TOPICAL REVIEW

ORIGINS OF AGRICULTURE IN THE AMERICAS*

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RECENT ARCHEOLOGICAL, BOTANICAL AND GEOGRAPHICAL WORK HAS PRODUCED so much information on native agriculture of the New World that it is time to review again what we know about origins and dispersal of agriculture in this hemisphere. Harris, a geographer (1967), summarized ideas on origins of agriculture of both Old and New Worlds. Smith (1968b) gives some brief observations on recent archeological evidence, but his paper was prepared in 1966. Here we will consider the most recent published materials and include some unpublished observations on the more important plants.

Carl Sauer in his "Agricultural Origins and Dispersals" (1952) reviewed the scanty materials available and suggested that agriculture began with root crops in southeast Asia and spread throughout the world. Excavations and studies of New World sites now lead many authorities to conclude that farming began independently in several areas of the Americas. MacNeish, who unearthed much of the evidence for early agriculture, has summarized his work and that of several associated specialists (1964a, 1964b, 1967a, 1967b). He suggests that active farming began before 5000 BC and that some agriculture may have been practiced as early as 7000 BC. Agriculture in South America may not be so ancient. Gourds and some squashes found in sites occupied by early fishing and gathering peoples of the Chilean and Peruvian coasts (Bird 1948; Engel 1963; Lanning 1965, 1967) may be from wild-growing, weedy, camp-follower plants, or from early domesticates. Agriculture at Huaca Prieta in north central Peru (Whitaker and Bird 1949) was practiced in 3000 BC when similar gourds and squashes were found in preceramic and premaize levels.

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Kaplan (1967) identified wild lima beans from a preceramic and probably pre-agricultural site at Chilca, Peru.

PLANTS AS RECORDS OF THE PAST

The plants man uses are a key to his past and to his activities and environment at the time he collected the plants. This is true whether we consider the plant remains from an ancient or recent archeological site, the plants in a settlement of primitive people or in a modern supermarket, or the food and shelter a Viet Cong or a lost American selects in Vietnam. The total pattern of plants, wild and cultivated, used in any community is unique and can be used to trace the history of the people.

How much we can reconstruct from the plant evidence depends upon how well we understand each species and upon the number and depth of studies and collections available from a region, from related areas, and from other time periods. Unfortunately, we have only scattered published data, and practically no collections which can be used for comparisons. Only a few specialists have the skills and interest necessary to study relationships between man and the plants he uses, or are able to identify the plants precisely. With the need of an inventory of New World plants recognized, several institutions and many individuals are now engaged in the preparation of floras. At present there is not an adequate published manual of plants available for any Latin American country.

Collections and detailed descriptions of cultivated plants and their wild and weedy relatives are rare. Edgar Anderson (1962) has written about the disdain of weeds and cultigens exhibited by the botanical taxonomists whose job it is to identify plants. Some justification can be found for their attitude. Variable weeds and constantly changing patterns of cultivated plants do not conform to the definite and recognizable categories many taxonomists prefer. Anderson and Cutler (1942) used the concept of races, similar to the use of that category in studies of man, for studies on maize and this practice has been followed in the survey of the maize of Latin America (Cutler 1946; Brieger and others 1958; Brown 1960; Grant and others 1963; Grobman and others 1961; Hatheway 1957; Ramirez and others 1960; Roberts and others 1957; Timothy and others 1963, 1961; Wellhausen and others, 1957, 1952).

Taxonomy of variants within a cultivated species is still poorly developed. Some progress toward an understanding of the complex relationships among cultivated plants is being made in the course of a search for plant breeding materials (Darlington 1963; Harlan 1966; Hutchison 1965; Schwanitz 1967). An extensive effort in this direction was carried on by several Russian expeditions to the Americas more than thirty years ago. A series of reports described the kinds of plants grown, their wild relatives, and their possible origins (Buka-

sov 1931; Vavilov 1931, 1951; Zhiteneva 1930). Studies since then have usually covered limited plant groups rather than the entire assemblage used in a region (see Correll's 1962 work on potatoes as an example). Studies and collections of indigenous cultivated plants and their associated related weeds are urgently needed. Many kinds are lost each year when residents of formerly isolated settlements change their habits and cease to plant their traditional crops.

The ancient kinds of cultivated plants still grown today are not only reservoirs of potentially useful breeding material but are unique records of the evolution of the crop and of the history of the people. While Dr. Whitaker and I were studying the cucurbits at the Tehuacán, Mexico, caves, we compared the archeological material with the squashes and seeds offered for sale in the local markets and streets (1966). Most of the kinds found in the caves, even in the oldest levels, were still grown in the region. Carter (1945) demonstrated how collections of plants from living Indians could be used to define ancient agricultural areas in the United States Southwest. Vavilov's (1951) centers for cultivated plants are largely based on the areas of greatest diversity of crops grown today. There may be additions to the basic old crops but names, uses, and agricultural practices usually serve to distinguish the new crops from the old.

AGRICULTURE IS LATE

Agriculture is a late feature in the long history of man's development since the time when plants and animals took separate evolutionary paths. The earliest effects of man on plants were slight, and as is the case with compound interest during the first few years, scarcely noticeable. As the years passed these changes accumulated. When man gathered food he scattered seeds and loosened the soil for vigorous roots. He carried his harvest to new habitats where his preferred kinds were accidentally planted amidst his rubbish and there had the opportunity to hybridize with species not present in the places where man had gathered them. Collecting, transporting in loose containers, winnowing, and other actions tend to increase the proportions of large seeds, fruits, and roots. Long before man became a farmer he had unconciously created plants which became weeds and his associates.

Oakes Ames (1939) was an outstanding thinker on ancient relationships of man and his useful plants. His influence can be seen in the work of his many students and associates like Anderson, who summarizes much recent research and speculation in this field (1956, 1960, 1962) and Mangelsdorf (see numerous publications under his name), who has studied the origin of maize and sparked the publications previously referred to on the maize of Mexico and the rest of Latin America. Their students and associates continue Oakes Ames' search for an understanding of man's ties to his cultivated plants.

Some plants prefer disturbed habitats like river banks, ocean strands, changing margins between forest and grasslands, usually dry beds and banks of arroyos, rocky talus slopes, and canyon shelves. Such plants are the grass relatives and partial ancestors of corn, *Tripsacum* and teosinte; the many wild relatives and ancestors of squash and pumpkins; wild tomatoes, ground cherries, and some wild relatives of cultivated amaranth, cassava, papaya, peanuts, pineapple, potatoes, and sunflowers. The natural habitats these cultivated plant relatives prefer are similar to the ones man creates by digging up plants, piling refuse, setting fires, building homes, or planting a garden. The inhabitants of disturbed areas are able to move into man-made spots, tolerate the open sun and loose soils of his fields, and find varied new conditions for mutants and hybrids which may develop.

THE BEGINNINGS OF AGRICULTURE

We will never know when man first learned that plants grew from seeds and roots or that he could plant these himself and harvest a crop where he wanted it. These ideas undoubtedly are very old. The possibility that man carried the idea of planting from the Old World should not be ignored. Deliberate planting, without ground preparation or post-planting care, may have been practiced occasionally many years before man came to the New World.

There is a long series of steps towards agriculture. One of the earliest steps would be to leave a plant alone, not damaging it, in recognition of the crop it would yield. Johannessen (1957) reports that the corozo palm (*Orbignya cohune*) is saved by Honduran farmers when clearing fields and that concentrations of them often mark archeological sites or former settlements. The plant provides food, oils, wine, and wood.

Sauer (1950) placed cultivated crops in four groups:

1. The unmodified wild plant, cared for, transplanted, or grown by man. The corozo palm, wild-growing tobaccos and devil's claw seeds sometimes scattered by Indians of the Southwest, mesquite and guaje (*Leucaena esculenta*) of the Tehuacán region (Smith 1967) are examples. The abundance of apparently wild-growing plants about villages and archeological sites has often been noted. Lundell (1939) remarked: "I found *ramón* (*Brosimum alicastrum*) groves covering the sites of every Old Empire ruin visited in Petén and Campeche, a fact which strongly indicates that the (fruit) tree must have been planted by the ancients, even as it is now planted by the modern Maya." Care of wild growing plants may be considered an early stage of agriculture, or horticulture as Ames (1939, p. 139) would term it, for he pointed out that horticulture involves the care of individual plants while agriculture is concerned with mass production.

2. Domesticated forms which are improved races of the wild plants. Forms of avocado and two native fruits, chupandilla (*Cyrtocarpa procera*) and cosahuico (*Sideroxylon* sp.) of the Tehuacán valley of Mexico (Smith 1967, 1968b) have larger fruits in later levels of the archaeological sites and on present cultivated plants of the valley than are found in early levels and on wild growing plants found in the region today.

3. Fully domesticated forms, grown when the wild form is completely discarded and only improved mutants and hybrids are grown. This is the case with some cacao, ground cherries, papayas, most peanuts, and potatoes.

4. Cultigens which in most cases depend upon the care of man for their continued existence. The wild ancestors may be unknown or the origins so complicated by hybridization, mutations, and selection that the origins are obscure. Maize, pineapple, the squashes, and sweet potatoes are examples. In each case it is possible to hybridize the cultigen with one or more wild growing or weedy species which are closely related and may have been one of the ancestors. Yet, the precise mode of origin and the plants and steps involved, the time and place or places of origin and modification are conjectural.

THE FIRST CULTIVATED PLANTS—ROOTS OR SEEDS?

It has often been suggested that plants with edible roots, tubers, and other underground parts were likely to have been the first to be domesticated (Ames 1939; Sauer 1952, 1965). The act of harvesting wild roots is similar to planting. After harvesting, pieces of the root stock which were missed or rejected may grow into new plants. The oldest archeological plant remains in both hemispheres are those of seed crops (Helbaek 1963) but this may be true because seeds and gourd rinds are more resistant to decay and destruction than roots. Even when roots and tubers are found in archeological sites, little attention is given to them because they are difficult to identify. Towle (1961) has made a serious effort to identify fragments of root crops from coastal Peru sites but collections are so scanty and methods so rough that intensive studies on the origin and evolution of the important earth vegetables depend largely on collections of plants cultivated today and of their wild relatives (Clausen 1944; Hodge 1951, 1954; Leon 1964; Schultes and Cuetrecasas 1953). Our best archeological records of diversity in the many root crops of coastal Peru are the excellent reproductions in pottery but these cover a relatively late and brief period of time.

The evidence suggests that by the time man became an agriculturist he was ready to plant both roots and seeds. People who live on gathered wild foods usually collect almost any edible seeds and roots and I suspect that early farmers grew whatever plants they found or could acquire which would provide food.

Mexican agriculture is often considered to be based on seeds and fruits but the underground parts of chayote, chilicayote, manioc, sweet potato, yam bean, and several other domesticates were widely used in Mexico and Central America. Roots and vegetative parts of many wild plants are gathered by native Mexicans (Sauer 1965) and Bronson (1966) has suggested that a large part of Maya subsistence was based on root crops. In Peru, where root crops are many and are important, gourds, squashes and beans were early domesticates. In the highlands quinoa, amaranth and lupines are widely grown and apparently ancient crops.

CULTIVATED PLANTS IN MIDDLE AMERICA

Mexico and northern Central America comprise the most important area for origin of cultivated New World plants. The oldest remains of agriculture and the largest numbers of cultivated forms and wild relatives of maize, squash, and some beans have been found there. Mangelsdorf, MacNeish and Willey (1965) provide a list of the major cultivated plants of Middle America, indicating the ones which they consider to have originated there.

Plants were domesticated at different times and in distinct areas. The pepo squashes and pumpkins (*Cucurbita pepo*) are earliest in central and northern Mexico and still are dominant kinds in the north. They were the only ones to be carried far north of Mexico and reached New England and Canada before Europeans did. The oldest pepo specimens are seeds and rinds from the Ocampo caves of Tamaulipas, Mexico, dated about 7000 BC. The seeds are only slightly larger than those of close wild relatives and are interpreted as being weedy campfollowers but may have been intentionally planted and cared for (Cutler and Whitaker 1961, 1967; Whitaker, Cutler and MacNeish 1957). By 5000 BC there were several forms of pepo, good evidence that it was being planted.

Moschata and mixta (*Cucurbita moschata* and *C. mixta*) appear earliest in sites in southern Mexico and are the common kinds grown in that region and along both coasts today. Both species spread only a short distance to the north of Mexico before 1492. Mixta apparently did not spread very far to the south, but moschata was grown as far away as Peru and Brazil. These southern extensions of moschata may, however, represent independent domestications.

Maize has received more attention than any other New World crop, probably because it not only is the most important crop of the New World but because the structure of the plant and especially the ear are unusual. Pollen grains from drill cores taken more than 70 meters below present-day Mexico City, at levels believed to have been deposited during the last interglacial period, about 80,000 years ago, have been identified as maize (Barghoorn, Wolfe, and

Clisby 1954; Irwin and Barghoorn 1965). Callen (1967) has suggested that another grass, species of *Setaria* or foxtail grass, may have been cultivated earlier but was later abandoned. The oldest maize associated with man has been found in levels dated to about 5200 BC and is believed to be wild corn (Mangelsdorf, MacNeish and Galinat 1964, 1967). The cobs are small, usually eight-rowed, the kernels partially covered by glumes as in weak forms of pod corn, but the structure is essentially that of modern corn. The lack of corn in earlier levels where other wild plant materials and some possibly ancient cultivated plants like gourds, squash and some beans are found suggests that wild corn was not abundant, was not used, had not reached the area, or had not been created and did not exist at the time the earliest levels of the cave were occupied.

Early studies of Mangelsdorf and Reeves (1939, 1959) suggested that maize could have originated in South America. Discovery of a variable species of *Tripsacum*, a grass closely related to corn (Cutler and Anderson 1941; Cutler 1946, 1954), unique kinds of maize, and complicated use patterns for maize (Cutler and Cardenas 1947) seemed to confirm this.

After the discovery of primitive and varied kinds of corn in early sites like Bat Cave (Mangelsdorf, Dick and Cámara-Hernández 1967), the Ocampo caves of Tamaulipas, Mexico (Mangelsdorf, MacNeish and Galinat 1967b), and in the Tehuacán Caves in the state of Pueblo, more attention was paid to Mexico. The dates for earliest corn known from South America are much later, about 1400 to 1200 BC (Collier 1961), the corn is less variable than the early corn of Mexico, and for a long period nearly all archeological corn from South America is solely of small-cobbed types belonging to a widespread and closely related group of races which were, and still are, grown from the Southwest of the United States (Cutler 1965) to Chile. To this group belong the races called Chapalote, Reventador, and Nal-Tel in Mexico (Wellhausen, Roberts, Hernandez and Mangelsdorf 1952), Pollo of Colombia and other countries of western South America, and several other small, flint or pop races.

Extensive studies on teosinte (Wilkes, 1967), a weedy grass of Middle America which crosses freely with maize and is the source of much of the variability of Middle American maize, neither prove nor disprove Mangelsdorf and Reeves' (1939) postulated origin of teosinte as a relatively late hybrid of maize and closely related *Tripsacum*. The distribution of teosinte, its appearance as a seemingly natural element in the vegetation patterns in some regions, and its occurrence in archeological sites in Mexico add strength to the idea that maize was domesticated there.

Most of the available information on prehistoric agriculture of the southern margin of the Caribbean is surveyed by Sauer (1965) and Harris (1967). The evidence seems to point to a later development than is documented for Peru

or Mexico. Of several recent finds of maize, most of it belonging to small-cob races, the oldest is dated about 200 BC (Mangelsdorf and Sanoja 1965; Wagner 1967). Mangelsdorf and Sanoja suggest as possibility for maize of Venezuela:

1. An early introduction of pop corn from Peru.
2. An early introduction from middle America.
3. An independent domestication of an indigenous wild corn.

Multiple sites of origin for corn, of which the Tehuacán region is only one, were suggested by Mangelsdorf, MacNeish and Galinat (1964). Kaplan (1967) states that the Mexican and Peruvian kinds of lima beans are independent domesticates derived from geographically separate races or subspecies of the wild lima bean which still ranges from Mexico to northern South America. The small limas, or seivas, of Mexico and the large lima of Peru are very different and are sometimes considered distinct species. Mackie (1943) placed all lima beans in a single species, as Kaplan does, but thought they originated in and spread from Guatemala. Multiple domestication of squashes would account for the distribution of the varied regional forms (Cutler and Whitaker 1961) but the ability of most wild and cultivated squashes to cross (Whitaker and Davis 1962) and the frequent occurrence of natural hybrids suggests that many distinct regional types could be the result of such mixing as well as of separate domestication.

INTER-AMERICAN CONTACTS

Many of the plants which were grown in Middle America in pre-Columbian times illustrate the contacts which existed with South American cultures. Manioc (usually called *yuca* in Spanish speaking countries, *mandioca* in Brazil) has many cultivated forms and wild relatives in Brazil, yet Rogers, one of the authorities on manioc, suggests (1963, 1965) that it was first domesticated in Mexico or not far to the south and that the diversity in manioc seen in northeastern Brazil is a result of the cultivated plant moving to that region and there crossing with its wild relatives. The oldest specimens of manioc, dated about 800 BC, come from Cupisnique levels of sites in coastal Peru (Towle 1961). Identifications of early Mexican manioc are not positive (Smith 1968b). Callen (1967b) reports that tissues from human coprolites dated at 900–200 BC from the Tehuacán caves matched comparison samples of manioc. The absence of manioc specimens from early sites in Mexico may reflect accidents of preservation and the rarity of specialists who can identify fragments. If, as Rogers suggests, manioc was domesticated in Middle America, it would have to be very early in order for it to spread so widely in South America and become involved in the creation of the many forms known there.

The chocolate plant, cacao (*Theobroma cacao*), probably originated in

Mexico and Central America (Cuatrecasas 1964). Chocolate beans were important in the commercial and political life of the Aztecs but in South America almost the only use of cacao was for the sweet pulp surrounding the seeds. The assemblage of wild, semi-wild, and cultivated species of Middle and South America forms an interbreeding population with the greatest variability of cultivated forms in northern Middle America. Man was responsible for some of the travels and hybridization in cacao but the chocolate the Aztecs drank probably came from plants domesticated in Mexico and not from South America.

Our best vouchers for contacts between Middle and South America are the peanut and tobacco. The peanut apparently was domesticated in south central South America where most of its close relatives grow (Krapovickas and Rigoni 1957, 1960) and where many varieties are cultivated. By about 1000 BC it was grown on the Peruvian coast (Towle 1961). Its earliest Mexican appearance is in the Tehuacán caves, in deposits dated at about 200 BC (Smith 1967). Guava, which is also believed to have come from central South America, makes its first appearance at Tehuacán at the same time.

The two most important species of tobacco originated in South America (Goodspeed 1954). The tobacco we usually smoke, *Nicotiana tabacum*, originated in Andean South America and spread northwards but may not have reached Mexico in prehistoric times. The stronger *Nicotiana rustica* probably also arose in South America and was brought by man to Mexico and the eastern United States. The tobaccos of the Indians of the southwestern United States are local species, apparently cultivated at times or intentionally spread by casual scattering of the seeds.

Wild tomatoes are centered in north coastal Peru but the center for varietal diversity of cultivated tomatoes lies in Mexico in the Vera Cruz-Puebla area. Jenkins (1948) suggests that the weedy cherry tomato spread throughout tropical America, with or without man's help. It was domesticated in Mexico, apparently because of its similarity to an older domesticate, the husk tomato (*Physalis* sp.). Whereas the peanut almost certainly had to be transported knowingly by man, the weedy cherry tomato could be spread by animals and birds eating the seeds, or even accidentally by man. No specimens have been recovered from South American sites and the few Mexican specimens tentatively identified as tomato are late. The many native names in Yucatán and the Vera Cruz-Puebla area suggest that it was in use long before Cortés arrived.

SOUTH AMERICAN DOMESTICATES

Active survey and excavation work is now underway in many parts of Latin America and we should soon have much better collections of prehistoric

cultivated plants. Towle (1961) has reported on plants from sites in Peru and provides lists of the ones known. Patiño (1963) discusses many of the cultivated crops of South America and notes the references in early European accounts. León (1964) surveys the major food plants of the Andes. No publication, however gives an adequate impression of the baffling number of kinds of edible plants offered in the markets of Latin America. Many of these foods belong to species still unknown. For example, a pepper of the market of La Paz, Bolivia, known locally as ulupica (*Capsicum cardenasii*), was given a scientific name only about ten years ago. Heiser (1963, 1965) has collected, grown, and studied several neglected groups of plants of Latin America. He finds that the common peppers of South America are *Capsicum pendulum* and *C. chinense* whereas the common pepper, *C. annuum*, which includes all the sweet peppers and the common chiles, was confined to Middle America in prehistoric times. There is a similarity here to the tomato in that most of the wild relatives grow in South America. A small hot pepper is widely distributed, in part by birds, in lowland tropical America.

Heiser has recently turned his attention to the many edible fruited species of *Solanum*, the genus to which the potato (*Solanum tuberosum*) belongs (Heiser 1964). Some of the domesticated species set no seed and need man to maintain them.

All the cultivated amaranths appear to be natives of the New World (Sauer 1967) and each of the three major grain amaranth regions in Latin America is dominated by its own peculiar cultivated species:

North America	*Amaranthus hypochondriacus*
Guatemala and Southern Mexico	*Amaranthus cruentus*
Andes and Argentina	*Amaranthus caudatus*

There is some diffusion, but on the whole the ranges of the species in the New World are distinct. This is similar to the case of squashes and peppers, with different species occupying quite definite and apparently ancient areas. Likewise, separate species of jack bean were grown in Middle and South America. *Canavalia ensiformis* was grown as early as 270 B. C. in Mexico (Kaplan 1967). Sauer does not give a very precise indication of where it could have originated but thinks it is derived from *C. brasiliensis* and was domesticated somewhere in tropical America. The jack beans found on coastal Peru are older, dated about 2000 B.C., and Sauer thinks this species, *Canavalia plagiosperma*, was derived, in the Andes, from a wild species of the same region. The wild jack beans are typical of many wild relatives of cultivated plants in their habitat preferences. On herbarium labels the most common notations of habitat are such words as: forest edges, open oak woodlands, edges of mountain forest, thickets, river banks, open ground of ravine banks. One of the wild jack beans

(*Canavalia maritima*) is the commonest and most widespread typical seacoast plant, growing on beaches of both hemispheres, associated often with the beach morning glory, *Ipomoea pes-caprae*.

LAKE TITICACA AS A CENTER FOR AGRICULTURE

The region about Lake Titicaca brings to mind Carl Sauer's (1952, p. 63) suggestion that: "Sedentary fishing peoples perhaps commenced the cultivation of plants and became the first domesticators of plants and animals." Around the Lake is centered a tremendous diversity in several crops with edible underground parts: potatoes, oca (*Oxalis tuberosa*), ulluco or papa lisa (*Ullucus tuberosus*), and mashua or añu (*Tropaeolum tuberosum*, a tuber-bearing nasturtium). Here is also a center for the important highland seed crops, quinoa (*Chenopodium quinoa*), Cañihua (*Chenopodium pallidicaule*), and tarwi (*Lupinus mutabilis*.) Cañihua is almost restricted to the drainage area of the Lake. About the Lake, too, or not far from it, are the centers for the only animals domesticated in the New World, the guinea pig, llama, and alpaca (Gilmore 1950). These facts suggest that this region may have been an ancient and perhaps independent center for agriculture. Unfortunately we lack good archaeological material of early man, of plants, and of animals to support this.

EARLY PACIFIC COAST AGRICULTURE

The most promising new evidence on agricultural origins comes from the coasts of Chile and Peru. Long ago Junius Bird (1948) recovered gourd fishing floats and containers from Chilean and Peruvian sites. At Huaca Prieta he found more bottle gourds (*Lagenaria siceraria*) and squash which were identified as *Cucurbita moschata* and *C. ficifolia* (Whitaker and Bird 1949). Recently Lanning (1965, 1967) and Engel (1963) have reported on early preceramic settlements on the Peruvian coast. In material from one of Lanning's sites we have an identified bottle gourd and an unidentified small *Cucurbita* which may be wild or cultivated. It resembles the smallest specimens from preceramic levels of Huaca Prieta which were identified as *C. moschata*, but also resembles some weedy species of squash like *C. andreana* of Argentina. Recently we also identified a gourd fragment recovered by James B. Richardson from a site near Talara, Peru, estimated to date between 5500 B. C. and 4500 B. C.

The occurrence of a wild species of *Cucurbita* in coastal Peru would confirm the independent nature of domestication of the South American squashes and support a belief in relatively independent centers of origin of agriculture. The widespread occurrence of similar small bottle gourds in early preceramic and apparently preagriculture levels from the United States to Chile suggests

a common source and probably would require the aid of man for transportation because there is no evidence that the bottle gourd was a widespread, self propagating wild plant in the New World.

The center of diversity and of wild relatives of the bottle gourd lies in Africa. There would be ample time for fruits to float to eastern South America and still carry viable seeds (Whitaker and Carter 1961). There is no way to explain how the bottle gourd spread so widely in the New World unless there still existed pockets of wild growing plants when man reached the New World, or man carried the gourd. Most American bottle gourds have slender and firm seeds, similar to the seeds of some African gourds and to those of some small gourds from China. Large gourds of southeastern Asia have broad, flat, and corky-margined seeds. A few such seeds were found in preceramic and premaize levels of Huaca Prieta (Whitaker and Bird 1949). While this may suggest some connection with Asiatic gourds, we cannot rely on this as evidence until we know more about the variability and genetics of seed forms of the gourd, and we have more specimens.

There are some parallels between the distribution of the bottle gourd and cotton, but there are great differences. Both genera have their centers of diversity in wild and cultivated species in Africa and the fruits of the gourd and some species of cotton are able to float in sea water for months and still contain viable seeds (Stephens 1966). Cotton is found in early levels of Huaca Prieta, about 2500 B. C. (Smith 1968b), and possibly as early as 5500 B. C. but definitely by 3500 B. C. in a Tehuacán cave (Stephens 1967). Cotton differs from the gourd, however, in that the cultivated species of Middle and of South America are distinct (*Gossypium hirsutum* and *Gossypium barbadense*) and that the Old World cottons belong to still different species. In addition, several wild and weedy cottons are New World natives. Recent studies (Phillips 1963; Fryxell 1965) indicate that neither a very ancient origin from widespread ancestors, nor recent origin by crossing of New World species with Old World cottons can explain the origin of the American cottons. At present the archeological material of American cottons provides no evidence for man's movements between the Old and New Worlds.

I have omitted reference to the sweet potato because there seems to be no doubt that it was domesticated in tropical America and Douglas Yen will soon publish on his recent work. If the sweet potato was present in Polynesia before Europeans carried it there, it apparently had no effect on the origins of agriculture and of cultivated plant complexes in the Americas.

With the exception of the bottle gourd, the plants found in New and in Old World pre-Columbian sites are distinct and offer no evidence of contacts.

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