Food Habits of Some Pre-Columbian Mexican Indians[1]

E. O. CALLEN[2]

In late 1951, some desiccated human feces from the Huaca Prieta de Chicama in Peru was presented to Dr. T. W. M. Cameron of McGill University by its excavator, Junius Bird. Attempts to soften this material in various chemicals finally led to the use of trisodium phosphate, as recommended by Van Cleave and Ross (1947) for the reclaiming of dried zoological specimens. Since Bird considered the material to be exclusively human, the medical term "coprolite" was applied by Callen and Cameron (1955) to designate each individual piece of material, whether large or small. They soaked the material for 48 hours in a 0.5% aqueous solution of trisodium phosphate, but later, with greater experience (Callen and Cameron, 1960) found by soaking for 72 hours, the coprolites regained what must have been their original consistency, and sometimes even their smell. The coprolites then tended to fall apart and precipitate when shaken. Subsequent experience (Callen, 1963) has shown that soaking for periods in excess of 72 hours facilitates the precipitation even more.

Examination of the precipitate revealed that there were many scraps of plant and animal tissue that gave promise of identification. The jack bean, *Canavalia,* had been common amongst the plant remains in HP-3 (see Fig. 1), but in the coprolites of level F a combination of stomatal characters, plant hairs (trichomes) and plant crystals, also seemed to indicate the presence of the genus *Phaseolus* (Callen and Cameron, 1960). When this was reported to him, Bird pointed out (1953, personal communication) that *Phaseolus* was unknown in Peru till after 800 B. C. However, a subsequent check of the dried plant remains, showed that *Phaseolus* was indeed present in HP-3, proving that the trisodium phosphate method of analysis could be used to identify plant tissues other than seeds.

Bird (1948) found that the early inhabitants of the huaca (HP-3) came from a pre-maize and pre-ceramic culture, and had apparently subsisted on fish and seafood, augmented by a primitive agriculture, but with little or no meat in the diet. Figure 1 records the five types of plant material that could be identified. As mentioned earlier, both *Phaseolus* and *Canavalia* were detected on the basis of the stomata, trichomes and crystals, but, in the absence of stomata, they could not be distinguished, hence both are included under "bean." *Capsicum* (chili) was identified thrice by means of seeds, the only seeds found in the coprolites. *Cucurbita* (squash) was identified by means of the bi-collateral vascular bundles found in this genus, but lack of knowledge of the local flora made it impossible to identify the remaining plant tissues.

In addition to the plant material, fish, mussel, crab and sea urchin were found, plus snails and arthropods. The diatoms and algae recovered had probably formed the food of the mussels. Except for a very few mussels, seafood disappeared from the diet shortly before 1000 B. C. According to Bird (1948), the seafood had been obtained from an off-shore reef, which disappeared as the result of a gigantic earthquake, when the sea advanced right to the base of the huaca, and cut off the seafood supply, which the coprolites only too clearly confirm.

Amongst other information, the presence of roasted material was noted, sometimes eaten alone, sometimes along with fresh food. Seafood and plant material were gen-

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[2] Associate Professor of Plant Pathology, Macdonald College of McGill University, Montreal, Quebec, Canada.

Huaca Prieta Coprolites

Pit	HP-5 800-500 BC						HP-3 2500-1250 BC											
Layer	A2	A4	B1	B4	C3	Hse	D1	D3	E1	F	G	H1	I2	L3	M	O	P1	PosUn
fresh food	x	x		x	x	x		x	x	x	x	x	x	x	x		x	x
roasted			x			x	x			x		x		x		x		x
bean	x	x	x	x	x	x		x	x	x	x	x	x		x	x		
Capsicum				x						x					x			
Cucurbita	x	x		x				x	x	x	x		x	x	x		x	x
fruit tissue								x	x	x			x	x				
other tissue	x		x	x	x	x		x	x	x		x				x		x
mussel			x	x		x	x	x		x		x		x			x	x
crab							x	x		x					x			
sea urchin							x	x		x					x			
diatoms			x			x		x		x		x						
algae								x									x	
fish								x	x	x			x	x			x	
arthropod						x	x			x					x			

Fig. 1.

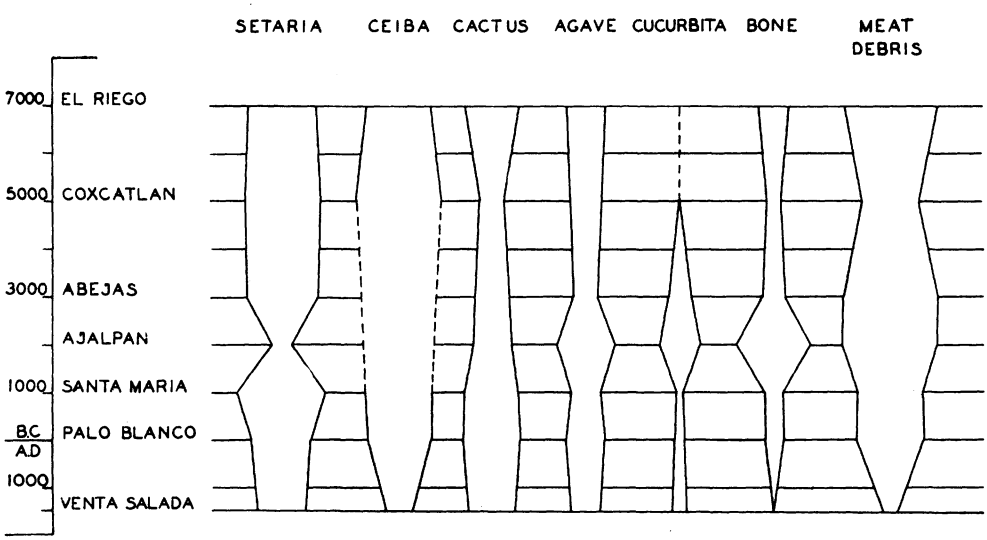

Fig. 2. Tamaulipas coprolites. Percentage occurrence.

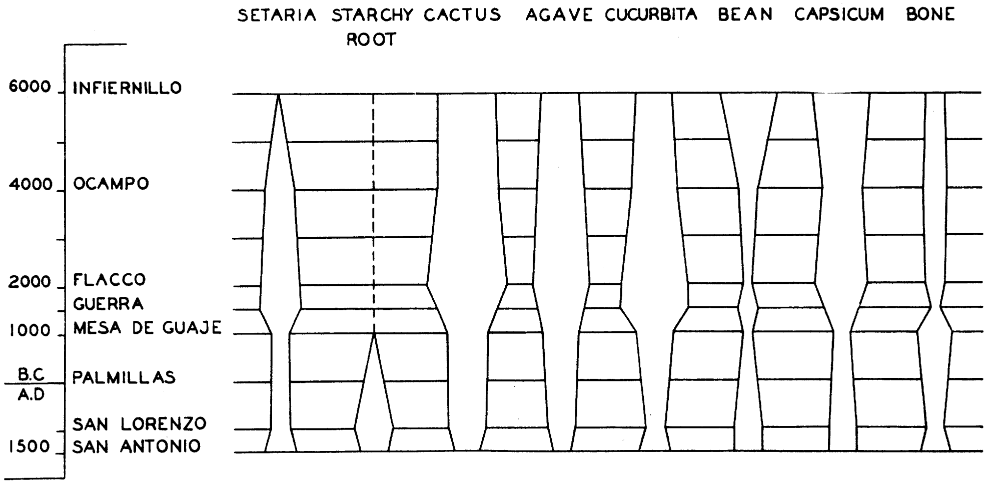

Fig. 3. Tehuacan coprolites, Coxcatlan Cave. Percentage occurrence.

erally either eaten together or one very shortly after the other, since they occurred in the same coprolite. As the human stomach normally empties in from two to four hours, food consumed during that period will have been churned up together, and subsequently appear in the same coprolite.

Although the trisodium phosphate method of coprolite analysis was described in 1955 by Callen and Cameron, the final results of this first analysis were not published until 1960. Nevertheless, news of the technique and its results reached the ears of Richard S. MacNeish, who had recently excavated the Ocampo Caves, in the Sierra Madre of Tamaulipas State, in northeastern Mexico. He had collected some 500 desiccated coprolites from two neighbouring caves, Tmc 247 and 248, and being anxious to know what they contained, he persuaded me to start analysing them in late 1957.

Although only about half of the Tamaulipas material has actually been processed to date, more than seven plants that formed the major portion of the vegetal diet, have been identified, and are presented in Fig. 2. It should be noted that:

1. *Setaria* the foxtail millet, appeared in the lowest levels of the Ocampo culture, about 5000 B. C.
2. The starchy root is probably one of the sedges.
3. The consumption of cactus, *Agave* (maguey), *Cucurbita* and *Capsicum,* and the remains of bone, have remained remarkably constant over several thousand years.
4. The consumption of beans and *Cucurbita* have not increased greatly in the diet over the millenia.
5. *Amaranthus* and *Zea* (maize) have been identified, but in such small quantities that they have not been included.
5. *Zea* was introduced to the area in the late Flacco period.

Slightly more detailed results are contained in a previous paper (Callen, 1963).

The presence of grass seeds came as a surprise, as none had been noted on the cave floor during the excavation. First identified as *Panicum,* this information was passed on to MacNeish, and only later was it identified by C. E. Hubbard of Kew Botanic Gardens, as the closely related *Setaria* (Callen, 1963). Meanwhile, MacNeish had published the information (Kaplan and MacNeish, 1960) that *Panicum* occurred in the Tamaulipas coprolites, and this has unfortunately been perpetuated by others.

The plant materials that have survived passage through the alimentary canal, are usually those that have been thickened in some way, though frequently chunks of soft parenchyma tissue have survived as well. Kodachromes of the followng Tehuacan plant

El Riego Culture
5200—3400 BC

Tc 50 | Tehuacan

	in coprolites		on cave floor	
		dominant		dominant
	%	%	%	%
Setaria	71	71	90	8
Ceiba	71	54	–	–
cactus	57	–	42	1
Agave	42	–	–	–
Capsicum	14	–	6	–
Cucurbita	–	–	–	–
Amaranthus	–	–	9	–
bean	–	–	–	–
Diospyros	–	–	–	–
Physalis	–	–	–	–
bone	28	–	43	–
meat debris	100	–	–	–
Zea	–	–	–	–

Fig. 4. El Riego culture.

Coxcatlan Culture
5200—3400 BC

Tc 50 | Tehuacan

	in coprolites		on cave floor	
		dominant		dominant
	%	%	%	%
Setaria	83	17	100	29
Ceiba	92	25	–	–
cactus	25	–	70	–
Agave	33	9	–	–
Capsicum	–	–	21	–
Cucurbita	–	–	–	–
Amaranthus	–	–	12	–
bean	–	–	–	–
Diospyros	25	9	–	–
Physalis	–	–	–	–
bone	17	–	35	–
meat debris	58	–	–	–
Zea	–	–	–	–

Fig. 5. Coxcatlan culture.

Abejas Culture
3400—2300BC

Tc 50 Tehuacan

	in coprolites			on cave floor	
		dominant	Tc 254		dominant
	%	%	%	%	%
<u>Setaria</u>	75	-	-	94	12
<u>Ceiba</u>	-	-	-	-	-
cactus	-	-	-	62	12
<u>Agave</u>	25	-	50	-	-
<u>Capsicum</u>	25	-	-	44	-
<u>Cucurbita</u>	25	25	-	6	-
<u>Amaranthus</u>	-	-	-	12	-
bean	-	-	-	-	-
<u>Diospyros</u>	-	-	-	-	-
<u>Physalis</u>	-	-	-	-	-
bone	25	100	100	12	-
meat debris	100	100	100	-	-
<u>Zea</u>	-	-	-	-	-

Fig. 6. Abejas culture.

Ajalpan Culture
1500—900 BC

Tc 254 Tehuacan

	in coprolites		on cave floor	
		dominant		dominant
	%	%	%	%
<u>Setaria</u>	20	-	-	-
<u>Ceiba</u>	-	-	-	-
cactus	40	-	-	-
<u>Agave</u>	60	-	-	-
<u>Capsicum</u>	-	-	-	-
<u>Cucurbita</u>	40	-	-	-
<u>Amaranthus</u>	-	-	-	-
bean	-	-	-	-
<u>Diospyros</u>	-	-	-	-
<u>Physalis</u>	-	-	-	-
bone	80	-	-	-
meat debris	100	60	-	-
<u>Zea</u>	-	-	-	-

Fig. 7. Ajalpan culture.

Santa Maria Culture
900—200 BC

Tc 50 Tehuacan

	in coprolites		on cave floor	
		dominant		dominant
	%	%	%	%
Setaria	95	30	90	20
Ceiba	70	30	-	-
cactus	65	20	30	-
Agave	30	6	-	-
Capsicum	30	-	20	-
Cucurbita	6	-	-	-
Amaranthus	6	-	10	-
bean	20	-	-	-
Diospyros	12	-	20	-
Physalis	12	-	-	-
bone	20	-	20	-
meat debris	70	-	-	-
Zea	-	-	-	-

Fig. 8. Santa Maria culture.

materials were shown to the meetihg, to demonstrate how easily some of them could be identified: *Setaria,* with thickened transverse ridges on the grain and glumes; the diagnostic seed coat (testa) of both *Capsicum* and *Cucurbita*; the very small-celled exocarp of the latter with its large stomata, and the peculiar mesocarp with cells frequently arranged in rosettes; the epidermis of *Opuntia* (prickly-pear cactus) with i s characteristic stomata and sub-epidermal layer of druses; *Agave* epidermis with cells arranged in a diamond shape around the stoma, and the characteristic types of crystals in its tissues; the organ cactus, *Lemaireocereus,* with its huge druses in the tissues; and *Ceiba* (silk-cotton tree) the starchy roots of which were frequently eaten, much of the starch of which still survived to be found in the coprolites. This is almost certainly due to the inability of the body to handle large quantitites of raw starch during the 24 hours that food is in the alimentary tract. The pericarp of *Zea* (maize) was also shown, but there were no characteristic microscopic characters.

Animal materials that had survived and could be identified, included bones, cartilage, meat and hair, and most of the kodachromes shown were taken of the Tamaulipas material. Bones of mice, snakes, and lizards have been found, sometimes intact,

Palo Blanco Culture
200 BC—700 AD

Tc 50 Tehuacan

	in coprolites		on cave floor	
		dominant		dominant
	%	%	%	%
Setaria	65	3	80	40
Ceiba	68	3	-	-
cactus	60	3	40	-
Agave	43	-	5	-
Capsicum	40	3	30	-
Cucurbita	10	-	-	-
Amaranthus	8	-	-	-
bean	30	-	-	-
Diospyros	16	-	-	-
Physalis	5	-	-	-
bone	20	3	10	-
meat debris	68	-	-	-
Zea	5	-	-	-

Fig. 9. Palo Blanc culture.

Venta Salada Culture
700—1540 AD

Tc 50 Tehuacan

	in coprolites		on cave floor	
		dominant		dominant
	%	%	%	%
Setaria	50	33	-	-
Ceiba	33	-	-	-
cactus	50	33	-	-
Agave	33	-	-	-
Capsicum	-	-	-	-
Cucurbita	16	-	-	-
Amaranthus	-	-	-	-
bean	-	-	-	-
Diospyros	-	-	-	-
Physalis	16	-	-	-
bone	-	-	-	-
meat debris	16	-	-	-
Zea	33	16	-	-

Fig. 10. Venta Salada culture.

and could, therefore, be identified, but for the larger animals, only the hair serves to identify the source of the meat. Hairs of *Sylvilagus* (jack rabbit) and deer were shown, to demonstrate that the medulla pattern (center of the hair) is frequently distinctive. The actual meat itself has not of course survived, only the decomposition products that have not been completely decomposed and absorbed. Eggshell and feathers have also been identified, the latter almost certainly of turkey. Since the local water has a high calcium content, survival of the eggshell was not, therefore, so surprising.

In the Tamaulipas material, many insects were also found, and there is evidence that grasshoppers, bees and wasps were consumed, the latter two indicating that honey must have formed part of the diet as well. Chewing lice, of a type found only on poultry have turned up several times. Details of these and other insects will be published elsewhere. Perhaps most interesting were the flies and beetles that feed on dung, or colonize dung, and those that parasitize the dung colonizers. They have supplied records that show clearly that we are dealing with insects of North American origin, and not introduced from the Old World after the Spanish Conquest. One of these is *Thylodrias contractus* Mots., the odd beetle, a scavenger on dried animal material (includcluding furs). There is definite fossil evidence of a Caucasian origin for it, and it seems reasonable to assume that it followed man over the Bering Land Bridge as he migrated into the New World.

Cooking appears to have been largely of the roasting type, with the outside frequently charred, and the interior still raw. This is true of such plants as *Ceiba, Agave* and *Opuntia,* though they appear to have been eaten raw almost as frequently. Small game such as mice and rabbits were apparently roasted on occasion as well. In the Tamaulipas material, almost the whole skeleton of a harvest mouse was recovered from one coprolite, with the limb bones of one side charred, whilest those on the other were intact. Similarly, the leg and foot bones of a bird were recovered, where one end of the bones was charred, the other not.

With the Tamaulipas results just becoming interesting, Richard MacNeish invited me, in January 1962, to join his team of scientists working on the Tehuacan archaeological-botanical expedition to southern Mexico. Many of the plants found in the Tehuacan coprolites proved to be the same as those eaten in Tamaulipas, with the exception of *Ceiba,* the silk-cotton tree, whose starchy roots are still being eaten in the Tehuacan valley today (C. E. Smith, Jr., personal communication).

Coprolites were obtained from seven of the nine cultures of the Tehuacan sequence (MacNeish, 1964), but as the two most recent ones were characterized by the development of villages, and religious and secular cities, relatively few coprolites were obtained from the caves and rock shelters of these two cultures. The oldest coprolites were obtained from the three youngest zones of the El Riego culture, which would date them around 6000 B.C. The most recent ones come from the Venta Salada culture, ending a little after the Spanish Conquest of that area.

These preliminary results, given in Figs. 4-10, show clearly which were the important food plants for man during a span of 7500 years in the Tehuacan valley. It should be clearly understood right away, however, that this is a cave diet, and not a city diet, which we have reason to believe was much more sophisticated (Callen, 1966). Most of the results come from the major cave excavated by the expedition, Tc 50, Coxcatlan Cave, which is more correctly described as a deep rock shelter. However, there is a gap of some 1500 years in an otherwise continuous record of 9000 years habitation of that cave. This gap is partially filled by a neighbouring cave, Tc 254, San Marcos Cave, though the diet appears to have been slightly different in that cave.

The figures used in the tables represent the percentage of coprolites of that culture containing that particular material. Where any plant is the principal material in that coprolite, it is referred to as being the dominant material, and there is a separate column for this figure, which is again given as a percentage of the total coprolites for that culture.

Small seeds and other debris were collected from the floors of the different zones and levels of cave Tc 50. Here too the figures shown represent the percentage of the total samples taken from such level or zone, irrespective of square. The average for each zone is seven or eight samples, so that this figure can only serve for comparison with the coprolite one, and not for any other purpose.

To summarize these tables (Figs. 4–10) quickly: *Setaria, Ceiba,* cactus, *Agave* and meat, in varying proportions or combinations, have formed the main part of the diet in Tc 50, whether it was being used as a nomadic habitation in earliest times, or simply by hunting parties in much later times. These hunting parties cannot have carried too great a supply of food with them, since the known cultigens, *Zea,* bean and *Cucurbita,* do not form a major part of the cave diet in either classic (Palo Blanco) or post classic (Venta Salada) times. Other possible explanations for this will be dealt with in a later paper (Callen, in preparation).

Figure 3 shows as near as possible the same plant materials from Tehuacan as seen on Fig. 2 from the Tampaulipas coprolites, to allow comparison. It should be noted that *Setaria* was already a major diet constituent in Tehuacan 1000 years before it apparently appeared in the Tamaulipas diet. On the other hand, *Cucurbita* appeared in the diet of both at about the same time, though it is not possible to identify the species from the coprolites since relatively few intact seeds have survived. Cactus and *Agave* tissue were also in use at the same time in approximately the same amounts, and the amount of bone in the coprolites is approximately the same too.

I am indebted to Dr. Richard S. MacNeish and Dr. Junius Bird for allowing me to examine their materials; to Dr. T. W. M. Cameron, now Emeritus Professor of Parasitology for his constant help and encouragement in the earlier stages of this work; to the 30 or so archaeologists and scientists of the Tehuacan Archaeological-Botanical Expedition, who have all in one way or another contributed odd bits of information that helped in the identification of the plant and animal material and especially "Scotty" MacNeish, archaeologist and leader, and Dr. C. Earle Smith, Jr., botanist of the expedition; to Dr. C. E. Hubbard of Kew Botanic Gardens; to the Entomology Research Institute, Ottawa, and the Department of Wildlife, National Museum of Canada, in Ottawa, for invaluable help. The processing of this material has been greatly aided by the financial assistance of the National Research Council of Canada.

Literature Cited

Bird, J. B. 1948. America's oldest farmers. Natural History **57**(7):296-303, 334-335.

Callen, E. O., and T. W. M. Cameron. 1955. The diet and parasites of pre-historic Huaca Prieta Indians as determined by dried coprolites. Proc. Roy. Soc. Canada **1955:** 51 (abstr.).

————. 1960. A prehistoric diet revealed in coprolites. The New Scientist **8** (190): 35-40.

————. 1963 Diet as revealed by coprolites. *In* Science in Archeology, ed. Brothwell and Higgs, Basic Books Inc., New York, 186-194.

————. 1966. Analysis of the Tehuacan. *In* Reports of the Tehuacan Archaeological-Botanical Expedition, R. S. Peabody Foundation for Archaeology, Andover, Mass., in press.

Kaplan, L., and R. S. MasNeish. 1960. Prehistoric bean remains from caves in the Ocampo region of Tamaulipas, Mexico. Harvard Bot. Mus. Leafl. **9** (2): 33-56.

MacNeish, R. S. 1964. Ancient Mesoamerican civilization. Science **143** (3606): 531-537.

Van Cleave, H. J., and J. A. Ross. 1947. A method of reclaiming dried zoological specimens. Science **105** (2725): 319.