Early Food Production in Africa

JOHN BOWER

The study of early food production in sub-Saharan Africa is at least as challenging as it is rewarding. Problems arise in large degree from the scarcity of relevant archaeological material, particularly the remains of domesticated plants from prehistoric sites. This is attributable to several factors, including poor preservation, difficulties in recovering such material, and the limited amount of work so far invested in obtaining it. But, problems notwithstanding, fresh data and new methodological approaches have revealed aspects of early African food production that are interesting in themselves, as well as in global perspective. For example, contrary to what occurred in most other parts of the world, livestock herding in Africa often predated the earliest evidence of cultivation of domesticated plants. Moreover, the initial spread of food production throughout much of sub-Saharan Africa was accompanied by iron, rather than lithic, technology.

This overview of current knowledge about early African food production is aimed at highlighting developmental patterns while also exposing limitations in our understanding of these patterns. Because of Africa's vast size, uniform coverage in reasonable depth of all parts of the continent is not possible. Thus, for example, I will not explicitly cover the complex Neolithic record from Africa's Mediterranean region. Instead, I will generally concentrate on bodies of data and lines of investigation that characterize distinctive features of the African version of initial steps in raising crops and animals.

LIMITS ON KNOWLEDGE

At the risk of striking a mildly pessimistic note, it seems prudent to begin with a look at impediments to our understanding of early food production in Africa. In part, this will help explain major lacunae in the present state of knowledge; it will also furnish a perspective for critical evaluation of generally accepted views on the topic.

Perhaps the most basic and most remediable problem in the pursuit of knowledge about early African food production is relative inattention to this aspect of world prehistory. Setting aside such special cases as Egyptology, archeological research in Africa has generally been dominated by paleoanthropological and Iron Age investigations. Considerably less effort has been devoted to other topics, including early food production. Certainly, the beginnings of food production in Africa have never received the concentrated attention that has been focused on this issue in most other continents.

There are nevertheless signs of substantial intensification of work on early African food production. For example, more than one-third of a book on the later prehistory of Africa, devoted to early food production. Moreover, the present decade has witnessed a spate of publications on early pastoralism in Africa, as well as important methodological shifts. These shifts include a tendency to replace the quest for origins with an inquiry that begins with a close look at contemporary agropastoral regimes, followed by a search for successively deeper historical foundations as revealed not only by archeology, but also linguistics and ethnology. Such symptoms of vitality point toward a burgeoning research emphasis on early African food production in the near future.

Regardless of how much intellectual and physical effort is mobilized, the work is bound to remain difficult for many years to come. This is partly because of problems inherent in data recovery, such as the inordinately small size of various African cereal grains, the high perishability of many cultivated plants, including tubers that are staple crops in parts of Africa, and the poor conditions for preservation of organic remains in the forest soils and sandy deposits that are so widely distributed in Africa.

In addition to problems of recovery, there are inherent sources of error in dating excavated plant and animal remains, especially when the dates are obtained from what is thought to be associated material, such as charcoal from firewood. The main source of error appears to be bioturbation, such as disturbance by termites and various burrowing animals. This can lead to spurious associations that can yield grossly inaccurate dates. Perhaps the most egregious example of such dating error is the case of the barley seeds from Wadi Kubbina, Egypt, originally dated at 17,000 years B.P. from associated charcoal; however, subsequent dating of the seeds themselves demonstrated that they lie between about 800 and 4,800 years B.P. This underscores the importance of using a high standard of evidence in accepting dates for early food remains, as has been applied in North America with profoundly significant results. Unfortunately, applying such a standard to

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the meager inventory of dated early cultivated plant remains from Africa would virtually wipe it out.

Another major impediment to research on early food production in sub-Saharan Africa is the lack of detailed paleoenvironmental information in circumstances where the spread of food-producing economies hinges on specific environmental parameters. For example, the spread of livestock herding is at least partly contingent on the absence of tsetse fly infestations, which in turn depends on an annual rainfall of less than 500 mm (Fig. 1). Although general patterns of climate history during the past ten millennia or so have been reasonably well established in most parts of Africa, these patterns are not necessarily reliable indicators of conditions in any particular spatiotemporal range. In fact, faunal assemblages from various sites in East Africa point toward environments that are somewhat at odds with what is suggested by general patterns of climate history. Thus, inferences about the ecological context of early food production should be viewed with caution.

Logistics is more or less a ubiquitous obstacle to the study of most aspects of African prehistory. In general, sites tend to occur in areas where it is not only difficult to work, but where the difficulties, for example, of obtaining water and provisions from remote sources, entail huge transportation costs that exceed the financial capabilities of many funding agencies. For reasons that frequently are related to the ecology of early food production, this is especially true of neolithic sites. One consequence of such logistical problems is that many research projects concerned with early African food production have operated on a shoestring. This has severely constrained investigators’ ability to pursue the kinds of efforts, such as major flotation programs, that might lead to the recovery of useful samples of plant foods.

Broadly speaking, the upshot of all these impediments is, of course, a general dearth of information. However, if one looks closely, one finds that the African data are not only sparse, but highly biased. Essentially, the record of early food production is one in which faunal remains are reasonably abundant and plant remains are generally conspicuous by their absence. This bias needs to be kept in mind when evaluating observations such as the one presented earlier about the temporal precedence of livestock herding over plant cultivation in African prehistory.

A VIEW FROM THE PRESENT

The problems of investigating early food production in Africa are at least partly offset by abundant African ethnographic and historical documentation of crop and herd-raising practices from precolonial to modern times. Such records not only serve as a wellspring of interpretative structures for archeological data, but often provide a more or less direct, if sometimes opaque, window into the past, connecting the farming and herding activities of an area’s living inhabitants with those of their predecessors. In some cases, linguistic evidence may help establish the ethnic source of prehistoric traces of farming, although the results are seldom unequivocal. Given the fluidity of ethnic boundaries in some parts of Africa, it may often be futile to pursue such questions of identity. The main contribution of such questions to our knowledge of early food production derives from their role in methodologically specialized attempts to discern specific patterns of agropastoral developments by working backward from their present state. But in more general contexts of inquiry aimed at reconstructing the history of food production in broad outline, ethnographic and historical records are indispensable guides to the meaning of archeological remains.

Several persistent features of the history and ethnography of African food production deserve mention. One is the special role of livestock in African economies, particularly south of the Sahara, where cattle are raised with varying degrees of intensity in
virtually every habitat where they can survive. In places from which cattle are excluded because of aridity, camels may be herded instead, and small stock (sheep and goats) are kept in a wide range of environmental circumstances. All such domestic animals, especially the larger species, tend to be regarded as wealth.

Within the range of variation in commitment to livestock herding that has been observed among African food-producing societies, there is an inflection point according to which some societies are regarded as pastoral and the rest are considered to be agropastoral. Generally speaking, this distinction is based on the extent to which a group depends on survival on its livestock rather than on crops. Societies in the first category obviously tend to organize their lives along the needs of their herds, which include water, forage, and protection from predators.

Because the search for pasture and water requires mobility, pastoralists tend to be broadly characterized as nomads. But this characterization masks great diversity in patterns of movement: variants include vast annual migrations over hundreds of kilometers, alternating relocations between wet and dry season pastures (seasonal transhumance) over only tens of kilometers, and radial excursions from more or less fixed settlement over distances that a herd can cover in only a day or two. This underscores the elasticity of the ethnographic concept of pastoral nomads, which has been further stretched by growing recognition that the economic regimes of African pastoralists tend to vary as much over time and with changing circumstances as do their patterns of mobility over space. Such variability cautions against indiscriminate use of broad generalizations about African pastoralists in interpreting the prehistoric record of African livestock herding.

African cultivators are adaptable in the sense of being willing to experiment with new crops and methods of cultivation, as is illustrated by their remarkably rapid, widespread, and effective adoption of relatively recently introduced crops such as maize and bananas. Moreover, they employ a complex array of agricultural techniques, including, for example, swidden cultivation, intercropping, decrue (planting behind receding floodwaters), and fertilizing with manure from penned animals. However, virtually all precolonial cultivation in Africa was based on use of the hoe and digging stick. Indeed, the only major exception was use of the plow in the highlands of Ethiopia.

In one case, a metric ton of charcoal, reduced from 88 m$^3$ of wood, was used to smelt only enough iron to make about four hoes and a few smaller implements. Smelting of this type on a scale that would equip a substantial population of horticultural farmers is capable of deforesting extensive tracts of land. This in turn, might catastrophically affect the productivity of soils exposed to intense leaching.

**Prelude to Food Production**

Although many approaches to the study of early food production are possible, questions of origin are ultimately inescapable: Why did food production replace hunting and gathering? Or why did it not? Why did this transition occur later in Africa than elsewhere? What species were domesticated and how was this accomplished? Was food production based on locally domesticated or introduced species? Because such questions are closely concerned with ecological issues, most attempts to provide answers are ineluctably drawn toward an examination of the ecology of early food production. Recently, this had led to consideration of the role of social structures, particularly such hierarchical ones as patron-client relationships, in ecological contexts leading to food production.

A contextual pattern for early food production is beginning to take shape on a global scale. Its salient features include relatively sedentary human occupation of resource-rich environments, sometimes containing highly productive aquatic habitats, such as rivers and lakes, from which a few species, usually plants, are subjected to domestication. The pattern encompasses a wide range of variation, especially as regards the edible, productivity, and reliability of wild food resources, so that particular trajectories of early food production vary substantially. However, the combination of a broad-spectrum resource orientation and sedentism is remarkably persistent in areas such as the Levant, China, and eastern North America, where independent shifts from foraging to food production have taken place.

In Africa, there is widespread evi-
Evidence of a broad-spectrum resource orientation among late prehistoric food-gathering cultures scattered throughout the continent, from its southern extremities to the Nile Valley, the eastern Sahel, the Ethiopian Rift Valley, and the western limits of the sub-Saharan grasslands zone. Moreover, there are substantial indications that some of the communities involved practiced more or less sedentary settlement behavior. This is especially true in northern Africa, where one indicator of sedentism is pottery. The use of pottery by foraging cultures is evident as early as the tenth millennium B.P., perhaps more than 2,000 years before the earliest transition to food production in Africa. However, in virtually all of these contexts, the shift to food production was at least partly derivative, involving the introduction of species domesticated elsewhere and, in some instances, lagged far behind the earliest occurrence of food production in Africa (in general, the farther south, the later). In fact, the only case currently under serious consideration as involving a possible early shift to food production based on locally domesticated species entails relatively mobile communities occupying resource-poor environments of the eastern Sahara. The circumstances are particularly interesting because it is cattle that are thought to have been domesticated. If this inference is correct, the early cattle keepers of the Sahara would not only occupy a virtually unique position in the history of African food production, but would also have established the pattern noted earlier, wherein livestock herding preceded crop raising in many parts of the continent.

At least as interesting as the possibility of a primary shift to food production by mobile societies living in harsh environments west of the Nile Valley is the fact that such a shift did not occur a few tens of kilometers to the east within the Nile Valley, where a terminal paleolithic mode of existence persisted for several millennia into the Holocene epoch. What makes this so intriguing is that ecological contexts in other areas of primary domestication were epitomized in the Nile Valley. Specifically, in addition to the richness of Nile Valley environments in preagricultural millennia, recent work has revealed that the late paleolithic occupants of this area exploited a wide variety of wild foods, including fish and root plants. Moreover, such a broad-spectrum resource orientation apparently was established earlier than in most other parts of the world, perhaps as early as about 21,000 B.P., and may have led to increasingly sedentary settlement behavior.

Although it is impossible to account definitively for this anomaly, one potentially relevant matter is North African climate history from the late Pleistocene to the mid-Holocene. Food-producing economies did not appear in the Nile Valley until a little earlier than 6,000 years ago, at the beginning of the Neolithic Wet Phase (Fig. 2). This means that preagricultural broad-spectrum subsistence regimes prevailed in the Nile Valley throughout most of two arid and wet cycles of climate. It needs to be emphasized that the cycles in question reflect major changes in precipitation, with the wet phases bringing perhaps as much as 47% more rain than modern averages and the hyperarid phases being dry enough to expose most of the floor of Lake Victoria. Although the ecology of the Nile Valley may not have been radically affected by these changes in climate in a direct way, the flow characteristics of the Nile River were altered in ways that probably
had a major impact on human existence.\textsuperscript{23} Such durability of economic practices despite tremendous environmental fluctuations suggests a degree of adaptability that may be exceedingly rare in human experience. It might further our understanding of the causes of the shift to food production if we could determine what exceptional ecological and social factors distinguish the early Holocene cultures of the Nile Valley from those implicated in primary food production in various other areas where broadly similar conditions of life prevailed. That project, however, lies far beyond the scope of this article.

**BEGINNINGS OF FOOD PRODUCTION**

Given the possibility that livestock may figure centrally in Africa's only claim to an early Holocene occurrence of primary domestication, it seems reasonable to begin a survey of "beginnings" by considering animal domestication. In so doing, we immediately encounter a curious fact: despite the abundance of wild animals in Africa, including about half of the world's species of wild ungulates, very few have been domesticated.\textsuperscript{32} In fact, the only animal that can be said with certainty to have been domesticated in Africa is the guinea fowl. A few other species, such as the cat and the donkey, probably were domesticated in Africa. Although many animals that contribute substantially to human subsistence, including virtually all that are herded by African pastoralists, for example, camel, sheep, and goats, were domesticated elsewhere. Cattle, which are of great importance in both prehistoric food-producing societies and modern ones, may well have been domesticated in Africa. Indeed, there are tentative indications that cattle domesticated in Africa may have formed the basis of a desert neolithic that predated by as much as three millennia any African food-producing economy based on crop plants.

Evidence of the very early occurrence of domesticated African cattle comes from sites in the Western Desert of Egypt, Bir Kiseiba, and Nabta (Fig. 3), with respective dates of about 9,500 B.P. and 8,800 B.P.\textsuperscript{33} Although the dates have not been challenged, Smith\textsuperscript{35} and a number of other individuals have vigorously criticized the conclusion that domestic cattle are represented at these sites. This complex problem remains open to investigation. It is sufficient here to note that Wendorf and Schild,\textsuperscript{25} the leaders of the research team in the Western Desert, have presented a strong argument in support of the presence of domesticated cattle at Bir Kiseiba and Nabta. Their argument includes a suggestion that the process of domestication may have occurred in the Nile Valley. However, they also acknowledge that neither the domestic status of the cattle from the Western Desert nor the possibility that they were domesticated in the Nile Valley has yet been fully confirmed.

Regardless of the eventual outcome of these investigations, it is generally agreed that domestic cattle are well represented in the Saharan desert no later than 7,000 years ago.\textsuperscript{33} This is interesting because the desert neolithic based on livestock predates the earliest occurrence of food-producing cultures in the Nile Valley or anywhere else in Africa by at least 500 years and, if domestic cattle are shown beyond doubt to have been present at Bir Kiseiba and Nabta, by perhaps as much as 3,000 years. The chronological priority of the desert neolithic, combined with penetration of the Nile Valley by pottery of Saharan style by about 6,500 B.P., when the earliest occurrence of food production in the Nile Valley is evident all the way from Khartoum to the delta, has convinced various workers that food production was transferred from the Sahara to the Nile Valley.\textsuperscript{26}

The presumed impetus for this transfer was a marked increase of aridity in the Sahara between about 7,000 and 6,500 B.P. (Fig. 2). However, despite the chronological coherence of the Nile Valley neolithic, its subsistence base was sharply differentiated, with livestock herding the dominant, if not the only form of food production in the Sudanese part of the Nile Valley, and crop plant cultivation prominent in the Egyptian neolithic. Moreover, the species of plants grown in the Egyptian part of the Nile Valley were mainly Asiatic in origin, consisting of such winter rainfall crops as wheat and barley. Thus, although the collapse of the desert neolithic under the pressure of drought may have contributed to the emergence of the Nile Valley neolithic, the formative process...
TABLE 1. Cultivated Plants of Africa (After Harlan)

<table>
<thead>
<tr>
<th>Latin name</th>
<th>Common name and use</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Plants of the Savannah Complex</strong></td>
<td></td>
</tr>
<tr>
<td>Acacia albida</td>
<td>White acacia; subsistence, companion crop</td>
</tr>
<tr>
<td>Adansonia digitata</td>
<td>Baobab; multiple use, subsistence</td>
</tr>
<tr>
<td>Bauhinia purpurea</td>
<td>Karite; oil from fruit, encouraged</td>
</tr>
<tr>
<td>Colocynthis citrullus</td>
<td>Watermelon; edible fruits, pot herb, cultivated, weedy</td>
</tr>
<tr>
<td>Corchorus olitorius</td>
<td>Tossa jute; pot herb, leaves and seedlings, cultivated</td>
</tr>
<tr>
<td>Digitaria exilis</td>
<td>Fonio; a cereal, cultivated and weedy</td>
</tr>
<tr>
<td>D. iburu</td>
<td>Black fonio; limited cultivation</td>
</tr>
<tr>
<td>Hibiscus cannabinus</td>
<td>Kenaf; a pot herb in Africa, cultivated</td>
</tr>
<tr>
<td>H. sabdariffa</td>
<td>Roselle; leaves and calyces, cultivated</td>
</tr>
<tr>
<td>Logania dicera</td>
<td>Bottle gourd; widely used, cultivated</td>
</tr>
<tr>
<td>Ozaya glaberrima</td>
<td>African rice; cereal, cultivated and weed races</td>
</tr>
<tr>
<td>Parkia biglobosa</td>
<td>Tree with sweet pods; locust bean, subsistence</td>
</tr>
<tr>
<td>Pennisetum glaucum</td>
<td>Pearl millet; cereal, the drier zones, cultivated and weedy</td>
</tr>
<tr>
<td>Polygala butyracea</td>
<td>Black beniseed; oil in seeds, West Africa</td>
</tr>
<tr>
<td>Solanum aethiopicum</td>
<td>African tomato; edible fruits</td>
</tr>
<tr>
<td>S. macrocarpon</td>
<td>A nightshade; fruits and legumes, weedy</td>
</tr>
<tr>
<td>Sorghum bicolor</td>
<td>Sorghum; cereal, sweet stalks, fodder, cultivated, weedy</td>
</tr>
<tr>
<td>Vcandzea subterranea</td>
<td>Earthpige; Bambara groundnut, pulse cultivated</td>
</tr>
</tbody>
</table>

**Plants of the Forest Margin Complex**

<table>
<thead>
<tr>
<th>Latin name</th>
<th>Common name and use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Afromomum memegueta</td>
<td>Grain of paradise; spice, West Africa</td>
</tr>
<tr>
<td>Blighia sapida</td>
<td>Ake apple; aril eaten, forest, West Africa</td>
</tr>
<tr>
<td>Brachia daetica</td>
<td>Guinea millet; cereal, Guinea only</td>
</tr>
<tr>
<td>Coffea canephora</td>
<td>Robusta coffee; forest zones</td>
</tr>
<tr>
<td>Cola acuminata</td>
<td>Cola nut; forest, West Africa</td>
</tr>
<tr>
<td>C. nitida et ala</td>
<td>Cola nut; forest, West Africa</td>
</tr>
<tr>
<td>Dioscorea bulbifera</td>
<td>Air potato; aerial tubers, wide distribution</td>
</tr>
<tr>
<td>D. rotundata</td>
<td>White guinea yam; forest, West Africa</td>
</tr>
<tr>
<td>Elaeis guineensis</td>
<td>Oil palm; forest, West Africa to Angola</td>
</tr>
<tr>
<td>Hibiscus esculentus</td>
<td>Olea; garden, vegetable, common in West Africa</td>
</tr>
<tr>
<td>Kerstingelia geocarpia</td>
<td>A groundnut; limited culture, West Africa</td>
</tr>
<tr>
<td>Labisia niger</td>
<td>Hyacinth bean; now widespread, East Africa</td>
</tr>
<tr>
<td>Plectranthus exculentus</td>
<td>Hausa potato; tuber, West Africa</td>
</tr>
<tr>
<td>Solenostemon rotundifolius</td>
<td>Rassa; becoming rare, West Africa</td>
</tr>
<tr>
<td>Sphenostilis stenocarpa</td>
<td>Yampea; tuberous legume, West Africa</td>
</tr>
<tr>
<td>Telfara occidentalis</td>
<td>Fluted gourd; fruits and seeds, West Africa</td>
</tr>
<tr>
<td>Vigna unguiculata</td>
<td>Cowpea; pulse, West Africa</td>
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</tbody>
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**Plants of the Ethiopian Complex**

<table>
<thead>
<tr>
<th>Latin name</th>
<th>Common name and use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avena abyssinica</td>
<td>Tetraploid oats; weeds in barley and emmer fields</td>
</tr>
<tr>
<td>Catha edulis</td>
<td>Chaff; a mild narcotic, chewed fresh</td>
</tr>
<tr>
<td>Coffea arabica</td>
<td>Primary coffee of commerce</td>
</tr>
<tr>
<td>Eleusine coracana</td>
<td>Finger millet; perhaps domesticated in Uganda</td>
</tr>
<tr>
<td>Ensete ventricosum</td>
<td>Enset; a relative of banana, stem base eaten</td>
</tr>
<tr>
<td>Eragrostis tef</td>
<td>Tef; the principal cereal of Ethiopia</td>
</tr>
<tr>
<td>Guizotia abyssinca</td>
<td>Naog; the main edible oil crop of Ethiopia</td>
</tr>
</tbody>
</table>

apparently was complex, and not just a matter of wholesale displacement of the desert neolithic into the Nile Valley. This brings us back to the problem of explaining why food production should have originated in the desert. Unfortunately, the only reasonable way to deal with the problem at present is rather lame to repeat earlier observations about the poverty of information on the subject, which renders any explanation highly tentative. But there are two other straws in the wind that deserve mention. One is the previously noted possibility that the actual place of domestication of the desert neolithic cattle was, in fact, the Nile Valley. If this is true, it would, by itself, explain nothing, but would require a redefinition of the problem. The other point relates to the abundant remains of plant foods recovered from a desert neolithic site at Nabta, which has been securely dated to about 8,000 B.P., well within the temporal span of the great early Holocene wet phase (Fig. 2). The site contains numerous features, some interpreted as traces of houses, from which charred plant fragments have been excavated. The seed and nut fragments represent a wide variety of species, including at least one tree, some herbaeaceous plants, and several grasses. The most frequently occurring of the grasses is sorghum, a summer rainfall plant (like most cereal crops of African origin), the cultivated varieties of which are important members of modern African subsistence regimes (Table 1). Both morphologically and biochemically, sorghum from Nabta is said to resemble cultivated forms more closely than it does wild ones, although it cannot be unambiguously identified as a domesticated species. If it is domesticated, it is the only such species from the Nabta plant assemblage, earlier reports of cultivated barley from the site having been disproved. Moreover, as we have seen, cattle may have been domesticated in the same area, although, perhaps, substantially earlier. If domesticated sorghum is confirmed at Nabta, it would predate by nearly two millennia the initial appearance of domesticated plants in the Nile Valley. Furthermore, the con-
text of primary food production at Nabta would represent a marked departure from the emerging global pattern discussed earlier. The groups implicated in the domestication of plants in the eastern Sahara may have been relatively sedentary; pottery is present, though not abundant, and house floors have been recognized, as have features interpreted as storage pits, wells, and so on. Nevertheless, these groups clearly did not inhabit a resource-rich area. In this respect, the contrast with circumstances in the Nile Valley is obvious, and points toward the possibility of uncovering causes of the shift to food production by comparing the desert and valley situations. Such inquiry, of course, is contingent on resolving questions as to the domesticated status of cattle and sorghum at early Holocene sites of the eastern Sahara, as well as determining whether the cattle were domesticated in the desert or the valley.

These unresolved issues should not deflect us from paying attention to plant domestication in Africa. The topic is important because of the wide variety of crop plants that have been domesticated on the continent. As shown in Table 1, these include three distinct associations, each adapted to different environments. Figure 4 shows that the constituents of these three groups apparently were all domesticated south of the Sahara, for this is where their wild progenitors are found. Unfortunately, although we know quite a bit about the probable areas of domestication, we have virtually no chronometric data concerning the earliest occurrence of the crop plants. In fact, the vast majority of the very limited number of dates on prehistoric crop plants from sub-Saharan Africa lie within the past two millennia. Because many of these dates come from South Africa, where research on early food-producing cultures has been pursued much more intensively than it has in most other parts of the subcontinent, the dates almost certainly are substantially later than the age of domestication, which occurred thousands of kilometers to the north.

In the present state of knowledge, the most convincing indication of the earliest dates for domestication of plants in Africa comes, ironically, from India. Evidence of African crops, including sorghum, in India during the fourth millennium B.P. suggests that these crops were domesticated by 4,000 B.P. if not earlier. Apart from the dates on the sorghum of questionable domestic status from Nabta, this is the earliest age so far proposed for African crops, preceding radiocarbon dates on domesticated pearl millet from West Africa by several centuries.

**SPREAD OF FOOD PRODUCTION**

Leaving aside the Nile Valley, where, by about 6,500 B.P., livestock herding is evident as far south as Khartoum, the first breakthrough of domesticated species into sub-Saharan Africa apparently occurred somewhat earlier than 4,000 B.P. At that time, cattle,
sheep, and goats were present at Donggodien, East Turkana (Fig. 3) and small stock were present at Enkapune Ya Muto, a site on the western escarpment of the Kenya Rift Valley. A few centuries later, there were cattle at various sub-Saharan sites in West Africa, including Daima, Nsere, and Kintampo (Fig. 3). No firm evidence of the cultivation of crop plants is present in any of these instances of the first occurrence of domestic fauna south of the Sahara, including the Nile Valley sites near Khartoum, such as Kadada, Shaimaib, and Kadero (Fig. 3). Thus, it seems that in sub-Saharan Africa, as in the Sahara, the transition to food production depended heavily, if not exclusively, on herding rather than agriculture.

It is questionable whether early stock-keeping in eastern Africa south of Khartoum really amounted to food production. From about 4,000 to 3,000 B.P., the remains of domestic animals at sites in Kenya and northern Tanzania comprised a small minority of the faunal assemblages, which were dominated by wild species. In fact, livestock herding during this period apparently differed markedly from the practices of specialized modern pastoralists in the same area, who are heavily dependent on their herds for subsistence and seldom, if ever, hunt wild animals.

At present, we can only speculate about the role of domestic fauna in the early “food-producing” cultures of eastern Africa. We can imagine, for example, that domestic animals were kept as subsistence insurance against shortages of wild resources, or as items of prestige in a hierarchically differentiated social system. In any event, by about 3,000 B.P. there is a preponderance of domestic animals at most sites, suggesting the emergence of specialized forms of pastoralism.

The southward spread of livestock herding at about 4,000 B.P. generally is attributed to the arid climate that prevailed in Africa north of the equator at the time (Fig. 2). This climatic regime had two important consequences that favored herding in eastern Africa: a marked reduction of the zone of tsetse infestation, broadly delimited by the 640 mm isohyets (Fig. 1), and a marked increase in the availability of prime grazing land in the rift valleys and elsewhere because of the shrinkage of the lakes. But when conditions for herding were improving in eastern Africa, the Post-Neolithic Arid Phase made it difficult to sustain herding economies in the Sahara. Consequently, the spread of livestock into eastern Africa can be seen as the outcome of “push-pull” pressures.

Although a generally similar ecological argument is often invoked to explain the first traces of food production in sub-Saharan West Africa, Stahl essentially, what has happened is that some workers have explicitly abandoned the quest for “the first cow,” “the first grain of domestic sorghum,” and so on, substituting an approach that can be characterized as working backwards from present-day African practices in subsistence farming and herding.

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has suggested a different scenario. Without denying that the arid phase at about 4,000 B.P. may have forced desert Neolithic cultures out of the Sahara into West Africa, she calls attention to evidence of increasing sedentism, use of ceramics, and subsistence intensification in different ways among different zones of sub-Saharan West Africa. This, she suggests, may imply that local developmental processes played a greater role in shaping early West African food production than did the ecological history of the Sahara.

By about 2,000 B.P., or perhaps a few centuries earlier, parts of East Africa (Kenya, Tanzania, and Uganda) were occupied by iron-making cultures that kept livestock—cattle, sheep, and goats—and also cultivated crop plants. At approximately the same time, there are rather more meager indications of plant cultivation from sites that contain pottery and ground stone hoes and axes in coastal areas of West Africa near the mouth of the Zaire River. Although direct evidence of plant cultivation by early Iron-Age cultures is scarce in East Africa, it is more abundant in sites farther south with stylistically similar material culture. This, together with such circumstantial evidence as iron hoes in East Africa, leaves little room for doubt that some type of agriculture or agropastoralism was brought into the area by its early Iron-Age occupants.

From this area, iron-making cultures practicing agropastoralism spread rapidly southward (Fig. 1), their rate of spread determined, perhaps in part, by tendencies toward ecological destabilization inherent in their technologies, including iron smelting and swidden cultivation. Some of the foraging cultures with which they had contact obtained livestock by exchange or theft and developed their own pastoral economies, such as that of the Khoe-Eskimos. Thus, by about 1,600 B.P., food production, in the form of sheep herding, had reached the Cape of Good Hope.

This outline of the spread of food production in Africa may give the impression that the process consisted of an inexorable southward flow of economies that depended on domesticated plants and animals. That view is supported by ethnographic observations, which suggest that once a foraging culture becomes committed to food production, it tends to cling tenaciously to its new mode of subsistence. However, recent work has revealed a much greater degree of flexibility in subsistence practices, especially among pastoralist and agropastoralist regimes, which are rather freely interchanged, given appropriate socioeconomic conditions.

This suggests that the spread of early food production in Africa may actually have entailed considerable oscillation, rather than being the linear process implied by my brief account.
NEW APPROACHES

At this point, the reader will doubtless be ready to accept at least one generalization about early food production in sub-Saharan Africa: we do not know about the subject is much more extensive than what we do know. As I indicated at the outset, two recently developed approaches to generating knowledge about this subject are contributing fresh data and new perspectives. One of these approaches clearly is a reaction to the shortcomings of conventional research. The other approach might have blossomed even if the "old" ways of seeking knowledge had been more productive, but in that case probably would have attracted less attention.

The first approach represents a true paradigm shift, in that it more or less stands the conventional approach to research on its head. Essentially, what has happened is that some workers have explicitly abandoned the quest for "the first cow," "the first grain of domestic sorghum," and so on, substituting an approach that can be characterized as working backward from present-day African practices in subsistence farming and herding. This is not simply a matter of drawing on ethnographic models to reconstruct prehistoric food production, or even necessarily a matter of establishing direct cultural links between present economic regimes and their prehistoric antecedents, although such methods may be included. What is fundamentally at stake is an effort to describe modern systems of food production, including such aspects as crop selection, field layouts, irrigation methods, livestock enclosure systems, and manuring, in sufficient detail to permit backtracking to earlier states of the systems and thus delineating patterns of the development. Although this is not the place for an exhaustive critique of the method, I should at least note that its strength lies in the fact that, as stated earlier, Africa contains abundant opportunities for linking the material correlates of modern behavior to the archeological record. The major weakness of this approach is that it tends to encourage rigidly uniformitarian inferences about the past, which sometimes obstruct the discovery of cultural characteristics that have no modern analogue.

The second approach involves using linguistic evidence to reconstruct the economies of the prehistoric ancestors of modern language groups, then to seek parallels to these economies in the history of archeologically defined entities. Although this method has been employed with varying degrees of success for many years in Africa, Ehrret has recently effected a major extension of its scope by using the method to merge the subsistence regime of what I have called the desert neolithic with the linguistically revealed domestic economy of the speakers of the Nilo-Saharan language family. The results are intriguing; among other things, they lend support to the early presence of domestic cattle at Bir Kiseiba and Nafata. Unfortunately, however, the basis for the merger, which is parallel archeological and linguistic chronologies of development, is built on a shaky foundation. The linguistic chronology requires dating assumptions, which, in Ehrret's words, entail "a large degree of guesswork." And, as I have tried to show, the archeological chronology of early food production in Africa is far from being securely established in most parts of the continent.

In the end, it seems that an adequate understanding of early food production in sub-Saharan Africa awaits the outcome of many years of future data collection, not only along new lines of inquiry, but especially as regards archeological recovery of primary evidence of prehistoric crop raising and herding. However, the results should be rewarding, particularly in contributing to our understanding of the global transition from food gathering to food production, which was a crucial aspect of cultural evolution. The African version of this transition appears to include various anomalies, such as the tendency for livestock herding, often in circumstances that imply a remarkably low degree of mobility, to predate cultivation. Moreover, our ability to discern the social processes embedded in early food production is enhanced by the abundance of ethnographic and historical information on farming and pastoralism in Africa. Thus, for example, the use of livestock as an instrument of wealth among contemporary pastoralists may point toward crucial social factors in the emergence of African pastoralists. Similarly, detailed ethnographic data on gender roles among contemporary cultivators may suggest social relations that were strongly implicated in the domestication of African plants. For the moment, however, such prospects remain, in large measure, unrealized, pending the results of as yet unaccomplished work.

Acknowledgments

Figure 4 and Table 1 are reprinted from The Origins of Agriculture: An International Perspective by Cowan and Watson, published by the Smithsonian Institution in Washington, D.C.

REFERENCES