ARCHAEOLOGICAL PLANT REMAINS FROM THE CENTRAL COAST OF PERU

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Between 1961 and 1971, Edward P. Lanning, then of Columbia University, Thomas C. Patterson, then of Yale, Michael E. Moseley, then of Harvard, and their students engaged in a systematic study of the archaeology of the lower portion of the Chillón Valley and the adjoining Ancón region of the central coast of Peru. As a result of their studies, a complete archaeological sequence was worked out for the area, spanning a period of about 12,000 years from 10,500 B.C. to the Spanish conquest in the 16th century A.D. The sequence began with the arrival of early hunting and gathering populations in the region and spanned the beginning of agriculture and settled life in the region, the development of irrigation farming, and the growth of large-scale population centers.[1]

Between 1969 and 1971, working under the guidance of Margaret A. Towle of Harvard, I undertook an analysis of the vegetable portion of the prehistoric middens from the sequence with the intention of describing changes in the subsistence economy of the region as these related to the growth of population and the evolution of social forms. The results of this study have been published elsewhere.[2] My intention in this paper is to list and describe the plant material recovered from these excavations and to provide dates and comparative data on the prehistoric occurrence of various vegetable taxa which will help to elucidate the early history of certain wild and domestic plants and their utilization on the Peruvian coast.

In order to understand the significance of the plant material, it is necessary to provide a brief overview of the area studied and the archaeological sequence. The Ancón-Chillón region includes the delta of the Chillón River and an area of coastal desert to the north covering a total of approximately 360 sq. km. The zone is located just to the northwest of Lima (11°58' to 11°40' south latitude by 77°13' to 77°03' west longitude). The area is predominantly an extremely dry desert due to the cold offshore ocean currents which prevent precipitation on the coast at low altitudes near the sea. As a result, much of the area has no natural plant cover. In fact, the resources available for human exploitation are very limited. There are three major biological communities which were exploited for resources by prehistoric populations (fig. 1). First, the ocean itself provided a rich marine fauna and flora. Second, the river valley supported a naturally irrigated strip of forest with a rich indigenous fauna and flora and later supported cultivated fields. And third, low altitude winter fog supported patches of <u>lomas</u> vegetation outside the river valley on the upper slopes of hills facing the sea (Weberbauer, 1936, pp. 16-21; Goodspeed and Stork, 1955, pp. 102-111).

Of the three resource zones, the ocean has probably been the most stable zone ecologically and the most constant potential source of food. Periodic disruptions of the littoral ecosystem resulting from changes in ocean currents are known to occur, but those documented historically have been of short duration (Murphy, 1923, pp. 68-71; 1926) suggesting that such events are far too brief to be easily discernible in the archaeological record. Aside from such occasional fluctuations in ocean currents, the only changes in the productivity of the littoral zone during the period of human occupation seem to have resulted from minor local changes in the configuration of the coast. Shell mounds of the Early Intermediate Period along a portion of the coast, at Ventanilla, are now stranded well inland on a sandy beach, suggesting that this portion of the coast has risen slightly. The altered configuration seems to have destroyed the shellfishing beds along this portion of the coast, because, although shellfishing continues as an important economic activity throughout the prehistoric period in other parts of the survey zone and along other parts of the coast, there is no evidence of later fishing or shellfishing activity along this beach.

The major change in the utilization of coastal resources which occurs in the archaeological sequence appears to reflect cultural choice rather than altered natural productivity of the littoral zone. Marine resources which are only sparsely reported from early sites, become increasingly significant through the late preagricultural and agricultural sites of the region — an economic trend which is repeated in many other locations in South America and in other parts of the world (Cohen 1975a, pp. 100-116; 1977a, ch. 6; 1977b, pp. 156-172; 1978, pp. 112-129).

A third variation in the use of cultural resources may reflect either natural or human agency. The bones of marine mammals, which increase in importance through the early part of the archaeological sequence in a manner paralleling the increasing economic emphasis on fish and shellfish, disappear altogether from the middens of this region after the Early Intermediate Period. These mammals may have been hunted to local extinction by this time. They may have disappeared as a result of the changes in the configuration of the coast; or they may simply have been disregarded by coastal hunters thereafter. In any case it is worthy of note that their disappearance corresponds roughly with the first evidence of large scale manipulation of domestic land mammals in the region (Cohen, 1975a, p. 111; 1977b, p. 167; 1978, p. 122).

The Chillón River is one of the few rivers on the Peruvian coast that flows throughout the year. At present, it supports between 6,000 and 7,000 hectares under annual cultivation within the zone surveyed. The annual temperature regime permits double cropping, but because of seasonal fluctuation in the flow of water in the river, only a fraction of this area can be irrigated for a second crop during the winter season of reduced flow. Large scale irrigation reaching substantially to its modern limits can be traced back at least to the Early Intermediate Period, but the history of irrigation prior to that time is obscure. The use of the river valley for floodplain farming and small scale irrigation can only be inferred from archaeological site distribution and refuse content (see below). In other regions of the Peruvian coast, agriculture is possible outside the irrigated river valley on the basis of puquios or sunken gardens excavated down from the ground surface to a depth at which the roots of crop plants could reach ground water (J. Parsons, 1968; Rowe, 1969). To my knowledge, neither published reviews nor Lanning and Patterson's surveys provide any evidence that this method of farming was practiced prehistorically in the Ancón-Chillón region, however.

Reconstruction of the wild river valley community prior to human interference is a problem. Ramón Ferreyra of the Museo de Historia Natural, Lima, has cited evidence in the form of modern remnants of primary forest and fossilized seeds which suggests that the river may once have supported forest vegetation in a band several kilometers in width.[3] In this case, the primary forest would have been substantially equal in area to that of the modern cultivated zone. As such, the valley would have been a rich resource base for prehistoric populations.

The lomas vegetation is the most problematic of the three zones. The vegetation is dependent on fog moisture and as such only occurs today in locations (hillsides near the sea above 300 m. altitude) and at seasons (midwinter) when the fog is densest. During this period, a highly visible green patch occurs on isolated hillsides in the region. The lomas vegetation is a loosely knit community of herbaceous annual plants plus a number of tuber-, bulb-, and rhizome-bearing plants, some species of which could have provided food for early inhabitants in the region, as well as supporting grazing fauna which could be exploited. At present these regions are used for grazing domestic herds and there is evidence that they supported herds late in the prehistoric sequence, but there is no evidence, in this region at least, that the lomas areas have ever been farmed or contributed any plant species which have become domesticated.

In 1970, during my visit, the lomas vegetation consisted only of tiny patches in one or two restricted locations in the survey zone. These patches contained tubers of the edible species Solanum tuberiferum in great abundance. I estimated 10 such tubers (not to be confused with true potatoes) per square meter (or a total of about 150,000 tubers in one patch) which, along with other edible species of plants and small fauna, even today would have provided a rich resource base for exploitation by a small human population. These resources would be available not only in the winter season when the lomas blooms, but throughout the year since the tubers would remain available for harvest long after the superficial parts of the plants, which provide the lomas vegetation with its bright green color, had disappeared.

The extent of the lomas vegetation at various times in the past, however, is in dispute. There is abundant historical evidence that the distribution of the lomas vegetation responds markedly to the alternation of wet and dry years (Goodspeed and Stork, 1955, pp. 110–111), and there is extensive evidence of fossil lomas plants and snails covering a much larger area of the survey zone than that which supported active vegetation in 1970 (see fig. 1). Lanning has argued that the expanse of fossil lomas vegetation represents a period of generally wetter conditions in the region, corresponding to a period of warmer climate between 6,000 and 2,500 B.C., and he argues that the lomas vegetation was extensively utilized by man only during that period (Lanning, 1967a, p. 51; 1967b). He has been criticized by Parsons who claims that the fossil lomas vegetation is nothing more than the remains of occasional wet years which do not correspond to any particular time period (M. Parsons, 1970, pp. 300–301). The Carbon 14 age determinations and the artifact content of Lanning's lomas sites are so consistent,[4] however, that there is no question that these sites represent exploitation of particular portions of the lomas vegetation corresponding to particular time periods. Lanning's climate hypothesis, however, is questionable. It is clear that the lomas vegetation was exploited primarily during one prehistoric era (just prior to the advent of agriculture). It is not clear that this use pattern necessarily reflects climate change. I have shown elsewhere that the decline in the productivity of lomas resources probably reflects overexploitation by man (Cohen, 1975a, pp. 101–105; 1977b, pp. 157–161; 1978, pp. 113–117).

The history of human occupation in the region can be traced in terms of the distribution of archaeological sites in or near each of the three resource zones and the appearance of organic refuse from each zone in the archaeological record. Lanning and Patterson have recognized approximately forty separate archaeological phases in the prehistory of the survey zone.[5] Three hundred archaeological sites have been mapped from the area so that settlement patterns for all periods can be approximated. Occupation of the region appears to have been continuous throughout the timespan represented with a single break (early in the sequence prior to the earliest preserved organic refuse). The gradual nature of the changes which occur in the artifact assemblage suggests that we are dealing with a continuous process of cultural development <u>in loco</u>. Outside influences are felt, of course, but there is no evidence of wholesale replacement of population or culture during the sequence.

The history of occupation may be briefly summarized as follows: prior to Preceramic Period 6 all archaeological sites represent temporary camps of mobile populations utilizing primarily wild resources. The earliest camps focus on the river valley, but over time the distribution of sites expands out of the river valley along the coast and into the areas of lomas vegetation. The earliest sites with good organic preservation occur in the lomas vegetation, outside the river valley, but these sites consistently contain river valley refuse as well as marine shells, indicating that these early lomas sites represent a portion of a hunting and gathering economy utilizing the resources of the coast and river valley as well as those of the lomas vegetation itself. In the most recent sites occupied by these mobile hunter-gatherers, those of the Encanto Phase of Preceramic Period 5, domestic squash appears in what is otherwise clearly a wild food exploiting economy.

In Preceramic Period 6, settled villages relying on domestic vegetable foods and marine resources appear, and all evidence of transhumant occupation and exploitation of the lomas vegetation abruptly ceases. The distribution of the early settled villages including the first large town or small city in the region, Chuquitanta (PV46-35), suggests that agriculture is based on floodplain farming. It is not until the Early Horizon that the movement of river valley sites outward from the natural floodplain of the Chillón River suggests the gradual expansion of an irrigation system in this portion of the valley. By the middle of the Early Intermediate Period, in the first two or three centuries A.D., the distribution of archaeological sites on the margins of the modern cultivated valley suggests that a valley-wide irrigation system about equal to that of today was in effect. There is an apparent decline in the number of sites occupied during the Middle Horizon which may reflect a decline in population. But by the Late Horizon, the distribution of archaeological sites again indicates that the valley-wide irrigation system was being fully utilized.

Finally, it should be noted that it is only very late in the sequence that domestic animals assume any importance. Bones and coprolites of llamas and guinea pigs occur only beginning in the Early Intermediate Period and it is only in the Late Intermediate Period and Late Horizon that widespread grazing of herds in the lomas regions is indicated.

Analysis of the Organic Remains

The desert conditions of the coast account for the good preservation of organic remains encountered. Good refuse samples with plant remains are available from sites of all periods beginning with the Arenal and Luz complexes of Preceramic Period 4. The collections I dealt with (totaling something over 50,000 specimens) came from 105 excavation units at 10 sites covering essentially the entire sequence. My data are supplemented by published reports on other collections from the sequence, the data from which are incorporated in this paper.[6] Since the refuse samples described come from excavations by a number of different individuals, it is impossible to make any simple summary of the techniques employed, which would aid the reader in the evaluation of the plant samples. All of the material excavated by the author was passed through a quarter inch screen. Samples of dirt passing through the screen were spread out on a light-colored background and examined by eye or through a low power lens in search of organic remains smaller than one quarter inch. Flotation and water separation techniques were <u>not</u> employed by me or by any of the other excavators to my knowledge. It should be pointed out, however, that the samples we dealt with were substantially different from those described by Struever (1968) and others who have described flotation techniques. The Peruvian coastal refuse is usually very solidly packed organic matter with a relatively small inorganic fraction. On the one hand flotation is impractical because of the quantity of floating refuse which would result. On the other hand, the fine-grained fraction is so minor relatively that it can reasonably be sampled by hand without flotation, which is a process for mass separation of quantities of sediment too great to be sorted by hand. Items as small as the seeds of coca (Erythroxylon sp.), less than one quarter inch in length, as well as the seeds of wild grasses were recovered from several sites excavated by Lanning and Patterson as well as those excavated by the author, suggesting that all excavators exercised sufficient care in screening and hand sorting or in saving dirt samples so that fine debris could be recovered. The failure to use flotation may have biased the sample slightly against small seeds in a quantitative sense but probably does not materially effect the qualitative list of plants identified.

It should also be pointed out that the list of plant remains recovered is strongly affected by the potential of identification. A good deal of work is involved in relating preserved nonflower structures from archaeological sites with the flower structures on which botanical classifications are based. The work of Towle (1961) on Peruvian ethnobotany has been invaluable in this regard, but her work was done prior to the discovery of archaeological sites relating to lomas vegetations. As a result, details of the anatomy of wild plants in general and of lomas plants in particular are poorly known in comparison to that of domestic crop plants, and as a result, proper identification of such plants in archaeological refuse is only rarely possible on the basis of present knowledge.

A total of forty taxa of plants were identified from refuse from sites in the Ancón-Chillón region. Of these, thirteen (Hymenocallis amencaes, Jusseia peruviana, Inga feuillei, Sapindus sp., Caesalpinia sp., Prosopis sp., Schinus molle, Asclepias sp., Typha sp., Equisetum sp., Tillandsia latifolia, Cyperaceae spp., and Gramineae spp.) all probably represent wild species indigenous to the area. In addition, five species are considered likely to have been indigenous to the area because they are listed by Macbride (1936-1971) or other authors as indigenous to the general area or because they are found early and consistently in the archaeological sequence; these are Galactia striata, Canna sp., Psidium guajava, Lagenaria siceraria, and Cucurbita ecuadorensis. One other taxon, Gossypium barbadense (cotton) although not originally considered indigenous to this region may prove to have been domesticated in or near this region as suggested by recent morphological studies of local cotton done by Stephens and Moseley (1973).

In contrast, twenty-one taxa are identifiable as domesticates which were apparently introduced into the area from outside:

Zea mays (maize)
Cucurbita ficifolia (squash)
Cucurbita moschata (squash)
Cucurbita maxima (squash)
Phaseolus lunatus (lima beans)
Phaseolus vulgaris (common beans)
Canavalia sp. (jack beans)
Arachis hypogaea (peanuts)
Erythrina sp.
Ipomoea batatas (sweet potatoes)

Manihot esculenta (manioc)
Pachyrrhizus tuberosus (jicama)
Solanum spp. (potatoes)
Polymnia sp.
Bunchosia armeniaca (ciruela)
Campomanesia lineatifolia
Lucuma bifera (lúcuma)
Persea americana (avocado)
Capsicum baccatum (pepper)
Capsicum chinense (pepper)
Erythroxylon sp. (coca)

The taxa are discussed in greater detail below.

Taxa indigenous or probably indigenous to the region

Hymenocallis amencaes occurs in contemporary lomas plant formations of the Ancón-Chillón region, and is probably indigenous to this area. Specimens were collected by the author in 1970. The plant produces edible bulbs which superficially resemble small onions. Fragments of comparably sized bulbs, possibly representing this species have been encountered in the refuse from a temporary lomas camp (PV45-26) of the Encanto Complex (Preceramic Period 5). They are not encountered in sites of any other period in the area.

Jusseia peruviana is an edible fruit native to the river valleys of the central Peruvian coast. Fragments of these fruits, identified by staff members of the Museo de Historia Natural, Lima, occur in fair quantity in refuse from a temporary lomas camp (PV45-26) of the Encanto Complex (Preceramic Period 5). The fruits are not encountered in middens from later agricultural sites, and there is nothing to suggest their domestication or subsequent utilization. This is, to my knowledge, the only recorded archaeological occurrence of this fruit in Peru.

Inga feuillei (pacay) is common in the coastal river valleys and is presumed indigenous to this habitat. This species is today grown as a cultigen for its shade and for the edible pulp of its large (20 to 40 cm.) seed pods, as well as for fodder (Towle, 1961, p. 47). Inga seeds and pod fragments occur for the first time in the survey zone at the Pampa Site (PV45-136), early in Preceramic Period 6. The remains occur consistently, though in small quantities, throughout the sequence. At one site of the Early Intermediate Period (Cerro Campana, PV46-16) Inga leaves occur concentrated in great profusion with quantities of llama dung, suggesting that the leaves were being used as fodder in the stall-feeding of llamas within the residential portion of the site. Wild and domestic forms of this species are not distinguishable in the archaeological record.

Prosopis sp. is another of the plants presumed to be indigenous to the river valleys of the central coast. This taxon is presently widely distributed in coastal valleys and is presumed to be part of the wild flora of the region. The wood is used for charcoal, the gum for gum arabic, and the sweetish pods and seeds are edible (Towle, 1961, p. 56). This plant is not found among the archaeological remains of the region, however, until the latter portion of the Late Intermediate Period (ca. 1300 A.D.) at the Ancón Necropolis (PV45-1) and then only a single fragment of one seed pod occurs.

Sapindus sp. is another taxon which occurs widely in the coastal valleys and which is presumed to be indigenous to the valleys of the central coast. It is a small tree, producing seeds used for beads and buttons, while the fruit contains saponin, a soap substitute (Towle, 1961, p. 62). The seeds are identified for the first time in the survey region during the Conchas Phase of Preceramic Period 6 (between 2100 and 1900 B.C.) at PV45-104 where they are perforated and attached to a textile. The seeds are found only very sporadically thereafter, but Towle reports them from Late Intermediate Period burials at the Ancón Necropolis (PV45-1)(Towle, 1961, p. 63). Sapindus seeds are reported from the Chihua Complex (ca. 4300-2800 B.C.) in the Ayacucho region of the Peruvian highlands (MacNeish, Nelken-Terner, and García Cook, 1970, p. 38).

Caesalpinia sp. is another of the taxa presumed to be part of the indigenous flora of the river valleys. Towle (1961, p. 44) identifies two species and suggests that C. spinosa is probably the species from this region. She lists dye manufacture as the major economic use, but I was informed at a market in Lima that the beans possessed (unspecified) medicinal properties. The beans first occur in the survey zone in Late Intermediate Period refuse from the Necropolis (PV45-1) at Ancón, and they are quite rare.

Schinus molle is another species considered indigenous to the river valley. Lanning lists the fruit of this tree as edible, and Rowe indicates that it is quite widely used in Peru today for making chicha.[7] The tiny seeds occur in small numbers fairly consistently in all sites in the region beginning with the Pampa Site (PV45-136) early in Preceramic Period 6.

Asclepias sp. (milkweed) is a shrub of the moist areas of the river valleys. There is no evidence to suggest that it was ever domesticated and it is probable that this plant is indigenous to the region. The pod fragments occur occasionally throughout the sequence in the survey region beginning with the Pampa Site (PV45-136) early in Preceramic Period 6.

Typha sp. (cattail) is another plant common to the swampy regions of the river valleys of the central coast and very probably indigenous to the area. The stems and leaves are used for construction purposes and the rhizomes are edible (Towle, 1961, p. 16). Fragments of the stems, leaves, and rhizomes occur throughout the sequence in small quantities beginning with the Pampa Site (PV45-136) early in Preceramic Period 6.

Equisetum sp. (horsetails) are another plant of the moist river valley regions which is undoubtedly indigenous to the region. The plant is inedible and was presumably collected for industrial purposes. Fragments of the stems of this plant are found very rarely in the collections beginning with the refuse from the Yacht Club Site (PV45-5) of the Playa Hermosa Phase of Preceramic Period 6 (ca. 2300-2100 B.C.).

Tillandsia latifolia is a species of epiphytic desert-dwelling plant whose leaves and flowers occur quite consistently in all archaeological sites of the region where organic refuse is preserved. The plants are inedible and lack known industrial uses. Lanning records finding large quantities of charred *Tillandsia* in the lomas camps, and the plant may have been used for fuel.[8] However, the plant grows so ubiquitously in desert portions of the survey zone that its presence at many sites in the region may be accidental.

Family *Gramineae* (grasses) is an extremely large taxon containing a number of genera and species, many of which are presumably indigenous to either the river valley or lomas vegetation. Towle (1961, pp. 17-20) has identified at least six genera of wild grasses in archaeological remains from the central coast, but she was working from specimens preserved in mummy bundles with their floral portions intact. Grass culms (stems) are preserved in abundance in all sites where vegetable remains are preserved, and the culms are invariably stripped of their leaf sheaths. I have been informed by Lawrence Kaplan that the absence of leaf sheaths is not a common feature of preserved grasses, so these naked culms presumably represent human modification. Lanning has described grass seed along with grinding stones from sites of the various lomas occupations, and he indicates that the concentration of grass seed increases in the later preagricultural sites.[9] I have found grass seed (charred and uncharred) in great abundance in sites of the Encanto Complex (Preceramic Period 5) where it appears to represent a major portion of the wild food harvest. The seeds, however, are not encountered thereafter.

Family *Cyperaceae* (sedges, reeds, rushes) represents another extremely large family comprising a long list of species indistinguishable without preserved floral parts. Like the grasses, the remains (stem and leaf fragments) occur throughout the portions of the sequence where there is good organic preservations.

Galactia striata is a small-seeded legume indigenous to the deserts of the central coast. The plant is a camp-following, desert-loving form which colonizes sand dunes and which is one of the few plants identified which could have been growing near sites in the desert portion of the survey area outside the river valley. Its occurrence in these sites, therefore, may be entirely accidental. This species has been recorded used as a fodder plant (White, 1920, p. 116) and as a medicinal plant (Roys, 1951, p. 295) although neither use is reported from Peru. The seeds and pods (identified for me by Dr. Thomas Elias of the Harvard Herbarium) occur for the first time in the survey region at the Pampa Site (PV45-136) early in Preceramic Period 6 and are found sporadically throughout the sequence thereafter in sites in the desert portion of the survey area.

Psidium guajava (guava) is the fruit of a small tree occurring wild and cultivated from Peru to Mexico. The tree produces small edible fruits between 2.5 and 10 cm. in diameter, round or pear shaped. The trees can be observed today growing along irrigation canals in the survey region, their fruit ripening in August or

September. Pickersgill (1969, p. 57) doubts whether the wild distribution of the guava would have included the central coast region, and suggests that it arrived here from the eastern slopes of the Andes. Ruehle (1948, p. 306) characterizes the distribution of the group as from sea level to 5,000 feet in dry regions of the American tropics. This distribution would not preclude its being indigenous to the coast. however. Ruehle also indicates that the tree is a good colonizer of disturbed habitats and that it persists largely untended in a quasi-wild state even today. The fruits and seeds are found in small quantities in refuse from the survey zone beginning with the Pampa Site (PV45-136) early in Preceramic Period 6 and extending throughout the prehistoric sequence.

Canna sp. (achira) is grown as a food and ornamental crop on the Peruvian coast up to approximately 2,000 m. altitude. A variety of wild and cultivated species are known and the tubers are edible. Towle (1961, pp. 33-35) indicates that the tubers are fibrous and not very tasty, and Gade (1966, pp. 408-409) suggests that achira is not a very good food producer. On the other hand, both John Rowe and Patricia Lyon have commented to me that achira is not only reasonably tasty but is also relatively popular among contemporary Peruvians. Gade places the center of cultivation of this genus in the upper portions of the altitude range and argues that although its prehistoric distribution is unknown, the crop could not have been found wild on the central coast (Gade, 1966, p. 407). Fragments of the tubers and leaves of this group occur in the lower levels of the Pampa Site (early Preceramic Period 6) among the earliest cultigens in the region, and I am inclined to leave the question open regarding the place of origin of this cultigen. Achira is one of the food plants for which quantitative data may be significant. Considering the unfavorable description of the root given by both Towle and Gade, the quantity and consistency of achira remains throughout the sequence is surprising. It is the dominant tuber among the remains of all samples beginning with Preceramic Period 6. However it must be pointed out that tubers in general are rare and that the preservation and recognition of achira may both be favored by the heavy skin of the tuber with its characteristic annular design.

Lagenaria siceraria (bottle gourd) is a particularly problematic plant both because it occurs very early in archaeological sequences in many parts of the world (it was apparently transported from the Old World to various parts of the New World before the migrations of man, so that its wild distribution is unclear) and because it is impossible to tell from archaeological specimens whether one is dealing with wild or cultivated forms. The gourd occurs in the survey zone for the first time in lomas sites of the Arenal Complex (Preceramic Period 6) and the seeds and fragments of the shells occur throughout the archaeological sequence. The gourd is known equally early from the Tamaulipas region of Mexico (Cutler and Whitaker, 1961, p. 482) and from the Ayacucho region of the Peruvian highlands (MacNeish, Nelken-Terner, and García Cook, 1970, p. 37). The question of whether the gourd occurred wild in the Ancón-Chillón valleys is still open, but considering its great antiquity here there is a good chance that it did. The presence of gourds at this early date certainly cannot be taken as evidence of agriculture. Although the earliest gourd remains in the Ancon-Chillón region are found in lomas camps, the water requirements of this crop preclude the possibility of its having grown in the lomas vegetation. The gourds found in the lomas camps are evidence of their transport from the river valley.

Cucurbita ecuadorensis (squash) is a wild species of cucurbit identified among squash remains from the lower levels of the Pampa Site (PV45-136) early in Preceramic Period 6. According to Cutler and Whitaker, this is the only truly wild species of cucurbit native to South America (Cutler and Whitaker, 1969, p. 396). This conclusion has been questioned by Hurd, Linsley, and Whitaker (1971, p. 219) who claim that there were at least two ancient wild species, C. ecuadorensis and C. andreana. Pickersgill and Heiser accept the argument for two wild species.[10] The same sources seem to differ as to whether the archaeological specimens from the Pampa Site should be assigned to one or both of these species. Either species may have been growing wild in the general area of the survey zone, although Pickersgill and Heiser argue that they are unlikely to have been growing at Ancón itself or in the Chillón Valley, neither of which provides a moisture regime comparable to that of their present wild habitats. The fact that the remains of wild squash occur here only after the occurrence of other, clearly domestic, species of squash supports the assumption that they were imported to the region, although it is possible to view them as local plants the use of which was discovered by stimulus diffusion. Wild squash is not encountered in the archaeological refuse of the survey area after the end of the first phase of Preceramic Period 6.

Gossypium barbadense (cotton) is one of two domesticated forms of cotton indigenous to the New World. G. hirsutum is found primarily in Central and North America, while G. barbadense occurs in tropical South America (Towle, 1961, pp. 63-65; Stephens, 1970, p. 368). Barbadense cotton appears in raw form at the Pampa Site (PV45-136) early in Preceramic Period 6 and then occurs in great quantity both in raw form (seeds, bolls, and fiber) and in textiles in great abundance in all subsequent sites in the region. Cotton is reported somewhat earlier from the Ayacucho region of Peru in the Chihua Complex between 4300 and 3800 B.C. (MacNeish, Nelken-Terner, and García Cook, 1970, pp. 37-38). I originally assumed in consequence that cotton had been imported as a domesticate into the Ancón-Chillón region. Recently, however, Stephens and Moseley have presented data on seed morphology demonstrating that despite their late date of occurrence, the earliest seeds from the Ancón-Chillón region are closer to the wild state than any yet encountered elsewhere in the New World (Stephens and Moseley, 1973, pp. 186-187). This finding suggests the possibility that the plant was domesticated from a wild form in this region.

Domestic imports into the region

Zea mays (maize) is clearly the most important of the species considered to be imports into the region. Its place of origin is unknown. The earliest evidence of maize is from Tehuacán, Mexico, where it occurs in levels dated between 5200 and 3800 B.C. (Mangelsdorf, MacNeish, and Galinat, 1967). Maize does not occur in the Ancón-Chillón region until the middle of the Colinas Phase of the Initial Period at the Tank Site (PV45-2) ca. 1200 B.C. On the other hand, it is known from the Peruvian coast in a preceramic context at Huarmey between 1900 and 1700 B.C. (Kelley and Bonavia Berber, 1963), and it has been identified from the Chihua Complex (4300-2800 B.C.) in the Ayacucho region of Peru (MacNeish, Nelken-Terner, García Cook, 1970, p. 38). According to my own measurements of cob size, the early maize on the central coast is already markedly advanced on the scale between the early maize at Tehuacán and the late prehistoric maize in Peru. In contrast to the average length and diameter of the earliest corncobs from Tehuacán (19-25 mm. by 8-10 mm.)[11] seven largely complete cobs from the Initial Period and Early Horizon at the Tank Site average 53 mm. in length and 16 mm. in diameter; thirty cobs from two Early Intermediate Period sites in the region average 42 mm. by 12 mm.; twenty-five cobs from the Late Intermediate Period at the Ancón Necropolis average 46 mm. by 18 mm. It is clear that maize arrived in the survey zone as a well developed crop, and there is no evidence to indicate that significant changes in the productivity of the maize plant (at least in terms of cob size) occurred subsequent to its introduction to the region. It should also be noted that maize, despite its apparent importance, was not utilized in the survey zone until well after its occurrence in other regions of Peru, despite the fact that culture contacts with these regions can be demonstrated at an earlier date (Cohen, 1975a, p. 114; 1977b, p. 170; 1978, pp. 125-127). The belated appearance of maize corresponds at least roughly with the beginnings of irrigation agriculture in the region, and it may be that maize was grown here only under irrigation. One other pattern is worth noting. In all sites prior to those of the Early Intermediate Period, maize remains consist mostly of cobs. In the Early Intermediate Period and in the sites of subsequent periods, the remains are primarily cobs at inland agricultural sites, but are primarily loose kernels at coastal sites outside the valley where maize must have been imported. It may be that beginning with the Early Intermediate Period we are witnessing a reorganization of economic distribution patterns involving the large scale transportation of partially processed maize to nonagricultural sites.

Phaseolus lunatus (lima beans) are another of the major cultigens of prehistoric Peru whose origins are uncertain. Archaeological samples from all known sites are already clearly domestic and there is no direct evidence of the domestication process anywhere (Kaplan, 1967, p. 202). Kaplan suggests that the various domestic races may have been domesticated separately in a number of regions (Kaplan, 1967, p. 202). The lima bean makes its first appearance in the survey region at the Tank Site (PV45-2) at levels dated to the Conchas Phase at the middle of Preceramic Period 6, and beans and pods of this species continue to appear sporadically throughout the prehistoric sequence. Lima beans, however, have been found domesticated in the Callejón de Huaylas, Ancash, Peru, as early as 5500 to 8500 B.C. (Kaplan, Lynch, and Smith, 1973, p. 77) so their appearance in the Ancón-Chillón region is strikingly late.

Phaseolus vulgaris (common beans) are again a crop of unknown origin. They have been recovered from the Tamaulipas region of Mexico in the period 4200–2300 B.C. (Kaplan, 1967, p. 205) and from Tehuacán, dated about 4900 B.C. (Smith, 1967, p. 258). They have recently been found, fully domesticated, in the Callejón de Huaylas, Ancash, Peru, in layers dated between 5500 and 8500 B.C. (Kaplan, Lynch, and Smith, 1973, p. 77) and they have been identified at Ayacucho in the Peruvian highlands tentatively in the Chihua Phase (4300–2800 B.C.) and definitely in the Cachi Phase (2800–1700 B.C.)(MacNeish, Nelken-Terner, and García Cook, 1970, pp. 37–38). In contrast, they are not found in the Ancón-Chillón region until the early part of the Early Horizon (ca. 900–600 B.C.) when they are identified in refuse rom the Tank Site (PV45-2). Like maize and lima beans, common beans are strikingly late in their occurrence in this region. Like maize, their appearance corresponds roughly with the transition from floodplain to irrigation agriculture in the area, and it may be that they were grown only under irrigation.

Canavalia sp. (jackbeans) first appear in the Ancón-Chillón region at the Tank Site (PV45-2) in layers dated to the Gaviota Phase of late Preceramic Period 6 where they appear fully domesticated. Canavalia beans are known from other regions of the coast at about the same time (Towle, 1961, p. 45). In the Ayacucho region of the Peruvian highlands they are reported from the Cachi Phase (2800–1700 B.C.)(MacNeish, Nelken-Terner, García Cook, 1970, pp. 38–39).

Arachis hypogaea (peanuts) are another important leguminous crop of prehistoric Peru whose origins are somewhat unclear. They are presumed to be native to the humid, lowland tropics of South America, originating perhaps in the foothills of the Bolivian Andes.[12] Peanuts occur in the Ancón-Chillón region for the first time at the Tank Site in levels dated to the Gaviota Phase late in Preceramic Period 6 (ca. 1900–1750 B.C.) which is to my knowledge their earliest dated occurrence in Peru.

Erythrina sp. is a shade and ornamental tree and shrub native to the American tropics. Its exact origins are unknown. The seeds, which superficially resemble common beans, are inedible but they are used for ornament as well as for medicine, for divination, and as amulets (Towle, 1961, pp. 45-46; Yacovleff and Herrera, 1935, p. 43). The seeds occur in the Ancón-Chillón region for the first time in the Late Intermediate Period at the Ancón Necropolis (PV45-1).

Bunchosia armeniaca (ciruela) is a fruit tree native to Peru and Brazil producing edible double-seeded drupes (Towle, 1961, p. 60). The seeds of this fruit occur in the Ancón-Chillón region for the first time at the Tank Site in levels dated to the early portion of the Early Horizon and they are represented continuously, if sparsely, in the prehistoric sequence thereafter. They have, however, been identified from preceramic levels at Huaca Prieta de Chicama on the north coast (Towle, 1961, p. 61).

Campomanesia lineatifolia is a South American plant occurring in the Andes from Chile to Colombia and now cultivated for its edible fruits which resemble those of the guava and are used in a similar fashion (Towle, 1961, p. 72). The earliest remains of this fruit which I uncovered came from Early Horizon levels at the Tank Site (PV45-2). Towle records specimens of this species from a site in the Chillón Valley which she refers to as "Chuquitanta," a name now applied to a large town occupied during Preceramic Period 6. At the time she wrote, however, the name was used to refer to a poorly defined cluster of sites of various periods. It is not clear from which site or from which period her specimens are derived (Towle, 1961, p. 72).

Lucuma bifera (lúcuma) is an evergreen tree species native to Peru and cultivated for its large (7-10 cm. diameter) fruits (Towle, 1961, p. 76). The seeds occur in the Ancón-Chillón region for the first time in Conchas or Gaviota Phase levels of the Tank Site (middle to late Preceramic Period 6). The seeds are very durable and preserve well, so it is unlikely that they would have remained undiscovered if they had occurred on this portion of the coast earlier than this period. They are, however, reported from the Ayacucho region of the highlands in the Chihua Phase (4300-2800 B.C.)(MacNeish, Nelken-Terner, and García Cook, 1970, p. 38). The seeds occur with great consistency and in large numbers throughout the remaining portion of the Ancón-Chillón sequence, and it would appear that they were a major food item from the time of their arrival throughout the prehistoric period.

Persea americana (avocado) is a fruit bearing tree native to tropical America. The seeds of avocados have been tentatively identified from Early Horizon deposits at the Tank Site (PV45-2) between 900 and 600 B.C., but otherwise they do not occur in the Ancón-Chillón region until the Late Intermediate Period, when they are encountered in deposits from the Ancón Necropolis (PV45-1). Avocados are reported generally from the Peruvian coast in the Early Horizon (Smith, 1968, p. 258) but they are reported in the wild state in the Tehuacán region of Mexico between 8000 and 7000 B.C. (Smith, 1967, p. 240).

Capsicum sp. (chili peppers). Barbara Pickersgill (1969, p. 54) distinguishes two species of peppers which occur prehistorically on the coast of Peru, each arriving there as a domestic crop. The earlier of the two is C. baccatum, which she identifies from fruits found in preceramic levels at Huaca Prieta de Chicama and from Conchas Phase levels of Preceramic Period 6 at the Punta Grande Site (PV45-100) in the Ancón-Chillón region. The second species, C. chinense, she describes as arriving on the coast in the Initial Period or Early Horizon when it is known from fruits excavated at the Tank Site (PV45-2). The samples she describes represent the earliest dated occurrences of the two species in the Ancón-Chillón region. Capsicum peppers occur sporadically throughout the remainder of the prehistoric sequence in the region. The peppers I have studied from sites after the Early Horizon (after ca. 200 B.C.) have all been of the baccatum variety. However, the sample is small and several examples have lacked the diagnostic parts which distinguish the two species, so this pattern is probably not significant.

Erythroxylon sp. (coca) is one of two species, E. coca or E. novogranatense, which occur in medium altitudes in the Andes of Peru and Bolivia. The latter species is distributed at lower altitudes and is probably the species found in coastal sites (Towle, 1961, p. 58). Chewed quids have been found in early Initial Period levels (ca. 1750 B.C.) at the Tank Site (PV45-2) in the Ancón-Chillón region. These have been tentatively identified by Dr. R. E. Schultes of Harvard as coca, although no chemical traces of cocaine can now be detected. Seeds of Erythroxylon sp. are definitely identified in refuse from the Late Intermediate Period at the Ancón Necropolis (PV45-1).

Solanum spp. (potatoes) are actually a complex of several cultivated species originating at high altitudes in the Andes, centering at high altitudes in the Andes, centering in Peru and Bolivia (Hawkes, 1967, pp. 211, 294-296). They are grown today in the Chillón Valley. Potatoes (tubers) occur for the first time in the Ancón-Chillón region in refuse from the Colinas Phase of the Initial Period at the Tank Site (PV45-2). Potatoes continue to be found sporadically throughout the prehistoric sequence, but the identifications in all cases are tentative, since starch grains are not preserved. One species of Solanum, S. tuberiferum, occurs today wild in great profusion (see above) in remnants of lomas vegetation in the Ancón-Chillón region. However, it is not a species which contributes to the domestic complex.

Polymnia sp. is a minor food crop of temperate regions of the Andean valleys. The small herbaceous plants produce edible tubers resembling sweet potatoes and are commonly identified as such (Towle, 1961, p. 96). Towle has tentatively identified one specimen from Colinas levels of the Initial Period at the Tank Site (PV45-2) as a Polymnia tuber. However, the destruction of the original starch content made it impossible for us to confirm her identification.

Manihot esculenta (manioc) is a tropical lowland shrub plant with tuberous roots (Rogers, 1965, p. 369). It is currently grown in Peru at altitudes from sea level to about 2000 m. (Towle, 1961, p. 61). Manioc tubers occur in the Ancón-Chillón region for the first time in the Early Horizon (ca. 900-600 B.C.) at the Tank Site (PV45-2) and they are found in small quantities consistently, throughout the remainder of the prehistoric sequence. Along with achira and sweet potatoes, manioc appears to be the only root crop of any dietary significance in the region. It is interesting to note, that of all the tuber crops, starch is consistently preserved only in the case of manioc, aiding in the identification.

Ipomoea batatas (sweet potato) is another tropical lowland American root crop presumably originating in moist tropical areas (Smith, 1968, p. 262). Sweet potatoes are grown today in the Chillón Valley where I observed the tubers being harvested in July and August (although I was informed that other tubers were being left in the ground for later harvest). Sweet potatoes (the tubers themselves) occur for the first time in the Ancón-Chillón region in Gaviota Phase levels of Preceramic Period 6 (1900-1750 B.C.) at the Tank Site (PV45-2) and the tubers occur in the refuse of the region sporadically and in small quantities throughout the remainder of the prehistoric sequence.

Pachyrrhizus tuberosus (jicama) is an herb with an edible tuberous root native to the eastern slopes of the Andes and grown under cultivation prehistorically in Peru (Towle, 1961, pp. 51-52). Tubers of this species are recorded by Engel (1967, p. 62) from Gaviota Phase levels (1900-1750 B.C.) at Chuquitanta (PV46-35). The tubers are not known, however, from other sites of the period in this region, nor are they encountered at later sites.

Cucurbita spp. (squash). In addition to the wild C. ecuadorensis and C. andreana (?) identified from collections at the Pampa Site, three domestic species of squash are identified from the Ancón-Chillón region and from other regions of prehistoric Peru. C. ficifolia is known from Mexico to Chile but its place of origin is unknown (Cutler and Whitaker, 1961, p. 469). According to Towle (1961, pp. 89-92) it is known from Huaca Prieta de Chicama in preceramic levels. Seeds tentatively identified as C. ficifolia (but clearly representing domestic squash) occur in remains from an Encanto site (PV45-26) during Preceramic Period 5, where they represent the first clearly domestic crop plant in what is otherwise a wild-food oriented economy. Although the seeds occur in a site in a region of lomas vegetation, squash is unlikely to have occurred wild in the lomas or to have been cultivated there, since its water requirements would not have been met by the limited moisture provided by the dense fog. The fruits must have been carried in from the Chillón Valley. C. ficifolia is one of three species of a squash identified from seeds, rinds, and peduncles in the levels of the Pampa Site (PV45-136) early in Preceramic Period 6 between 2500 and 2300 B.C. C. moschata is a species of squash usually considered to be of Mexican or Central American origin, and it occurs between 4900 and 3500 B.C. at Tehuacán (Cutler and Whitaker, 1961, p. 214). In the Ancón-Chillón region it occurs along with C. ficifolia in great abundance in the lower levels of the Pampa Site (early Preceramic Period 6) where both are clearly domestic. Remains of the two species continue to occur sporadically throughout the sequence. C. maxima, one species of squash usually considered to be South American in origin (Towle, 1961, p. 90), is now considered to be related to the South American wild form, C. ecuadorensis (Cutler and Whitaker, 1969, p. 392), or to C. andreana (Pickersgill and Heiser, 1977, p. 814; 1978, p. 144). It is, however, the last species of cucurbit to appear in the Ancón-Chillón region, where it has only been identified tentatively from Late Intermediate Period deposits at the Ancón Necropolis (PV45-1). Elsewhere in Peru, its earliest occurrence is in Early Intermediate Period levels in the Ica Valley, about 600 A.D. (Cutler and Whitaker, 1961, p. 483). In contrast to the first appearance of squash (of any species) in the Ancón-Chillón region, Cucurbita (unspecified) are reported from the Piki Complex in Ayacucho between 5500 and 4300 B.C. (MacNeish, 1969, p. 38; MacNeish, Nelken-Terner, and García Cook, 1970, p. 37). However this report is considered questionable and has been discounted by some authorities.

Among the vegetable remains recorded, the squashes show perhaps the most striking quantitative variation. One domestic species occurs in an Encanto site of Preceramic Period 5 (3600-2500 B.C.) in small quantity. In the early Preceramic Period 6 Pampa Site (2500 to 2300 B.C.) the remains of three species of squash (two domestic and one wild) occur in enormous abundance in the lower levels. The squash gradually diminishes as one progresses upward in the deposits of the Pampa Site, until near the surface (ca. 2300 B.C.) squash have become rare. From this time on, although squash occur with some regularity, they never again occur in any abundance. Squash has three types of structures, peduncles, seeds and rinds, all of which are fairly resistant to decay, so poor preservation cannot account for this pattern entirely. It is possible to account for the absence of squash remains on the basis of some pattern of utilization which eliminated these remains, but because of the pattern of disappearance at the Pampa Site and the great consistency with which squash is rare or absent at later sites, I am inclined to hypothesize that this cultigen was in fact not as significant a plant in the diet, at least of this particular region, as one would suppose from reading traditional texts.

Summary and Conclusion

The dates of the earliest occurrence of the various plant species in the survey area are summarized by period (Table 1) and by cultigen (Table 2). The early preagricultural periods are represented only by gourds, grasses, and sedges, and an occasional identified wild taxon such as Jusseia peruviana. This sparsity of identified taxa does not reflect lack of preservation but rather the lack of anatomical studies permitting the identification of fragments of the wild plants of the region, particularly those of the lomas vegetation.

The first definite domesticated plants (C. ficifolia) appear in the Encanto Complex of Preceramic Period 5. Since the first domestic crop arrives suddenly in fully domesticated form, it can be argued that agriculture may have been learned by "diffusion" from another region, although we have no way of knowing what experiments in the control of indigenous plants might have preceded the arrival of squash in the river valleys. It is not impossible that some sort of incipient control of indigenous plants was already in effect, but we have no evidence that such was the case. There is in particular the possibility that the bottle gourd (Lagenaria siceraria) was domesticated at the time of its first appearance in Arenal sites as early as 6000 B.C., but domestication is impossible to determine from the archaeological remains. It is also possible that cotton was domesticated locally, but there is no evidence to suggest that such domestication took place prior to the arrival of domestic squash.

The arrival of domestic squash had no immediate impact on the economy. During the Encanto Phase of Preceramic Period 5, domestic squash appears in lomas camps of what is clearly a transhumant population relying primarily on wild food sources, particularly intensive harvesting of wild grass seeds. Shortly thereafter, however, beginning with the Pampa Site (early Preceramic Period 6) sedentary life begins based on large quantities of squash, and a variety of new minor cultigens along with seafoods. During

Preceramic Period 6 a variety of new cultigens gradually accumulates, and squash disappears as a major staple. Two major staples of the prehistoric economy, maize and common beans, do not appear, however, until the Initial Period and the Early Horizon, when they are perhaps associated with the beginnings of irrigation agriculture.

Two very striking patterns emerge. First, almost without exception, the cultigens which formed the basis of the agricultural economy are not indigenous, but are derived from other regions. Second, and more important, many of these cultigens, even the most important ones such as maize and common beans, were not utilized in the Ancón-Chillón region until long after they were available in other regions of Peru, with which in many cases culture contacts can be demonstrated in even earlier periods. Maize occurs 700 years after its first appearance elsewhere on the coast and at least 1200 years after its first appearance in the highlands. Common beans occur at least 4000 years after their first highland occurrence.

These delays in the arrivals of crop plants represent perhaps the most significant pattern to emerge from the study. The Ancón-Chillón region consistently lags well behind other culturally related areas in the utilization of major domesticates. This suggests, in the first place, that old concepts of crop diffusion and of diffusion horizons as chronological markers are certainly invalid. It suggests also that crops do not simply spread or diffuse in an even manner, but rather that they are selectively utilized by populations in particular locations in response to specific needs. I have suggested elsewhere that the pattern of arrival of certain cultigens in the Ancón-Chillón region is specifically related to population pressure on various resources (Cohen, 1975a, 1977b, 1978).

Finally, attention must be called to certain quantitative patterns. I have indicated elsewhere that little confidence can be placed in quantitative analyses of plant remains from archaeological sites (Cohen, 1975b). There are, however, certain quantitative peculiarities in the material from the Ancón-Chillón region which _may_ suggest significant patterns if they are encountered by other workers in other regions. Most important, as indicated above, squash, after its initial period of use, is extremely scarce throughout the sequence, and it may be that this was simply a less significant crop in the coastal valleys than is usually assumed. Corn and beans occur about as expected, but the tuber crops are very scarce. Neither potatoes, sweet potatoes, nor manioc occur in any quantity, but achira, usually considered a minor crop, occurs with some frequency. Other highland tubers, such as _añu_ and _ullucu_ and _oca_, are totally absent. Equally surprising is the great abundance of lucuma, which like achira, is usually considered a minor item in the diet today.

Author's Note

This paper documents all available, identified vegetable remains, and only those remains, which resulted from the excavations of Edward P. Lanning, Thomas C. Patterson, Michael E. Moseley and their students in the Ancón-Chillón region during the 1960's in addition to material reported by Frédéric Engel from an excavation in the Chillón Valley. The paper does not take into account vegetable taxa reported by Margaret A. Towle (1961) in her compilation of earlier paleobotanical research except as her data pertain to taxa described in my own study.

Inclusion of Towle's data would expand the list of minor plant taxa identified from this region to the scope of a full monograph but would not significantly alter the history of cultivation in the Ancón-Chillón region as described here. The reader is referred to Towle's monograph for an appreciation of the full range of utilized wild plants reported from this region and the full range of minor cultigens occurring at least in ceremonial contexts (mummy bundles) in the region by the Late Horizon. Unfortunately, the bulk of her data from this region comes from collections evidently undertaken early in this century without stratigraphic controls or modern dating techniques, so that the cultural affiliations of most of her specimens are unclear.

In a previous paper in which I discussed the evolutionary implications of the Ancón-Chillón sequence, I presented a summary of the botanical evidence which differs in some details from the sequence presented here (Cohen, 1975a, 1977b, 1978). Reference was made to two cultigens listed by Towle because of their potential importance, quinoa (*Chenopodium quinoa*) and chirimoya (*Annona cherimolia*). Since these taxa have not been identified from the collections of more recent workers, they are not listed in this paper. Also, in the previous paper, two taxa (*Capsicum chinense* and *Pachyrrhizus tuberosus*) recently identified by other workers in this area, but not seen by the author were omitted. They have been included here.

Finally, in the previous paper, oca (*Oxalis tuberosa*) was tentatively and mistakenly identified. I have now omitted it from the list of cultigens associated with the Ancón-Chillón area.

May 15, 1973
revised September 28, 1977

NOTES

[1]Lanning, 1967a; 1967b; Patterson, 1966; 1967; Patterson and Moseley, 1969. All absolute dates provided in this article are based on estimates or extrapolations provided by these authors from radiocarbon age determinations. The date for the beginning of the sequence is based on an estimate provided by Lanning and Patterson which is an extrapolation from a single radiocarbon determination from the Cerro Chivateros site. The date and the estimate have been challenged by Fung Pineda, Cenzano Z., and Zavaleta, 1973.

[2]Cohen, 1975a; 1977b; 1978 (three publications of the same article).

[3]Personal communication to the author.

[4]Lanning, 1967b, and personal communications from Lanning and Patterson.

[5]Lanning, 1967a; 1967b; Patterson, 1966; Patterson and Moseley, 1969. For the relationship of these phases to the modern standard subdivisions of Peruvian chronology established by Rowe and modified by Lanning, see Table 1 in Cohen, 1975a, 1977b or 1978.

[6]Lanning, 1967a and 1967b; Patterson and Moseley, 1969; Moseley, 1968; Pickersgill, 1969; Engel, 1967.

[7]Lanning, 1967a, p. 15; personal communication from Rowe.

[8]Lanning, field notes of the Ancón survey; Lechtman and Moseley, 1975, p. 137.

[9]Lanning, field notes of the Ancón survey.

[10]Pickersgill and Heiser, 1977, p. 814; 1978, p. 144 (two publications of the same article).

[11]Mangelsdorf, MacNeish, and Galinat, 1967, p. 179.

[12]Krapovickas, 1969, p. 427; Pickersgill and Heiser, 1977, pp. 812-813; 1978, pp. 142-143. See note 9.

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TABLE 1

First Occurrence of the Main Economic Plants in the Ancón-Chillón Region by Cultigen

CULTIGEN	FIRST APPEARANCE IN REGION	FIRST APPEARANCE IN PERU
Zea mays	Late Initial Period 1200 B.C.	Huarmey 1800 B.C.[a] Chihua Complex, Ayacucho 4300-2800 B.C.[b]
Cucurbita ficifolia	Encanto Complex 3600-2500 B.C.	?(*Cucurbita* sp., Piki Complex, Ayacucho 5500-4300 B.C.)[b]
C. maxima	Late Intermediate Period 1000-1476 A.D.	Ica Valley, Early Intermediate Period[c]
C. moschata	Pampa Phase 2100-1900 B.C.	?(*Cucurbita* sp., Piki Complex, Ayacucho 5500-4300 B.C.)[b]
Phaseolus lunatus	Conchas Phase 2100-1900 B.C.	Ancash 5500-8500 B.C.[e]
P. vulgaris	Early Horizon 900-600 B.C.	Chihua or Cachi Complex, Ayacucho 4300-1700 B. C.[b] Ancash 5500-8500 B.C.[e]
Canavalia sp.	Pampa Phase 2500-2300 B.C.	Cachi Complex, Ayacucho 2800-1700 B.C.[b]
Arachis hypogaea	Gaviota Phase 1900-1750 B.C.	
Ipomoea batatas	Gaviota Phase(?) 1900-1750 B.C.	
Manihot esculenta	Early Horizon 900-600 B.C.	

Solanum spp.	Late Initial Period 1200 B.C.	
Bunchosia armeniaca	Early Horizon 900–600 B.C.	Huaca Prieta, Chicama 1900 B.C.[d]
Lucuma bifera	Conchas Phase 2100–1900 B.C.	Chihua Complex, Ayacucho 4300–2800 B.C.[b]
Persea americana	Early Horizon 900–600 B.C.	
Capsicum baccatum	Playa Hermosa Phase 2300–2100 B.C.	
Erythroxylon sp.	Early Initial Period 1750–1650 B.C.	
Gossypium barbadense	Pampa Phase 2500–2300 B.C.	Chihua Complex, Ayacucho 4300–2800 B.C.[b]
Inga feuillei	Pampa Phase 2500–2300 B.C.	
Canna sp.	Pampa Phase 2500–2300 B.C.	
Psidium guajava	Pampa Phase 2500–2300 B.C.	
Lagenaria siceraria	Arenal and Luz Complexes 6000–5000 B.C.	Jaywa Complex, Ayacucho 6600–5500 B.C.[b]

[a]Kelley and Bonavia Berber, 1963; [b]MacNeish, Nelken-Terner, and García Cook, 1970; [c]Cutler and Whitaker, 1961; [d]Towle, 1961; [e]Kaplan, Lynch, and Smith, 1973.

TABLE 2

First Occurrence of Plant Taxa in the Ancón-Chillón Region by Period

Late Horizon	None
Late Intermediate Period	Cucurbita maxima, Caesalpinia sp., Erythrina sp., Prosopis sp.
Middle Horizon	No sample
Early Intermediate Period	None
Early Horizon	
Late	No sample
Early	Phaseolus vulgaris, Bunchosia armeniaca, Manihot esculenta, Campomanesia lineatifolia, Persea americana, Capsicum chinense
Initial Period	
Late	Zea mays, Solanum spp.(?), Polymnia sp.(?)
Middle	None
Early	Erythroxylon sp., Capsicum chinense(?)
Preceramic Period 6	
Gaviota	Arachis hypogaea, Lucuma bifera, Ipomoea batatas(?), Pachyrrhizus tuberosus
Conchas	Phaseolus lunatus, Lucuma bifera(?), Sapindus sp.
Playa Hermosa	Capsicum baccatum, Equisetum sp.
Pampa	Cucurbita moschata, Cucurbita ecuadorensis, Inga feuillei, Galactia striata, Canna sp., Psidium guajava, Asclepias sp., Gossypium barbadense, Canavalia sp., Schinus molle, Typha sp.
Preceramic Period 5	
Encanto	Cucurbita ficifolia, Jusseia peruviana, Hymenocallis amencaes
Corbina	No sample
Preceramic Period 4	
Canario	None
Arenal and Luz	Lagenaria siceraria, Tillandsia latifolia, Gramineae, Cyperaceae

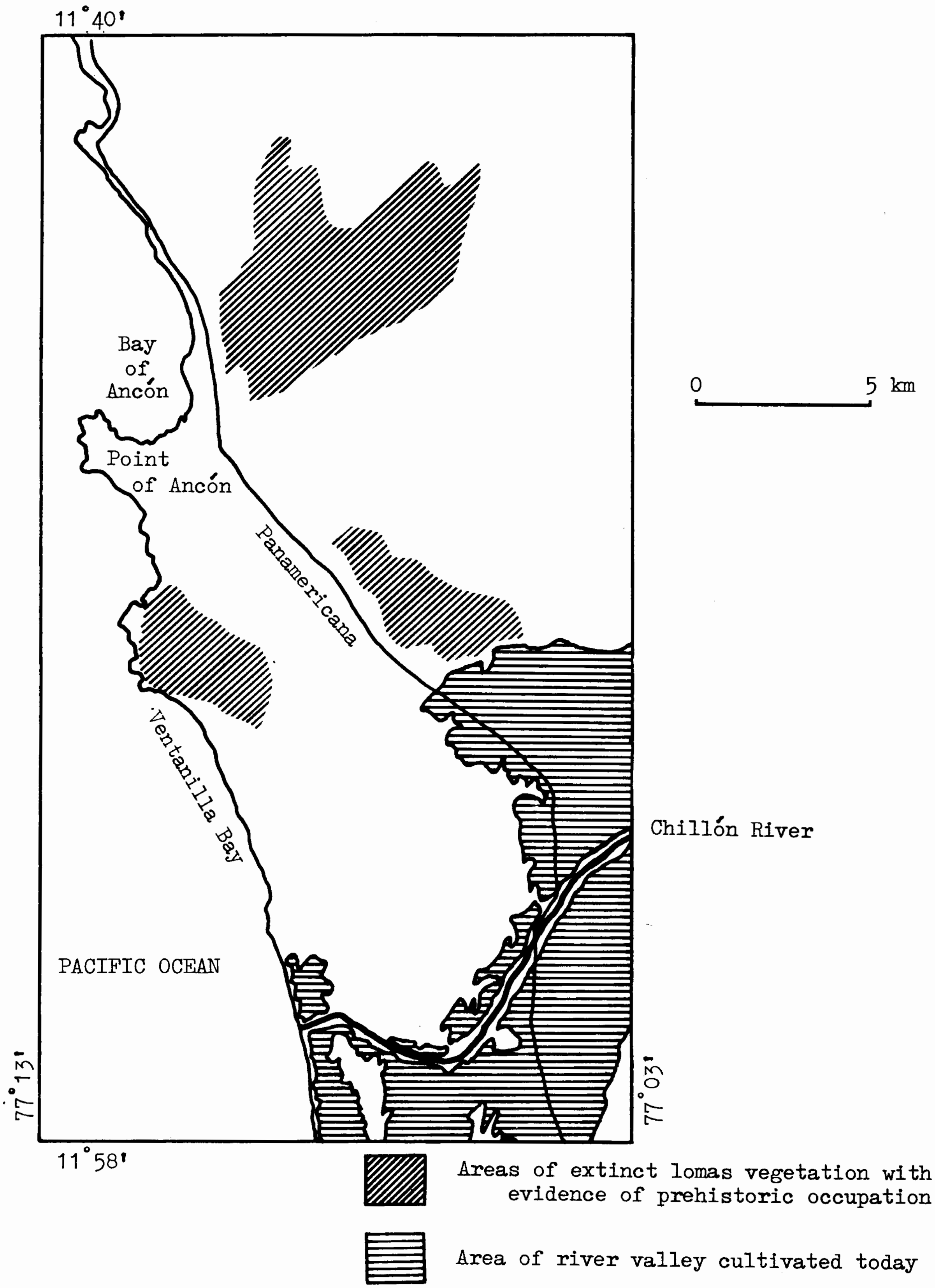

Plate IX. Fig. 1, the Ancón-Chillón region.