

The domestication process in Northeast Africa: ecological change and adaptive strategies

Introduction: Palaeoenvironmental considerations

Increasingly, evidence on the extent and chronology of climatic change in northern and eastern Africa during the later Pleistocene and early Holocene makes it possible to understand better the effect such episodes of stress or amelioration may have on the emergence there of pastoral and mixed farming economies some time between eight and six thousand years ago.

The aridity and cooler conditions that characterised the period between c. 20,000 and 12,000 years ago (Rognon, 1976) drastically reduced or entirely precluded human occupation of the desert and can, therefore, be presumed to have been responsible for increasing the populations of the retreat areas north and south of the Sahara and along the Nile. The moister and more favourable conditions that resulted from the northward influence of the tropical monsoon climate during the early Holocene caused the lakes to fill again or levels to rise and put water into the stream systems fed from the high desert massifs. In the Nile the flood level fluctuated with the changes in the climatic regimen in East Africa and on the Ethiopian plateau but was generally high between 10,000 and 5,000 BC with lows between 8,000 and 7,500 BC and again between 5,000 and 4,000 BC. The extended low floods along the Blue Nile between about 9,000 and 6,500 BC presumably reflect drier conditions during that time on the Ethiopian Plateau (Butzer, 1980: 272; Williams and Adamson, 1980: 300 - 301).

The effect of this climatic amelioration on the human and animal populations can be seen in the repopulation of the desert after 10,000 BC (Clark, 1976 [a]; Wendorf and Hassan, 1980). Particularly important was the extensive use made of water resources (where these existed), especially the protein and fat to be obtained from hippopotamus, fish and certain molluscs (Smith, A. B., 1980: 452 - 4; Phillipson, 1977 [a]: 47 - 9). This was possible in particular along the Nile and in the central Sudan, round the Saharan lakes, along the sea coasts and southward in the region

of the East African lakes. Between about 10,000 and 3,000 BC the Sahel and Sudanic vegetation belts may have extended as much as 4° northward of their present limits (Hobler and Hester, 1969; Maley, 1977) thereby making available to the Saharan people the wide range of grasses of these zones, some of which were later domesticated and became important staple crops in West Africa and Ethiopia (Harlan, 1971).

The previous period of lowered temperatures and reduced evaporation during the late Pleistocene had permitted the Mediterranean flora to move south; the recent discoveries at Wadi Kubbania indicate that one result of this was that wheat and barley were able to grow 18,000 years ago in Upper Egypt as far south as Aswan and as much as 10° south of where their centre of origin in southwest Asia is considered to have been (Wendorf *et al.*, 1979). Since relict communities of Mediterranean species are still present today in refuge areas in the massifs of the central Sahara, it is not unreasonable to expect that barley, at least, would have survived in favourable localities in the valley of the Nile and so have been available to be brought under cultivation. Early Holocene fossil remains and representations in rock art show that the large game animals of the Ethiopian and Holarctic faunal provinces also spread widely again within the Sahara at this time (Mauny, 1956 [a]; Jaeger, 1975: 404 - 5). The rock art shows not only the importance of hunting for the epi-Palaeolithic immigrants into the desert but also hints at the kind of special relationship that developed between the hunters and the animals they hunted. In particular is this the case with wild cattle which were spread at least as far south as the southern limits of the winter rainfall which, today, are approximately on the latitude of the Tropic (Gautier, 1968: 85 - 9). This special relationship and the fossil remains suggest that the north African wild cattle were ancestral to the first domesticated cattle there, perhaps as early as 6,000 BC. While, therefore, the desert areas were much restricted between 12,000 and 5,000 years ago compared with their extent today and water and grazing were relatively more plentiful, the balance was clearly a delicate one as can be seen by the evidence for remobilization of dunes from Senegal to Chad and the western Sudan between 6,000 and 4,000 and again about 2000 years ago (Talbot, 1980: 41 - 5). Successful exploitation of resources in this relatively fragile environment would have favoured mobility and social groupings of fluctuating size, coalesced or split into smaller units as seasonal availability of resources dictated. This is the pattern favoured by hunter/gatherers in Africa today (*e.g.* Lee, 1976) and by the nomadic pastoral populations of northern Africa (Monod, 1975: 99 - 183) and can provide a model for that of the early post-Pleistocene populations (Clark, 1980: 572).

Climatic and accompanying environmental fluctuations can be seen, therefore, as directly affecting population densities in the Sahara and along the Nile so that a rhythm of movement was initiated out of the desiccated areas in times of drought (as happened from the Sahara into the Sahel and savanna in the 1970s) and back again when water and grazing sources once more became available (Dalby *et al.*, 1977). The stresses on the social and economic behaviour of hunter/gatherers and

pastoralists in the desert during times of drought, as well as those affecting the Nile populations due to the influx into the valley from east and west, clearly necessitated readjustment in life-ways that affected the whole social system. Environmental change was but one, albeit an important one, of a number of interacting factors that affected the way in which early Holocene human populations readjusted. When one or more of these factors — ecological and cultural — underwent change the chain reaction set up affected the whole socio-economic system. The particular patterns that emerged throughout this vast area when equilibrium, if we can call it such, was re-established, were as varied as the circumstances of the ecology and selective preferences of the populations made possible. For prehistorians this variability is manifest in the regional differences seen in the technology and the economic evidence that can be interpreted from the associated food waste and the other land-use behaviour suggested by the demographic patterning. Changing ecology, therefore, is suggested to be by no means the only, though one of the most important influences affecting the development of food production in the predominantly arid regions of northeast Africa. It is considered that we should not look at the different regions with the often locally specialised material aspects of their technologies as isolates. Rather are they part of a general system or complex of behaviour adapted to desert and river that must be treated as an entity since there is an underlying web of traits that determined a more holistic approach transcending the specifics of individual technologies. The behaviour behind the artifacts can be expected to become more understandable against the models available from ethnography when studies of residue patterning on sealed occupation sites and of edgewear leading to identification of the uses of stone and bone tools become the rule and not the exception.

It is the dispersed nature of resources, their seasonal availability and the degree of mobility needed for their exploitation that can be seen to have encouraged and maintained regular contacts between widely separated groups and regions and set up a network of exchange relationships manifest, for example, in the trade in amazonite (Mauny, 1956 [b]). We can look at these desert and waterside cultures at two different levels, therefore — that of the general behavioural level and the overall similarity in life-ways dictated by the desert environment; and the more specific, localised, level that should eventually allow us, through technological studies of style and raw materials, to identify boundaries from the significant characteristics local assemblages have in common and that may, thereby, perhaps have wider ethnic implications.

The northern Sahara: The desert cultures

We are still a long way from being able to do this meaningfully for any one region but, at the more general behavioural level it is possible to see some broad differences between the artifact assemblages that lie north of the Tropic and those below.

Those to the north are characterised mainly by backed bladelets, in particular straight backed forms and geometric microliths not infrequently produced by the micro-burin method. There are sometimes a large number of denticulated forms of scrapers and blades. Pottery is absent or not common at first and the barbed bone points do not occur except on the Nile and in the Fayum. Grinding stones for cereal grasses are sometimes common and sometimes rare.

There was a lag of several thousand years before the earlier Holocene wetter phase began some 6,000 - 7,000 BC and these more humid Holocene climatic episodes were of shorter duration in northern Africa than in the south — about 7,500, 6,000 - 5,000 and 4,500 - 1000 BC — and the conditions appear to have been generally drier in the northern Sahara with such lake areas as occurred drying out more quickly (Williams, 1984). Hunting and grain collecting appear to have been the basis of the economy which can perhaps at this time be best interpreted in the light of what is known about the terminal Pleistocene and early Holocene sites (the Esnan, Qarunian, etc.) investigated by Wendorf and his team on the Nile in Upper Egypt and the Fayum (Wendorf and Schild, 1976: 259 - 319); by Hobler and Hester around Dakhla Oasis (“Libyan Culture”) (Hobler and Hester, 1969); by Hassan at Siwa Oasis (1978) and by the epi-Palaeolithic (Lubell *et al.*, 1976) and the Neolithic of Capsian Tradition of the Maghreb (Roubet, 1979). Except along the Nile, all of these sites appear to have been camps or settlements of relatively small groups of people. The ethnic affinities of the peoples reflected in the cultural assemblages north of the Tropic are less well known than those further south. However, since fossil remains ascribed by Chamla and others to both Negro and Afro-Mediterranean stock are found in the Sahara in Neolithic and early proto-historic times (Chamla, 1968: 199 - 201) and the remains described as “early Mediterranean” are found associated with Upper Capsian occupation sites in the eastern Maghreb (Camps, 1974: 158 - 62), it may have been people of this stock who repopulated the northern Sahara in the early Holocene.

The central and southern Sahara: Waterside sites and the Khartoum Complex

The central and southern Sahara, on the other hand, during epi-Palaeolithic and Neolithic times appears to have been a zone of overlap between temperate and tropical rains. The high levels and so wetter episodes of Lake Chad date to some 9,000, 7,000 - 6,000, 4,000 and 1,500 to 1000 years BC; the drier times were c. 8,000, 5,500, 2,500 - 2000 years BC and the last 2000 years (Servant and Servant, 1980; Williams, 1984). In general, these events are reflected, though incompletely, in the desert massifs (Hoggar, Tibesti and Air) (Street and Grove, 1976). The cultural manifestation associated with the onset of the Holocene wetter episode after 8,000 BC, the Khartoum Complex, is best known for its waterside adaptation along the Nile and round the Saharan lakes and playas with a related manifestation in the region of the East African lakes. Here specialisation in fishing, hippopotamus hunting and

mollusc collecting reduced the need for mobility and resulted in quite extensive and at least some semi-permanent settlement areas with wattle and daub structures and a material culture that included several varieties of barbed bone points, sometimes net-sinkers, curved backed microliths including a large backed lunate form, and large, wide-mouthed and deep bowls or pots with several decorative motifs notably the well-known "Wavy Line" pottery. The oldest dates for Khartoum Complex sites are between 7,400 and 6,000 BC: *e.g.* on the Nile near Khartoum at Sarurab II — $9,370 \pm 110$ and $9,330 \pm 110$ BP (A. R. M. Khabir, personal communication); $9,080 \pm 70$ and $8,640 \pm 70$ BP from Ti-n-Torha in the Acacus (Barich, 1974: 170), and $8,130 \pm 100$ BP at Nabta Playa in the Western Desert of Egypt (Wendorf *et al.*, 1976: 112) and there can be little doubt that the associated pottery is a regional and independent development, most probably resulting from the need to process large quantities of fish and molluscs (mostly *Pila*). The manner of preparing the fish and recovery of the oil, in large open pots, found among the Bozo on the middle Niger (Ligers, 1966, II: Plate IX) does not appear to differ greatly from the description of the methods of the Ichthiophagi on the Red Sea coast and, apparently, also on the Nile given by Diodorus, Strabo and other classical geographers in the first century BC (Budge, 1928: 63, 67 - 8). The Khartoum Complex people used some eight or more species of fish and in particular large Nile perch are not uncommon. They also made extensive use of wild grasses judging from the amount of grinding equipment at their occupation sites (Arkell, 1949: 16 - 17, 30 - 73). Hunting of medium-to large-sized land mammals also provided an important part of the diet but of special significance, it would seem, was hippopotamus-hunting. The importance of this animal appears to have been underplayed due, no doubt, to the difficulty of estimating numbers of kills when animals are butchered where they were killed, often away from the camp sites. Nonetheless, hippo bones are usually cited as "not uncommon" on Khartoum Complex camp sites (Arkell, 1949: 22) and the amount of meat from one of these animals is equalled only by that from an elephant. The Wayto hippo hunters of Lake Tana and other parts of Ethiopia provide an ethnographic analogue for these waterside sites of the central Sudan, if allowance is made for the greater abundance of fish in the latter region. The Wayto were probably originally Nilotes and much more widely distributed (on the Takazze, for example) than today. They are a despised minority who, until recently, lived by hunting, gathering and fishing. Their way of life in all its aspects was based upon the hippopotamus (Gamst, 1979). The dense populations of hippo on Lake Tana led to relatively large groupings and extended Wayto permanent settlements. An adult hippo weighs between 1524 and 2540 kgs so that a single animal will provide a large amount of meat and, which is particularly important for hunter/gatherers, of fat that would feed a Wayto village of 50 people for a considerable time. A similar, though less well documented, population that concentrated on hippo hunting existed on Lake Abaya in the southern Ethiopian Rift. It is, thus, clear that the Wayto are not a special case so that they may provide a basis for a model against which to compare the way of life of the po-

pulations responsible for the Khartoum Complex along the main river and other waterways of the Nile system.

Where aquatic foods were scarce or absent, a greater emphasis was placed on terrestrial mammal hunting, availability of species and their size being environmentally determined (Barich, 1974: 160).

Although deductions based on technological inferences are not generally reliable, it would, nevertheless, appear that this more southerly region inhabited by the makers of the Khartoum Complex and related cultural entities, allowed greater opportunities for experiment and cultural development even though the northern peoples were in a more favourable position to be affected by cultural influences originating outside the continent. Along the Nile, both in the north and, especially, in the Sudan, the sizes of settlements and the reliance on aquatic foods suggest that populations were able to increase to a density not previously achieved and they may have been able to reduce considerably the amount of seasonal territorial displacement that would otherwise have been necessary and to establish this on more regulated lines (Clark, 1972: 131 - 3).

Skeletal remains with the Khartoum Complex suggest that this and the descendant Complexes that follow may be ethnically related to the ancestors of the Sudanese Negroes (Derry, 1949) as also, perhaps, to the largely vanished Negro populations of the Sahara (Briggs, 1967: 66 - 72).

Earliest evidence of food production

The inhabitants of both the northern and southern Culture Areas had achieved a degree of pre-adaptation that necessitated, at least at first, no very drastic behavioural changes following the acquisition of domestic plants and animals. Equally it is likely that herding and cultivating were not activities that were adopted before it became necessary or expedient to do so. This is well documented by the case of the Sandawe in Tanzania (Newman, 1970) or the San Bushmen in Botswana today (Lee, 1979: 409 - 14) and is determined by the amount of input of labour versus returns in continuing the traditional pattern of behaviour. The effect on foragers of environmental or demographic stress may lead to an intensification of foraging activities with more time and energy put into food procurement and greater distances travelled; or to broadening the economic base by bringing more of the territorial resources into use; or again to making more intensive use of the staples which may be collected in greater abundance for storage so that a reserve is built up. This, in turn, means that the storage areas have to be protected, exchange networks may become more regularised and symbiotic relationships between groups with different behaviour patterns may be established. Also, of course, some groups will choose to maintain virtually unchanged their traditional life style within the symbiotic system.

As yet, the chronology and evidence for domestication in northeast Africa is so incomplete and uncertain that the circumstances and causes leading up to it and

the time when herding and plant cultivation began still have to be convincingly identified; a situation that will only be possible after further systematic excavation and analysis of the settlements and their contents and of intersettlement relations. By 5,000 BC domestic ovicaprids were present in north Africa. At Nabta Playa in the Western Desert, ovicaprids have been identified with the early Neolithic dating to 6,000 BC (Wendorf *et al.*, 1976). It is possible that *Bos* may also be domestic here and claims have been made that the earliest domestic cattle in the Tassili may also be as much as 8,000 years old (Mori, 1965: 240). This rather argues against an earlier stage of small stock herding and a later one when cattle dominated; only further research will resolve this problem. Also to be determined is the extent to which environmental stress was an initiator of economic change. Clearly, no one-to-one relationship should be expected in view of the differences in rainfall regimen and onset of wetter and drier phases in the desert. Also the extent to which influences from southwest Asia may have affected the change to agriculture remains to be determined. Few, surely, believe that this was on the scale once claimed by egyptologists and today the emphasis is on internal, not external, factors that were the catalysts leading to domestication. Were these factors the same in the north as to the south? was there any significant delay in the appearance of domesticates in the south? and, if so, what was the reason for such delay? Did herding of cattle and experimental capturing and taming of other animals first take place in the desert areas or did it start in the Nile valley? Data at present favour the desert but systematic studies of settlements in the valley belonging to the crucial period 8,000 to 5,000 BC mostly still remain to be undertaken. The more abundant food sources, the larger groupings and improved facilities along the river can be expected to have permitted a degree of experimentation in manipulating animals and plants that could, when stress occurred, have resulted in the adoption of herding and/or cultivating as ways of supplementing and improving the diet. On the other hand, it can be argued that the close association of humans and animals in the oases brought about by increasing desiccation, might equally have given rise to herding behaviour. This still remains an open question until more evidence becomes available, though this writer inclines to favour the riverine peoples as having first taken the crucial steps towards food production. These are all questions which require to be answered before the course of domestication in northeast Africa can become clearer. One may suspect that the process began at much the same time and for much the same reasons in both desert and valley.

Studies of the San Bushmen in the Kalahari and of nomadic pastoralists and marginal cultivators in the western Sudan and the Sahel suggest strongly that, in arid or semi-arid environments, agriculture does not always provide the security that is usually assumed to accompany food production (*e.g.* Tubiana and Tubiana, 1977).

On ethnographic and prehistoric evidence a range of adaptations may be expected to have manifested themselves by 5,000 BC in the north and 4,000 - 3,000 BC

in the south. This is beginning to become clearer from the recent work in the central Sudan where, after the Nile began to cut into its bed about 5,000 years ago and to expose large areas of the alluvial plains to settlement, several experimental patterns of exploitation began to emerge in the valley of the Nile (Williams, in press). This is exemplified in the settlements belonging to the Shaheinab Complex between about 3,500 and 2,500 BC during a period of increasing desiccation. Excavations at Esh Shaheinab itself (Arkell, 1953), Kadero (Krzyżaniak, 1978), Zakiab (Haaland, 1978)

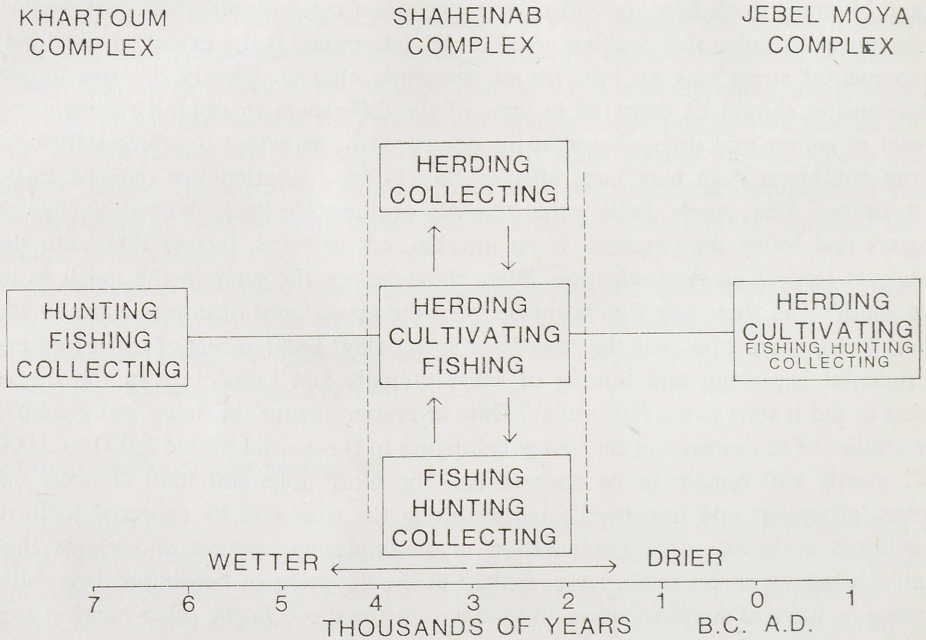


FIG. 1. Model for Holocene economic adjustments in the Central Sudan

and other sites show the economic base to have alternated between hunting, fishing and collecting; hunting, herding, fishing and collecting; herding and collecting; herding, cultivating and fishing and further permutations. These patterns, ethnography suggests, are likely to have been highly flexible; they may have changed seasonally or as a response to short-term environmental or demographic stress. An attempt has been made to show this by the arrows in Figure 1. Also on the Upper Nile, the replacement of old by new kinds of equipment, or ceramic decoration and the continuation of some of these up to and into the beginning of the present era, as seen in the Jebel Moya Complex, exemplifies a technological and ethnic continuity that has its roots far back in the Khartoum Complex (Clark, 1984). A similar situation seems to have existed in the Sahara (if the evidence from Dhar Tichitt is not too far to the west to be meaningful in the northeast) until the populations

were displaced in the first millennium BC by a combination of ecological necessity and militant, metal-using, horse-riding nomads from the north (Munson and Munson, 1969).

An appreciation of the relative importance of herding and cultivating for the populations along the Nile and in the desert is also crucial for understanding the domestication process. So far as the desert is concerned the emphasis can be expected to have been on stock-raising. The acquisition of stock removed, or much reduced, a group's vulnerability to famine; it provided a ready supply of meat on the hoof and milk products enabled less favourable or marginal areas to be brought into permanent use, thereby solving the problem of population increase attendant upon adoption of a food producing economy. At the same time, acquisition of stock, especially cattle, made possible a hierarchical social organization (Murdock, 1959: 33 - 34).

While extensive stands of wild grasses remained available in the desert it is to be expected that these were mostly collected, not cultivated, as is the case today. A likely model also is provided by the historic Hottentots or Khoikhoi who kept cattle and small stock but did not cultivate (Elphick, 1977: 23 - 42). The numerous grinding stones show the importance of grains but not how they were obtained and it is necessary to rely on unequivocal identification of the plant remains themselves to be certain on this crucial issue. Such cultivation as there may have been is hardly likely to have gone beyond the casual kind of planting and reaping that characterises the desert peoples today away from the irrigated oases (Forde, 1934: 396).

In the valley of the Nile itself it might be expected that the greater abundance of edible grasses and other plant foods would have provided even less incentive to cultivate and, even in Meroitic times, classical authors speak of only small barley and millet (presumably *Sorghum bicolor*) gardens and the extensive use of wild plant foods (Jones, 1932, Vol. 8: 143). From Nubia southwards the local grasses such as sorgum, *Pennisetum* and *Brachiaria* presumably replaced wheat and barley because these crops are not well adapted to tropical conditions except under irrigation. But the underlying pressures and stimuli that made the populations there turn to cultivating some of the wild species they had been collecting have not yet been identified. Certainly important factors must have been the need, in times of stress, to maintain population densities at the level which aquatic foods had made possible and to absorb the normal increases which the improved protein diet resulting from herding (meat and milk products) may be expected to have produced. Cultivation and produce exchange may also have enabled a hunting/gathering group successfully to prevent pastoralists from ousting them from their traditional foraging territory. Again, the products of cultivation provide a back-up for pastoralists when sickness or poor rains affect the grazing and reduce the stock yield.

If the domestic status of the plant remains from Kadero is confirmed, then these indigenous grasses first began to be cultivated in the fourth millennium BC. This is quite probable if the domestication process in northeast Africa was in any way

parallel to that in India where herding was being practised between 4,500 and 5,000 BC and rice may have been cultivated about the same time (Jacobson, 1979: 482 - 3). Alternatively, a relatively late date in the first millennium BC would not be unexpected with *Sorghum bicolor* becoming an important source of carbohydrates during Meroitic times and its rapid adoption by surrounding peoples.

The problem remains that, where wild plants and animal species abound as they did in Africa, the incentive for economic change, particularly towards cultivation and the added input of labour this demands, is likely to have been delayed until pressures on the social system and resources forced some groups to turn to cultivation thereby meeting the increased demand for large supplies of grain. Agriculture is not the only way of overcoming scarcity of resources; it did not follow, apparently from the Wadi Kubbaniya experiment, and, with the virtually unlimited wild food-stuffs available in the early Holocene, it would not be cause for surprise if the general move to mixed farming came relatively late in the rich environment of the Nile valley and the tropical parts of the continent.

At one time it seemed that African agriculture, outside the Nile valley, was indeed late in developing but increasingly early dates are now being associated with what have been identified as domesticated plant and animal remains, indicating that the first appearance of these may have been earlier than has previously been thought. If food production is an autochthonous development as a result of pressures and not a ready-made introduction from outside, then the speed and manner of its spread can be expected to have been uneven — coming early in some parts, late in others — depending on geographical, ecological and other factors. The reliability of isochronic maps or diagrams showing this spread, however, will only be apparent after much more well authenticated and dated evidence has been produced.

Ethiopia

Unlike the eastern and western deserts which were linked into a certain unity by the Nile, the Ethiopian high plateau was isolated geographically. On the other hand, the Ethiopian Rift may be regarded as an extension of the arid southwest Sudan and it seems probable that there were contacts between the plains and the plateau which, by reason of its temperate highland ecology, provided the human inhabitants with several different choices when faced with the need to turn from hunter/gathering to food production. Cattle herders are attested in the Rift by 1,500 BC (Clark, 1976 [b]: 77) but they were already in the Lake Turkana basin by 2,500 - 2,000 BC (Barthelme, 1977 and personal communication) so that the first introduction of stock-raising to Ethiopia cannot have been any later than the middle of the third millennium. The characteristically Ethiopian food plants *teff*, *nuq* and *enset* emphasise the isolation of these high plateau inhabitants from those of the plains to the north, while the longtime use of wheat and barley and of finger millet seemingly show that some contact, perhaps movements from the plains onto the

plateau, took place from time to time, in particular from the north and west. Unfortunately we have no evidence as to when any of these food plants were domesticated except for finger millet though confirmation would be desirable before the 2,000 BC date claimed for these very fresh remains from Axum area can be finally accepted since they are associated with a camel tooth in the exposed terrace outside a shelter close to an Axumite settlement (Phillipson, 1977 [b]).

Wheat and barley with livestock could have been introduced to early Cushitic-speakers on the Ethiopian plateau by Nilotes or pre-Nilotes seeking refuge from one or more of the periods of economic stress accompanying the onset of desiccation in the Sudan between the third and first millennia BC. Alternatively, since it is hard to see why *teff* and *enset* should have been brought under cultivation if wheat and barley were already available, these cereals could be imports with the plough complex by Pre-Axumites from south Arabia in the last half of the first millennium BC (Clark, 1976 [b]: 80 - 82). Negroid peoples who still remain as minorities on the southern parts of the plateau, are most likely to have first brought the *enset* under cultivation and the techniques of the Tschako, for example, may be representative of the ways in which the pseudo-stem of this curious plant — the false banana — was first cultivated and eaten (Straube, 1963: 26 - 32). *Enset* is a staple that supports some of the densest concentrations of rural population in the continent and in prehistoric times can be expected to have favoured relatively dense groupings and larger settlements together with a considerably reduced need for mobility.

There is abundant ethnographic evidence to provide models for the domestication process in Ethiopia but there is almost no archaeological evidence against which to test them and it behoves prehistorians, when political circumstances become more favourable, to put this right. At present it seems that stockraising may have begun in the mid-third millennium but whether the Ethiopian food plants were brought under cultivation at the same time or later remains an open question as does the extent to which events in the Sudan plains to the north and west may have influenced the course of events on the plateau and brought new peoples there. In turn, did plateau peoples move down into the plains and what effect, if any, did this have on the pastoralists of the clay plains and along the Nile? At least one instance when the Axumites sacked Meroe in historic times shows that earlier incursions should not be unexpected.

Some potential behavioural models

This paper has raised more questions than it has answered but no apologies are made for this since we do not have the data needed to provide answers. One approach can be through predictive models using archaeological, ethnographic, linguistic and historical sources that can be tested in the field. Figure 2 presents several star diagrams that attempt to show some of the different kinds of behaviour patterns that might be predicted in different eco-systems before and after the economic changes

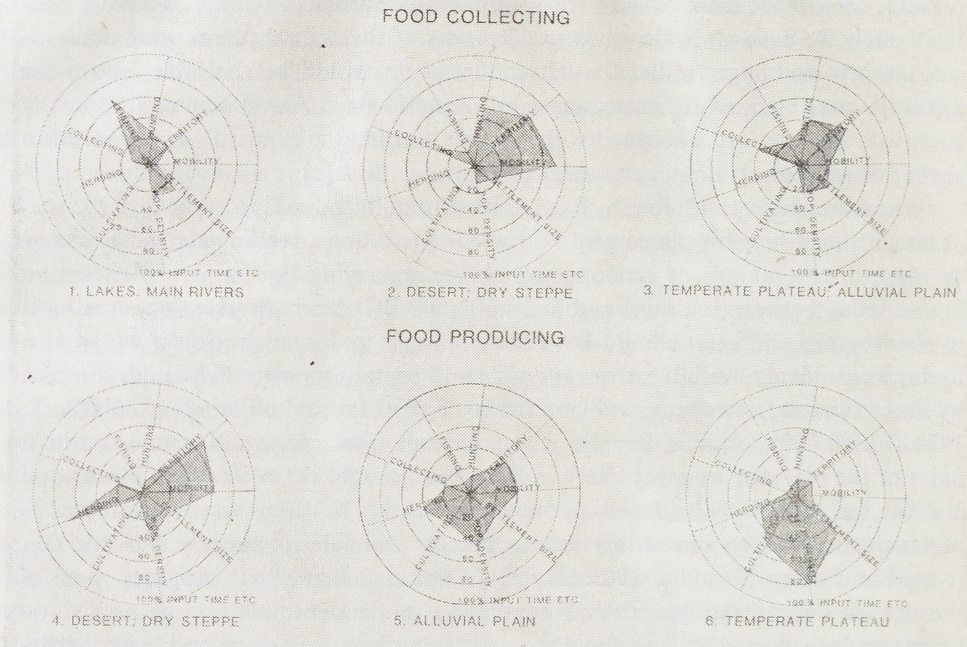


FIG. 2. Land-use model for pre-and post-domestication economies in North-East Africa

brought about by domestication. They are designed to emphasise that it was a broad spectrum of resources that was probably exploited by these prehistoric populations; to show the relative importance of some of the behavioural responses such as changes in population densities, mobility patterns, etc.; and to indicate how the emphasis shifted after food production. The models these diagrams represent are based on estimates of the relative importance of the main food-getting activities — hunting, herding, etc. — of relative settlement and territory size, distances travelled in the yearly cycle, etc. These estimates are obtained from such archaeological data as are available and from ethnographic literature on the peoples of the Sudan, Sahara, Sahel and Ethiopia examined in relation to that for peoples with similar economies in comparable eco-systems obtained from the Ethnographic Atlas (Murdock, 1967).

For the Khartoum Complex and later communities round the lakes and along the Nile the data for Shaheinab, Shabona (Clark, 1973), *etc.*, and the Wayto of Ethiopia and Bozo of the inland Niger delta, suggest much fishing and hunting of hippo and a wider amount of collecting, in particular of water plants of which the Wayto use some eight or nine. Population densities and settlement size would have been relatively large; the necessity for mobility was considerably reduced as also was the size of territories.

For the desert hunter/gatherers, using evidence from the San Bushmen, Hadza (Woodburn, 1968), Nemadi (Gabus, 1952) and other ethnographic peoples and the

very incomplete archaeological data, the emphasis is on hunting and collecting, on increasingly fluid social groupings splitting up and joining for communal hunting during the rains; the emphasis here is on mobility and extended territories.

On the temperate plateau grasslands with forest in Ethiopia and the annual grass and parkland of the central Sudan, scattered, incomplete, ethnographic evidence on the various Fuga, Watta hunting groups of Ethiopia (Shack, 1966: 8 - 12), the Bon, Ribí and Midgan of Somalia (Murdock, 1959: 59 - 63) and the Okiek of Kenya (Blackburn, 1974) suggest that a pattern emphasising hunting and collecting is repeated and territorial range, settlement size and mobility lie between estimates for the waterside sites and those in the desert.

After domestic animals and plants became available some of the waterside as well as other hunting/gathering populations persisted, indeed some still exist, much modified, today by establishing regular exchange relationships with surrounding food producers — fish, meat, hides and honey, for example, being exchanged for grain. This example of symbiotic relationship — Wayto, Okiek, Bozo, Pygmy (Turnbull, 1961), *etc.* — assured their survival. More than one model for desert pastoralists can clearly be constructed but, from a study of the Zaghawa, Tuareg (Nicolaissen, 1963; S. E. Smith, 1980), Fulani (Dupire, 1962), Baggara (Cunnison, 1966), Kibabish (Asad, 1970) and other peoples a pattern emerges emphasising herding, collecting and sporadic cultivation and grain supplies supplemented by barter, a system of seasonal dispersal and coalescing of social units and extensive territory utilization.

In the alluvial plain hunting and collecting may still be practised and, where seasonal inundation occurs, fish may be an important supplementary source of food. Stock-raising becomes all important accompanied by moderate amounts of cultivation done by women and girls. A seasonal pattern of congregating in large villages and dispersal into numerous small cattle camps is hypothesised necessitating regular patterns of land-use based on the data available for the Nuer (Evans-Pritchard, 1940) and other Nilotic peoples as well as patterns described from the Sudan (TOTHILL, 1948), for the Hausa (M. G. Smith, 1965) and other groups in the eastern Sahel, *etc.*

Lastly, on the temperate plateau, the economic base comes from cultivation and herding (Simoons, 1960). In prehistoric times herding in the northern parts of the plateau must have been as important as cereal cultivation but of lesser importance in the *enset*-growing areas to the south until the intensive system of cultivation by transplanting and manuring was introduced (Shack, 1966). Models for this diagram are suggested by the Cushitic-speaking Agau (Gamst, 1969) in the north, the Nilotic Gummi in the northeast (Simoons, 1960: 52 - 6) and the various, so-called "archaic" tribes — the Baka, Basketto, Dime, *etc.* — of southern Ethiopia (Jensen, 1959: 29 - 85; Haberland, 1959: 189 - 260).

These are, of course, only hypothetical constructs of unknown reliability though it should be possible to test them and so modify or replace them. Their value lies

in the framework they can provide for future research. There is now a need to undertake spatial analysis studies to show patterns of prehistoric land-use, excavation to obtain much more complete plans of settlements, more depth and breadth in analyses of food remains to obtain greater reliability and confidence in the identification of plant and animal domesticates and we need suites of dates rather than having to rely on results from a single sample. All these and more are essential for identifying the economic base and the kind of behaviour on which the social unit was maintained. There is now a need to regard each archaeological site as but a part of a system and to study the ecological data on a regional scale through such techniques as, for instance, site catchment analysis and estimating habitat values.

These are some of the methods and approaches whereby we can expect to arrive at a more complete understanding of the processes that underly the change from hunting and gathering to food production in Africa. This understanding will certainly be neither quick nor easy but, if we set about it in the way that the search for human origins is undertaken — by pooling resources and expertise in the form of interdisciplinary and international research teams with specific problems to solve, crucial localities to investigate in depth, and dynamic models to test — an exciting new break-through in our understanding of how and when domestication in Africa came about is inevitable.

References

- Arkell, A. J. 1949. *Early Khartoum*. London.
 — 1953. *Shaheinab*. London.
- Asad, T. 1970. *The Kababish Arabs: Power, authority and consent in a nomadic tribe*. New York.
- Barich, B. E. 1974. *La serie stratigrafica dell'Uadi Ti-n-Torha (Acacus, Libia)*. Rome.
- Barthelme, J. 1977. Holocene sites northeast of Lake Turkana. *Azania* 12: 33 - 41.
- Blackburn, R. H. 1974. The Okiek and their history. *Azania* 9: 139 - 157.
- Briggs, L. C. 1967. *Tribes of the Sahara*. Cambridge, Mass.
- Budge, E. A. W. 1928. *A history of Ethiopia, Nubia and Abyssinia* 2 vols. London.
- Butzer, K. W. 1980. Pleistocene history of the Nile valley in Egypt and Lower Nubia. In: M. A. J. Williams and H. Faure (eds.) *The Sahara and the Nile*: 253 - 280. Rotterdam.
- Camps, G. 1974. *Les civilisations préhistoriques de l'Afrique du Nord et du Sahara*. Paris.
- Chamla, M. C. 1968. *Les populations anciennes du Sahara et des régions limitrophes*. CRAPE, Mémoire IX. Algiers.
- Clark, J. D. 1972. Mobility and settlement patterns in sub-Saharan Africa: A comparison of late prehistoric hunter/gatherers and early agricultural occupation units. In: P. J. Ucko, R. Tringham and G. W. Dimbleby (eds.), *Man, settlement and urbanism*: 128 - 148. London.
- 1973. The University of California, Berkeley Expedition to the central Sudan. *Nyame Akuma*, 3: 56 - 64.
- 1976a. Epi-Palaeolithic aggregates from Gréboun Wadi, Air, and Adrar Bous, northeastern Ténéré, Republic of Niger. In: Berhanou Abebe (ed.) *Proceedings of the Pan-African Congress on Prehistory and Quaternary Studies, 7th Session 1971*: 67 - 78. Addis Ababa.

- 1976b The domestication process in sub-Saharan Africa with special reference to Ethiopia. In: E. S. Higgs (ed.) *Origine de l'Élevage et de la Domestication*, Colloque XX, Preprint UISPP: 56 - 115. Nice.
- 1980. Human populations and cultural adaptations in the Sahara and Nile during prehistoric times. In: M. A. J. Williams and H. Faure (eds.) *The Sahara and the Nile*: 527 - 582. Rotterdam.
- 1984. Prehistoric cultural continuity and economic change in the central Sudan in the early Holocene. In: J. D. Clark and S. A. Brandt (eds.) *The causes and consequences of food production in Africa*: 113 - 126 California University Press.
- Cunnison, I. 1966. *Baggara Arabs: Power and lineage in a Sudanese Nomad tribe*. Oxford.
- Dalby, D., R. J. H. Church and F. Bezzaz. 1977. *Drought in Africa*, 2. Bath.
- Derry, D. E. 1949. Report on the human remains. In: A. J. Arkell, *Early Khartoum*: 31 - 33. London.
- Dupire, M. 1962. *Peuls nomades: Etude descriptive des WoDaabe du Sahel nigérien*. Inst. d'Ethnologie: Trav. et Mem. 64. Paris.
- Elphick, R. 1977. *Kraal and castle: Khoikhoi and the founding of White South Africa*. Newhaven.
- Evans-Pritchard, E. E. 1940. *The Nuer*. Oxford.
- Førde, C. D. 1934. *Habitat, economy and society*. London.
- Gabus, J. 1952. Contribution à l'étude des Nemadi. *Bull. Soc. Suisse d'Anthrop. et d'Ethnol.*: 49 - 83.
- Gamst, F. C. 1969. *The Qemant: A pagan-Hebraic peasantry of Ethiopia*. New York.
- 1979. Wayto ways: Change from hunting to peasant life. In: R. L. Hess (ed.) *Proc. Fifth Int. Conf. on Ethiopian Studies*, Session B: 233 - 238. Chicago.
- Gautier, A. 1968. Mammalian remains of the northern Sudan and southern Egypt. In: F. Wendorf (ed.) *The Prehistory of Nubia*. I: 80 - 99. Dallas.
- Haaland, R. 1978. The seasonal interconnection between Zakiab and Kadero, two Neolithic sites in the central Sudan. *Nyame Akuma* 13: 31 - 33.
- Haberland, E. 1959. V. Die Basketto and VI. Die Dime. In: A. E. Jensen (ed.) *Altvölker Südäthiopiens*. I: 189 - 263.
- Harlan, J. R. 1971. Agricultural origins: Centers and non-centers. *Science* 174: 468 - 474.
- Hassan, F. A. 1978. Archaeological explorations of the Siwa Oasis region, Egypt. *Current Anthropology* 19: 146 - 8.
- Hobler, P. M. and M. J. Hester, 1969. Prehistory and environment in the Libyan desert. *Bull. S. Afr. Archaeol. Soc.* 23: 120 - 130.
- Jacobson, J. 1979. Recent developments in south Asian prehistory and protohistory. In: B. J. Sieglar, A. R. Beals and S. A. Tyler (eds.) *Annual Review of Anthropology* 8: 467 - 502.
- Jaeger, J. J. 1975. The mammalian faunas and hominid fossils of the Middle Pleistocene of the Maghreb. In: K. W. Butzer and G. L. Isaac (eds.) *After the Australopithecines*: 399 - 418. The Hague.
- Jensen, A. E. 1959. I. Die Baka. In: A. E. Jensen (ed.) *Altvölker Südäthiopiens*, I: 29 - 85.
- Jones, H. L. 1932. *The geography of Strabo* (Translated H. L. Jones) I - VIII. London.
- Krzyżaniak, L. 1978. New light on early food production in the central Sudan. *Journ. Afr. Hist.*, 19: 159 - 172.
- Lee, R. B. 1976. !Kung spatial organisation. In: R. B. Lee and I. deVore (eds.) *Kalahari hunter/gatherers: Studies of !Kung San and their neighbors*: 73 - 97. Cambridge, Mass.
- 1979. *The !Kung San: Men, women and work in a foraging society*. Cambridge, Mass.
- Ligers, Z. 1966. *Les Sorko (Bozo): Maitres du Niger*. 4 vols. Paris.
- Lubell, D., F. A. Hassan, A. Gautier and J. L. Ballais. 1976. The Capsian escargotières. *Science* 191: 910 - 920.

- Maley, J. 1977. Palaeoclimates of central Sahara during the early Holocene. *Nature* 269: 573 - 577.
- Mauny, R. 1956a. Préhistoire et zoologie: La grande "faune éthiopienne" du Nord-ouest africain du paléolithique à nos jours. *Bull. IFAN*, 18 Série A: 246 - 279.
- 1956b. Perles ouest-africaines en amazonite. *Bull. IFAN*, 18 Série B: 140 - 147.
- Monod, T. 1975. *Pastoralism in tropical Africa*. London.
- Mori, F. 1965. *Tadrart Acacus: arte rupestre e culture del Sahara preistorico*. Turin.
- Munson, P. J. and C. A. Munson. 1969. Nouveaux chars à boeufs rupestres du Dhar Tichitt (Mauritanie). *Notes africaines* 122: 62 - 63.
- Murdock, G. P. 1959. *Africa: Its people and their culture history*. New York.
- Murdock, G. P. 1967. *Ethnographic Atlas*. Pittsburgh.
- Newman, J. L. 1970. *The ecological basis for subsistence change among the Sandawe of Tanzania*. Nat. Acad. Sci. Washington.
- Nicolaisen, J. 1963. Ecology and culture of the pastoral Tuareg. *Nationalmuseets skriftet: Ethnografisk* 9: Copenhagen.
- Phillipson, D. W. 1977a. *The later prehistory of eastern and southern Africa*. London.
- 1977b. The excavation of Gobedra rockshelter, Axum. *Azania* 12: 53 - 82.
- Rognon, P. 1976. Essai d'interprétation des variations climatiques au Sahara depuis 40,000 ans. *Rev. Géogr. Phys. et de Géol. dyn.* 18: 251 - 282.
- Roubet, C. 1979. *Economie pastorale préagricole en Algérie orientale: Le Néolithique de Tradition capsienne exemple: L'Aurès*. Paris.
- Servant, M. and S. Servant-Vildary. 1980. *L'environnement quaternaire du bassin du Tchad*. In: M. A. J. Williams and H. Faure (eds.) *The Sahara and the Nile*: 133 - 62. Rotterdam.
- Shack, W. A. 1966. *The Gurage: A people of the ensete culture*. London.
- Simoons, F. J. 1960. *Northwest Ethiopia: Peoples and economy*. Madison.
- Smith, A. B. 1980. The Neolithic tradition in the Sahara. In: M. A. J. Williams and H. Faure (eds.) *The Sahara and the Nile*: 451 - 466. Rotterdam.
- Smith, M. G. 1965. The Hausa of northern Nigeria. In: J. L. Gibbs (ed.) *Peoples of Africa*: 121 - 155. New York.
- Smith, S. E. 1980. The environmental adaptation of nomads in the West African Sahel: A key to understanding prehistoric pastoralists. In: M. A. J. Williams and H. Faure (eds.) *The Sahara and the Nile*: 467 - 488. Rotterdam.
- Straube, H. von. 1963. *Westkuschitische Völker Südäthiopiens III. Völker Süd-Äthiopiens*. Stuttgart.
- Street, F. A. and A. T. Grove. 1976. Environmental and climatic implications of late Quaternary lake-level fluctuations in Africa. *Nature* 216: 385 - 90.
- Talbot, M. R. 1980. Environmental responses to climatic change in the West African Sahel over the past 20,000 years. In: M. A. J. Williams and H. Faure (eds.) *The Sahara and the Nile*: 37 - 62. Rotterdam.
- Tothill, J. D. 1948. *Agriculture in the Sudan*. Oxford.
- Tubiana, M. J. and J. Tubiana. 1977. *The Zaghawa from an ecological perspective*. Rotterdam.
- Turnbull, C. M. 1961. *The Forest People*. New York.
- Wendorf, F. and F. A. Hassan. 1980. Holocene ecology and prehistory in the Egyptian Sahara. In: M. A. J. Williams and H. Faure (eds.) *The Sahara and the Nile*: 407 - 419. Rotterdam.
- Wendorf, F. and R. Schild. 1976. *Prehistory of the Nile Valley*. New York.
- Wendorf, F., R. Schild, N. El Hadidi, A. E. Close, M. Kobusiewicz, H. Więckowska, B. Issawi and H. Haas. 1979. The age of barley in the Egyptian late Paleolithic. *Science*. 205: 1341 - 1347.
- Wendorf, F., R. Schild, R. Said, C. V. Haynes, A. Gautier and M. Kobusiewicz. 1976. The prehistory of the Egyptian Sahara. *Science* 193: 103 - 114.

- Williams, M. A. J. 1984. Late Quaternary environments in the Sahara. In: J. D. Clark and S. A. Brandt (eds.) *The causes and consequences of food production in Africa*: 74 - 83 California University Press.
- Williams, M. A. J. and D. A. Adamson. 1980. Late Quaternary depositional history of the Blue and White Nile rivers in central Sudan. In: M. A. J. Williams and H. Faure (eds.) *The Sahara and the Nile*: 281 - 304. Rotterdam.
- Woodburn, J. 1968. Stability and flexibility in Hadza residential groupings. In: R. B. Lee and I. DeVore (eds.) *Man the hunter*: 103 - 110. Chicago.