean?

The term sedentism is used in many different ways and encompasses a range of settlement forms (25). What one author labels sedentary another may label semi-sedentary; some authors focus on settlement permanence, others on settlement size (47, 126). Even where sedentism is defined, ambiguity may remain. Higgs & Vita-Finzi (77:29), for example, defined sedentary economies as those “practiced by human groups which stay in one place all the year round,” but these authors also recognized sedentary-cum-mobile societies having “a mobile element associated with sedentary occupation.” Most authors see sedentism as a process “whereby human groups reduce their mobility to the point where they remain residually stationary year-round” (80:374), and sedentary settlement systems as “those in which at least part of the population remains at the same location throughout the entire year” (G. Rice, in 30:183). For the sake of convenience, I use these definitions here.

Sedentism is usually considered a relative rather than an absolute condition (e.g. 130:270). “Sedentary” settlement, therefore, usually means a condition less mobile than some previous one. Thus, Brown & Vierra (29:189) refer to the settlement systems of the Middle Archaic Period of the American Midwest as ones of “increasing degrees of sedentary settlement.” Bar-Yosef & Belfer-Cohen (9:490, 10:186) refer to the Natufian Phase in the Levant as the period of the “emergence” of sedentism, a period of increasing “degrees” of sedentism, a trend to be “deepened” during the succeeding Early Neolithic Phase (see also 27). Archaeologists envision the “emergence” of sedentism as a process akin to a settlement system’s batteries running down: People move less and less until they are not moving at all. The transition is thus quantitative, not qualitative. It is not clear, however, whether the slow “emergence” of sedentism is always real, or is in some cases a product of a poor sample of the archaeological record. Depending on chronological controls and sites’ temporal distribution, a slow transition could appear to be quick, or vice versa.
This view of gradual quantitative change also comes from archaeologists’ tendency to think of mobility in terms of a single scale, a single continuum of residential mobility, rather than as a multi-dimensional phenomenon. But in thinking about sedentism as a point on a continuum of residential mobility, or as a system-state opposed to “mobile,” archaeologists conflate the many different dimensions of mobility—individual mobility, group residential movements, territorial shifts, and migration—each of which can vary independently of the others (90). There is no single continuum of mobility (47), and continuing to rely on one diverts attention from the relationship between camp movement and foraging. The question of what causes sedentism actually subsumes many different questions: What controls whether people move as a camp, as families, or as individuals? What controls how far an individual can travel in a logistical foray? What controls how frequently or how far a group moves over the course of a year (90)? What controls how frequently a group shifts its annual range?

Is Sedentism a Threshold Phenomenon?

Not only do archaeologists tend to see sedentism as emerging slowly along a continuum of residential mobility, but many also see it as an important social and behavioral threshold, a “point of no return” (9:490), after which sedentary peoples cannot return to a mobile life-style. In most cases this concept is probably correct, but Ames (2) provides a potential counter-example. In evaluating radiocarbon dates from sites in the plateau region of the northwestern United States, he argues that pithouse construction, indicative of seasonal sedentism, is episodic rather than continuous. While periods without house construction could result from many factors, they may indicate intermittent sedentism. The nature of archaeological data makes it difficult to assess the accuracy of a model in which sedentism develops continuously over time. Imagine a settlement system oscillating between states of greater and lesser residential mobility. In all likelihood, sites produced when people are less residually mobile will be more visible archaeologically; those produced by an intervening period of high residential mobility will be less visible, and if undated may even be interpreted as special-purpose camps of the sedentary system (see 158). The assumption that sedentism “emerges” slowly and is a “point of no return” might erroneously appear to be confirmed.

Even when sedentary settlement systems develop, they do not necessarily involve all of a region’s people. As some people reduce their residential mobility, others may continue to be residually mobile, perhaps developing a mutualistic relationship with the sedentary villages. We must recognize that statements such as “sedentism slowly emerged” do not capture the totality of the prehistoric social landscape. Hunter-gatherers today are encapsulated by and interact with nonforaging peoples (see review in 112), and the interstices between horticultural societies are frequently filled with nomadic foragers or pastoralists (145, 146). It is highly likely that mobile foraging or pastoral
peoples filled the interstices between horticultural or agricultural settlements in the past as they do today, influencing the nature of those sedentary societies and in turn being influenced by them (109). A growing number of archaeological studies of forager-farmer interaction, e.g. for the Neolithic in central Europe (e.g. 62, 63) and Ireland (61), and for the late prehistoric period of the southwestern United States (145, 146), testifies to the importance of these interactions.

Recent studies of horticultural societies suggest new insights into the relationships among gardening, foraging, and village movement, especially for Amazonia (56, 58, 66, 88, 123, 159). The variables that affect foraging are also relevant to horticulture, for both can be evaluated in terms of time, returns, cost, and risk. Both Vickers (159) and Heffley (75), for example, use Horn’s Model to describe Siona-Secoya and Athapaskan residential movements, respectively; the only difference is that where Heffley discusses seasonal changes, Vickers refers to multi-year changes.

Archaeological studies of horticulturalists’ mobility strategies are changing received views of prehistory. Archaeologists in the American Southwest, for example, are reevaluating the concept of sedentism, and many think the agriculturalists there, those occupying pueblo villages as well as those who lived in pithouses, were more mobile than previously assumed (55, 122, 123, 166, 167; papers in 108). Preucel (123), for example, argues that the larger the population the greater the distance some farmers must walk, and the greater the probability that daily or periodic logistical moves will develop into seasonal residential movements. (This was the situation of many Puebloan settlements at the time of contact.) Seasonal rather than year-round sedentism might account for the archaeological record of the Basketmaker and Puebloan periods. Seasonal settlement may also account for variability in Natufian sites in the Levant (30).

In sum, sedentism need not be a threshold phenomenon. Not everyone is equally involved in changes in mobility, and the inception of village life entails changes in (but not a cessation of) movement. Additionally, reductions in residential mobility produce changes in mobility on different levels and scales under different conditions, resulting in considerable variability among cases currently classed together as “sedentary” (25).

The Causes of Sedentism

THE “PULL” AND “PUSH” HYPOTHESES Price & Brown (125) label the two basic hypotheses explaining hunter-gatherer sedentism as the pull and push hypotheses. In the pull hypothesis, the presence of abundant resources is both a necessary and a sufficient condition for sedentism to appear. To an earlier generation of theorists, it seemed a straightforward assumption that humans would take advantage of the opportunity to reduce mobility: “in general sedentary life has more survival value than wandering life to the human race, and... other things being equal, whenever there is an opportunity to make the transition, it will be
made" (11:134). Sedentism, it was argued, is a more efficient form of resource procurement, because it saves the effort of moving—in particular, the effort of moving children, the elderly, and the infirm (126, 147). Part of the reason for assuming sedentism to be efficient is that Western society sees movement as burdensome and undesirable; but many other societies do not (41).

Many archaeologists continue to rely upon the "pull" hypothesis. "Resource abundance" allegedly accounts for sedentism among the Ainu and Owens Valley Paiute (161); paleoindians of California (110); the aboriginal inhabitants of coastal eastern North America (120), coastal areas of the arctic (172, 117) and northern Europe (134); and Archaic hunters of the Andean puna, central Mexico (113), the midwestern United States (29), and the Great Basin (76, 103). Marine and wetland resources are the usual candidates for resource abundance. (We leave aside the issue of whether sedentism is actually demonstrated in each of these studies.)

The pull explanation of sedentism seems reasonable, but it is fraught with empirical difficulties. Archaeologists long assumed that agriculture, for example, would always result in sedentism because people could then produce abundant food resources. However, we now know that agricultural practices often precede sedentism, sometimes by many centuries, in the American Southwest (166, 167), Mesoamerica (53), and the American Midwest (29). Furthermore, although few agricultural societies change residences throughout the year (126), some are nonetheless residentially mobile, even ones like the Raramuri, for whom agricultural products constitute nearly 100% of diet (42, 59, 68). It was long assumed that the transition from pithouses to above-ground pueblos, a transition that almost surely indicates a reduction in annual residential mobility, was associated with an increased use of maize. However, in at least some parts of the southwest, the settlement transition does not appear to be associated with an increased use of maize (e.g. 55, 162; papers in 108). The relationship between agriculture and mobility is now open to question (68).

Sedentism may not reduce mobility, nor may it be as efficient, as was once thought. Binford (17) suggested that when residential mobility is constrained, logistical mobility must increase. Eder (47:851) found this to be true among the Batak, where mobility was shifted from local groups as whole units to lower levels of social organization. As the Nata River Basarwa became less residentially mobile, men made increasingly longer foraging trips, and women gathered a wider range of bush foods, including lower-quality foods, working longer hours to process them (44, 79). In both cases, reduced residential mobility does not seem to have reduced overall energy use; instead, it reorganized it (and may even have increased it). We should point out that the Basarwa, the Batak, and other foraging societies undergoing sedentization today are instances of secondary or contact sedentism—a change in settlement behavior imposed upon nomadic peoples by outside governments for purposes of census and control. While it is difficult to separate the effects of reduced mobility
from those of a hostile political environment, we nonetheless cannot assume that a sedentary existence is more efficient than a residentially mobile one.

It is true, of course, that if hunter-gatherers are to become sedentary (and remain hunter-gatherers) then food must be available in a single location year-round, either continuously or as a stored resource. Binford (19) argued that hunter-gatherers would forgo such opportunities to become sedentary because residential mobility allows them to collect information continually about their natural and social environment, and thus to prepare for local resource failure. However, others point out that environments fluctuate on different scales and that ethnographic cases come from environments that fluctuate widely from year to year (57). In areas where resource fluctuation is infrequent or less severe there may be little need to remain mobile to gather information.

Even where the conditions for sedentism appear to exist (e.g. resource abundance and/or large-scale storage), there is not always archaeological evidence of sedentism (28, 144). One simple simulation study suggests that if foragers wish to maintain maximum foraging return rates they should move residentially even if it is energetically possible to remain in one location (92). Resource abundance may be a necessary but is probably not a sufficient condition for sedentism.

As an alternative to the "pull" hypothesis, the "push" hypothesis proposes that hunter-gatherers are forced into sedentism by subsistence stress. In this scenario, as efficiently gathered resources become scarce, foragers intensify their subsistence efforts, taking a greater range of foods and spending more time in harvesting and processing them. Researchers invoke several factors to explain intensification, including population increase, climatic change, and territorial constriction (37, 126). In essence, these all involve resource stress—a shortage of food supply relative to population size. Rafferty (126) developed a model in which three different settlement patterns—nonsedentary, nucleated sedentary, and dispersed sedentary—result from different environmental conditions and different cultural responses to resource stress, including emigration, population limitation, and technological/organizational change. To this useful model one might add greater attention to the concept of stress. Does stress result from one lean season or does it require a series of lean seasons? Is stress a periodic or a chronic state of subnormal caloric intake?

Understanding sedentism involves understanding the relationship between residential and logistical mobility, between movement of the camp and foraging. Assuming that foragers (or horticulturalists) wish to maximize the return rate from foraging (or gardening), the decision to move is based not solely on whether they can stay where they are but also on the difference between the expected returns of the current and the next potential camp, after allowing for the cost of moving. Local resource abundance must be weighed in terms of the regional foraging potential. Many variables can affect this basic equation, including the cost of moving, the regional population density (displacing oth-
ers increases the “cost” of moving), and the degree of risk attached to the resources of different areas. Much creative research remains to be done in this area.

NON-MATERIALIST APPROACHES The push and pull hypotheses are both firmly grounded in a materialist paradigm. In both, sedentism occurs initially (for whatever reason), and as a result foragers intensify production. (Many studies of sedentization indicate that intensification is coeval with or soon follows the appearance of sedentary villages.) However, some argue that sedentism results from the perceived need for intensification. In this scenario, what we might call the social competition hypothesis, effort expended in mobility is channeled to producing resources for competitive feasts, long-distance trade, or other prestige-seeking activities (12, 73). Lourandos (102), for example, argues that a shift towards semi-sedentism was driven by the development of increasingly complex social networks and alliance systems. (Note that many archaeologists would argue the reverse.) Lourandos suggests that environment and demography play a role in establishing the initial need for social competition, but others find the reasons less clear why some hunter-gatherers intensify (and become sedentary) and others do not (e.g. 12). Determining whether or not sedentism precedes intensification and social competition is critical to testing the social competition hypothesis. To date, discussion relies upon generalized archaeological sequences where it is not easy to say which comes first.

STUDYING MOBILITY FROM ARCHAEOLOGICAL REMAINS

To this point I have mentioned a number of archaeological studies purporting to demonstrate changes in mobility. I cannot evaluate all these studies here, but I can note that it is difficult to study mobility archaeologically. Both the resource base and mobility itself are difficult to document.

Measuring Resource Abundance

Evaluating hypotheses of sedentism requires that archaeologists document actual availability of food in a particular locality. Many archaeologists simply assume food abundance from subjective evaluations of a region’s potential. Continuous, year-long occupation of villages and continual seasonal availability of food within a feasible foraging distance have been documented only for a few cases (e.g. 127, 134). Food abundance must be measured objectively and must take harvesting and processing rates into consideration—for these are crucial factors in selecting resources to use (142). Measures of sheer abundance are not adequate. The biomass per hectare of forest is greater for mice than for deer, for example, yet prehistoric hunters hunted deer, not mice, because deer provide much higher return rates than do mice.
Even where the resource base is well documented it is normally limited to those resources for which there is archaeological evidence of use. But in order to test hypotheses about mobility and sedentism the nature of both used and unused resources (or regions) must be documented, because "abundance" is relative. To know what one resource offers means knowing what it offers relative to others.

Stone Tool Technology

For many years, archaeologists have measured the size of prehistoric foraging territories and thus the degree of mobility through the distribution of stone tools relative to the geologic sources of their raw material (e.g. 82, 138). Paleoindian Clovis and Folsom projectile points, for example, are often found 100–300 km from their sources. Some archaeologists argue that this indicates high residential mobility (see papers in 48 and 149) or a combination of residential, logistical, and territorial mobility (94). Such information provides a rough indicator only of range, rather than mobility, since the raw material could have been acquired through residential or logistical movements, or trade.

Archaeologists have tried recently to reconstruct mobility by examining the organization of stone tool technologies (e.g. 4–7, 16, 23, 86, 91, 114, 118, 154, 155). Organization here refers to "the selection and integration of strategies for making, using, transporting, and discarding tools and the materials needed for their manufacture and maintenance" (114:57). Many factors affect tool production, use, and discard; but currently the relationship between technology and mobility takes precedence in research (156).

Archaeologists debate the relationship between mobility and technology. Bifacial tools or cores are generally associated with frequent and/or lengthy residential or logistical movements (26, 91, 94), while expedient flake tools and bipolar reduction are associated with infrequent residential moves (118). However, the distribution of lithic raw material could alter these associations significantly (5). Other researchers focus on the statistical relationship between tool assemblage size and diversity. Shott (141) suggests that collectors produce assemblages with no correlation while foragers produce assemblages with a strong positive correlation; additionally, he suggests that there should be an inverse relationship between technological diversity and residential mobility (140). However, correlations between assemblage size and diversity could be related to many factors (104, 153). Torrence (157), for example, argues that technological diversity relates directly to the degree of risk involved in prey capture rather than mobility per se.

Reconstructing mobility strategies from prehistoric technology is hampered by several difficulties. First, there are no simple relationships between mobility and tool manufacture. Many other variables intervene—e.g. tool function, raw material type, and distribution, hafting, and risk. Second, the reconstruction of different tool manufacturing methods from debitage is fraught with
interpretive difficulties. Third, stone tools are not routinely used to a significant extent by any living foragers, making it difficult to test ideas relating stone tools to mobility. Analyses of ethnographic data often make the unverified assumption that as the total technology goes (including its organic parts) so goes the (usually absent) stone tool component. At present, then, many interpretations of stone tool assemblages as indicators of mobility are subjective, intuitive, and sometimes contradictory.

Site Structure

Another avenue of research into mobility lies in the analysis of site structure, the spatial distribution of debris within a site (54, 97a). Studying changes in modern Basarwa residential sites, Hitchcock (80) found that as residential mobility decreased, the abundance and diversity of debris left in a site increased, as did site size and the number of storage features (although group size did not increase). Site size and artifact density are frequently used as indicators of reduced residential mobility (10, 126), although they can be attributed to several other factors as well, such as frequency of reoccupation (31). The distribution of remains may be a better indicator of residential mobility since it appears to be directly related to the length of time a location is occupied. Specifically, instead of simply throwing or sweeping trash off to the side (as mobile foragers do; see 116), sedentary Basarwa used secondary trash dumps located farther from houses than those in camps of residentially mobile groups. They also used specific areas for specific activities; thus, as residential mobility decreased, internal site differentiation increased (80). While many factors (e.g. social organization and cultural conventions) affect the use of space, the site structures among nonresidentially mobile horticulturalists and recently settled foragers and pastoralists appear to be more internally differentiated than those of residentially mobile peoples (e.g. 42, 43, 59, 97, 100).

Much of this space differentiation seems to be directed toward the privatization of space (40, 100, 170) and may be related to a change in methods of conflict resolution. One way conflict is generated among foragers is through one individual’s refusal to meet demands to share. (Contrary to many claims, foragers do not always share freely and gladly.) Mobile foragers use movement to resolve social conflict; but if this option is not available, people may “privatize” space (170) by placing houses further apart or by building enclosed houses and fenced households to hide food and goods and discourage demands to share (80). Criteria for recognizing mobility strategies archaeologically must develop hand-in-hand with a theoretical understanding of how social relations change as residential mobility decreases.

Houses

Reduced residential mobility can be demonstrated through indicators other than site structure. The presence of human commensals—house mice, for example—may indicate a continuous supply of fresh trash and hence year-
round occupation (9). Perhaps the most commonly used archaeological indicator of a reduction in residential mobility is the presence of houses. Cross-cultural studies demonstrate that investing labor in houses is related to low (or no) residential mobility (e.g. 55). But even substantial housing may not indicate a cessation of residential movements. Cedar plank houses built by Northwest Coast peoples, for example, were partially dismantled in the spring and moved to fishing locations.

Unfortunately, the presence of any kind of dwellings, even of those requiring little energy investment, is often taken as evidence of year-round sedentism. Unless we understand the factors involved in house construction (21), differential preservation of indications of houses can lead to erroneous reconstructions of mobility. For example, as a group of people become territorially constrained, they may visit the same places repeatedly each season. Binford refers to such arrangements as embedded mobility (19, 60). Under these circumstances, people may construct facilities, including houses, at some locations. This may be why houses appear in rockshelters when settlement systems appear to be becoming sedentary (1, 9). But these houses could indicate redundant use of locations through residential or logistical mobility due to territorial circumscription or a reduction in long-term mobility options. Evidence of house scavenging (168) likewise could indicate continuous or seasonal use, or be a product of reoccupation on even longer time scales.

Individual Differences in Mobility

Finally, it is important that we understand the differences in individual mobility patterns within a society. For example, in some foraging societies good hunters remain out longer (and thus travel more) than poorer hunters, while in other societies the reverse is true (78). Ethnographic accounts suggest that men generally travel further than women in daily foraging trips, even remaining out for one or several nights (this appears to be true even when women hunt); thus, there can be gender differences in degrees of logistical mobility. Such variability is extremely difficult to detect archaeologically, although one avenue lies in detecting different kinds or degrees of mechanical stress on human osteological remains. Larsen et al (99) show that the femurs of males sustained greater mechanical stress than the femurs of females for a prehistoric adult hunting and gathering population in the Great Basin. This difference in stress suggests that males were more mobile than females.

THE EFFECTS OF MOBILITY

The difficult task of recognizing different patterns of mobility from archaeological data is important to an understanding of how changes in mobility relate to other aspects of human society. Research suggests that changes in logistical, residential, and long-term mobility strongly affect sociopolitical
organization, trade, territoriality, demography, and enculturative processes. Particularly important are the effects of reduced residential mobility.

**Sociopolitical Organization**

While foragers are often characterized as “egalitarian,” a concept undergoing increasing scrutiny (52), many are clearly nonegalitarian, with political hierarchies, wealth competition, and extreme social and gender inequality (125). Keeley (89) demonstrates that groups occupying one camp for more than five months of the year live at substantially higher population densities, rely more heavily on stored food, and have greater wealth distinctions than foragers who are more residentially mobile. It is likely, therefore, that a reduction in residential mobility encourages or is part of a process resulting in inequality.

Some see sedentism as lifting the constraints residential movements impose upon a foraging society. Following the argument that sedentism is a product of resource abundance and increases efficiency, many assume that sedentary hunter-gatherers simply have more time and resources to devote to what Gould (57) calls “aggrandizing” behavior. Here, inequality appears to be the inevitable response of human nature to the accumulation of surplus made possible by sedentism.

But sedentism probably does not lift previous constraints as much as it replaces them (93). Specifically, sedentism probably occurs under, or soon results in, conditions where residential and/or long-term mobility are no longer viable solutions to local resource failure. Sedentary hunter-gatherers must use other mechanisms to reduce the risk inevitably associated with reliance on a single resource or location (38, 73). These may include efforts to increase household production and storage by restricting sharing networks, by using slaves, and by permitting men to control the labor of women (wives or sisters) and affinals, thus fostering gender and social inequality (39, 74, 93, 137).

Additionally, more time and effort may be put into alliance formation, entailing for example competitive feasting (73) and the manipulation of marriages to ensure access to another group’s resources. Accordingly, trade may change as societies become sedentary; trade may in addition become more critical as a symbolic indicator of social alliances (35). Territoriality may also increase as competition for resources escalates with population growth (34, 37). Such competition might also increase perceived cultural or ethnic differentiation between groups. Given that sedentism requires methods other than mobility to reduce risk, the temporal and spatial parameters of resource variability probably condition the specific forms of social, trade, and territorial relations (93, 129, 135).

**Demography**

The association of certain behaviors with sedentism implies that they are generated not only under conditions of low residential mobility but also under conditions of population pressure (89). In some cases population growth may
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eventually force sedentism. However, as mobile populations today become sedentary, their populations grow, often dramatically (e.g. 22, 79, 131, 132). Medical care plays a role in this growth, but changes in women’s foraging behavior may also increase fertility and the rate of population increase.

The nature of the relationship between mobility and fecundity is not clear (13, 169, 49). As pointed out above, a reduction in residential mobility generally increases resource processing. Adults in sedentary Basarwa camps are busier at home than adults of mobile camps (45). For women, this transition could increase fecundity in two ways. First, by increasing the amount of work women do, increased resource processing may decrease the frequency and intensity of breastfeeding, a primary factor in increasing fecundity (32). Second, a reduction in female traveling, through a trade-off of foraging for resource processing, may also decrease aerobic activity and, through a still poorly understood physiological process, increase fecundity (13). These trends could be affected by changes in diet as well, by increasing caloric intake and/or by using storage which, by leveling out seasonal fluctuations in food intake, could maintain long-term energy balance and increase fecundity (49, 84). Children may also become incorporated into the work force of adults (45), decreasing the perceived cost of children, and encouraging fertility (46).

Reduced residential mobility may also decrease child mortality, which may be more critical to population growth than an increase in fertility (67). While it has long been assumed that sedentism increases the rate of contagious disease, Pennington & Harpending (119) point out that mobility encourages “traveler’s diarrhea,” producing a chronic state of poor health in the children of mobile populations that eventually takes its toll. Reducing mobility could increase child survival and hence population growth.

**Enculturation and Cultural Change**

The changing adult work patterns associated with the changing resource harvesting and processing requirements of sedentism may also affect childrearing (83) and alter enculturation. As the Basarwa became sedentary, for example, men spent more time away from home and women spent more time at home processing resources and doing other work (45, 79). These factors may conspire to reduce the time men and women spend with children, encouraging young children to work more, especially in the care of infants, and thus cause a shift from parental to peer-group enculturation (46, 45). Although the process is by no means clear (and many factors are involved), peer-group enculturation appears to encourage processes of gender role enculturation (46) and the formation of modal personalities different from those of parental enculturation. Such a shift in enculturation patterns could alter culture in sedentary communities.
CONCLUSION

There are no Gardens of Eden on earth, no single locales that can provide for all human needs. Mobility—residential, logistical, long-term, and migration—was the first means humans used to overcome this problem. Changes in the way humans choose to be mobile dramatically affect other aspects of human life, from demography to enculturation. Theoretically, then, mobility must be critical to understanding human evolutionary change. From this perspective, it is encouraging to see theoretical and archaeological scrutiny of early hominin foraging and mobility patterns (137a). Potts, for example, has asked whether the concentrations of fauna and stone tools at places such as Olduvai Gorge are evidence of home bases or are intentional caches of stone to be used by foraging hominids, perhaps in scavenging carcasses (121). The foraging and mobility patterns of early hominids were in all likelihood quite different from those of any known foragers or nonhuman primates. Documenting variability in these patterns is important to an understanding of how selective processes shaped human evolution [see Potts’s (121) comparison of the archaeology of Olduvai and Koobi Fora].

By deconstructing the concepts of mobility and sedentism, we see the need to construct more useful approaches than a simple polarization of mobile vs sedentary societies. Indeed, it is no longer useful to speak of a continuum between mobile and sedentary systems, since mobility is not merely variable but multi-dimensional. No society is sedentary, not even our own industrial one—people simply move in different ways. The dimensions of movement need to be disentangled and studied independently so that we can understand how factors altering one component affect other areas of behavior and culture. We will also need more detailed theoretical arguments linking group movement and daily activities with economic structures, labor requirements, childcare, marriage, and trade. Numerous technical and theoretical difficulties surround the archaeological study of mobility, and archaeological, ethno-geographic, and ethnohistoric data must be used creatively in developing methodological tools for the study of prehistoric mobility. Such middle-range research promises a large reward, for the analytical study of mobility and foraging will provide a clearer understanding of important evolutionary processes.

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