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FOOD AND THE EARLY HISTORY OF CULTIVATION

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ABSTRACT.—A cultural argument is proposed to explain the origins and development of cultivation in different areas of the world. It is suggested that culturally valued foodstuffs which reflected cultural categories of edibility, taste and other forms of sensory appeal may have had more of an influence on the domestication of plants than the search for staple crops. The role of food processing, cooking and the exchange of foodstuffs in the development of cultivation and the diffusion of plants and animals is examined. Then ideas are examined against the existing evidence of cultivation from archaeological sites in S.W. Asia, S.E. Asia and E. Asia and Middle and South America.

INTRODUCTION

The origins of agriculture remain one of the central issues of prehistory. The problems of where, when, how, and particularly why agriculture first developed have been the subject of much research, discussion and debate (e.g. Struever 1971; Hutchinson 1975; Reed 1977; etc.). A combination of archaeological and botanical techniques, such as the recording and mapping of crop plant diversity and related wild species as well as research into crop plant genetics, have produced general answers to the first two questions, i.e., where and when, but the other problems (how and why), remain unanswered. This is not to deny that many hypotheses to these problems have been put forward, but none have received unqualified approval. The aim of this paper is to add to these hypotheses by providing an alternative explanation, and in doing so to widen the field of discussion on this central issue.

DEFINITIONS AND HYPOTHESES

There is some confusion in the literature concerning the use of the terms agriculture, horticulture, cultivation and domestication. By "cultivation" we mean the deliberate intervention by humans into the breeding cycle of selected plants through a sequence of intentional acts and techniques such as those involved in the preparation of fields, the husbanding of crops and the selection of seed or root stock. Such deliberate acts vary in their form and complexity but we suggest that plants, tilling, harvesting and the selecting of seed or root crop for future use are the basic attributes of a subsistence system known as cultivation. Horticulture is often used as if synonymous with cultivation, and both terms are regarded as a less intensive form of agriculture. We consider horticulture and agriculture should be regarded as opposite poles of a continuum of cultivation systems, involving differences in scale of operation and in crop diversity. In general, horticultural

systems are small scale, garden systems which involve a wide range of crop plants from herb to tree species each represented by only a few individuals. Agricultural systems are larger scale systems of cultivation with extensive crop areas often divided into fields on which are cultivated a limited range of species each in large quantities. Agriculture is often equated with production of staple foodstuffs though, as will be seen, this need not always be the case and what constitutes a staple is often difficult to establish.

Although, in the literature, domestication is often used synonymously with agriculture, we wish to restrict the term to a set of morphological and/or genetic traits which distinguish selected crop plants from their wild ancestors. It is assumed that under the process of human selection, isolation and protection plant species will undergo change. Archaeological evidence and botanical experimentation suggest that the process of domestication of a plant to the point where it can be easily recognized involves a considerable period of time. The length of time varies between species but may take, hundreds, and in many cases, thousands of years for such changes to occur. It is often difficult to establish a baseline from which to measure changes, least of all to gauge the rate of change, and the natural variation of wild species is often poorly understood. However, it is assumed that cultivation preceded major changes in plant species and thus our ability to recognize domestication.[1]

A staple crop is one which provides the carbohydrate bulk for a population for most of a year. The archaeological identification of a staple remains problematic. The discovery of large quantities of the remains of a single species is often assumed to establish the existence of a staple but factors such as differential preservation because of the nature of the plant material, how it was processed, consumed and discarded all contribute to complicate such interpretations. The consideration of plant remains in the reconstruction of the range and quantities of plants cultivated at any one site must be treated with caution, as Hubbard (1975) has recently noted with regard to the changing staples of the Greek Neolithic. However, large numbers of sites in the same region which regularly show high frequencies of certain types of plant remains, can, in certain circumstances, be taken as evidence for the existence of a staple (eg., the wheats and barleys of the late Neolithic in Southwest Asia and rice in the Southeast Asian Neolithic).

Recent approaches to the question of how and why cultivation first developed have followed two general models, the deterministic and the stochastic. Deterministic models attempt to relate change in subsistence to stresses caused by environmental change, (particularly climatic change) and/or to population pressure. In such models people were forced to adopt cultivation to survive or to maintain and develop certain lifestyles. Stochastic models explore the range of subsistence strategies open to hunter/gatherers within particular environments by correlating the ecological, demographic and social factors which may have encouraged people to change their mode of subsistence. The latter models have mainly focused on sub-tropical regions where many of the world's crop plants originated and which are areas of localized environmental diversity which provided ideal situations for the development of cultivation.

These models present major problems as total explanations for the origin of cultivation. Deterministic models assume that people are largely controlled by external forces and that stress occurs irrespective of social and economic factors. Ethnographic research among recent or contemporary hunter/gathering societies suggests that few lead a precarious existence or would be subject to stress in even the most severe circumstances envisaged by those archaeologists who proposed deterministic models. Binford (1968) has clearly stated the deficiencies of such models and raised another issue when he noted (1968:327) that the problem is "not why agricultural and food-storage techniques were not developed everywhere, but why they were developed at all." Stochastic models, with their broader approach to the issues, provide a better explanation but they remain rooted

in the interplay between environment, population and energetics and rarely invoke cultural factors as part of their explanation.

Both deterministic and stochastic models, as well as the archaeological and much of the botanical research devoted to their development and proof, have tended to concentrate on a narrow range of what are assumed to be important staple crops. However, there are clear signs from the prehistoric record of many parts of the world that the exploitation, adaptation and diffusion of staple crops was preceded by the cultivation of a wide variety of other plants. The approach, which will be developed in this paper, is that the cultivation of these plants should be considered in terms of their cultural value to societies existing in the past, rather than to their more essential utilitarian role in subsistence activities. Crucial among these cultural values is the importance of crop plants as food in a cultural sense, rather than as food in terms of sustenance.

THE RARE AND THE RELISHED

In all cultures certain objects are more esteemed than others and such prized items are endowed with high cultural value. The concept "value" is culturally specific and can be based upon a number of quite disparate criteria which need not relate to the objects most obvious material or utilitarian value to us as outsiders. An object may be culturally valued because of specific properties considered to be inherent in it or because it is associated with other objects of equal or greater value, power, and influence. Valued objects obtain their status because they are sometimes in short supply within a particular environment (because of restricted location, seasonal variations, etc.), because demand for the object exceeds its supply, because this supply has been artificially restricted, or because the object is foreign to a particular cultural environment, i.e., it is an exotic.

Many objects can therefore become prized for a variety of reasons within cultural environments. They can also take many forms, possess more than one meaning, and fulfill numerous functions within a number of contexts. Four major categories can be generally defined, although there is often considerable overlap in their uses and all involve the possible exploitation of plants. These four categories are articles associated with material culture, decoration, medicine and finally food.[2] In terms of plant sources they include raw material for artifacts and other items of material culture (clothing, building, etc.), dyes and other colorings, cosmetics, aromatics, stimulants, medicaments and, of course, a number of herbs, spices and other flavorings associated with food.

In this paper we will be concerned particularly with food, not because we think that the food sources are more important than the others, but because we believe they do have particular relevance to the development of the cultivation of staple crops.

Food is itself a cultural category and involves those substances which a culture considers edible or in some way sustenance of health. Initial selection of any item from a given environment is heavily influenced by notions of edibility. The quantities selected and the amount of energy exerted in acquiring food depends upon notions of preference. Preference is not an open to free choice by individuals within cultures but selection is molded through cultural habits and socialization; even where certain substances are recognized as being consumable, they may be proscribed by certain cultures for a number of reasons. Such negative rules concerning the selection of foodstuffs are well known in the etnographic and historical literature (Douglas 1966, Tambiah 1969, etc.). Positive notions of preference for particular foodstuffs are often not related to concepts of nutritional worth (although they may be associated with indigenous concepts of health, "essentialness," wellbeing, etc.) but are related to a wide number of concepts of cultural value. A cursory glance at the ethnographic literature reveals that such preferences are based upon a wide range of factors. In terms of food the most important considerations are often taste, color, smell and texture—concepts associated with the senses. Other factors

include the role of food in terms of its part in larger social and ritual activities, and whether or not such items comprise part of what are considered essential for a meal or to complete a particular dish.

Taste undoubtedly plays an extremely important role in the selection of foodstuffs. Although little information can be found on this subject in the ethnographic literature, there are numerous accounts from many cultures of the importance attributed to sweet items derived from such sources as honey, fruits and natural sugars and from salt and related flavorings. Peoples with quite different modes of subsistence appear to relish such delicacies and expend an inordinate amount of time, energy and sometimes wealth to secure supplies. It is also clear from the literature that while many of these items have been collected from wild sources, others have long been the subject of careful cultivation. Indeed it is often easy to forget today that many items which are in easy supply were once extremely rare and highly esteemed.

ETHNOGRAPHIC INFERENCE AND ARCHAEOLOGICAL EVIDENCE[3]

It has been argued that cultivation may have first begun on household rubbish dumps and in small permanent garden plots close to settlements and on such sites a great diversity of plant species flourished in a human-constructed and human-protected environment. Some of these plants may have been adventives or weeds or may have served special functions in the societies. In such locations plants species which were later to become major staples are found, although initially they may not have been important food sources. A number of authors have put forward such ideas, suggesting the humans, by creating such protected environments, accidently or deliberately began to interfere in the natural breeding cycle of plants (Anderson 1952; Hawkes 1969; Harris 1969, 1973). As such changes occured, it is argued, humans came to recognize the benefits of isolating, protecting and developing plant species under particular conditions and gradually varieties and/or new species were developed which can now be recognized as domesticates.

It is our argument that among these early, protected and carefully husbanded plants were those to which high cultural value was given. Ethnographic evidence (eg., Anderson 1952:138-9) reveals that garden plots often contain a mixture of herbaceous and woody plants and a high percentage of spices, flavorings, drugs and other medicaments, gums, oils, perfumes, industrial and ornamental species and highly prized tasty fruits and nuts. Even among people often regarded as non-cultivators, similar patterns can be discerned. Jones (1975) describes rubbish-heap exploitation among the Anbara Aborigines of Arnhem land in Australia. A native fruit tree *(Eugenia suborbicularis)* and the exotic watermelon are found respectively around wet and late dry season camps. The seeds of these plants are discarded where eaten, and while there is no formal technique of cultivation or protection, there is an awareness among the Anbara that the seeds will later germinate and supply fruits at these locations the following year. Watermelon seeds have also been carried to new camp sites to establish new colonies. Diane Bell has informed us (per. comm., 1980) that on central Australian outstations the only indigenous plant introduced into garden plots by Aborigines is the ***pituri*** *(Duboisia hopwoodii)*, a native tobacco which also acts as a stimulant. There is evidence to suggest that ***pituri*** was moved around the landscape prior to European contact and thus may be regarded as an ancient cultivar. Today most of the exotic plants grown on such outstations are mostly highly prized items, such as tomatoes and watermelons.

Archaeological evidence to support the idea that the first plants cultivated were those highly valued is quite equivocal. The causes for this are obvious. Firstly such plants are often those least likely to be preserved in archaeological contexts. Secondly, the research emphasis has often concentrated on the discovery and identification of staples and thus other plants have often been overlooked. However, published data from Southeast Asia,

the Americas and perhaps from Southwest Asia indicate the presence of non-staples in the record and these, we suggest, are crucial in any consideration of the early history of cultivation.

Southeast Asia is the homeland of three of the world's staples, the greater yam *(Dioscorea alata)*, taro *(Colocasia esculenta)* and rice *(Oryza sativa)*. No significant archaeological remains of yam or taro have been recorded, but rice appears in Thailand about 6-5000 years ago (BP) and slightly earlier in India (Glover 1979). Plant remains from Spirit Cave in northwestern Thailand are the earliest so far found in southeast Asia, and are dated to between 11 and 8000 BP (Gorman 1970). These remains have been subject to much debate, their cultivated status is unclear because there is no sign of domestication and no obvious staple. The plants which were found include both forest species and leguminous annuals which were seed reproduced. These comprise foodstuffs as well as plants which nowadays are used as stimulants, condiments, oils, poisons and containers (the genera included *Canarium*, *Aleurites*, *Madhuca*, *Areca*, *Terminalia*, *Piper*, *Trapa*, *Cucumis*, *Lagenaria* and the family *Leguminoseae)*. None of these plants today represents a staple in Southeast Asian communities. However, contemporary local use of these species and the presence of both forest perennials and annual herbs in the deposits, suggest some form of concentrated exploitation of these sources in antiquity (Yen 1977). This material could be interpreted as supporting our argument for the selection of culturally valued products, but at present there is no clear evidence of cultivation at the site and therefore our argument here remains speculative.

Even though China is known as a region where the early domesticates include a wide range of nuts, spices and vegetables as well as oil-bearing plants, pulses, roots, tubers, fibres and cereals (Ho 1977), the evidence for early forms of cultivation in China is like that of Southeast Asia, extremely sparse. China, however, supplies ample evidence for food habits in antiquity which reveal great variety and sophistication from early times with considerable value being placed on a number of rare items, including exotics (Schafer 1963; Chang 1977). The extensive and very ancient Chinese pharmacopoeia should also not be forgotten.

The evidence from Mexico is clearer. The earliest recognizable domesticates have been dated to levels aged between 9-7000 BP in the Tehuacan Valley. These domesticates include the chili pepper *(Capsicum annuum)* and the avocado *(Persea americana)* as well as certain species of squash *(Cucurbita* spp.), bean *(Phaeseolus* spp.) and fruit trees, such as the cosahuico *(Sideroxylon cf. tempisque)* and chupandillo *(Cyrtocarpa procera)*. Again, none of these can be assumed to be a staple and there is a predominance of sweet tasting fruits, oily fruits and legumes, condiments and other plants with multiple uses. MacNeish (1967) suggests that the earliest forms of cultivation were garden systems such as barranca (canyon) and hydro-horticulture, and Harris (1973) has subsequently suggested that this evidence fits the dump heap/household garden theory.

In the Tehuacan Valley *Setaria* millets, amaranth and wild maize *(Zea mexicana)* were also exploited with these early domesticates but there is no indication that these plants were themselves domesticated before 7000 BP. Maize does not begin the process of domestication until after this date and large scale agriculture based upon maize as a staple does not begin until 4300-3500 BP. It is therefore significant that the first domesticates were non-staples, including perennial trees and annuals. The process of domestication can occur quite rapidly and accidentally in annuals, such as grasses, (Wilke *et al.* 1972). By contrast, the domestication of fruit trees may take several centuries, if not millennia because they require several years to bear fruit and cross-pollinate readily with wild individuals. Thus the domestication of maize and fruit trees may be regarded as separate processes of perception, selection and isolation.

The archaeological evidence for early cultivation in Southwest Asia does not immediately appear to support our hypothesis, perhaps because the literature has been

dominated by study of the major domesticates—wheats and barleys along with legumes (peas, horse-bean, vetch, lentils and chick peas)—between 11 and 8000 BP, along with the problems associated with animal domestication. Deterministic models appear the most likely and most favored explanation for the origins of cultivation in this region. It is well known, however, that Southwest Asia was also the center of domestication of a large range of multi-purpose plants (Harlan 1975). If the evidence for early domestication from a number of sites in the region is carefully examined, the range and importance of many of these plants becomes apparent. Zohary and Spiegal-Raoy (1975) have noted that the earliest evidence for the domestication of major fruit and nut trees, including the grape, olive, fig, date, almond, pomegranate, sycamore fig, etc., occurs in protohistoric times (6000-5000 BP) in Southwest Asia, and that by the early Bronze Age they had become important in the economies of many settlements. To this list of plants must be added the walnut. The natural range of all these seed and clonally reproduced woody species is peripheral to this region. Together these fruit and nut plants are rich in carbohydrates, proteins and vitamins, but more importantly many are oily, flavorsome and some are sweet.

Grape seed remains, both wild and domesticated, have recently been discovered in the Levant at Nahal Oran in Kebaran and Natufian levels (ca. 11000 BP and 10000 BP) (Hillman 1975), which according to Zohary and Spiegel-Roy (1975), is well outside the normal range of the plant. Nahal Oran also provides the earliest evidence for fig exploitation in Kebaran levels and olive in Pre-pottery Neolithic B Levels (c. 9500 BP). Almonds and apple seeds occur in Neolithic strata at Hacilar and Catal Huyuk (8500-8000 BP) (Helbaek 1970).

Oils and related products have long been important in Southwest Asia in cooking and for use as incense, perfumes, resins, gums or simply for burning. Many were obtained from a variety of plant sources including olive, flax and legumes, while the range of species exploited throughout the region in Mesolithic and Neolithic times suggests that many were subject to protection and perhaps cultivation. The pistacho *(Pistacia atlantica)*, which is found on archaeological sites only in the form of seeds, is an abundant plant with a variety of uses including incense, resin and gum. The sap of the pistacho produces turpentine and its bark can be used in tanning. Of course, the nuts can be eaten raw or baked or ground into a flour.

Seasonings and flavorings were also common in Southwest Asia. Caper *(Capparis spinosa)* berries and seeds can be used fresh or can be pickled or ground. They are present at a number of early sites including Tell Abu Hureyra and Ali Kosh. Many other plants belonging to this category, which have been widely exploited in this region since historical records first began, are rarely found on archaeological sites. One reason for this may be that the parts exploited for their flavor are often seeds which are ground, such as coriander, cumin and caraway, or leaves such as dill, rosemary and other herbs. Many of the items were probably only used in small quantities and some which were valuable were undoubtedly carefully conserved and stored. In such cases it is unlikely that traces will survive in the archaeological record although there are a few fenugreek seeds from Neolithic levels at Hacilar (ca. 7450 BP). Hackberry *(Celtis australis)* and juniper have been found in the Neolithic Anatolian sites and both can be used in the preparation of alcoholic beverages. Juniper is also used as an aromatic resin in bread. The botanist Helbaek (1970:230), commenting on the presence of juniper seeds in a cache of wheat at Hacilar writes: " . . . it could be possible that the fragrance was appreciated for some culinary purpose by the Chalcolithic Hacilar." Other plants which may also have been highly valued in this area as aromatics, such as the Damask rose and myrrh, play an important role in cultural life at later periods in history, although their exact antiquity is unclear.

In considering the changes in subsistence patterns in Southwest Asia, the development of animal domestication may also be relevant to our hypothesis. Meat is often highly prized among many communities, especially hunter/gatherers, although even among these groups it often forms only a minor portion of the total diet of the people. Not just meat but particular cuts, fatty parts and specific organs are often esteemed and the hunter who procured such food often held a position of importance in the community. But there are major difficulties in not only supplying meat to communities through hunting but also in keeping it fresh. The status of meat as highly prized food is transitory. It should be pointed out that animals, like plants, supply a wide range of resources besides meat, blood and milk, animals also provide hair, hides, horn, sinew, bones, perfumes and flavorings.

It could be argued that in order to secure a regular and reliable supply of animal resources people intensified the relationship between man and naturally herding animals, such as sheep, goats and cattle (and in the Andes, llamas) to the point of "ownership" and began a process of selective culling and breeding which ultimately led to domestication. Thus the resources were stored on the hoof and the herd themselves became a resource which increased the wealth and status of the "owner" and could be converted into other sources of value and status through exchange for women, goods or even other foods. The early dates for the domestication of certain animals, such as the gazelle and goat in the Near East in Mesolithic and early Neolithic times (from ca. 11000 BP), and the llama in the central Andes (from ca. 7000 BP) therefore appear to be more acceptable. The domestication of plants and animals may both have been the result of attempts to maximize resources highly culturally valued in specific societies.

THE CULINARY ACHIEVEMENT

Many items, which were culturally valued, may have been in demand long before people took up cultivation. The increase in demand for such items, their intensification as well as the increase in the range of their uses, however, may have been influenced by other cultural developments. Of particular importance in terms of the use of foodstuffs may well have been developments in culinary traditions.

Until quite recently there has been little interest among anthropologists in culinary traditions of other cultures, but there are signs that this attitude is changing (Arnott 1975; Kuper 1977; Fenton & Owen 1981; Goody 1982). Levi-Strauss (1966; 1969; 1973; 1979; 1981) in particular has examined the importance of cooking in human affairs, a crucial aspect of cultural tradition in many cultures, particularly among South American Indians and this subject has been the focus of much of his research. Food, because it is consumed by people, shared by people, sustains human communities and dominates so much of their activity, is surrounded with a rich corpus of cultural meaning. Wild food sources are somehow transformed into edible, acceptable "cultural" items through the process of preparation, cooking and presentation before they are consumed. This is the culinary achievement and its meanings and importance in many cultures has been greatly elaborated since prehistory.

A number of foods can be eaten raw and many are preferred in this state. But many other foods cannot be consumed raw, not just because they are indigestible or unpalatable but also because they are poisonous or otherwise injurous to health if not processed in some manner. Undoubtedly the great store of knowledge regarding plant and animal species that people built up over the millennia that they subsisted as hunter/gatherers was not only concerned with where to locate sources of food, but also with their properties as plants and as potential food substances. The knowledge and skills which were developed involved how to transform these objects into useful resources and to extend

their uses for new and varied ends. It is logical that this skill and knowledge eventually involved the manipulation of plants and animals and in terms of preparation, cooking and presentation these were concentrated in the environs of campsites.

Cooking is an advanced form of processing and the finished product a high point of cultural achievement.[4] In this processing and cooking a number of techniques are employed often utilizing developments in technology: cutting, grating, pulping, grinding, etc. Cooking is often achieved through a careful exploitation of heat and belongs in part to people's skilled use of fire in a number of contexts. Cooking also involves the combination of often quite different substances, sometimes associated with the use of fire. It is thus an elementary form of chemistry. This transformation through cooking, and other forms of processing, also assisted in the preservation of foodstuffs.

Cooking methods observable in ethnographic situations vary considerably. The most basic, and perhaps the oldest, involves the direct application of heat in roasting which required little skill and a simple technology. Meats can be roasted and certain nuts, fruits, roots and cereals can be treated in the same manner. But many plant sources are better cooked in containers through boiling, baking, braising, steaming, or frying. Such techniques are probably not as old as roasting though they too may have a considerable antiquity. Pottery or iron vessels are not a pre-requisite for such methods for gourds, bamboo (G. Benjamin, pers. comm.), leather (Ryder 1966), and earth ovens (Firth 1963:95-103; Sillitoe 1977) can also serve the purpose.

The role of cooking and processing in the development of demand for various foodstuffs is obvious. Cooking is a creative art, it encourages diversity and elaboration of existing techniques thus helping to establish new forms, tastes and desires. A number of resources, which assist in this process, include flavorings which not only play a crucial role in the process of cooking but also enhance the final outcome. The skillful use of rare, prized and exotic items extend the range of food possibilities and the need to maintain a regular supply of such items may well have been a major factor in establishing a demand for such sources to be near to the centers where processing and cooking took place—the hearth settlement.

The presentation of food should finally be considered. This involves notions of meals and appropriate dishes for a meal. Meals are often structured events, rich in symbolism and surrounded by rules, which are centers of social activity (Douglas 1975; 1982). The presentation of foods involves aesthetic considerations in terms of what the food looks like as much as how it tastes. These are important considerations in terms of the expansion and elaboration of food sources and thus a factor in what is exploited and cultivated as food in any particular culture.

THE CULINARY ARTS IN PREHISTORY

The evidence for the processing, cooking and presentation of food in prehistory is equally equivocal. Pottery is often considered more in terms of its form, decoration and fabric than its function. More attention has been paid to agricultural tools and cultivation methods than to the technology of food processing. Again, this is partly a result of the paucity of the archaeological evidence and a reflection of the nature of prehistoric research.

The use of fire appears very ancient. Hearths are claimed to have been present at Middle Pleistocene living sites, such as at Choukoutien in China. They are more common in later Pleistocene deposits where their presence is often equated with cooking, though what is being cooked and by what means is often unclear. Indeed, techniques of cooking are difficult to infer on many archaeological sites unless there are clear signs of ovens or fire-blackened containers which cannot be equated with other functions. Fire reddened stones in association with hearths are even more difficult to interpret, though

charcoal from middens which may reveal the presence of oil when examined under a microscope, can perhaps be taken as an indication of cooking (Dickson 1977). Food remains around hearths in the form of carbonized and charred bones and plant remains may indicate roasting or baking, but, again, such interpretations should be treated with caution.

Stone and shell tools undoubtedly fulfilled many functions, making an interpretation of their use difficult, although the utilization of microscopic techniques to establish use wear pattern and plant gloss improve deduction in the area. Interpretation of such tools, however, often rests on the use of ethnographic analogy. Grindstones are often equated with the preparation of meal and flour even though such tools can also be used for grinding ochres and preparing other non-edible raw materials. In South America microliths are often set into boards for the processing of plants, particularly manioc. Where caches of microliths are found in archaeological contexts they have often been interpreted as evidence for the processing of such food. Recently DeBoer (1975) expressed doubts as to the validity of such claims, particularly concerning manioc preparation in prehistory.

Other aspects of food processing, such as soaking, leaching, freezing, squeezing, drying, peeling, threshing and winnowing, may be inferred from the use made of particular plants or parts of plants, but hard evidence is difficult to come by. The andean root complex, for example, requires soaking and freeze-drying to render edible certain tubers and to enable them to be stored. Archaeological evidence for such techniques is sparse because often no structures are needed for processing. Elsewhere in the world (in northwestern Europe and British Columbia) certain arrangements of postholes have been interpreted as drying racks for plants, meat and fish, even though such claims are little more than inferences from ethnographic analogies.

An interesting analysis of plant remains which may indicate processing has been put forward by Dennell (1974). Using a series of carbonized seed deposits from a number of Neolithic Bulgarian sites, Dennell has attempted to assess the stage of processing exhibited by the remains. On the basis of evidence of crop composition, seed size and other plant material placed within the archaeological context he claims to be able to distinguish four categories: post-threshing, post-winnowing, storage and cooking disasters!

Storage methods have been widely reported in the ethnographic literature for not only agriculturalists but also hunter/gatherers (see Testart 1982) and may be inferred for prehistory. The presence of prepared rooms, jars, caches, pits, racks, etc. have been recorded or inferred from various archaeological sites in many parts of the world.

Though most of the evidence for processing and cooking appears so negative an interesting case involves the processing and cooking of maize in the Americas recently reconsidered by Katz *et al.* (1974). Maize, by itself, is almost a complete diet. However, under normal cooking the amino acids lysine and tryptophan remain largely unavailable.[5] Therefore a diet based upon maize would lack one amino acid needed to make it a complete protein as well as niacin, one of the B group vitamins. Only if maize is boiled in an alkaline solution are lysine and tryptophan made available. Katz and his co-authors examined the distribution of maize cooking practices and established that cooking in alkali is present in Mesoamerica and North America but not in South America. This distribution of cooking methods may reflect different historical patterns to the diffusion of maize and cooking techniques. Maize originated in Mexico but spread to South America about 7-6000 years ago where it developed quite independently from Mexico with little subsequent contact (Pearsall 1978). Maize was spread to North America more recently, about 3-2000 years ago. Cooking in alkali, therefore, appears to have been invented some time between 6000 and 3000 BP in Mexico. Archaeological evidence for such a cooking technique is equivocal though it has been recently suggested that caches of land snails (*Pomacea* sp.) at Tikal may indicate that the shells were being used in

cooking to supply alkali (Nations 1979). It is interesting to note that shell in abundant quantities is often found on archaeological sites in Mesoamerica. Finally the consumption of the *Phaseolus* spp. beans with maize appears to be much older than cooking techniques using alkali and it is known that such beans contain significant amounts of lysine and niacin.

EXOTICA, STAPLES AND THE DIFFUSION OF PLANTS

So far we have been discussing how culturally valued resources within a particular environment may have been the first items selected by man for special attention which eventually led to cultivation. The desire to secure a better supply of such items, however, or to seek out new forms need not have led directly to cultivation. Many items may have been impossible or extremely difficult to cultivate within the areas where certain people lived and so they may have been obtained from outside, where supplies were more regular, through a process of exchange with other communities. Such exchanges were to have an important effect on the history of cultivation.

If demand for a product within a particular environment is increased because it is needed for exchange purposes, then it follows that its value is increased, additional amounts will be needed to be produced and more regular supplies ensured. If the source is even rare within the environment within which it is found, or is seasonal or otherwise limited, then people will attempt to secure a more regular supply, perhaps through cultivation. Such items need not be rare but commonplace—they only become rare and thus valued once they travel some distances from their source. One person's exotic is another person's staple. Such a process may well have seen the production of staples within particular areas.

These exchanges encouraged not only the diffusion of processed plants but also the plants themselves, often accompanied with the knowledge and skills needed to establish the plants beyond their normal ranges. In this process an exotic might soon become merely an esteemed object, then commonplace and indeed become a staple.

This argument for the importance of exchange in the establishment, development and diffusion of plants and cultivation also works well for animal domestication. The exchange of meat or other poorly prepared animal products over large distances was difficult if the products began to deteriorate quickly. It was probably easier to move live animals, and once outside their normal ranges, such animals had to be carefully tended until required. Thus, in the exchange of animals not only did selection occur at the start of the exchange cycle, but the populations existing in other areas were carefully cared for. Such practices would have encouraged domestication to occur at a relatively fast rate.

THE EXCHANGE AND DIFFUSION OF FOOD RESOURCES IN PREHISTORY

While questions relating to trade and exchange are widely discussed in the archaeological literature they are nearly always concerned with the movement of material objects rather than of plants and animals. The movements of plants and animals are nearly always discussed in terms of diffusion (Sauer 1952), including the transfer of the knowledge and techniques of cultivation and often the migration of peoples. However, historical sources clearly indicate that there was extensive trade and exchange of foodstuffs in more recent times, sometimes quite localized but at others over considerable distances. These transfers may have been staples but many of the food items were small in quantity though high in value, particularly the trade in spices throughout the Old World (Miller 1969).

One problem in assessing the diffusion of crop plants and its importance in the early history of cultivation is in establishing their natural ranges. This can only be achiev-

ed by examining the contemporary distribution of their putative ancestors and most of the work in this field has been done on major Eurasian cereals. The diffusion of these has been the center of much discussion. Binford (1968) suggested that in the early post-Pleistocene in Southwest Asia wild stands of wheats and barleys were extensively exploited by people and produced sufficient surpluses to sustain population increases to a point where eventually pressure was placed on local resources. The greatest pressures were felt at the margins of the natural ranges of these cereals and it was in such locations that the techniques of cultivation were first developed in response to declining yields. Flannery (1969), reviewing the archaeological evidence for this hypothesis, showed that einkorn, emmer and two-rowed barley appear to have been brought into cultivation at the periphery of their natural ranges. The same applies to many of the items already discussed for Southwest Asia in this paper, fruit and nut trees and various herbs and spices.

An alternative, or perhaps a supplementary, hypothesis to this argument could be that plants (and animals) were moved outside their natural ranges in prehistory through the mechanism of trade and exchange (see the suggestive comments of Flannery 1965). Outside their natural ranges items would be exotics, in limited supply and highly valued. The desire to secure more reliable supplies and larger quantities of these plants (and animals) led to attempts to establish them outside their natural ranges. It could be argued against this hypothesis that trade and exchange can only occur at a later "stage" of cultural evolution, when large populations and complex social organizations have become established. Ethnographic evidence, and indeed much prehistoric evidence, proves such arguments have little foundation. In terms of Southwest Asia, recent research has established the importance of trade and exchange networks of items of material culture of high value over long distances (eg., obsidian *cf.* Renfrew, and Dixon 1976) and that such networks are extremely ancient. It may well be that plants, often associated with food resources, also traveled through similar networks.

Evidence from the other major centers of early cultivation suggest that similar patterns may have been involved in diffusion of plants and the techniques of cultivation while at the same time encouraging innovation. The diffusion of maize in the Americas has already been mentioned. The earliest evidence for maize in South America comes from Real Alto in Ecuador from levels dating to ca. 4445 BP, (Zevallos et al. 1977, Pearsall 1978), from Ayacucho in Peru in Chihua levels (6300-4700 BP) (MacNeish 1969, 1970) and from a number of locations on the north central coast in late Pre-Ceramic times (4500-3800 BP). The introduction of maize into Peruvian agriculture is but part of a larger trend in the diffusion of plants into this area. Plants from lowland South America, such as manioc, sweet potato, cotton and chili peppers as well as others from the eastern Andes, such as beans and peanuts, were introduced into an existing cultivation system based upon roots and tubers (Pickersgill 1969). The exploitation of these local and introduced staples as well as introduced legumes, condiments and drugs form the basis of very environmentally specialized agricultural systems (Brush 1976; Farrington 1980) which appear to have been integrated into a series of vertical economies (Murra 1972). Such systems can be identified throughout Andean prehistory from ca. 4500 BP (MacNeish, Browman & Patterson 1975).

Evidence for this massive diffusion of plants in South America is abundant but we lack information on the causes of plant movements. It may well be that trade and exchange played an important part in the movement, though studies of such systems have not been made on any scale. Lathrap (1973) has reconstructed the trade patterns for lowland South America for which he claims a considerable antiquity. Certainly many of the crops cultivated in Peru originated in the tropical lowlands. In the case of maize, it was difused very early, before it was even a staple in Mexico and Pearsall (1978:64) has suggested that in terms of South America " . . . this movements was probably not due to a large influx of people from the north, but rather a linear exchange of a new and interesting house garden plant."

Other examples from various areas of the world could also illustrate the point that the diffusion of plants as well as the knowledge and techniques of cultivation have been associated with patterns of trade and exchange. As a final point one might again indicate the tremendous exchanges of plants in Asia, particularly between India, China and mainland and island Southeast Asia. Proper study of this complex is still underway but it is interesting to note that the widespread distribution of many of the plants of Indonesia/New Guinea to distant parts of the world may well be associated with the expansion of maritime trading systems from the Indonesian archipelago (Urry 1981). Many of these crops are not staples but spices and were highly valuable trade items.

CONCLUSION

The early history of cultivation should be sought in cultural preferences for certain items highly valued by particular societies in the past. Among these highly valued items were foodstuffs, particularly food plants, and those which were likely first subject to cultivation were not staples but probably were more valued for their taste or other specific properties. The development and intensification of the cultivation of plants for food probably was enhanced by other cultural factors associated with increasing interest in food as a focus of cultural attention.

These factors included changes in preparation, processing, cooking and presentation. Highly valued food sources were also objects to be exchanged and their value increased as they were distributed outside their natural ranges. Such exchanges created new demands and cultivated plants helped establish more regular supplies. Hence knowledge about plants and cultivation, often accompanied by new techniques, were diffused over large areas.

Unlike many other models which see humans as basically uninnovative creatures at the mercy of the environment and forces beyond their control, we propose that humans are conscious actors in their worlds, creating and utilizing resources for cultural ends. The early history of cultivation must be seen as a major cultural achievement, establishing a richer use of resources and embellishing and extending all aspects of cultural life.

NOTES

[1]Helbaek (1966) reports that Pre-Pottery Neolithic barley remains from Beidha in Palestine show no signs of domestication but were found in large quantities and in association with domesticated emmer. He suggests that the barley should be regarded as a "cultivated wild" type.

[2]Within the category food we include drinks, particularly alcoholic beverages, which probably were also important in the developments discussed below.

[3]Brothwell and Brothwell (1969) provide a good overview of the sources of food and its dietary role in antiquity but say little about its cultural value.

[4]Good surveys of food processing in various areas of the world are rare, but see Yen (1975) for Oceania.

[5]In general maize is deficient in these essential amino acids. Tryptophan is the predursor of the vitamin niacin. Cooking in lime liberates both the amino acids and enables niacin to be produced thereby increasing the nutritional quality of maize though reducing its nutrient content.

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