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Nimrods, Piscators, Pluckers, and Planters: The Emergence of Food Production

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The central thesis of this article is that Mesolithic/Archaic technological innovations enabled some hunter/gatherers to create an abundant and stable resource base which could not be adversely affected by socioeconomic competition using food resources. In contrast to earlier hunter/gatherers, highly competitive individuals with accumulative personalities emerged in the new resource-rich communities, and they used the competitive feast as a means of developing, extending, and consolidating their power. It is in the context of these "accumulators" and the feasting complex that the first domesticates generally appear and diffuse most readily. This view stands in contrast to many models that posit domestication occurring in marginal hunting/gathering groups experiencing severe resource stress. The view of the first domesticates as prestige items used by accumulators to outclass their rivals explains the otherwise mystifying nature of many of the first domesticates, including dogs, gourds, chili peppers, and avocados.

INTRODUCTION

". . . after all these years of work on the problem of how and why agriculture began, I see no final answers."

R. S. MacNeish (1974:233)

". . . If you asked me, 'Why did agriculture begin?' I'm not sure what I'd give you as a cause."

Kent Flannery (1986:512)

Few topics in prehistory have engendered as much discussion and resulted in so few satisfying answers as the attempt to explain why hunter/gatherers began to cultivate plants and raise animals. Climatic change, population pressure, sedentism, resource concentration from desertification, girls' hormones, land ownership, geniuses, rituals, scheduling conflicts, random genetic kicks, natural selection, broad spectrum adapta-

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tions, and multicausal retreats from explanation have all been proffered to explain domestication. All have major flaws. As Flannery (1986) notes, the data do not accord well with any one of these models. Either the existing models are poorly conceived, cultures are more complex in this matter than archaeologists have assumed, or we have thus far overlooked a vital part of the puzzle.

In this article, I argue that a vital component has indeed been overlooked, one which when added to the problem results in a more powerful and more satisfying solution. That factor is the emergence of socioeconomic inqualities and competition among complex, economically specialized hunter/gatherers toward the end of the Pleistocene as well as in the Holocene. Specifically, I view the competitive and feasting aspects of economic rivalry among these complex hunter/gatherers as the driving force behind food production. This is a further extension of arguments and models developed previously (Hayden 1981a:528). These will not be repeated here in detail, although they are briefly summarized. The model presented in this article not only exhibits good congruence with most traditional data related to domestication, but also explains additional observations that otherwise seem puzzling, such as the choice of the first domesticates. I will not undertake a review of all the existing models of domestication as a number of these reviews already exist (e.g., Cohen 1977; Flannery 1986; Rindos 1984; Wright 1971; Redding 1988).

Before the origins of domestication can be explored in detail it is essential to understand several important characteristics of generalized hunter/gatherers as opposed to complex hunter/gatherers. "Generalized hunter/gatherers" can be defined as those that rely on scarce and/or unpredictably fluctuating resources, resulting in low population densities (ca 0.01–0.1 per km^2), highly mobile and opportunistic foraging strategies (foragers in Binford's terms), and generalized tool kits with little interassemblage variability (Hayden 1986). Of critical importance for the argument that I present is the idea that *the nature of this resource base renders human competition over these kinds of food resources destructive of those resources* and hence, maladaptive. As argued elsewhere (Hayden 1981a), this may be because generalized hunter/gatherers rely primarily on *K*-selected species of animals and plants. These species have limited numbers of offspring and long maturation rates and can thus be easily overexploited even with preindustrial technologies. Examples of these species include most big and moderate sized animals such as elk, deer, beaver, and kangaroo, as well as many plant tubers, rhizomes, and stalks. While some contemporary foragers make limited use of other resources with short maturation rates and prodigious numbers of offspring, the quantities used are limited in abundance, or highly dispersed, or too unpredictable in nature to change the fundamental character of the gener-

alized hunter/gatherer adaptation. A critical point for the model that follows is that the fluctuating nature of the forager's resource base also makes an intense egalitarian and sharing ethic highly adaptive for generalized hunter/gatherers (Belovsky 1987; Winterhalder 1986; Hayden 1981a, 1981b; Gould 1982).

In contrast, "complex hunter/gatherers" can be defined as those that use significantly more abundant and more reliable resources than generalized hunter/gatherers, thus permitting higher population densities (>0.1 per km^2), specialized foraging strategies ("collectors" in Binford's terms), semi-sedentary logistical settlement patterns with specialized tool kits at sites of intensive resource harvesting, and varying degrees of *economically* based status competition accompanied by socioeconomic differentiation. Tangentially, although the mass harvesting and storage of herd animal meat, beginning in the Upper Paleolithic, may have led to a certain degree of complexity, this appears to be of a slightly different nature and is not known to have led to domestication anywhere.

In many, if not most, cases, the effective exploitation of abundant *r*-selected plants and animals, with copious offspring and short maturation times, results in the most pronounced characteristics of complex hunter/gatherers and leads to domestication. Even more important for the present considerations, reliance on *r*-selected resources such as salmon, cod, insects, rodents, grass seeds, and nuts renders overexploitation of such resources almost impossible using preindustrial technologies. A single cod can lay over 28 million eggs, while a doe rabbit will produce as many as 70 offspring each year (Childe 1981:34). The systematic and effective use of species with high reproductive rates, in turn, means that individuals in communities can compete with each other using these food resources without adversely affecting the resource base. For instance, it is inconceivable that Northwest Coast Indians or Natufian collectors could have had any significant effect on the fish or seed resources in their areas (e.g., Burley 1980:71; Kew 1976). Among hunter/gatherers *the eclipse of rigid egalitarianism and sharing that was brought about by the emergence of economic competition (made possible in turn by the effective exploitation of highly productive r-selected resources) is possibly the single most important development in cultural evolution in the last 2 million years.* It can be linked to the emergence of food production, hierarchical societies, craft specialization, slavery, intensive warfare, and many other important cultural traits.

The ultimate and immediate reasons for the emergence of socioeconomic inequalities are not essential to document for the present discussion. However, it is clear from the archaeological record that once abundant resources began to be tapped using Upper Paleolithic and Mesolithic technology, status goods and distinctions appeared and proliferated for

the first time in human history, notably among "specialized" hunter/gatherers, i.e., collectors. These status items imply the emergence of socioeconomic inequality and competition on a significant scale—a kind of behavior completely unknown among typical generalized hunter/gatherers.

Given the current state of archaeological research, it seems relatively certain that neither specialized hunter/gatherers (collectors), nor the systematic and intensive use of *r*-selected resources, nor status inequalities based on economic competition, occur prior to the latter part of the Upper Paleolithic. In fact, the systematic and intensive use (vs occasional, opportunistic procurement) of the most abundant *r*-selected resources such as fish and grains does not seem to occur in Europe or the Americas or perhaps anywhere before 15,000–10,000 years B.P. Thus, specialized hunter/gatherers are a relatively recent phenomenon. They become much more widespread during the Mesolithic and Archaic wherever *r*-selected resources occur in abundant concentrations, e.g., the Northwest Coast, the Levant, Japan. Archaeologists and ethnographers have only recently begun to recognize the special status, uniqueness, and complexity of specialized hunter/gatherers (Binford 1980; Price and Brown 1985; Rowley-Conway 1983; Thompson et al. 1985; see also Wagner 1960). The key to the change from limited fluctuating resources to more abundant and stable resources (and from generalized foragers to specialized collectors) is primarily the result of Mesolithic/Archaic technological developments such as fine basketry, netting, boiling, grinding stones, mortars, fishhooks, leisters, harpoons, weirs, snares, bows and arrows, leaching facilities, sleds, and canoes. These are described elsewhere together with my views on why these technological changes took place (Hayden 1981a), a topic I will return to later.

While specialized hunter/gatherers might occur wherever resources are abundant and reliable, it may be that pronounced socioeconomic complexity with economic based status competition such as that described for Northwest Coast cultures, emerges only where resources are *extremely* abundant and impervious to overexploitation. Whether or not the *r*- vs *K*-selection distinction will ultimately be useful in explaining such developments, it seems clear that the resource base must have become more stable, more abundant, and more resilient in order to support socioeconomic competition based on food resources.

FORCES AFFECTING PRODUCTION

While the exact benefits and costs of various strategies used by hunter/gatherers to adjust their populations to resource changes have been largely unexplored by researchers, it is nevertheless evident that during 2 million years of generalized hunter/gatherers adaptation, those strategies

did not change significantly. Whatever the mechanism, it appears that in the face of repeated natural resource fluctuations of major and minor magnitudes, and of short and long duration, bands consistently chose to move out, curtail their numbers, fight with neighbors, or risk starvation rather than begin to produce food. There are many possible reasons why cultivation and animal raising were universally rejected during this time as viable resource strategies: the effort required in food production may have been perceived as too excessive for the returns; economic alliances may have provided easier and less costly alternatives during famines; experimenting with food production especially during famines may not have been profitable or practical; life may have been too nomadic. Certainly, the added costs of clearing, spading, planting, and weeding garden plots must have seemed unreasonable and excessive to Paleolithic hunter/gatherers just as they do to the modern Hadza (Woodburn 1966).

But whatever the reason, the archaeological record speaks of no cultivation or herding in the face of major and minor climatic fluctuations, resource stresses of all imaginable magnitudes and durations, occurring in all possible environments, for 2 million years. Why should any such perturbations result in food production in the last 10,000 years? I argue that they should not and did not.

A major change in some other aspect of the hunter/gatherer environment or culture must be invoked to explain the switch to food production strategies. Appeal to significant increases in population pressure at the end of the Pleistocene has been one popular suggestion (Cohen 1977); however, this model has too many shortcomings to be viable (Hayden 1981a; Flannery 1986). Even Cohen (Cohen and Armelagos 1984:592–596) and his supporters (Roosevelt 1984:574, 577) admit that there is no evidence for increasing nutritional stress immediately prior to the onset of domestication (see also Buikstra et al. 1986). If neither famine nor resource pressures propelled hunter/gatherers toward food production, what other factors could have been powerful enough to overcome the inherent initial liabilities of this subsistence strategy? According to Flannary (1986:16, 516) the answer must be sought in terms of human motivation.

I argue that the advent of competition between individuals using food resources to wage their competitive battles provides the motive and the means for the development of food production. This is not an entirely new proposition, for Bender (1978), Aikens (1981), Matson (1985:245), and others (e.g., Kabo 1985:606–607) have suggested that food production is predicated on sedentism and status inequalities or other features of social complexity such as communal land ownership. Similarly Duffy (1986:17) has argued that food production cannot emerge under the sharing ethic that is so adaptive for and characterizes generalized hunter/gatherers. The

development of private ownership of resources must precede food production. I argue that this occurs only among complex hunter/gatherers and I attempt to develop Aikens' and Matson's suggestions in more detail.

On the other hand, my presentation differs substantially from Bender's (1978, 1985) in that she does not tie domestication or socioeconomic competition or inequality to any economic factors; I do. Bender posits social changes, especially social alliances, as acting independently of technology and economy to create pressures on production, whereas I do not. Finally, there is only limited causality in Bender's scenario; social systems, including alliances, emerge as inexplicably as they disappear.

The causality I view as operating is strongly economic in nature and follows many suggestions made by Cowgill (1975). In most cultures where resources permit rudimentary or moderate socioeconomic competition, competing individuals take on what I shall refer to as the role of "accumulators" (a term initially proposed by Rob Gargett—in Hayden and Gargett, 1990). Accumulators try to maximize their power and influence by accumulating desirable foods, goods, and services and by carefully channeling these through themselves and dispensing such commodities as rewards to those who will support them. Hunter/gatherers everywhere are aware that gifts create debts. And it is debts that make up the accumulator's power and prestige. The most effective context for acquiring debts and distributing desirable commodities that accumulators seem to have discovered is the competitive feast, exemplified by the potlatch, the Kula, moka, and many other local variants. For the present purposes, one of the most important characteristics of these feasts is that highly desirable, rare, valuable, and often labor intensive foods or delicacies (too effort demanding for daily consumption) are employed to impress guest competitors with the host's wealth and power, and to increase the magnitude of the debts incurred by the guests. As will be seen later, this has important implications for the development of domestication. For now, it can simply be noted that the accumulator's power is based on, and limited by, the amount of goods, especially food, that he can persuade his supporters to contribute, or to "loan," to him for his competitive feasts.

It should be evident that once socioeconomic competition emerges, accumulators and feasts should also develop. Once this threshold is crossed, aspiring accumulators can be expected to exert all their ingenuity to bribe, coerce, cajole, and con other members of the community into supporting competitive feasts and producing as many delicacies or other high-quality foods as possible for feasts.

Accumulators are highly motivated to find ways to get other people to produce significantly superior quality and greater quantities of food than needed for subsistence. Under these conditions, the limits of specific hunter/gatherer resources, especially those hard to obtain, must inevita-

bly be reached; yet, accumulators, by their very competitive nature, will actively seek ways to produce ever better and ever more. Where desirable plants and animals were amenable to controlled production, this situation should have led to domestication. Where desirable plants and animals did not lend themselves to controlled production (as in arctic zones), the influence of accumulators must have been limited by the natural availability of resources (Fig. 1).

While staunch unilineal evolutionary models of cultural evolution cannot be sustained, it is difficult to imagine how the transition from egalitarian generalized hunter/gatherers to any more complex forms of society could have occurred without first passing through a stage in which a few accumulator individuals competed to achieve socioeconomic dominance. In most, and possibly all cases, I suggest that this competition initially took the form of economically based competitive feasts.

The specific nature of accumulators and their societies undoubtedly varied from place to place over time. There are at least two major variants that seem to emerge from generalized (egalitarian) societies. The first

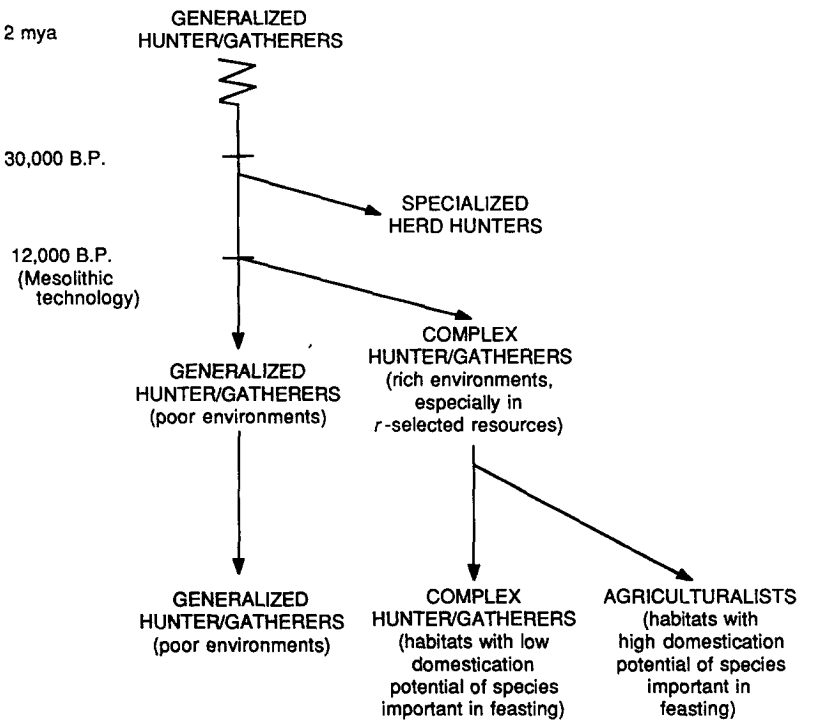

FIG. 1. The evolution of hunter/gatherer characteristics in relation to changes in the resource base over time.

resembles the Big Man societies of Melanesia in that each family independently controls or owns their own basic resources. Accumulators therefore have no economic leverage other than the attractions of the feast that they can provide, including prestige trade goods. The second form of accumulator works through a residential corporate group such as the long houses on the historic Northwest Coast. In these cases, the residential corporate group owns important resources such as fishing locations, or the group owns production facilities such as boats, weirs, drive lines, or drying houses. The accumulators in these communities act as spokesmen and administrators for their residential corporate groups. In fact, it is often probably the accumulators or their ancestors that play key roles in developing the necessary facilities to exploit these resources and in establishing claims to the exclusive use of such resources. Residential corporate groups probably emerge under conditions where access is restricted to important resources and/or where there is frequent need of many people to exploit these resources most effectively. In the context of such corporate groups, accumulator administrators can exert additional economic leverage on their corporate supporters.

There may be other, as yet unrecognized, forms of accumulator societies; however, whatever their specific form, accumulator societies seem to represent a necessary transition stage from egalitarian to stratified societies in which social, economic, and political power become concentrated to an unprecedented extent in the hands of a minority and are based on the competitive control of economic resources and services.

Expectations

While a series of hypotheses can be derived from this model and "tested" against the data, the model in reality was inductively developed. It emerged from the data as much as it guided the search for confirming data. Nevertheless, in all future applications, there are a number of expectations that should be met if the accumulator/feasting model is to remain viable. These are as follows:

1. Initial domestication should occur in rich environments with abundant resources for hunter/gatherers.
2. There should be reasonable evidence or arguments for the development of status inequalities in communities prior to, or concomitant with, initial domestication.
3. While evidence for feasting is difficult to establish using archaeological data, the general characteristics of prehistoric communities should at least be consistent with such behavior, e.g., the advent of trade in prestige items or feasting gift-items. More direct evidence such as feasting debris

and specialized structures may precede or accompany the first domesticates where recovery conditions are suitable and where excavation has been extensive enough.

4. The first domesticates should display qualities that can be construed as desirable for feasting. While this will vary according to the nature of local diets, and perhaps tastes, it can generally be expected that intoxicants, delicacies, dietarily deficient types of food, or any items conferring prestige would be prime candidates for initial food production and domestication.

5. Finally, resource stress, population pressure, and resulting malnutrition are not expected to increase significantly prior to the first appearance of domesticated species. I have always maintained (Hayden 1972, 1981a:522–523; 1986) that these are equilibria that hunter/gatherers can be expected to keep relatively constant, a premise supported by Buikstra et al. (1986) and most contributors in Cohen and Armelagos (1984). If the frequency and severity of resources stress and malnutrition do change at all, they should initially improve with the effective exploitation of *r*-selected resources, not deteriorate (as per Cohen 1977). On the other hand, once competitive feasting and powerful accumulators emerge, they can logically be expected to limit the access to resources by less powerful community members and to encourage excessive exploitation of many food species. The result would be the increases in indicators of resource stress that Keeley (1988) has noted for complex hunter/gatherers, although the causality is reversed, i.e., complexity creates resource stress; resource stress does not create complexity.

EXAMPLES

Ethnographically Complex Hunter/Gatherers

There are few good ethnographic accounts of complex hunter/gatherers in environments with species conceivably suitable for domestication. Nevertheless, there are a few and these provide a great deal of support for the model that I have just outlined. Archaeologists and ethnologists have long known about incipient or actual cultivation or animal raising in these societies, but have chosen to ignore such instances because they do not fit established models of domestication. However, with the accumulator/feasting model of domestication, these observations not only make sense, but provide an important link between the prehistoric past and the ethnographic present.

The most dramatic example comes from the Northwest Coast. While indigenous cultures in this area are typically portrayed as exclusively hunter/gatherer/fishers, a more detailed examination of the ethnography

reveals that, in fact, a number of plants were clearly cultivated, other plants were managed, and one animal species was domesticated. All of these cases were primarily of importance in the competitive feasting complex. The plants that were most central to Northwest Coast agriculture were springbank clover (*Trifolium wormskioldii*) and Pacific silverweed (*Potentilla anserina*) (Turner and Kuhnlein 1982). Both of these plants were grown in privately owned and inherited gardens belonging predominantly to the elites. These were physically demarcated and sometimes guarded by slaves. The earth was spaded and large stones, sticks, and other debris were removed; individual plants were transplanted and tended. Harvesting was intensive work with a low return (0.5–1 kg of roots/hour), and was usually carried out by women or slaves (Turner and Kuhnlein 1982).

The critical aspect of these indigenous agricultural products, however, involves their use. In addition to being very tasty, roots of both these species were rich in carbohydrates. In the protein-rich environment of the Northwest Coast, these plants were highly valued, not only because of their carbohydrates, but perhaps also because of the work involved in cultivating, harvesting, and preparing them. In effect, they were delicacies. These plants therefore played central roles in the competitive feasts of the area. As Boas observed,

> The long and the short cinquefoil-roots (i.e. silverweed) are given at great feasts to many tribes, for they are counted when chiefs count their feasts in rivalry. (Boas 1921:541–542).

The longer silverweed roots were reserved exclusively for chiefs and elites at feasts. Smaller roots with more fiber and less carbohydrates could be procured and eaten by anyone. It is clear from the above passage that the large roots were valued items given away at feasts, and the greater the quantity that a chief could give away, the greater would be his prestige. Obtaining large, long roots depended on controlling the labor required to prepare gardens properly, exerting exclusive access to them, and harvesting them. Giving away such roots was a testimony to the power of the chief. Camas (*Camassia* spp.) and riceroot (*Fritillaria* spp.) were also major carbohydrate root plants served at large feasts. And, like clover and silverweed, the best patches were owned by elites and cultivated in a rudimentary fashion (Turner and Kuhnlein 1983). Any excess could be traded to further enhance the owners' positions. In all these cases the plant characteristics that the Northwest Coast elites strove to promote (such as palatability and especially size) are the same characteristics that early domesticates tend to exhibit everywhere.

Tobacco was similarly extremely important in all competitive and related feasting. Some feasts were even known as "tobacco feasts." To-

bacco, too, was cultivated, some species being grown far outside their usual habitats (Turner and Taylor 1972).

But there is an even better known, yet more neglected, domesticate in the Northwest Coast. It is also frequently found among complex hunter/gatherers in other parts of the world. This is the domesticated dog. On the Northwest Coast, dogs had a number of roles. On the one hand, dogs were associated with and constituted symbols of high status. This may have been due to the use of dogs as guardians of property for accumulators, or the extra effort involved in keeping and feeding dogs, or the use of dogs in elite hunting, or other similar reasons.

On the other hand, in some prehistoric coastal locations and in the part of the Interior where I have been excavating for the past four years, dogs were eaten and relished as exceptional delicacies. As with all kept animals, the number of animals raised at any one time must have been very limited, time consuming, and labor intensive. They were unlikely to be used for daily subsistence needs. The use of any domesticated animals as a daily meat staple would require enormous herds. For example, if goats (on which good herd data are available) are used to illustrate this point, a group of 25 people relying primarily on meat would require about two goats per day for subsistence. Using fertility rates, mortality rates, and age ratios cited by Cribb (1987) as typical, this yields a minimum herd size of 1733. With added animals as insurance against disasters the herd size would be well over 2000. This seems far beyond the numbers of animals that would be kept at the beginning of the Neolithic. Thus, the use of meat from domesticated animals as a staple food during the early phases of domestication seems unlikely. Domesticated animals appear much more likely to have been eaten only on special occasions. Even today, among traditional pastoralists and farmers, domesticated animals are primarily eaten at feasts while in New Guinea, wild pigs are used as nonfeasting foods and domesticated pigs are primarily used for feasting, pacts, or debt-creation as rare, valued property. As Clement of Alexandria noted, "Sacrifices were devised by men, I do think, as a pretext for meat meals" (MacMullen 1981:41). Sacrifices are central events in all pastoralist feasts. Thus, like pigs in New Guinea, the consumption of dogs in the Northwest should probably be viewed as special event food. Dog feasts could have been used to symbolize the amount of control an accumulator had over labor. This is undoubtedly why early contact explorers of the Northwest such as Simon Fraser (Lamb 1960:84, 87, 93, 116, 121) were repeatedly served dog meat by the accumulators or chiefs of complex hunter/gatherer villages who wanted to establish advantageous trading relations with Europeans. Voyageurs were especially fond of such meals.

The value in raising animals for food such as dogs, pigs, and sheep undoubtedly resided not only in the meat protein, which was highly es-

teemed in fish-based economies, but more importantly in the ability to raise animals with unusually high fat contents, an even more relished and important nutrient for almost all hunter/gatherers (Speth and Spielmann 1983; Hayden 1981b). Serving animals with high fat content at competitive feasts would therefore greatly enhance hosts' status, as indeed it still does in simple and complex cultures throughout the world, including our own. Only by keeping animals and intentionally feeding them to increase their fat content could individuals achieve this goal. When this became a regular feature in communities, animals could be expected to be bred for their feasting and perhaps other qualities. The fact that dogs may have been important status or ritual animals, or that they were kept as pets or used for hunting, does not preclude their use as important food items among complex hunter/gatherers, as indicated by Ohnuki-Tierney (1974:96). On the other hand, generalized hunter/gatherers sometimes tame wild dogs like the dingo, but rarely feed them and never breed them or eat them, even in times of famine (personal field data).

In Australia, the most specialized and complex hunter/gathering societies occurred in southern Victoria. Here, the same complex of rich resources, semi-sedentism, permanent structures on mounds or with stone walls, and dense populations (4.7 per km^2) are combined with major construction efforts involving the digging of elaborate canals up to 3 km long, 2.5 m wide, and 1 m deep to enhance the production and capture of fresh water eels, another high-fat food source (Lourandos 1980; Williams 1987). Gatherings of up to 2500 people occurred at these sites. Thus complex hunter/gatherers here, too, are associated with incipient or full food production. Of greater importance for the thesis of this article is the fact that Lourandos (1980:257) feels that there is good evidence for competition using economic resources in the area.

These examples clearly reveal the powerful nature of forces at work in ethnographic complex hunter/gatherers that militate for increased production of more, larger, and richer foods used as status items in competitive feasts. The existence of these forces in complex hunter/gatherers (and their absence among generalized hunter/gatherers) also enables archaeologists to understand why cultivation and certain domesticates spread rapidly under certain conditions. For example, on the Northwest Coast (like the Arctic and Subarctic) few feasting plants or animal resources appear to have had much potential for domestication. Other species may have been easy to domesticate but did not play central roles in feasting due to their dietary roles or other factors. Therefore, agriculture was very limited.

However, when Europeans arrived in the early 1800s, they brought with them domesticated plants that grew well in Northwest Coast virgin forest soils and which acquired important roles in feasting due to their

dietary desirability. The potato, in particular, grew very well and was prized because of its carbohydrate content as well as its trade value for coastal societies that had a surfeit of protein. Because of this value and probably due to the labor investment involved in clearing forest and tending and owning the prepared plots and their produce, it should come as no surprise that the chiefs and elites were the ones that introduced and promoted the planting of potatoes with women and slaves clearing plots and doing the actual gardening (Suttles 1951). Nor should it be surprising that potatoes were no ordinary food, but esteemed "as a luxury" (Swan 1968:33). These are precisely the conditions under which I expect prehistoric domesticates to have spread. That Northwest Coast societies were "primed" for agriculture is demonstrated by the extremely rapid spread of potatoes to all Coastal groups within a brief 15-year period between 1827 and 1840 (Suttles 1951). This contrasts markedly with the frustration experienced by missionaries and government administrators that have tried to introduce agriculture to more generalized hunter/gatherers in Australia, Africa, and North America. Moreover, given the resource richness of the Northwest Coast, the rapid spread of potatoes can hardly be attributed to resource stresses, whereas it makes a great deal of sense when viewed as a new and valuable item that could be used in competitive feasts. I now turn to the archaeological record to see whether prehistoric observations accord with this scenario.

A Note on Archaeological Inference

It is relatively easy to identify the motivations that led some individuals to adopt food production in the complex ethnographic hunting/gathering cultures of the Northwest Coast. It is also easy to document competitive feasting activities in these societies and to determine what role specific foods played in competitive feasting and the overall diet. However, when purely archaeological cultures are examined, these matters are much more difficult to reconstruct with certainty due to poor recovery and reporting of many key variables, as well as the limited extent of most excavations and the limited selection of site types. Because of this difficulty and the exploratory nature of this article, the arguments concerning archaeological examples will sometimes emphasize the plausibility and possibility of explanations suggested by the accumulator/feasting model, rather than definitive conclusions. Moreover, initial domestication behavior varies incredibly in its expression, ranging from condiments to possible staples, to herd animals, to dogs, to gourds. Any attempt to understand this diversity at the present stage of explanation must employ some constructs based on "how possible" arguments. On the other hand, some kinds of data, such as the comparative abundance and stability of re-

sources, population densities, the emergence of prestige goods, differential burial treatment, the development of exchange networks, and the appearance of domesticates themselves, are all relatively sound data to work from where they are available.

This being said, there are still critics of archaeological inference who argue that the lower levels of archaeological theory are not well established and that it may be unjustifiable to infer the presence of socioeconomic differentiation on the basis of differential burial goods, the appearance of prestige and exotic trade items, or even differential house sizes. I can only point out that these are among the most widely accepted indicators of socioeconomic differentiation in archaeology today. Some of these variables such as the differential occurrence of grave goods have been exhaustively and repeatedly modeled and tested by archaeologists (Tainter 1975; Peebles 1971; O'Shea 1984). If it is not possible to accept the general tenor of these inferences, it seems unlikely that any anthropological inferences derived from archaeology will ever gain acceptance. Other indicators, such as the procurement of exotic items, conceivably could develop without feasts or accumulators. Yet, the vast majority of ethnographic instances are associated with feasting and accumulators, and such exchange is logically and empirically a central feature in feasting and accumulative systems. Regional exchange consistently appears where these systems operate. Regional exchange, in conjunction with other indicators, can thus be used as *one* of several important indicators of the existence of feasting and accumulator systems.

In general, I believe that it is counterproductive to hold advances in general theory for ransom until the price of lower level theory work has been fully paid. This article deals primarily with general theory, not lower level inferences. The latter are topics that I have tried to deal with elsewhere. I acknowledge that there is no one-to-one correspondence between people with the greatest socioeconomic control on the one hand, and the most elaborate burials, the most prestige goods, or the biggest houses on the other hand. *Individual* human motivations are simply too diverse for these relationships to be realistic or reliable. In fact, I have helped document the variability in these relationships ethnographically (Hayden and Cannon 1982, 1984:191–201). I have also gone on to demonstrate that when *groups* as opposed to *individuals* are the units of analysis, idiosyncratic individual differences tend to cancel each other out and that material values for groups correspond extremely well to archaeological assumptions and expectations. Thus, while a *specific* accumulator might not be buried with exceptionally lavish grave goods, accumulators as a *group* can be expected to be buried with more lavish grave goods than supporters or individuals not participating in feasts. Similarly, communities with accumulators should exhibit a much wider spectrum of

burial-furniture assemblages than communities without accumulators. These findings suggest that the indicators used to infer socioeconomic differentiation and the presence of accumulators are reasonably sound and provide a good base for approaching the problem of domestication at this stage of inquiry.

The Near East

In the Near East, the first hints of richer resources and complexity occur in the Geometric Kebaran (14,000–12,000 years B.P.) of the Levant, and by the end of this phase, some indications of the emergence of complex hunter/gatherers are present: reduced nomadism, limited use of *r*-selected cereal grains, increase in population (reflecting the increase in available resources), and some status trade items, e.g., *dentalium* (Mellaart 1975:19–27). The Kebaran gives rise to the Natufian (12,000–10,000 years B.P. in several localities) some of which exhibit the first evidence of sedentism, storage, the use of fish, much larger sites, much denser populations (implying richer resources), possible ritual or feasting structures, much more trade and status paraphernalia, domestic dogs, and clear evidence of socioeconomic inequality in burials, habitations, and status goods (Mellaart 1975; Wright 1978; Bar-Yosef 1983; Davis and Valla 1978; Henry 1985). In my opinion, something resembling the accumulator/feasting complex must have been present in the Natufian. Shells from the Mediterranean and Red Seas, Anatolian obsidian, decorated mortars, polished stone dishes and cups, stone figurines, decorated bone tools, paved structures and at least one structure with plastered and painted walls, slab covered and paved burials, and personal jewelry in the form of chaplets, diadems, frontlets, bonnets, bracelets, necklaces, and anklets all speak of considerable socioeconomic inequalities and quite powerful accumulators (Mellaart 1975:30–37; Wright 1978; Bar-Yosef 1983; Henry 1985).

In this, and most of the other examples, there is a period of hundreds or even several thousands of years between the beginning of complex hunter/gatherer adaptations and the development of domestication. This may reflect the time it takes for those with pretensions to subvert existing sharing ethics and establish private control over resources, to find ways to convince others to support competitive feasts, or to plumb the limits of newly developed technologies for exploiting *r*-selected resources. Whatever the reason, it appears that the first experiments in domestication and food production did take place in the Natufian, for the first evidence of domesticated cereals comes for the Pre-pottery Neolithic A components of Mureybet (10,140 years B.P.) and Jericho (10,350–9350 years B.P.). These food producing Neolithic components developed from the Natufian (Kirkbride 1966:57; Bar-Yosef 1970; Mellaart 1975:44–47). Aceramic

Neolithic components elsewhere also exhibit strong continuity with the underlying Natufian (Henry 1985:380).

The choice of cereal grains for the first domestication experiments, as well as the very modest scale of this enterprise, is also revealing. As a rule, except for short periods of seasonal availability, generalized hunter/gatherers have a difficult time obtaining carbohydrates in their diets (Speth and Spielmann 1983; Hayden 1981b). Thus, cereal grains would be highly valued foods for most groups, especially if they were provided out of season via various means of storage. Cereals would be a food of considerable worth in competitive feasts. This could explain why the residents of Mureybet transported wild einkorn and barley to sites far outside their natural habitats and put special efforts into making them grow in the less favorable environment around Mureybet (Mellaart 1975:44–47). The same argument can be applied to Neolithic Europe where grain was not a staple but a "luxury food" (Kaelas 1981:88). Like the large cultivated clover and cinquefoil roots of the Northwest coast, neolithic grain required much more effort to produce than wild resources.

However, recently, Katz and Voigt (1986, following Braidwood 1953) have suggested that the real reason that cereals were so important, and the first plants to be domesticated, was because they were used to produce beer. Beer and/or other intoxicants, such as tobacco, are central to many competitive feasts throughout the world. If beer was being used by Natufians (or Europeans) in their feasts, it would fit the basic tenets of the present model very well and explain why accumulators in some areas tried to augment and stabilize their access to cereal grains.

Somewhat further east in the fertile Crescent on the hilly flanks of the Zagros Mountains, domestication followed a slightly different path (based on Braidwood and Howe 1960; Hole and Flannery 1967; and Hole et al. 1969). In Iraqi Kurdistan, the Upper Paleolithic Baradostian (40,000–21,000 years B.P.) displays no signs of complex social or economic organization. However, after an occupational hiatus of about 10,000 years, the succeeding Zarzian phase (ca. 12,000 years B.P.) in the Terminal Paleolithic does exhibit evidence of socioeconomic status differences. Not only are there more and larger and more sedentary sites than at any previous time, indicating a much richer use of resources thanks in part to mortars and grinders (such as might be used for wild barley, wheat, and acorns), but significant status objects also appear for the first time. Thus, major increases in the resource base involving the effective exploitation of *r*-selected resources (grass seeds and fish) again appears to be accompanied by the emergence of socioeconomic competition and status rivalry. The latter is inferred from the occurrence of ground stone bracelets, beads, pendants, stone bowls, and rods (at Karim Shahir and M'lefaat), scallop and dentalium shells (at Pa Sangar), red ochre burials (at Asiab), and

apparently ceremonial (i.e., potential feasting) specialized architecture (at Asiab). Shortly after this (at 10,600 years B.P.), grave goods swell to include thousands of stone beads associated with children, imported obsidian, bitumen, and the earliest recorded copper pendant anywhere in the world (at Shanidar—Solecki 1961:694) plus carved bone pins, daggers, and decorative pieces at most sites. All these attest to unusual levels of competition for status items. At about the same time, clay tokens begin to appear in villages of complex hunter/gatherers or initial food producers at Mureybet, Chiekh Hassan, Tepe Asiab, Tepe E, and Ganj Dareh. These clay tokens appear to have been used for keeping economic accounts (Schmandt-Besserat 1986) and attest not only to abundant resources but also to the kinds of debt and credit accounts typical of manipulations by accumulators for feasts.

This complex of enriched subsistence, increased sedentism, status objects (especially those associated with children), extensive trade for status items, and occasional specialized buildings suitable for major competitive feasts all precede the first appearance of domestication, as they do in other parts of the world. In the Zarzian case, animal protein may have been of greater feasting value than cereals. While Natufians had abundant gazelle and fish resources, their Zarzian cousins sought animal protein whenever they could get it. Zarzians used snails, rats, lizards, birds, clams, crabs, toads, tortoises, and other small animals in much greater quantities than previously (Reed and Braidwood 1960:169). Given this situation, goats and sheep especially fattened and served at a competitive feast would bring great prestige. The more and fatter the goats or sheep, the more the prestige. Such tending, raising, and feasting on animals is probably closely paralleled by the raising of pigs for important moka competitive feasts in New Guinea (Strathern 1971; Nairn and Strathern 1974). Even in contemporary Near Eastern herding societies, animals are primarily killed and eaten at important festivals, not for everyday subsistence needs. Such a feasting complex would have led to developments similar to those represented at the villages of Zawi Chemi Shanidar with its possibly domesticated sheep, sedentism, and status items dated to 10,870 years B.P. (Solecki 1964) and Ganj Dareh with domesticated goats at 9000 years B.P.

Jomon

In Japan, the development of social complexity and domestication is more difficult to follow due to substantial regional variability in subsistence, culture, excavation, and reporting. Nevertheless, there appears to be a growing consensus that from its inception, the Jomon culture of Japan (10,000–2250 years B.P., with a transition phase from 12,500 to

10,000 years B.P.) represents a highly successful complex hunting, gathering, and fishing adaptation characterized by the use of acorns, seeds and nuts, salmon, deep sea fish, shellfish, and storage pits; nearly full sedentism; sophisticated pottery including elaborate ceremonial vessels; permanent pithouse structures; large communal buildings; and many ornamental and ceremonial objects including initial and Early Jomon decorated lacquered bone combs and pots, a wide range of highly decorated status pottery, earrings, pendants, carved bone hairpins, shell bracelets and ornaments, phallic stone scepters, probably fine textiles, wood working, and basketry (Aikens and Higuchi 1982:118, 127; Aikens and Dumond 1986:170).

Interregional trade is attested to from at least Early Jomon involving obsidian, stone earrings, Sobata wares, and possibly other ceremonial wares, earspools, figurines, phallic scepters, and carved hairpins (Aikens and Dumond 1986; Chard 1974:125). Nagamine (1986:262) also observes that clay figurines occur only at the larger Jomon sites with open plazas and pit graves which may be directly or indirectly related to high-status individuals. These sites are also interpreted as places of communal or intercommunity rituals, such as would be expected with competitive feasting. The high-status individuals that can be inferred to have existed from wealth items, special graves, and figurines are logical candidates for accumulators with family members that shared their high status. All these factors indicate the Initial or Early Jomon emergence of individual wealth, status differences, accumulators, and competitive feasting that must be related to the abundant Jomon resource base (Aikens and Higuchi 1982:182–185; Aikens and Dumond 1986:170; Anderson 1987; Ikawa-Smith 1986).

These characteristics are in nature similar to the same complex of variables observed in the Near East: sedentism, storage, a rich resource base, the first indications of status (and by inference the emergence of accumulators), trade, and ultimately the development of specialized large public structures suitable for competitive feasting as well as constituting testimonials to accumulators' influence and ability to marshal labor for their own purposes. These communal buildings were probably similar to Polynesian *marae* in their communal ritual and feasting operations. While these characteristics, except the large communal structures, are documented from the Initial Jomon (10,000–7250 years B.P.), it is not until Early Jomon time (6000–4500 years B.P.) that the first clear evidence of plant domestication occurs. The nature of the first domesticates (in Early Jomon deposits at Torihama and Hamanasuno) again provides an important clue to the conditions under which domestication emerges. These include the bottle gourd (*Lagenaria*), mung beans (*Vigna* sp.), hemp (*Cannabis*), colza (*Brassica napus*), shiso mint (*Perilla frutescens*), bur-

dock (*Arctium*), and one buckwheat (*Fagopyrum*) seed (Crawford, n.d.a.; 1983:23–25). The single buckwheat grain may eventually prove to be intrusive (as in the case of the early Wadi Kubbaniya domesticates). However, both buckwheat and the beans, as well as oil-rich seeds, are high in carbohydrates and could have constituted especially prized foods for feasts in an environment where fish, shellfish, and deer provided an abundant protein supply. Shiso mint, hemp and colza all have very oil-rich seeds, while hemp may also have been used as an intoxicant in prestige feasting in a manner similar to tobacco and alcohol.

The bottle gourd, however, is a totally unexpected first cultigen given traditional models of domestication involving resource stress, for it provides no food at all aside from the negligible amounts in seeds. Under starvation pressure, it makes no sense to begin cultivating bottle gourds; yet, in Mexico, the eastern United States, and Japan they are among the first, if not *the* first, domesticates. While this does not accord with the traditional models of domestication, bottle gourd domestication fits reasonably well with suggestions about the central role of accumulators and competitive feasts. As Flannery (1986:6) has argued, the bottle gourd was almost certainly valued for its use as a container rather than for its food value. Good containers for liquids are frequently hard to obtain for hunter/gatherers, and gourds are ideally suited. Unusually large varieties, probably obtainable only from cultivated plants, would make especially prestigious serving vessels in feasts. Moreover gourds can be attractively decorated to enhance their display and status value (Fig. 2). In fact, they are *still* decorated and used for food and beverage serving in feasts and rituals in the Maya area of Mexico and Guatemala (Hayden and Cannon 1984: Figs. 99 and 100). Moreover, large (cultivated) gourds would be useful for making fermented beverages which may have been a central feature of Initial or Early Jomon competitive feasts. In these contexts, bottle gourds play an important, status enhancing role. It thus makes a good deal of sense for accumulators to try to invest time, energy, and obligations to obtain more and bigger gourds. Similarly, Pearson (1986:219) observes that in central Japan, Middle Jomon cultivated plant remains represent condiments rather than major subsistence crops.

In addition to these cultigens, domestic dogs are present in the Jomon, possibly from the outset. As on the American Northwest Coast, ritual burial treatments indicate that at least some dogs were not food items, but objects that conferred status on their owners. Whatever the specific motive for keeping and domesticating nonfood dogs, I feel that it must be directly tied to increasing the ostentation and status of aspiring accumulators. However, these same or other dogs may also have been used for food in Jomon communities (Anderson 1987:278) and may have been raised by accumulators to increase their fat content and thus the desir-

FIG. 2. Unusually large gourds used for the ritual drinking of *atol* at community feasts and rituals in Chanal, Chiapas (Mexico). Note particularly the elaborately woven ritual basketry stands for holding the gourds, the ritual cloth covering (on the left), and the repaired cracks indicative of the special status of these gourds. Gourds used in similar competitive displays in other Maya villages were often decorated with abstract or iconic images using dye, paint, or carving. It is suggested that especially large or elaborately decorated gourds played important roles in prehistoric competitive feasts, and that they were grown and domesticated for these purposes. Reproduced by permission of the Smithsonian Institution Press from *American Archaeology: Past and Future* edited by D. Meltzer, D. Fowler, and J. Sabloff. © Smithsonian Institution, Washington, D.C. 1986, p. 301.

ability of dogs for feasting. Ohnuki-Tierney (1974:96) observed dogs being treated "affectionately, like a child" among the Ainu, who subsequently killed the dog and "relished eating it." The Ainu bear festival provides another example of a raised ritual animal being eaten. Thus, there is no necessary conflict between the ritual or status vs the food roles of dogs.

In addition to these more established cases of Jomon domestication, Esaka (1986:226) has suggested that the paper mulberries, peaches, and lacquer found in Early Jomon deposits are not indigenous to Japan and thus may constitute domesticates. If he is proven correct, these would also clearly fit notions of plant production for feasting and prestige items.

Eastern Archaic

The research related to domesticates in the Eastern United States Archaic is currently in an unfortunate state of ambiguity. They key issue is whether squash (*Cucurbita pepo*) was an indigenous cultigen or an introduced tropical one, and when it was introduced. At present, suggestions

for 4000–5000, 2000–6000, 7000, and even 9000 years B.P. can be found in the literature (Crawford 1982:211; Gardner 1987). While very early occurrences of such a domesticate, followed by an unusual hiatus of 2000–5000 years before any other domesticates were adopted, would require a reassessment of the kinds of conditions that currently appear to have existed in the Early Archaic and the beginning of the Middle Archaic, such a reassessment might not be out of line with the model proposed here.

On the other hand, general agreement now exists that whenever squash was initially introduced or domesticated, it became widely distributed only after 4500 years B.P. Soon after this, groups in the Kentucky and Tennessee area began cultivating and domesticating sumpweed (*Iva annua*), sunflower (*Helianthus annuus* at 3500–3000 years B.P.), and goosefoot (*Chenopodium berlandierei* at 3400 yr B.P.—Smith and Cowan 1987). Thus, the period from 4500 to 3500 yr B.P. is clearly the most important context for the spread of cultivation and domestication in the east. Once again the seeds of all these species are rich in carbohydrates and oils especially in the case of sunflower and squash seeds (containing 49.4 and 46.7% lipids, respectively—Watt and Merrill 1975). Like large silverweed and clover roots on the Northwest Coast, these would have been highly prized foods and difficult to obtain for any but elites or accumulators because they were not native to the east and would have required considerable labor to cultivate, manage, control access to, and process for feasting consumption. Did accumulators exist at, or prior to, this time?

The answer to this question appears affirmative. Certainly at the Koster Site, Middle Archaic-2 (6850–7300 years B.P.) groups were capable of extracting sufficient resources to maintain semi-sedentary or full-sedentary villages with substantial permanent structures (Brown and Viera 1983:165–184). This level of resource exploitation, especially using *r*-selected species such as certain fish and seed resources, should be able to support economic competition and accumulators without adverse effects. In fact, multi-regional exchange networks which I believe reflect status competition appear at this time, as do cemeteries which Chapman (1981) argues are related to the first stages of economic competition and development of socioeconomic status differences. While Chapman was dealing with European megalithic burials, it is interesting that some of the American Middle Archaic-2 and -3 cemeteries are large pits covered by mounds perhaps not dissimilar in nature to some English barrows. In fact, significant cemeteries begin to appear only in the Mesolithic under rich resource conditions, e.g., in Denmark (Albrethsen and Peterson 1976; Price and Petersen 1987) and Nubia (Wendorf 1968; see also Clark 1980:93).

By 5900–4900 years B.P. clear status differences begin to appear in burials of the Helton Phase (Brown 1983; Jeffries and Lynch 1983). At the Black Earth Site, in particular, graves from the 5900–4900 years B.P. period were associated with a wide range of ornamental and ceremonial objects indicating unusual wealth and status consistent with accumulators, competitive feasting, and ceremonialism. These grave objects include shell pendants and beads, antler beads, shell discs, plummets, bar gorgets, bone pins, antler and turtle shell cups, various pieces of decorated bone, fluospar crystals, miniature grooved axes, and variously worked stones (Jeffries and Lynch 1983). In Missouri, squash and bottle gourds appear by 4250 years B.P. and coincide with the development of regional and interregional exchange networks, which I feel is an acceptable fit with expectations.

Thus, in the eastern Archaic, the establishment of a rich resource base (fish and seeds) that could not be overexploited can be viewed as leading to competitive, economically based feasting and the emergence of accumulators. These in turn either preceded or coincided with the cultivation and domestication of highly prized (and often exotic) foods which would have been especially valuable in feasts including squash, sunflower, sumpweed, and goosefoot.

Mesoamerica

Lastly, because of the extensive work carried out there, it is appropriate to consider evidence from Mesoamerica. Two Mexican sequences are of main concern: the Tehuacan Valley (MacNeish 1964, 1967) and the Oaxaca Valley (Flannery 1986).

In the Tehuacan Valley, a late "Big-game" hunting culture, or incipient Archaic culture, persisted until about 8500 years B.P. From 8500 to 6800 years B.P., typical Archaic traits appeared including grinding stones, mortars, basketry, nets, fabrics, snares, and traps. Many of these traits greatly amplified the effective resource base resulting in a fourfold population increase, much larger sites (Fig. 3), and probably a logistically organized settlement system of collectors (MacNeish 1964; Stark 1986:301). It can be expected that the largest and most permanent sites would have been located on the floodplains of the major rivers and streams and that these base camp sites have been largely or completely destroyed by subsequent deforestation, erosion, and millennia of cultivation. Nevertheless, even in the shreds of settlement patterns that remain, evidence of status differences can be detected. These consist of marginella beads, bone plaques, paint dishes, stone bowl fragments, and trade obsidian (MacNeish et al. 1967). Other evidence of increasing social complexity probably involving economic competition and control over people

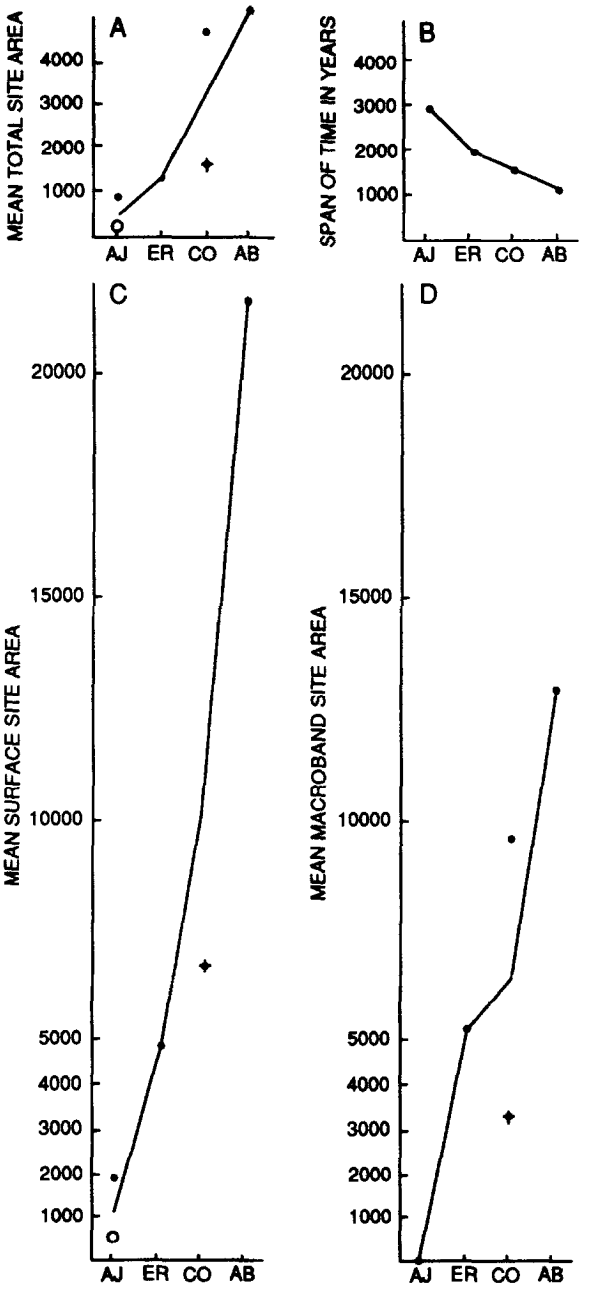

FIG. 3. Graphs showing total size or component area (in square meters) for each Archaic phase in the Tehuacan Valley. Figure reproduced by permission of the Society for American Archaeology and the Smithsonian Institution Press from Stark (1986) in *American archaeology: Past and future* edited by D. Meltzer, D. Fowler, and J. Sabloff, p. 301. Smithsonian Institution Press, Washington, DC.

in one form or other is revealed by Archaic child and adult human sacrifices and cannibalism (MacNeish 1964:533). It should be remembered that slaves were kept by other complex hunter/gatherers such as the Calusa in Florida (Goggin and Sturtevant 1964) and the Northwest Coastal and Interior groups and that slaves were sometimes sacrificed by elites in these groups.

One of the most exotic trade items in the Tehuacan Archaic deposits is also the first domesticate: the avocado. The avocado is not native to the Tehuacan Valley and clearly had to be imported. Avocado cultivation in this new environment undoubtedly involved some efforts in tending the plants. The other early domesticate is even more surprising: the chili pepper. If Tehuacanos began to domesticate plants because they were experiencing food shortages, the chili pepper is perhaps the most unpromising candidate with which to begin. In fact, it makes no sense at all in the context of traditional models. On the other hand, both the chili and the avocado are highly relished condiments and delicacies today. Avocados have a high oil content (16.4%—Watt and Merrill 1975) which would be valued by hunter/gatherers in lipid-low environments, while chili peppers are still primarily used by high-ranking village officials and wealthy families in remote Maya villages partially as a sign of status and wealth (Hayden 1987:185). As such, both the chili and the avocado can be viewed as prestigious feasting foods in competitions between accumulators (perhaps even involving the first chili contests). The addition of squash and bottle gourds soon after these first domesticates also makes sense primarily in feasting terms, as I will argue below.

In the valley of Oaxaca, the situation is not as clear-cut, primarily due to the interpretive position that Flannery has chosen to take. Nearly all published data are derived from the Guila Naquitz rockshelter near Mitla. The lower two stratigraphic units (D and E) are considered nonagricultural. They are dated as older than 9800 years B.P., although three of the five radiocarbon dates were rejected as being far too young. While Flannery's preferred dating may be confirmed, this situation indicates substantial disturbance of these early levels. The succeeding levels C and B (dated at 8600–9400 years B.P.) are where domesticated plant remains first occur. These consist of bottle gourd (*Lagenaria siceraria*) and squash (*Cucurbita pepo*).

Flannery has long held the view that population pressure and resource stress cannot be reasonably viewed as causal factors in the domestication process or other significant cultural developments (Flannery 1976:225–227). In his Oaxacan studies he has consistently emphasized nonecological explanations and presented data in fashions that do not lend support to population pressure or ecological interpretations. It should come as no surprise then that Flannery portrays the Archaic population density of

Oaxaca as very low and unchanging until 4000 yr B.P. (1986:506). By arguing that the environment could amply support a far denser population (Flannery 1986:314–315), he vitiates the population pressure model completely (Flannery 1986:503, 515).

While I agree with Flannery that population pressure models are not satisfactory and that human intentions ought to be brought into the explanatory framework, I feel that Flannery has overly emphasized selected aspects of his results.

In the first place, he gives the impression that caves are important for campsites and that the family of five postulated to have used Guila Naquitz was the only group in the area. On the basis of comparative ethnography, it is extremely unlikely that this or most other rockshelters were used except in case of dreadful climatic conditions, and then only for short periods. There must have been many open-air campsites in the area, especially closer to the river, where many more people could and did camp. What Flannery (and MacNeish) has excavated are most likely the food remains from very occasional visits of a small segment of a much larger band. It simply does not make any sense to have an environment as underutilized as Flannery would like his readers to believe. According to his own calculations, his family of five could live for 4 months at the cave by foraging over no more than 2.5 ha. If foraging was extended to the more usual catchment radius of 5 km, cave residents would be able to harvest 195 tons of acorns, 673 tons of agave hearts, 1923 tons of prickly pear fruits, 4.7 tons of venison, and many hundreds of tons of other resources (Flannery 1986:314–315). But these are merely the resources of a peripheral, seasonal, and seldom used campsite. Surely the base camp of any band must have been toward the center of the valley, for here, on the low alluvium which Flannery largely ignores in his models, there were thick forests and expanses of open water that had remarkable "potential for providing subtropical and subaquatic resources in *great* quantity" (Schoenwetter and Smith 1986:217—emphasis added).

Between Flannery's calculations and the pollen evidence for the central valley, the image that emerges is one of a veritable hunting/gathering paradise in which low population densities clearly seem out of place. Where, then, are the missing people and the missing sites? I suggest that the sites may have been largely eroded off the slopes and lower alluvia by the extensive deforestation, cultivation, and mechanized agriculture of more recent millenia, leaving only shreds of these early settlement patterns. Schoenwetter and Smith (1986:218) clearly believe that early villages existed on the lower alluvium. However, this is precisely the area most productive for agriculture, and it is precisely the area where millenia of farmers have completely altered the environment and its erosion/deposition regimes (Flannery 1986:255). Any base camps of early, sed-

entary, complex hunter/gatherers may have been obliterated along with the best evidence for trade, status items, accumulators, feasting structures, and differential burial statures. In fact, no burials at all from this period have been recovered. We can only conclude that the vast majority have been destroyed or are beyond recovery.

I believe that the circumstantial evidence argues strongly for the evolution of very resource rich communities of hunter/gatherers in the Valley of Oaxaca during terminal Paleo-Indian and especially Archaic times. We know that these communities relied on acorns, agave hearts, mesquite, susi nuts, prickly pear and abundant aquatic and floodplain resources. Flannery (1986:503) himself views this as a collecting, logistical system with large base camps. I believe the richness of the resources permitted groups to be semi-sedentary and to adopt forms of economic competition within and between groups resulting in competitive feasts between accumulators. If these developments follow the same pattern documented elsewhere in the world then feasting, exchange, and accumulators emerged prior to, or coincident with, the first concerted production of food. The exotic lithic materials found at Guila Naquitz that came from over 50 km away (Flannery 1986:142) may simply be the most visible part of this exchange system viewed from a very peripheral campsite.

As with the first domesticates in the Tehuacan Valley, the first Oaxacan domesticates do not make much sense in terms of reducing the risk of starvation. The bottle gourd has no significant food value, but as suggested in the Jomon case, it does have great significance in serving rituals even today in Mesoamerica. While Flannery is correct that the bottle gourd is a useful container for hunter/gatherers, it and similar species must have always been useful as containers over the last 2 million years. Flannery's model does not explain why hunter/gatherers should have decided to domesticate the bottle gourd only in the last 10,000 years.

The other early Oaxacan domesticate, squash, may or may not have had palatable flesh. At least today, prolonged cooking and caramelizing of the flesh produces a highly desirable sugary meal in the Maya Highlands. However, it may be as Flannery (1986:17) suggests that the seeds were actually of greatest initial importance. Squash seeds tend to have a high oil content (46.7%—Watt and Merrill 1975) and should have been relished on that account alone in any status feasting. Given the sparse natural and even cultivated occurrence of squash, it could hardly be considered as a staple food initially or to have been a significant deterrent to starvation in famine years. On the other hand, squash seeds do fill an important role as a delicacy. After all, only 17 cucurbit seeds were recovered from the entire site of Guila Naquitz, ranking thirteenth in edible weight among plant species and far behind the thousand acorns and thousands of other

staple plant food remains. If increasing food quantity was the major concern of the first domesticators, it made little sense to start with cucurbits.

DISCUSSION

Although all of the following elements are not critical in order to sustain the major thesis of this article, I would like to briefly recapitulate an evolutionary scenario of important relationships and explore their implications.

The principle that generalized hunter/gatherers share widely, but lack economic competition, private resource ownership, significant storage, sedentism, boasting behavior, and significant status symbols due to their limited and unpredictably fluctuating resource base is a principle well established in ecological anthropology. The major factor of concern is the danger of overexploiting resources and provoking or aggravating famines. Under these conditions, when resource stress occurs, hunter/gatherers move out of stricken areas, reduce their own populations if stress continues, and/or displace other groups forcibly. They do not try to increase food supplies through attempts at food production. In times of resource shortages such attempts would be doomed to failure, in better times it is doubtful whether any community would find the extra effort worth the trouble, as the Hadza clearly state (Woodburn 1966).

Perhaps, as I argued in 1981, situations of food stress motivated some groups to explore the use of alternate resources such as seeds, fish, toxic or poor yielding nuts, and small mammals. Whatever the reason, hunter/gatherers at the end of the Pleistocene did develop a new, Mesolithic/Archaic technology enabling them to efficiently exploit unprecedented vast amounts of resources in some areas (Hayden 1981a). The reproductive characteristics and abundance of many of these resources rendered it impossible to overexploit them and created a more stable resource base for full- or semi-sedentary village life.

Depending on local resource characteristics, a threshold was crossed in which economic competition could thrive to varying degrees. The importance of this development cannot be emphasized enough. There are many possible economic and ecological reasons why competition should emerge under conditions of abundant and reliable resources. I am currently investigating this development in the Interior of British Columbia. While several alternative scenarios are viable at this point, it is clear that competitive economic behavior including competitive feasting emerges *only* under conditions of resource abundance. Contrary to the assumptions of structuralists like Bender (1978) and Flannery (1976), neither the

nature of preexisting social structures nor unique, random changes in these structures appear to be important for the emergence of competitive behavior and feasting. However, this is a topic for another paper. All that needs to be established for the present purposes is that economically based competition *did* emerge. In many of the cultures examined above, it is clear that economic-based competition for individual influence, wealth, and power was well established, e.g., the Northwest Coast, the Natufian, the eastern Archaic. In some cases, signs of economic competition are present that achieve maximum expression only after the introduction of some domesticates. This continuing centralization of power and control subsequent to the domestication of several species is consistent with expectations of my model where environments are favorable.

Initially, however, complex and competitive hunter/gatherers must have been relatively egalitarian in the sense that everyone had access to basic resources. The early forms of complex hunter/gatherers would have differed from egalitarian generalized hunter/gatherers primarily in permitting members to engage in storage and economic competition, at least as long as it did not jeopardize the livelihood of others. Aggressive and innovative individuals were allowed to *try* to use the productive potential of others for their own personal gain and to accrue some of the symbols of power and influence. The means to this end was through the holding, managing, and manipulating of competitive feasts and rewards. The organizer became an accumulator. The organization, as well as the pressure and tactics used to increase or obtain desirable foods and goods, is clearly illustrated in the film *Kawelka* (Nairn and Strathern 1974) where the local Big Man exerts great efforts to secure and reconfirm numerous promises from other families to provide specific quantities of goods for a major competitive feast. It takes years to orchestrate the debts, payments, and minor supporting feasts among local families in order to sponsor a major feast. Because failure can mean permanent indebtedness and even death as a reprisal for defaulting on debts, all possible means are used to persuade families to contribute as much as they can. Using this as a model for complex hunter/gatherers' social organization in rich environments, it is easy to see how and why pressures to cultivate, produce, and increase both size and quantity of foods emerged. Under pressures and promises of recompense in exotic status objects, some individuals clearly felt it worthwhile to spend the extra effort to clear, prepare, and tend gardens.

In this scenario, the domestication process is dependent on several variables. First, it depends on the amount of influence of accumulators as a local class of individuals. For any region with several communities, this must depend on the overall richness and stability of resources in the area (as well as labor requirements) rather than on the individual or social characteristics of single leaders in the communities.

Second, domestication depends on the availability of potentially domesticable feasting plants and animals in the environs of communities, i.e., those species reasonably responsive to labor intensive care for increasing their size or other desirable characteristics. There are few such plants or animals in arctic, subarctic, or extremely arid areas. Thus, while specialized and complex hunter/gatherers sometimes occur in these environments (e.g., Sheehan 1985; O'Shea and Zvelebil 1984), they developed no domesticates. The complex groups in the European and Russian Upper Paleolithic with their very elaborate status items are other good examples that lacked suitable domesticates, although the depiction of a Magdalenian horse with a bridle indicates that some form of animal tending may have been practised (Bahn 1983).

Third, the choice of specific plants or animals is largely dependent on the character of the local diet and the desirability of specific foods for feasting (as well as the suitability of the species for domestication). Local dietary limitations in specific types of nutrients probably account to a large degree for the emic tastiness or desirability of certain food types. For instance, in protein-rich environments like the Northwest Coast, Japan, and the Levant, carbohydrates were highly prized. In lipid-limited environments, fats and oil-rich plants were often imported and locally grown (sunflower, avocados, squash seeds) or, in the case of animals, individual animals were fattened (probably with cultivated or stored plants in many cases) before consumption. Fatness is one of the most important characteristics of domesticated animals everywhere (Armitage 1986; Eaton and Konner 1985:285), and it seems likely that animals were domesticated primarily for the increased fat content that could be achieved, rather than to increase the meat supply per se. Thus, if ever a technique is developed for determining relative fat content from faunal remains, the accumulator/feasting model predicts that there should be a clear increase in fat from wild to the first tended and domesticated animals.

Fourth, domestication also depends on the availability of nonfood species that can be used in competition feasts, rituals, and other displays. I suggest that the bottle gourd (various sizes being used as status-display serving and brewing vessels) and the dog (used as a symbol of consumption, but perhaps also used to protect owners and property) fulfilled this role in some areas.

These same factors must have also determined the pathways of diffusion. The Peruvian coastal societies provide one example of this. Highly complex communities with monumental architecture and elaborate hierarchies developed along this extremely arid but marine-rich coast without any domesticates. However, when a suitable domesticate for this environment was introduced, it was immediately incorporated and produced

in abundance (Feldman 1983:295–300). The same situation occurred on the Northwest Coast with the potato and in the Eastern Archaic with sunflower and squash. In contrast, there are no accumulators or competitive feasts in most of Australia and domestication never spread there. Some forms of food production did seem to be developing in the southeast of Australia where resources were exceptionally rich and population densities were high.

Domestication spread unevenly in the eastern Archaic (Crawford 1982; n.d.b.). In terms of the present model, this can be viewed as being due to differences in the power and influence of accumulators conditioned in turn by the varying resource abundances of riverine vs inland communities.

In many areas, once the resource threshold for economic competition without negative effects had been crossed, it appears that it took accumulators several centuries or millennia to effect changes in customs and the social system so that they could exert enough influence to get food production under way (e.g., the Natufian, the Early eastern Archaic, the early Mesoamerican Archaic, Initial Jomon). This lag may be caused by the difficulty of going from the mandatory sharing and anti-individualistic ethic of generalized hunter/gatherers to the private ownership of resources and ego-centered debtor relationships involved in food production and competitions between accumulators. The lag may be caused by the time needed to perfect the new technologies and strategies in order to bring production sufficiently above the competition threshold. The delay might also be caused in some instances by the lack of good, locally available cultigens. In fact, it may be useful to rank potential cultigens on the basis of the effort required to cultivate them. If this list is restricted to feasting foods, accumulators with weakly centralized power should be able to obtain production only of the least effort-demanding cultigens, while accumulators and elites with increasingly greater control and power should be able to obtain the production of increasingly more effort-demanding cultigens.

The preceding review has indicated that there are a surprising number of common constellations of cultural features associated with domestication. Although they probably do not constitute absolutely necessary conditions, they clearly hold clues to understanding the domestication process. These features include the ability to intensively use fish, shellfish, seeds, acorns and other nuts; full- or semi-sedentism; permanent and often semi-subterranean structures; ground-edge axes (probably related to cutting wood for permanent structures); storage; trade (especially in obsidian, copper, and shells); ornaments; the use of intoxicants such as tobacco and alcohol; the breeding of dogs; and the eventual emergence of specialized structures suitable for communal competitive feasts. Al-

though these structures are often termed "ritual buildings," I believe that viewing them as communal feasting structures is far more likely to produce useful insights into the nature of past societies and the dynamics of change. This is not to say that ritual displays did not take place in such structures, for ritual displays are integral parts of most competitive feasts.

If this model is evaluated as a theory of domestication it can be described as relatively powerful due to the broad scope of observations that it embraces.

It explains the timing of domestication as occurring only after Mesolithic/Archaic technology was developed.

It explains the environmental context in which domestication occurred: resource-rich rather than resource-poor environments.

It explains the cultural context of domestication: complex, specialized hunter/gatherers with accumulators and feasting complexes.

It explains the pattern of diffusion of domestication and why domestication never was adopted in Australia even after European contact but was rapidly adopted by the Northwest Coast groups soon after European contact.

It explains why hunter/gatherers continued to exist in resource-poor areas up until European contact, as well as in areas where there were few domesticable species important for feasting.

It explains the nature of the first domesticates and the full range of domesticates: the condiments, the containers, the intoxicants, the lipid-rich foods, the carbohydrates, and even dogs.

It explains an aspect of pig use that has long puzzled anthropologists, namely why both wild and domesticated pigs are used and why domestic pigs are valued so much more and used for feasting, marriages, or debt-creation.

It explains why ornaments, status differences in burials, and ultimately specialized structures emerge among the richest complex hunter/gatherers and why these features precede domestication.

Lastly, it explains why food production using domesticates stayed at very low levels for long periods after the initial "discovery" of domestication in virtually every area examined. Crawford (n.d. b; personal communication) has drawn particular attention to this puzzling feature for the Eastern Archaic and the Jomon. I argue that the long-lasting limited initial role of domesticates is due to their use in infrequent feasting contexts, rather than as an integral part of daily nutrition. Such foods would be labor intensive, difficult to produce, and not worth the effort for daily consumption. The present model does not deal with the subsequent intensified use of plants and animals for daily subsistence. This is beyond present concerns, but may have been contingent on the eventual development of techniques and cultigen varieties with equal or better food

returns per time investment to those from hunting and foraging. This scenario could certainly explain the otherwise curious bimodal distribution of dependence on agriculture (with peak's at 10 and 60%) noted by Hunn and Williams (1982:6) in their cross-cultural survey. Status emulation and other factors may also have played important roles in the transformation of status domesticates to everyday staples.

Thus, the model exhibits broad scope and considerable explanatory power. Another characteristic of this model that makes it appealing is the clear and powerful causality that it incorporates (individual competition for influence, control, and power leading to domestication). Accumulators and elites have been plausibly implicated in other technological changes such as the development of metallurgy, why should they not also play key roles in food production? Accumulators are entrepreneurs in many domains; food production is an especially apt focus of their efforts given the critical role of feasts in their manipulation of power and goods. Salmon (1982) argues that clear causality is of fundamental importance in archaeological theories. Social structural explanations of domestication such as Bender's (1978) have considerable problems in this area. The present model also incorporates human intentionality which Flannery and other archaeologists feel is crucial in explaining behavior.

However, even more importantly, I feel this model is a suitable antidote to the recent retreats behind smokescreens of jargon, ethereal abstractions, systems, stochasticy, random kicks, and multicausal flow diagrams as explanations for cultural changes. It is true that cultures are complex systems. However, the abandonment of simple explanations should always be a last, undesirable resort. The goal of science is, after all, not to create black boxes that operate in mystical ways, but to discover the underlying *basic* principles that order the universe. I am confident that understanding the advent of food production is amenable to this latter process, and the above model is presented as one step toward the achievement of that goal.

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