Archaeology consists of both reconstructions and explanations. Ethnoarchaeology has always been conducted with an eye towards reconstructing the whole, and even the small. It emphasizes the linkage between human behavior and material remains. Other studies have been inspired more by difficulties in explaining the world, and have explored the causes behind modern phenomena. Archaeology is still useful.

A Southwestern Beginning to an African Study

When I first saw it, site D:2025 was a scatter of rock and pottery around a shallow depression. It had been built, exactly 1,117 years before, as a farmstead for a small group of Naasazi farmers in the northwestern Arizonas that populated a hilltop site containing a pit house, a wattle-and-daub summer hut, a few storage structures, and a large scatter of refuse that suggested a fairly short stay. It was not a site for a small group of Naasazi farmers that lived in the hills of Black Mesa in what is now northern Arizona. It was an unimposing site containing a pit house, a wattle-and-daub summer hut, a few storage structures, and a large scatter of refuse that suggested a fairly short stay. It was not a site for a small group of Naasazi farmers that lived in the hills of Black Mesa in what is now northern Arizona. It was an unimposing site containing a pit house, a wattle-and-daub summer hut, a few storage structures, and a large scatter of refuse that suggested a fairly short stay.

Several of us were interested in the relationship among the three sites. They were generally believed to be part of a Naasazi population that had hunted and farmed on Black Mesa in what is now northern Arizona. It was an unimposing site containing a pit house, a wattle-and-daub summer hut, a few storage structures, and a large scatter of refuse that suggested a fairly short stay.

Figure 1. A Kofyar compound, with five circular huts and one rectangular entrance. Compounds tend to be circular, with one hut per adult and specialized huts for beer brewing, cooking, and sometimes storage.

The Idealized Plain

Geographers have dealt with this type of problem before, and they have worked out a solution: imagine a situation untainted by the quirks of history, landscape, or human behavior—an idealized, uniform and rational and knowledgeable people. This provides a mental laboratory for isolating the basic dynamics of settlement and the relationship between settlement patterns and the activities of people in settlements.

This is what J.H. von Thünen did in the early 19th century. Concerned with the underlying principles of land use, he reasoned that, when other factors are held constant, the farmers in a town will maximize profit by planning land use according to the costs of transporting crops to town. Since transport cost is largely a function of distance, land use patterns should be explained by the distance between town and a given plot. This explained the concentric rings of land use that occur not only around towns, but as the geographers later showed, around individual farmsteads as well (Chisholm 1979). Knowing what factors govern land use on an idealized surface provides a basis for understanding real situations, where variables are not so controlled. Figure 2 shows the classic model of concentric land use.

Figure 2. J.H. von Thünen's model of land use around an isolated town. The importance of this model is that it suggests that the actual land use patterns in the concentric bands, as these will vary from case to case. The benefits of this strategy is that an idealized, uniform plains in order to isolate the effects of a single variable that is paramount in determining land use. In this case, the variable is transport cost, but other geographers such as Chisholm have shown how the time variable produces concentric land-use patterns in non-monopolized economies.

Central Place Theory, which offers key insights into market settlement patterns.

Both Central Place Theory and von Thünen's land-use theory have been useful to archaeologists, but the model's two views of the world have shed no light on agrarian settle- ments such as those on Black Mesa. What I really needed was a model of the relationship between a small town and its farming, or of the relationship between a market town and the marketing its people do, but of the relationship between small farming settlements and the farming done. Could we not imagine a small population of rational farmers on a uniform plains? Is there any way to predict how they will settle, and how their settlement pattern will change through time?

Attempts at modeling this process have not been especially successful. The model usually used by archaeologists interested in the problem, borrowed also from a geographer (Hudson 1982), envisages settlement evolving through three stages. In the first, farms are located randomly, like plants. In the second, clusters of farms might be formed by fissioning; this follows the conventional assumption that daughter settlements would stay as close to the parent as possible.

Or, new immigrants would avoid existing farms, producing unclustered settlements. Finally, competition over land would force the smaller farms to sell out to the larger ones, leaving widely spaced farms. From this model, which has been used widely in archaeology, and other archaeological attempts to capture the dynamics of farm settlements, one could assemble a set of...
notions about how farms should theoretically behave. Initial settle-
ments should be randomly located. When settlements fail, the "off-
spring" should be as close as possible to the parent as the cultivated perimeter allows. Immigrants should settle away from existing settlements. Cur-
rently, Hudson and others dealt with rising rural population yet assumed no change in agricultural intensity (see box on Intensive Farming). How should farmsteads, in theory, behave? I considered the need for a set of baseline expectations for agrarian settlement, such as those provided for market towns by Chris-
taller and for land-use patterns by von Thünen and Chisholm. That summer Bosker classified traditional farming systems as "weak" because of the "zero point" with a small initial pioneering population.

The Kofyar
It was perhaps coincidence that I had also been working with Robert
Netting, a cultural anthropologist whose work on agrarian ecology has inspired many archaeologists. I was grateful for his reanalysis of the remark-
able data he had collected on the Kofyar, a group of farmers in the Jos Plateau of Nigeria. When Netting published his dissertation on the Kofyar in 1980, he had concentrated on their home-
land, where a relatively used population practiced highly intensive cul-
tivation (see box). But the Kofyar were also establishing farms in a frontier area a day's walk to the south, where they could capitalize on the abundant farmland by re-
verting to extensive cultivation. They were also marketing agricul-
tural surpluses for the first time. One might think of the Kofyar, the more their frontier seemed to offer a unique oppor-
tunity to try to seek the sort of underlying logic of settlement on a real plain that von Thünen and Christaller had isolated on imaginary ones. Although there are no geographic or uniform plains in real life (any more than there are perfectly

Intensive Farming
At the heart of most discussions of traditional farming systems is a broad theory published by Ester Bosker, a Danish agricultural economist, in 1965. In Boeker's essay, in which population growth is forever limited by agricultural productivity, Bosker sees population growth as the major cause of increased agricultural productivity. But increases in productivity exact dispro-
portionate increases in labor.

Therefore, traditional farming systems on a scale ranging from extensive to intensive. Extensive agriculture is relatively easy. In its most common form, crop cultivation in primary and secondary for-
dary trees are cut and burned, and crops are planted in the ashes. After only a few years, the field is left to reestablish itself. At some time, there will be more land in fallow than in cultivation. This can be a highly profitable method of farming that requires minimal effort for preparation and cooling. The problem with extensive farming is that it requires an abundance of farmland, and when population density rises, traditional farming techniques must be used.

When the acreage per person shrinks, farmers must start to cultivate plots that have been fallowed for shorter and shorter periods. These plots tend to be less

Figure 3. The edge of the Jos Plateau and the northern Benue Trough, in north-central Nigeria. The hazards of raiding and slaving left the savanna between Lagos and the southern edge of the British gained control of the area. Namu and Kurgus were probably raided despite their defensive walls. Kofyar farmers gradually established farms on the thin soils south of their homeland during the 1930s and 1940s, reaching the deep, fertile soils south of Namu by 1952. The evolution of the settlement system on this frontier has been reconstructed by various lines of evidence, including earlier ethnographic records, aerial photographs, interviews with "pioneers," and a survey of abandoned compounds.

Piecing Together a Settlement System
Namu is a small town 30 kilometers south of the Jos Plateau of Nigeria (Fig. 3). It is on the northern edge of the Benue Trough, where there is a vast savanna that, until a few decades ago, was among the richest farmland with very low population. The low population, concentrated in walled villages, led to a very diverse economy, including Kwaude, and Kurgus, was due to the threats of raiding and slaving by emirates such as Lafia and Wase. The Kofyar and other groups sought escape in the rocky hills of the Jos Plateau, where they endured high population densities and the hard work of intensive agriculture. The Kofyar began to farm the fertile Benue lands in the early 1950s, first migrating down seasonally and later moving permanently. On the frontier, the farmers intensively cultivated all the grains they had in the homeland: sorghum for food and millet for beer. They also raised livestock, usually goats and rice as cash crops. They mostly lived in single-household compounds, 6 to 10 members per household. This model, I call "settlements" (Fig. 1).

By 1969, when Netting first came to the Jos Plateau, the Kofyar population was in-
olved in farming on the Benue frontier. The Kofyar moved more consistently than the farmers

What the Kofyar were doing in those settlements—whether or not they were certain no analog for the Ana-
sari, and I had no illusions about the complexity of the processes, or which agrarian settlement operated; I was convinced then (and now) that we have to think about the trajectories that such systems might follow. But it seemed to me that, considering the complexity of agriculturists might mean that the Kofyar have a field policy, the best thing to do was to try to recon-
struct the agricultural system on a real plain, to see how farmers met through the many factors to make their decisions.

on compass, a distance measuring device useful in computer navigation. It eventually identified close to 500 settlements on the aerials, recorded their locations, and investigated the compounds that had been abandoned since the photo-

csubraphs were taken.

At the University of Arizona, I developed a database system that allowed me simultaneous access to data from the computer printouts that allowed us to track down several hundred previously recorded households. We also released over 500 households on the frontier, and for each we recon-
structed a household settlement his-
tory. When computerized later, these settlement histories provided an in-
dispensable tool to study how household decisions are related to agriculture and domestic aspects of the evolution of Kofyar settlements. I will briefly describe a few of the lessons to be learned from this reconstruction.

Are Pioneer Settlements Random?
One of my first topics of investiga-
tion was how settlement locations were determined on the frontier, and if we should expect these deter-
motants to occur at the beginning of the frontier. When we first turned out that pioneer settlements were not located randomly, which probably should surprise no one.
Instead, compounds were consistent spatially, usually forming ragged strips (Fig. 4a). When I asked these early settlers why they settled close to each other with such abundant farmland all around them, they asked how they could farm together unless they settled together. They were referring to multi-household work parties that play a key role in their farming system. Koyfari have both small-scale and large-scale details, which operate on a simple reciprocal basis, and large parties called mu mu (beer farming) at which people served the Koyfari prized beverage—millet beer. (Millet can be grown in the same field with sorghum, and it fits neatly into the Koyfari labor calendar [Stone et al. 1999]. It is mostly brewed into a slightly alcoholic beer for labor parties, but it can also be eaten or sold.) Archaeologists are aware that settlement spacing can be related to the interaction that occurs between settlements. In the 1960s and 1970s, there were even attempts to measure interaction rates, but the type of interaction had usually been trade in exotic goods, and settlements had usually been villages and towns. On the Koyfari frontier, there were small compound settlements whose spacing was determined in large part by agricultural collaboration. Work parties were, after all, the most common form of interaction; Koyfari work one hour on other farms for every four hours on their own plots, and the overwhelming majority of this outside work occurs within a 15-minute walk (Stone 1991). When I looked at other frontiers, the premium on having access to supra-household labor pools turned out to be common. For example, 19th century pioneers in northern Argentina tried to settle in strips rather than in the government-favored pattern of each farmstead on a 25 hectare square of land; one of the reasons was agricultural labor mobilization (Edict 1977). How can farmsteads be closely spaced without being reduced to small plots? Simple: farms are elongated, with residences near the center. This turns out to be a common solution, occurring in both Argentina and Nigeria, as well as in Germany, where the pattern is called Waldhauen (Mayoh 1973). Paths and dirt roads “attracted” compounds because of all the foot and bicycle or even motorcycle traffic, and because they allowed the lorries and pickup trucks of crop traders to drive close to the farm fields after the harvest. The attraction of compounds to each other and to roads produced strong patterning in settlement spacing: 82 percent of all compounds are located between 100 and 200 meters from their nearest neighbor. Compounds were never isolated unless they housed an unusually large group, and even then there would be attempts to recruit other farmers to the local. The archaeological wisdom that interaction controls settlement spacing was partly right. But it is clear that there was a particular kind of interaction—collaboration in food production—that was critical in shaping this arrangement of farmsteads. The conventional wisdom that a settlement’s cultivated perimeter determines settlement spacing is somewhat misleading. We may be fooling ourselves in assuming that farmsteads or hamlets use circular perimeters, as plot shape is easily altered to allow sites to adjust their spacing.

How Do Farmers Pick Locations?

Saying that the farming system pulls farmsteads towards each other doesn’t tell us where the settlements end up. Analysis of site location has been a mainstay of research in archaeology, although general rules of location have been slow to materialize. How the Koyfari criteria for site selection changed through time was intriguing. It is perhaps counter-intuitive that in placing their farmsteads these veteran farmers did not make fine distinctions regarding soil quality. Koyfari first moved into areas named Ungwa Long and Mangkogom, south of Nazmu and Kweande (Fig. 3). The Long has deep, fertile, and well-drained soils derived from sandstones; in Mangkogom, they are thinner, less fertile, and more rocky. Yet, despite these difference in agricultural potential, population seems to have poured into these two areas at comparable rates. Ungwa Long spread east and west, following the good sandy soils, but at the same time it spread south, onto poorer shale-derived soils with drainage problems (Fig. 4a). The farmers consistently avoided only the very worst soils, where there were obvious problems with swamps or ironstone (laterite). They were simply weighting proximity to human labor, the fuel that powered their farming system, over access to optimal soils.

If farmsteads were not necessarily drawn to the best soils, to what were they drawn? Were they drawn to water? The answer is yes and no. Rainfall is sufficient for agriculture in the Benue savanna, and crops are not irrigated; but domestic water supply is a daily necessity for the farming. Consequently, farmsteads were drawn very strongly to water; in fact, an analysis of early frontier residential locations shows only 15 percent to be farther than 500 meters (around a 10-minute walk) from a stream (Fig. 5). Although Boserup’s model of intensification (see box) doesn’t deal with the relationship between site location and intensification, the pattern of pulling towards water fits it perfectly. The intensification process is supposed to be controlled by farmers’ tendency to minimize unnecessary labor. Since even suboptimal soils could produce good harvests with little work, the main potential cause of unnecessary labor wasn’t an agricultural task at all, but the chore of fetching the heavy, ever-necessary resource, water.
On the early frontier, then, site spacing is neither random nor determined by each settlement's cultivated perimeter. Sites are pulled towards each other by the need for agricultural collaboration, overriding fine distinctions of soil quality. Where these settlements are placed on the landscape is initially shaped by the drainage system, as farmers mini- 

mize the potentially greatest cause of unnecessary labor; this I see as an extension of Boserup's basic premise to the settlement system.

Responding to Higher Population Density

By the mid-1960s, settlement had changed dramatically (Fig. 4b). As the countryside filled, the rules that shaped the settlement system began to change. Whereas initial settlers were attracted to water rather than soil, farmers facing increasing competition over land quickly reoriented themselves toward large, more productive plots, regardless of the proximity of water. This meant two things: first, that farmers could produce crops more quickly and, second, that the areas around them began to be used for agriculture. The pattern of intensification on the best soils and abandoned on poor soils is repeated in the settlement history of several other areas that I analyzed. It seems that as the agricultural system matured, and the easy harvests from virgin land de- 


dined, farmers began to judge soil differently. The reason seems to be labor intensification: as the ratio of agricultural input to output rose, it could easily eclipse water transport as the most labor-prolific activity. The worse the farmland, the more these labor intensifications were taken as direct analogues for the past; they should be compared with other cases to work towards a more general understanding of settlement. For instance, a crucial difference be- 


tween farming in the Benue Valley and on Black Mesa is the reliability of water. With the Kofyar, streams played a pivotal role in shaping settlement until farmland became scarce; when access to land came to dominate their decision-making process. In arid areas, water may become the most strategic of resources when population densities are high in Ungwa Long. The patterns of intensive farming near Ungwa Long. In areas where Kofyar have not abandoned their farms, the agricultural system has become both intensive and intricate. Here a large labor group (four men) works in a field where three mutual, and where sorghum were interplanted; the work is done as a group, the harvest is split, and the community is divided.

Figure 5. Intensive farming near Ungwa Long. In areas where Kofyar have not abandoned their farms, the agricultural system has become both intensive and intricate. Here a large labor group (four men) works in a field where three mutual, and where sorghum were interplanted; the work is done as a group, the harvest is split, and the community is divided.