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The beginning and growth of agriculture in Mexico

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The most complete sequence of the development of agriculture is given by the Tehuacán Archaeological-Botanical Project, of which the field work was done in 1961 and 1962 by a team under R. S. MacNeish, which has studied the Tehuacán Valley in Puebla from the beginning of human occupation, about 9000 B.C., to the Spanish Conquest. We are only concerned with the first part, up to about 2000 B.C., by which time cultivated plants contributed more than a quarter of the food supply. The area was chosen because it was a promising region to search for wild maize, and what was believed to be wild maize was indeed found there, although the claim has since been disputed. At any rate maize was improved as time went on, and other plants were domesticated or introduced from other regions, a phenomenon which can be illustrated by the sequence previously studied in NE Mexico. At the same time, population gradually increased and permanent settlements developed.

The long development of food production in parts of the American continent through some 7000 years is a remarkable story that illustrates the outstanding empirical successes of early plant breeders, all the more so since these peoples remained virtually uninterested in animal domestication as a source of food, either as meat or as milk products, until they came into contact with European ways from the 16th century A.D. onwards.

The food-crop plants of the New World were necessarily different from those of the Old World, starting as they must from different wild progenitors. Mexico has been chosen as an example, as it was there that cultivation of the very successful crop-plant, maize, seems to have originated, and it was a land that in time developed a high civilization with concentrated population centres that needed an organized large scale food supply. The Tehuacán Archaeological-Botanical Project was the result of a deliberate search for wild maize. A clue had been given by the finding of small cobs at Bat Cave, New Mexico, and in Tamaulipas, NE Mexico, but these cobs were neither small enough nor old enough (about 3000 B.C.). Searches in SE Mexico produced similar results. The finding of maize pollen in a bore-hole beneath Mexico City suggested Central Mexico, and P. C. Mangelsdorf had bred back a pod/popcorn of a primitive type. Search had to be conducted where such a grass could be expected to grow, and where it might be preserved. It had to be a highland region, with dry caves, and summer rains with dry winters, so that the grass did not grow until the danger of winter frosts was past. Tehuacán was a likely place, and it proved a fortunate choice.

The results have been published in a number of reports and articles. The first two annual reports were published in 1961–2, by the R. S. Peabody Foundation of Andover, Massachusetts, and give a pretty full account of the field work (MacNeish, Byers *et al.* 1961, 1962). The place of the third annual report is taken by an article in *Science*, ‘The domestication of corn’ (Mangelsdorf, MacNeish & Galinat 1962). Then came an article by MacNeish in the *Scientific American* (MacNeish 1964), and another in *Antiquity* (MacNeish 1965), ‘The origins of American agriculture’, which includes, besides Tehuacán, brief accounts of work done in other parts of

Mexico, the coast of Peru, the Southwest of the United States and elsewhere. The full Tehuacán reports began with 'Environment and subsistence' and 'non-ceramic artefacts' in 1961–2; these made an important start, but they are not all published yet. There was a summary article by MacNeish (1971), not the result of any new work, but apparently of rethinking by MacNeish, and it reinterprets the settlement patterns by seasons. It contains a good deal of speculation, and introduces new terms such as Barranca horticulture, hydro-horticulture and Barranca agriculture, whose meaning is not altogether clear, so I have taken little notice of it.

The Tehuacán Valley is the scene of the longest sequence of cultural periods to be studied in Mexico, starting with the first human occupation about 10000 B.C. and continuing to the Spanish Conquest. The work was directed by R. S. MacNeish, whose enthusiasm had a great deal to do with its success. The succession was divided into phases, marked by the appearance of new traits while the old ones tend to persist. The steadiness of the development suggests continuity of population, though insufficient skeletal material has been studied to demonstrate this directly. The climate was stable throughout most of the succession, but it is believed that it was drier and more like the existing climate of the arid plateau of Northern Mexico before about 7000 B.C. The Valley was occupied by a lake until the early Quaternary, after which it was captured by the Rio Santo Domingo draining eastward to the Gulf Coast, and subsequently the water table in the Valley was lowered progressively. About 450 sites were found, 350 of which were assigned to particular phases, and the season a particular deposit belonged to was deduced from the plant remains.

In the first phase, named Ajuereado, beginning perhaps as early as 10000 B.C. and continuing until about 7000, the population consisted of some 3 bands of 4–8 people, perhaps 20–25 people in all, who were wandering hunters and gatherers. They are believed to have hunted jack rabbits, birds and turtles, and occasional horses and antelopes. Seeds of wild chili peppers and avocados suggest that these were gathered.

In the next phase, El Riego, roughly from 7000 to 5000 B.C., the horse and antelope became extinct and the emphasis seems to have shifted to the collection of wild plants. The grain *Setaria* had already appeared in the previous phase, and it continues from then on. It shows no improvement and if it was ever cultivated, this could only be inferred from the quantity found. A squash, *Cucurbita mixta*, was domesticated, and MacNeish claims that the avocado was cultivated, but it cannot have shown many signs of it yet. Besides these a number of wild plants were collected, including amaranth. It has been suggested that the domestication of plants began with maguey (*Agave*) and prickly pear (*Opuntia*) in the 6th millennium B.C. but MacNeish disagrees on the grounds that there are still plenty of wild specimens growing in the Valley, and they show no signs of improvement. In any case, maguey is an unpromising source of sustenance, because the leaves need 3 days roasting, then they are just edible. Cotton was found in this phase in Coxcatlán cave, but there are three reasons for regarding it as intrusive, namely that no more instances of it occur until 2000 years later, and the material itself is closely comparable with modern *Gossypium hirsutum* from Mexico. Further, there were signs of disturbance in the stratigraphy. At the end of the period a few cobs of what is believed to be wild maize were found, but they contained less sustenance than a single grain of modern maize. The population has been estimated to have increased about fourfold by the end of the phase.

The subsequent Coxcatlán phase lasted from about 5000 to 3500 B.C., and is marked by more cultivated plants; it is estimated that about 10% of the sustenance of the people was derived from them. Most of the maize found was still unimproved, but a few cobs of early cultivated

varieties were found. Tepary beans (*Phaseolus acutifolius*), *Cucurbita moschata* as well as *mixta*, chili peppers, and amaranth were all cultivated. Some plants, such as zapotes, could not have been grown in the Valley without some form of irrigation, possibly mere watering, and it is possible that a considerable increase in the use of fruits, regarded as luxury foods, in the middle of the Coxcatlan phase, is a result of this. Hunting and trapping yielded animal foods, chiefly deer and rabbits. It has been estimated that the population had increased about tenfold by the end of this phase.

The next phase, called Abejas, lasted from about 3500 to about 2300 B.C. It is marked by more rapid development, and cultivated plants contributed 25–30 % of the diet, which included, beside the two types of squash, tepary beans, chili peppers, and amaranth already mentioned, jack beans (*Canavalia enciformis*), and possibly the common bean (*Phaseolus vulgaris*), besides avocados and three varieties of zapote. About half the maize cobs found were cultivated, and they included a tripsacoid variety, meaning one with characteristics introduced by hybridization with *Tripsacum* or teosinte, which results in the cobs becoming very woody. Neither of these relatives of maize grows in the Valley now, and they have not been found in the archaeological record, so it is believed that the hybridization must have occurred in a neighbouring region, perhaps the Balsas river basin in Guerrero. In subsequent phases tripsacoid varieties became very common. At one time I feared lest I should have to discuss Dr Beadle's contention (Beadle 1972) that maize arose from teosinte, but there does not seem to be any possibility that such a thing could have happened in Tehuacán, so I can leave it to others more expert.

The first sign of the domestic dog is at about 3200 B.C. and it was eaten. MacNeish says that the first pit-house villages developed about this time (MacNeish 1965, p. 88) but I still remember asking Flannery about this and getting the rather acid reply 'half a pit house'. MacNeish said earlier (1962, p. 35) that he 'keeps having the nagging feeling that villages began during this time period' so it may be that the wish was father to the thought.

The subsequent Purrón phase is known chiefly for the first pottery to be found in the area. It was found in one cave and its importance can easily be exaggerated. It is of very poor quality, thick, badly smoothed, with gravelly temper, and fired at a low temperature, and it follows the shapes of the stone bowls which preceded it in the area, so it could not be claimed that it was a local invention even if it had not been preceded by a long time by pottery in Columbia and Ecuador.

Purrón was followed from 1500 to 850 B.C. by the Ajalpan Phase, by which time the people were living in wattle and daub houses in hamlets, from which they sallied forth in the wet season, spring and summer, to hunt and collect, but growing enough food to support themselves for the remainder of the year. There were no signs yet of ceremonial buildings or pyramids, whose rise belongs to the Santa Maria phase, which lasted until about 150 B.C. In this phase agriculture, accompanied by irrigation, was well developed, and remains of the canals are found in the valley. Since all the excavations were either in caves, or to a limited extent on open sites, they ceased to yield remains of the most important sections of the population by the Palo Blanco phase (150 B.C. to A.D. 700) which corresponds to the Classic Period elsewhere since those who made use of caves were mostly peasants, slaves or hunters.

Northeast Mexico

This is an area where MacNeish had previously obtained two successions which complement one another, in the Sierra de Tamaulipas and the Sierra Madre. The earliest plants believed to

have been cultivated in this area are *Lagenaria*, the bottle gourd, *Capsicum*, the chili pepper, and *Cucurbita pepo*, the pumpkin. The latter is perhaps especially significant since it did not appear in the Tehuacán area until after 1500 B.C. On the other hand, another type of squash, *Cucurbita moschata*, seems to have been domesticated in the Tehuacán region before 3500 B.C. but did not reach the northeast until after 2000 B.C. The first appearance of maize in the northeast was of a primitive but clearly domesticated type called Nal-tel between 3000 and 2200 B.C.

Oaxaca

This area is not far from the Tehuacán Valley about 150 km to the southeast. It was studied by a team under Kent Flannery, who had been one of MacNeish's team in Tehuacán, where he had reported on the animal bones. He found deposits from 7800 B.C. onwards, and deduced from them that the climate throughout differed little from that of the present day. Inhabited caves providing dry conditions for the preservation of plant remains were found some 60–90 m above the valley floor. From the beginning of the succession there were many wild plants suitable for gathering, for example squash, beans and possibly *Tripsacum*. He detected an early seasonal settlement pattern, of which I think I detect the influence in MacNeish's 1971 article in *Archaeology*, already mentioned. He found that there were large gathering and trapping camps in the summer rainy season, small deer-hunting camps in the autumn and winter, and the meagrest just before the February rains. He questions whether some members of the group may have stayed the whole year in the summer gathering camps.

The valley differs from that of Tehuacán in that it had a high water table and was frost free, whereas that in Tehuacán was low but some powerful mineral springs could be, and in later times were, harnessed to irrigate large areas by canal. The high water table of Oaxaca made various methods of small-scale irrigation possible, and brought considerable areas into cultivation. Whether because of this or not, some impressive sites grew up. Oaxaca became a nuclear area, the home of the great Zapotec state, with great ceremonial centres such as Monte Alban, whereas Tehuacán faded into a marginal area by the last few centuries B.C.

The early history of American agriculture: recent research and current controversy

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Since the completion of the Tehuacán Archaeological-Botanical Project's field work more than a decade ago our picture of the early history of agriculture in the New World from primitive food gathering through ten millennia has been broadened, both by the acquisition of further data from Mesoamerica and other parts of the continent, and by critical consideration of the Tehuacán sequence itself as expounded in the four volumes of the final report which have so far appeared (Byers 1967*a, b*; MacNeish 1970, 1972) as outlined by Bushnell