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THE CHINAMPAS OF MEXICO

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THE CHINAMPAS OF MEXICO

They are highly productive farm plots surrounded on at least three sides by canals. Created in an ancient drainage project, they were the economic foundation of the Aztec empire

by Michael D. Coe

When the Spanish conquistadores entered Mexico in 1519, they found most of the peoples in the region unwillingly paying tribute to the emperor of the Aztecs, who ruled from a shimmering island capital in a lake on the site of modern Mexico City. Less than 200 years earlier the Aztecs had been a small, poor, semibarbaric tribe that had just settled in the area after centuries of wandering in search of a home. Shortly after their arrival they fought with their neighbors and were obliged to retreat to two small islands in the lake. There they adopted a unique form of land reclamation and agriculture known as the chinampa system. This system, which had long been practiced on the margins of the lake, was one of the most intensive and productive methods of farming that has ever been devised. It provided the Aztecs with land to live on and with the first surplus of food they had ever known. Their new wealth enabled them to create a standing army that soon subjugated nearby peoples. Driven by the demands of their sun-god for sacrificial captives, and supported by chinampa agriculture (which was also practiced by some of their vassals), the Aztecs quickly expanded their empire throughout Mexico.

The Spaniards toppled the Aztecs within two years and razed their magnificent pyramid temples, but the chinampa system has persisted to the present. Now, after enduring for perhaps 2,000 years, it too appears to be facing extinction.

Chinampas are long, narrow strips of land surrounded on at least three sides by water. Properly maintained, they can produce several crops a year and will remain fertile for centuries without having to lie fallow. The important role

they have played in the long history of Mexico is probably unknown to the *chinamperos* who tend them and to the many tourists who visit the most famous chinampa center: the town of Xochimilco south of Mexico City.

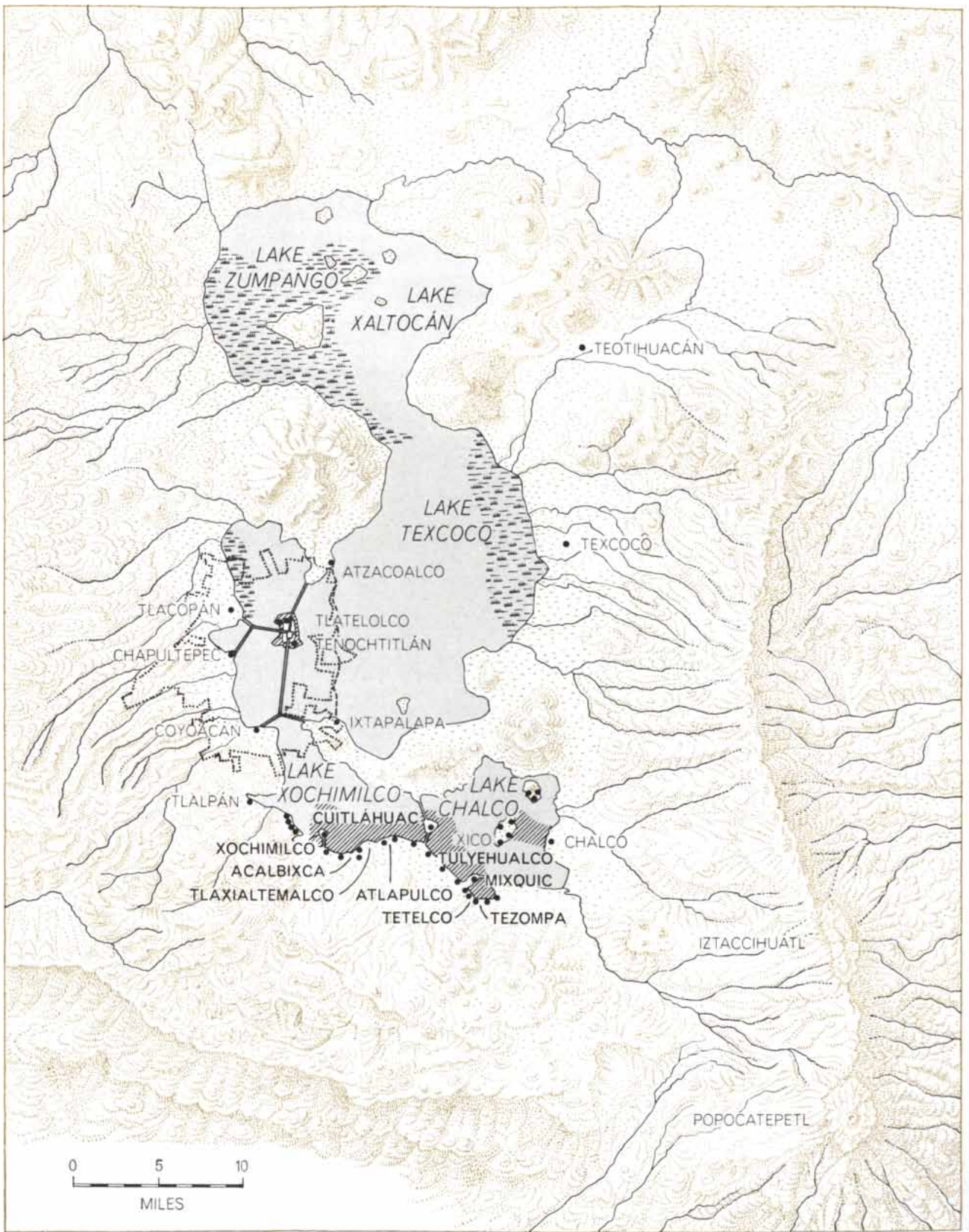
In Xochimilco the guides relate the charming story that chinampas are, or once were, "floating gardens." This is a tall tale that goes back at least to 1590, when a Father Acosta included it in his *Natural and Moral History of the Indies*: "Those who have not seen the seed gardens that are constructed on the lake of Mexico, in the midst of the waters, will take what is described here as a fabulous story, or at best will believe it to be an enchantment of the devil, to whom these people paid worship. But in reality the matter is entirely feasible. Gardens that move on the water have been built by piling earth on sedges and reeds in such a manner that the water does not destroy them, and on these gardens they plant and cultivate, and plants grow and ripen, and they tow these gardens from one place to another."

Acosta may have been deceived by the rafts of water vegetation that even today are towed to the chinampas and dragged onto them as compost. The real interest of a chinampa town such as Xochimilco lies not in its fables and its tourist attractions—flower-garlanded boats plying canals, waterborne mariachi bands and floating soft-drink purveyors—but in the problem of the nature and origin of the chinampas and the relation of this form of agriculture to the rise of the pre-Columbian civilizations of central Mexico.

The chinampa zone is located in the Valley of Mexico, a landlocked basin entirely surrounded by mountains of

volcanic origin. The valley, which is a mile and a half above sea level, has an extent of some 3,000 square miles. In pre-Spanish times a sheet of water, called by the Aztecs the Lake of the Moon, covered a fourth of the valley during the rainy summer season. In the dry winter season evaporation reduced this shallow body of water to five separate lakes: Zumpango on the north, Xaltocán and Texcoco in the center and Xochimilco and Chalco on the south [see illustration on opposite page]. The last two were really a single lake divided by an artificial causeway. Villages were established in the valley sometime late in the second millennium B.C.; since then the valley has supported dense populations of farmers. During the first or second century A.D. the populous city of Teotihuacán, which covered at least eight square miles at the northeastern edge of the valley, came to dominate the region. Although Teotihuacán was overthrown as long ago as A.D. 600, its enormous pyramid temples still stand. The last, most powerful and best known of the civilized states of the valley before the arrival of the Spanish was the empire of the Aztecs, centered on the island of Tenochtitlán-Tlatelolco in the western part of Lake Texcoco.

Since the Spanish conquest in 1521 man has drastically changed the valley. In the colonial era the water was partly drained in the course of reclaiming land for agriculture. Far more, however, was removed by a great tunnel bored through the mountains to the north in 1900, during the rule of Porfirio Díaz. The valley has been further dried out by the tapping of springs and digging of wells to provide water for the rapid growth of Mexico City. Of the estimated six billion cubic meters of water avail-



CHINAMPA AREAS (hatched) and the Valley of Mexico are shown as they appeared in summer at the time of the Spanish conquest in 1521. In the rainy summer season the five lakes coalesced into one large lake: the Lake of the Moon. Tenochtitlán-Tlatelolco was the Aztec capital. The dotted line marks the limits of modern Mexico City. The broken line between Atzacualco and Ixtapalapa

shows the location of the great Aztec dike that sealed off and protected the chinampas from the salty water of Lake Texcoco. Causeways and aqueducts leading to the Aztec capital are also shown. The names of the nine chinampa towns that remain today are given in heavy type. The large black dots without names are the sites of the freshwater springs that fed the chinampa zones.

able in the valley each year, 744 million cubic meters is consumed by the urban population. Most of the rest evaporates. As a result only isolated puddles of the Lake of the Moon remain, including parts of Lake Texcoco and Lake Xochimilco. Dehydration has so weakened the underlying sediments that the larger buildings of Mexico City are sinking at the rate of about a foot a year.

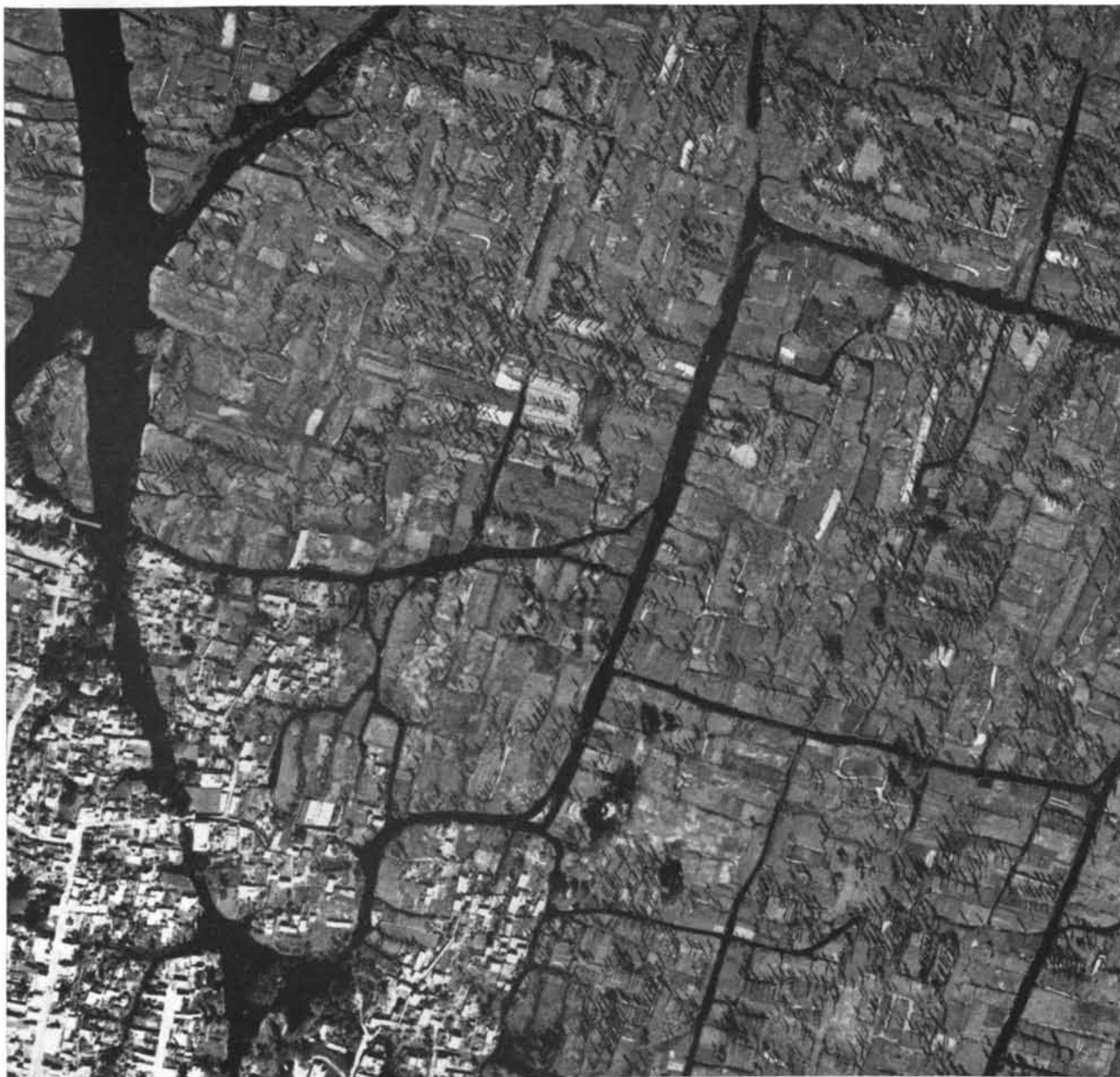
The removal of the water has also had a disastrous effect on the chinampas. From ancient times down to the past century or so many chinampa towns—small urban centers surrounded

by the lovely canals and cultivated strips—existed on the western and southern margins of the old Lake of the Moon. Today only nine remain, and eight of them are probably doomed. Xochimilco alone may endure because of its importance as a tourist center.

In a masterly study of Xochimilco published in 1939 the German geographer Elizabeth Schilling established to the satisfaction of most interested scholars that the chinampa zone is an example of large-scale land reclamation through drainage. Recently detailed

aerial photographs have confirmed her judgment. These show Xochimilco to be a network of canals of various widths laid out generally at right angles to one another to form a close approximation of a grid. This could not have been achieved by a random anchoring of "floating gardens." Departures from the pattern have probably come about through destruction and rebuilding of the chinampas, which are easily ruined by flooding and neglect.

To the trained observer the photographs reveal carefully planned canals that drained the swampy southern shore



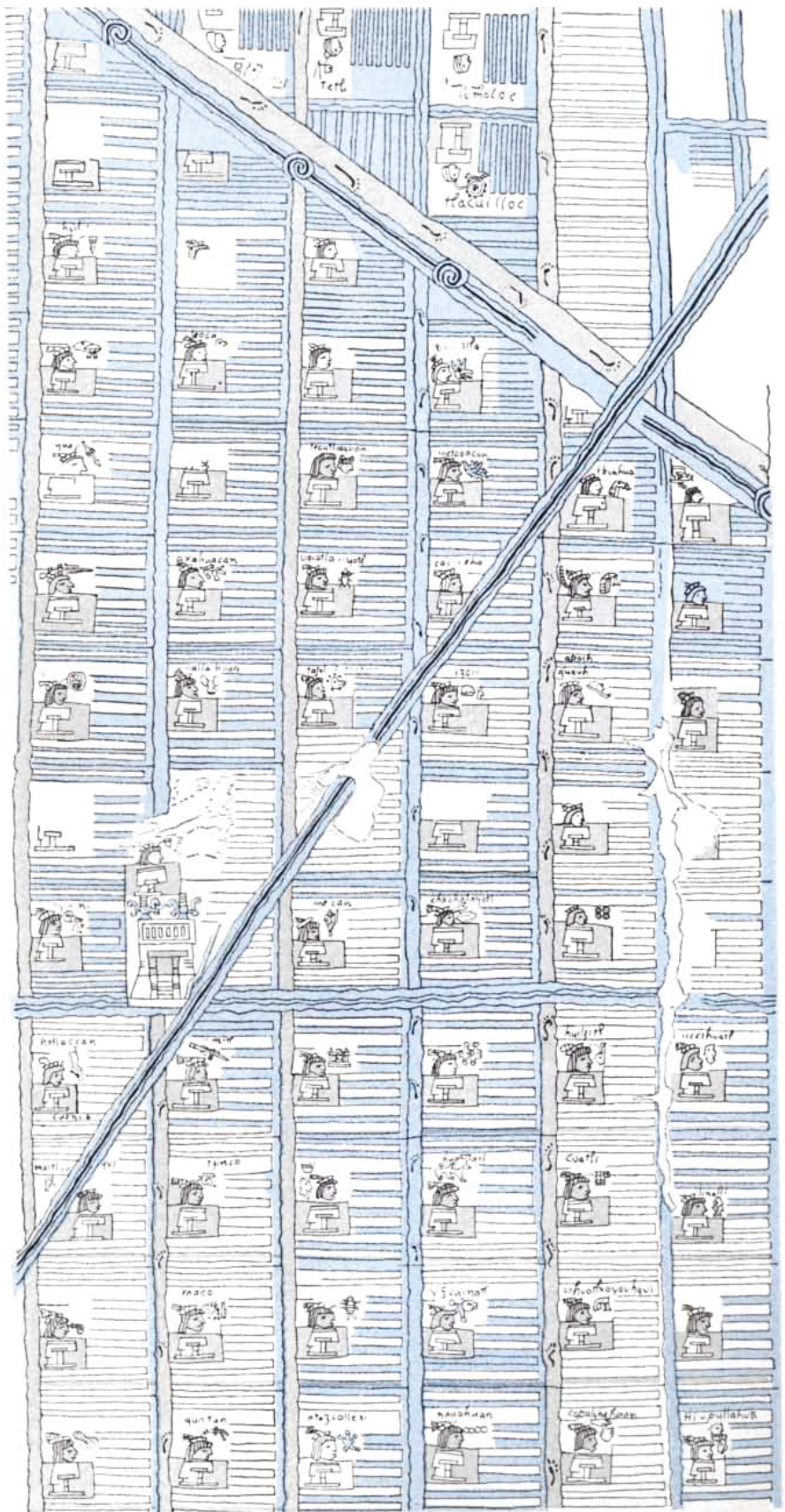
CHINAMPA GARDENS and canals that surround each of them on at least three sides form a grid pattern in this vertical air view. The grid "tilts" about 16 degrees east of north. Many of the canals

that appear to be silted up are simply covered with waterweeds. Part of the town of Xochimilco, south of Mexico City, is at lower left. First canals were dug 2,000 years ago to drain swampy areas.

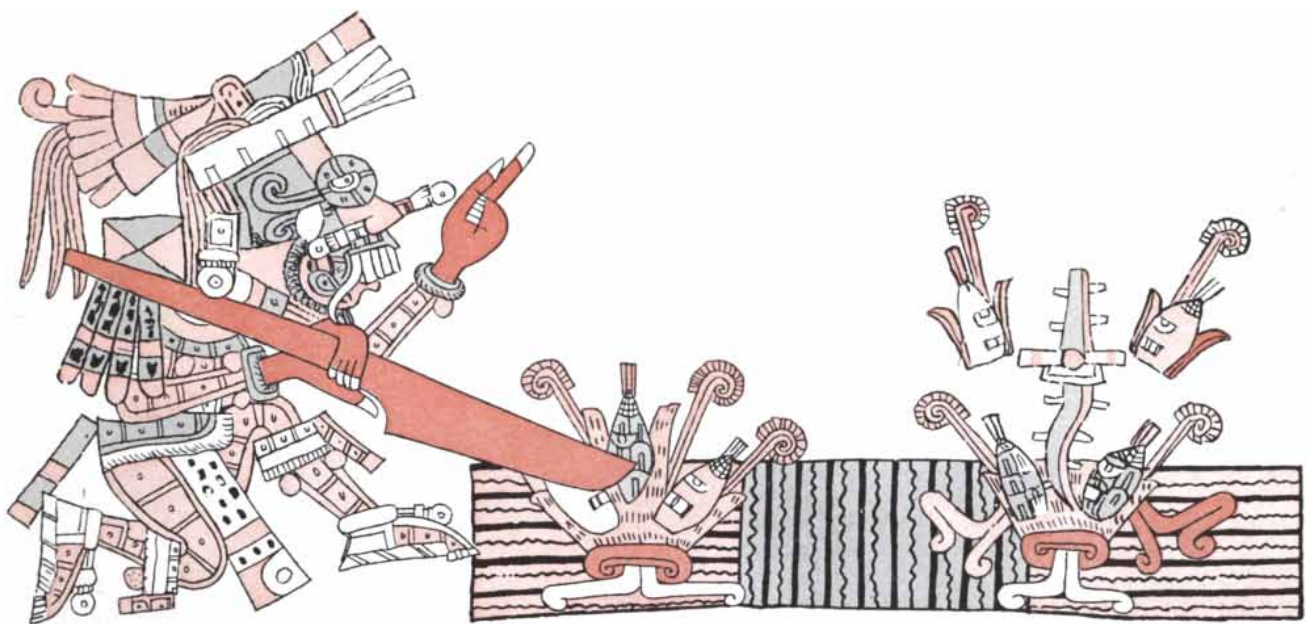
of Lake Xochimilco, where water flowing in from numerous springs had been held in the spongy soil. Here the water table was higher than the surface of the open lake to the north. The canals permitted the spring water to flow freely into Lake Xochimilco and thence into Lake Texcoco, which was deeper. The peaty sediments then released much of the trapped water. Mud dug out in making the canals was piled between them, adding height to the narrow islands and peninsulas that constitute the chinampas. The sides of the garden plots were held in place by posts and by vines and branches woven between them. Later living willow trees replaced many of these wattle walls. Until a few decades ago the water flowed out of Lake Xochimilco into Lake Texcoco through the willow-bordered Canal de la Viga, which carried native women to the market of Mexico City in canoes laden with the rich produce of Xochimilco. Now abandoned, the canal is largely silted up.

In many ways this remarkable drainage project resembled land-reclamation schemes elsewhere, such as those in the fens of eastern England or the polders of the Netherlands. It was unique, however, in the kind of farm plots that resulted, in the technique of their cultivation and in their enormous productivity. Each chinampa is about 300 feet long and between 15 and 30 feet wide. The surrounding canals serve as thoroughfares for the flat-bottomed canoes of the farmers. Ideally the surface of the garden plot is no more than a few feet above the water. Before each planting the *chinamperos*, using a canvas bag on the end of a long pole, scoop rich mud from the bottom and load it into their canoes. The mud is then spread on the surface of the chinampas. In the wet season (June through October) water held in the chinampa provides enough moisture for the crops; toward the end of the dry season, when the canals are lower, the plots must be watered. After a number of years the surface of a chinampa is raised too high by the repeated application of mud and must be lowered by excavation. The surplus soil is often removed to a new or rebuilt chinampa.

New chinampas are made, naturally enough, by cutting new canals, which today is accomplished with power dredges. Older plots that have fallen into disrepair are often reconditioned. In both operations rafts of water vegetation are cut from the surface of the canals, towed to the plot and dragged



ANCIENT AZTEC MAP of a portion of Tenochtitlán-Tlatelolco shows that it was a chinampa city. Six to eight plots are associated with each house. Profile of the householder and his name in hieroglyphs and in Spanish script appear above each house. Footprints indicate a path between plots or beside a canal. This is a copy of a small part of the damaged map, which is in the National Museum of Anthropology in Mexico City.



DIGGING WITH A "COA," the cultivating stick of the ancient Mexicans, the rain-god tills magic maize. The drawing is copied

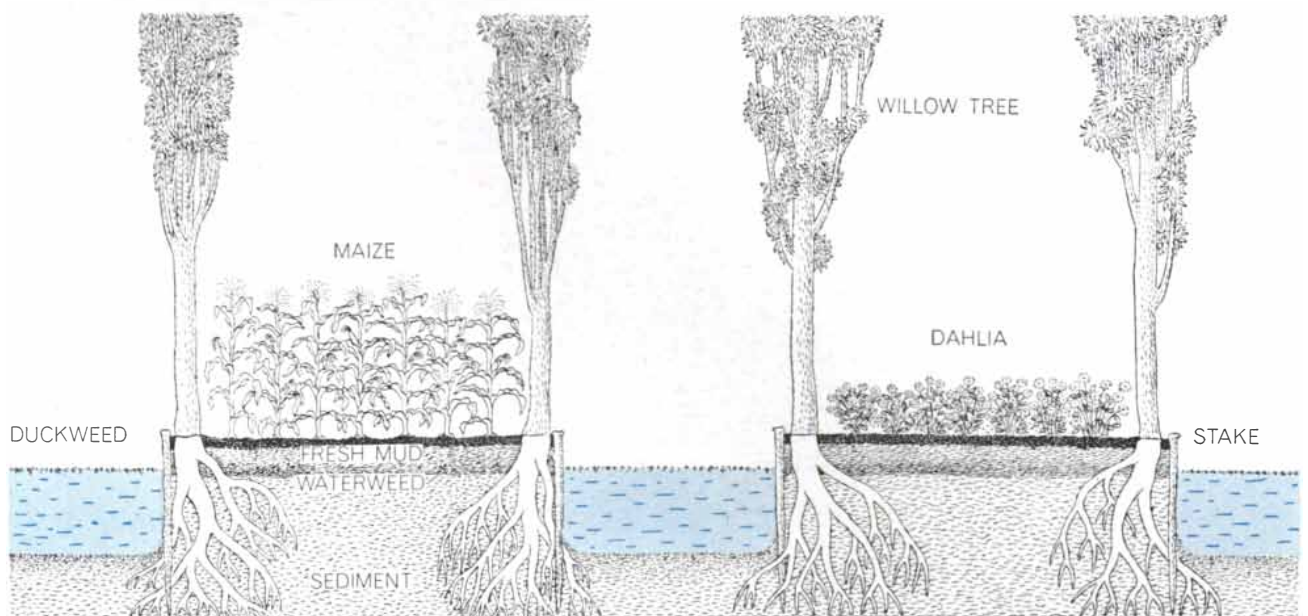
from a late preconquest Mexican religious work. The *coa* is considerably broader near the digging end than it is toward the handle.

into place one on top of another until they reach the desired height. After that they are covered with the usual mud. Thus each plot has its own built-in compost heap.

An essential element in chinampa farming is the technique of the seed nursery, which has been thoroughly investigated by the anthropologist Pedro Armillas of Southern Illinois Uni-

versity and the geographer Robert West of Louisiana State University. The nursery, at one end of the chinampa near a canal, is made by spreading a thick layer of mud over a bed of waterweeds. After several days, when the mud is hard enough, it is cut into little rectangular blocks called *chapines*. The *chinampero* makes a hole in each *chapin* with a finger, a stick or a small ball of rag, drops in the seed and covers it

with manure, which now comes from cattle but in Aztec days came from humans. For protection against the occasional winter frosts the seedbed is covered with reeds or old newspapers. During dry weather the sprouting plants are watered by hand. Finally each seedling is transplanted in its own *chapin* to a place on the chinampa, which has been cultivated and leveled with a spade or hoe (the Aztecs employed a



CROSS-SECTION DIAGRAM of chinampas and canals gives an idea of their construction. Fresh mud from bottom of canals and

weeds for compost beneath the mud keep the chinampas fertile. Trees and stakes hold the sides of the chinampas firmly in place.

digging stick called a *coa*) and then covered with canal mud. The only crop for which the seedbed stage is not necessary is maize, which is planted directly in the chinampa.

The *chinamperos* report that they usually harvest seven different kinds of crop a year from each plot, of which two are maize. Crops raised today at Xochimilco include five varieties of maize, beans, chili peppers, tomatoes and two kinds of grain amaranth—all of which were cultivated before the Spanish arrived. Also grown are vegetables introduced from Europe, such as carrots, lettuce, cabbages, radishes, beets and onions. Xochimilco means “place of the flower gardens” in the Nahuatl language spoken by the Aztecs and still used today by the older people of the chinampa towns. The growing of flowers for sale goes back to the pre-conquest era, when flowers were offered on the altars of the pagan gods. Native species have imaginative Nahuatl names: *cempoaxóchitl* (“twenty flower,” a marigold), *oceloxóchitl* (“jaguar flower”), *cacaloxóchitl* (“crow flower”). The gardens produce dozens of varieties of dahlia, the national flower of Mexico. European flowers include carnations, roses and lilies.

Carp and other fishes abound in the canals and are netted or speared by the *chinamperos*. Another inhabitant of the canals is the axolotl, a large salamander valued by zoologists as a laboratory animal and prized by the people of Xochimilco for its tender meat and lack of hard bones. Water birds were once caught in nets but are now scarce due to the indiscriminate use of firearms.

A basic question for the archaeologist and the historian is: How old are the chinampas? The traditional histories of the peoples of central Mexico list the Xochimilcas as one of eight tribes (the Aztecs were another) that came into the valley after a migration from a legendary home in the west. They were settled at Xochimilco by A.D. 1300 and were ruled by a succession of 17 lords. In 1352 and again in 1375 they were defeated by the Aztecs; finally, in the 15th century, they were incorporated into the Aztec state, which had absorbed the rest of the chinampa zone as well.

Some recent archaeological evidence makes it appear certain that Xochimilco, and by extension the other chinampa towns, existed long before the Xochimilcas arrived. A local newspaperman and booster of Xochimilco, José Farias



SEED NURSERY, made from small squares of rich mud, is an essential element of chinampa farming. Each square, or *chapin*, holds one seed and manure for it. When seedlings sprout, they will be transplanted in the *chapines* to places on the chinampa.



SCOOPING UP MUD from the bottom of the canal, the *chinamperos* load it into their canoe. They will spread the mud on the chinampa plot before setting out the new crop.

Galindo, has been collecting fragments of ancient pottery and clay figurines found by the *chinamperos* in the mud of the canals and in the garden plots. It is evident that such signs of human residence must postdate the initial digging of the canal system; until that had been done no one could have lived in the tangled marshes. Aztec bowls, dishes and figurines of gods and goddesses abound in Farias Galindo's collection, as might be expected from the many references to Xochimilco in Aztec documents. Of particular interest is the much older material that has been found. This includes a bowl of Coyotlatelco were made between A.D. 600 and 900, heads broken from figurines of the Teotihuacán III culture, which flourished between A.D. 200 and 600, and Teotihuacán II figurine heads, which are as old as the beginnings of the great city of Teotihuacán in the first and second centuries A.D. Therefore it is likely that the chinampas of Xochimilco were planned and built almost 2,000 years ago.

Who was responsible? The only power in central Mexico at that time capable of such an undertaking was the growing Teotihuacán state, so that whoever built Teotihuacán also created the chinampas. Another piece of information points to the same conclusion. The grid of the Xochimilco canals is not oriented to the cardinal directions but to a point 15 to 17 degrees east of true north. So are the streets of the ruined city of Teotihuacán, and so are the grids of most of the other chinampa towns. We do not know why this is, but there were probably astrological reasons. It has been said that an urban civilization as advanced and as large as Teotihuacán must have been based on irrigation agriculture, but field archaeologists can find no trace of large-scale irrigation works. It seems far more likely that the growth of Teotihuacán was directly related to the establishment and perfection of the chinampas on the southern shore of the lake. Successive peoples and powers entered the valley

and took advantage of the same system. On the eve of the Spanish conquest Xochimilco was a flourishing island town under Aztec control, with at least 25,000 inhabitants—craftsmen as well as farmers. Cortes wrote of its "many towers of their idols, built of stone and mortar." The town, which was and still is on higher and drier ground than the chinampas, was approached from the south by a causeway crossing many canals. Its numerous wooden bridges could be raised to delay the approach of enemies. At the mainland end of the causeway was a large market; this is now the center of town. Xochimilco was divided into 18 *calpullis*, each with its own name. The Aztec institution of the *calpulli* is not well understood, but it seems to have been a local ward based on kinship. Their names survive today, and every *chinampero* knows to which ward he belongs. The *calpullis* were grouped into three larger units; the town as a whole was ruled by a native lord closely related to the Aztec emperor.

Wills, petitions and other documents filed early in the colonial period show that in Xochimilco land tenure, as well as the social system, was basically the same as that in the Aztec capital of Tenochtitlán-Tlatelolco. There were three categories of chinampa lands: (1) chinampas belonging to the *calpullis*, which could be used by a *calpulli* member to support himself and his family as long as he did not leave the land uncultivated for two years in succession; (2) office land, which belonged to the position filled by a noble official but not to him personally; (3) private land, which could be disposed of as the individual saw fit.

The island capital of the Aztecs was also surrounded by chinampas. The National Museum of Anthropology in Mexico City possesses a remarkable Aztec map on a large sheet of native paper made from the inner bark of a fig tree. This document, studied in recent years by Donald Robertson of Tulane University, shows a portion of the Aztec capital generally covering the section that is now buried under the railroad yards of Mexico City. In all likelihood it was drawn up as a tax record by Aztec scribes and used by bureaucrats into the period of Spanish domination. The similarity of the plan to that of modern Xochimilco is obvious. It shows a network of canals laid out in a grid, with the larger canals crossing the pattern diagonally. Roads



POTTERY FIGURINES of the types found in the chinampas and canals of Xochimilco were made in Aztec times, A.D. 1367 to 1521 (top three), during the Teotihuacán III period, A.D. 200 to 600 (middle four), and in the Teotihuacán II era, A.D. 1 to 200 (bottom). This ancient evidence of human occupation indicates that the chinampas are 2,000 years old.

and footpaths parallel the major canals, which the Spaniards said were crossed by wooden bridges.

The plan depicts some 400 houses, each with the owner's head in profile and his name in hieroglyphs. The Spanish later added Spanish transliterations of the names and also drawings of churches and other colonial structures. The property surrounding each house consists of six to eight chinampas. It was the cutting of canals and the construction of chinampas by the poor and hungry Aztecs who first came here in the 14th century A.D. that filled in the swampy land between the low rocky islands on which they had camped. The work eventually resulted in the coalescence and enlargement of the islands into the marvelous capital city that so impressed the conquistadores.

The more substantial houses of stone and mortar occupied the central sections of the capital, where the land was higher and firmer. In the very center were such large public buildings as the pyramid temples and the palaces of the emperor and his chief nobles. The bulk of the population was nonagricultural, consisting of priests, politicians, craftsmen, traders and soldiers. Nevertheless, Tenochtitlán-Tlatelolco was a chinampa city; the Spanish described it as another Venice. Thousands of canoes laden with people and produce daily plied the hundreds of canals, which were bright green with water vegetation. An Aztec poet has described the beauty of his native home:

*The city is spread out in circles of
jade,
Radiating flashes of light like quetzal
plumes.
Beside it the lords are borne in boats:
Over them spreads a flowery mist.*

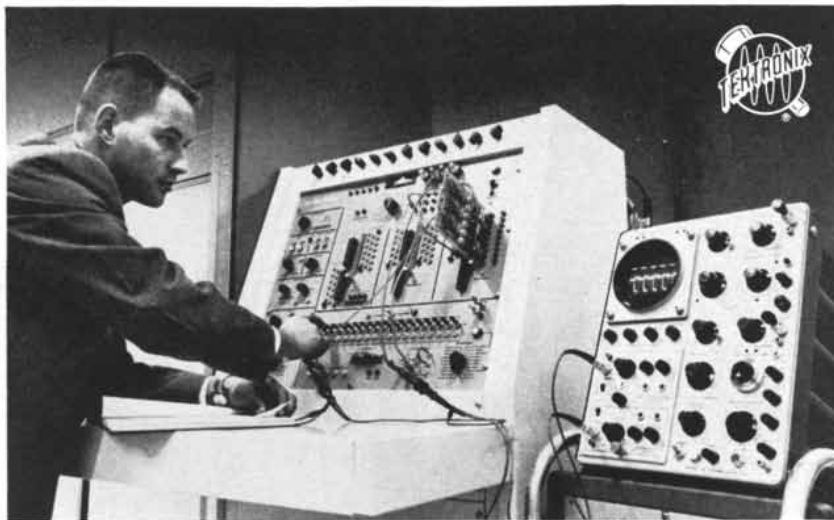
The real basis of the native economy in the Valley of Mexico was the chinampa zone, which extended all the way from Tenochtitlán-Tlatelolco south to the shore of Lake Xochimilco and then east into Lake Chalco. The rest of the land in the valley, although it produced crops, was far less favorable to farming because of the arid climate. The chinampas, however, presented two difficult problems apart from those involved in their cultivation and day-to-day maintenance. One problem was to keep the water level high, the other was the prevention of floods.

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RUINS OF TEOTIHUACÁN, the large city that dominated much of Mexico from about A.D. 100 to 600, are still among the most impressive in Mexico. The rise of this great urban center may have been made possible by the development of the chinampas to the south.

the Lake of the Moon by the summer rains and had been concentrated by evaporation in the eastern part of Lake Texcoco. It was essential to keep the deadly salts away from the chinampas. For this reason the chinampas could only function properly if they were fed constantly by freshwater springs, which maintained the water level and held back the salt water. Such springs are found today in greatest abundance south of Lake Xochimilco, where chinampa towns still exist. Long ago there were adequate springs on the island of Tenochtitlán-Tlatelolco, but the rapid growth of the Aztec capital and its associated chinampas made the springs inadequate. The problem was solved by the construction of aqueducts to bring fresh water from mainland springs. It has sometimes been assumed that the sole purpose of the aqueducts was to carry drinking water to the inhabitants of the capital, but, as the ethnohistorian Angel Palerm of the Pan American Union has noted, their thirst must have been incredible.

These covered masonry watercourses were no mean structures. The first was

completed in the reign of Montezuma I (1440–1468); it brought water over a causeway from the west into the city from a large spring at the foot of Chapultepec hill. Cortes wrote that the flow was “as thick as a man’s body.” A second aqueduct was built by the emperor Ahuítzotl (1486–1502). For this aqueduct a spring at Coyoacán, on a point of land separating Lakes Texcoco and Xochimilco, was enlarged; the aqueduct ran along the causeway that led north to Tenochtitlán-Tlatelolco. Ahuítzotl’s effort was initially crowned with disaster: the volume of water was so great that violent floods resulted. The flow of the spring diminished, it was recorded by pious Aztec chroniclers, only when the emperor sacrificed some high officials and had their hearts thrown into it, along with various valuable objects.

The second major problem of the chinampas—periodic flooding by salty water—was also finally solved by construction works. The nitrous salts, which had already made the waters of the eastern part of Lake Texcoco unsuitable for chinampas, rose and moved into

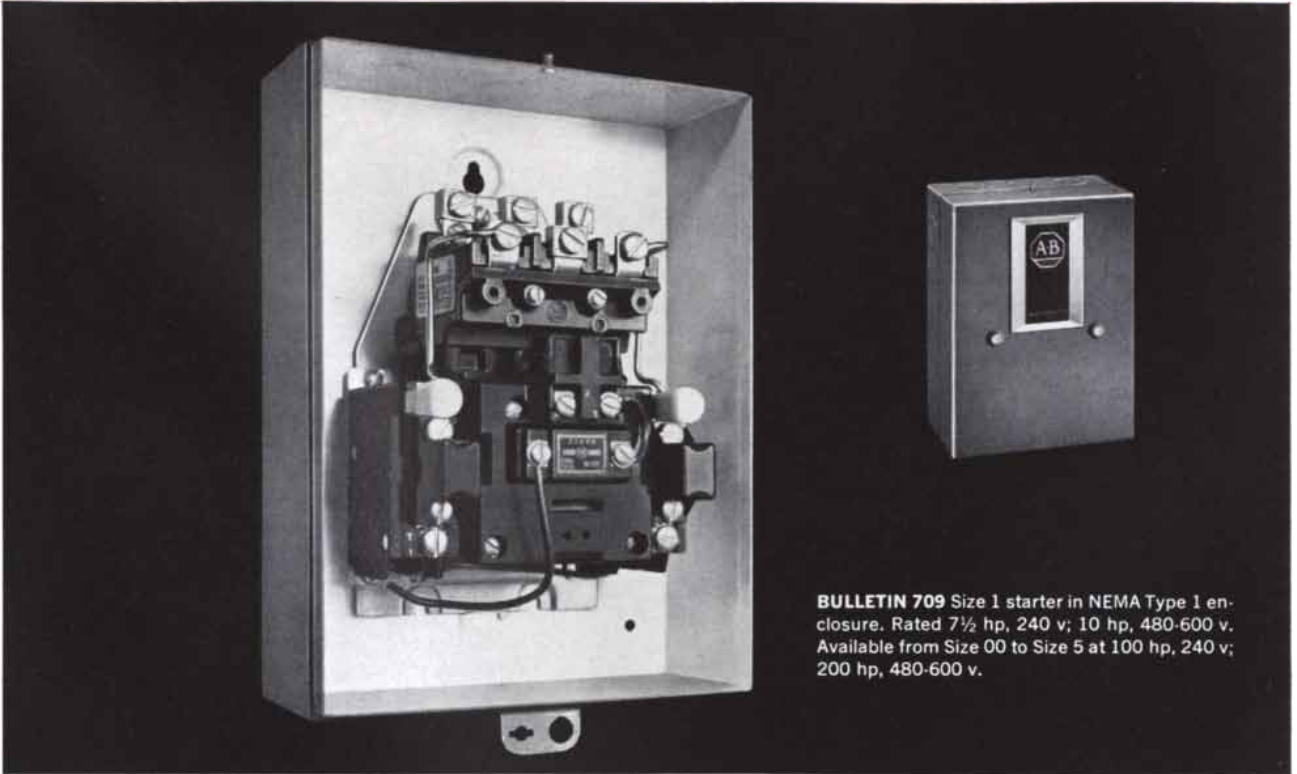
the chinampa zone during the summer rains, in spite of the flow from the springs. The problem apparently became acute only in the Aztec period, when, according to the pollen chronology worked out by Paul B. Sears of Yale University, the climate of the region seems to have been wetter than at any time since the end of the last ice age. The floods nearly destroyed the entire economy of the Valley of Mexico. In the 15th century Nezahualcóyotl, the poet-king of Texcoco, supervised for his relative Montezuma I the construction of an enormous dike of stones and earth enclosed by stockades interlaced with branches. The dike, on which 20,000 men from most of the towns of the valley labored, extended 10 miles across the Lake of the Moon from Atzacolco on the north to Ixtapalapa on the south. It sealed off the Aztec capital and the other chinampa towns from the rest of Lake Texcoco, leaving them in a freshwater lagoon. The three stone causeways connecting the capital with the mainland were pierced in several places and floodgates were installed to provide partial control of the water level in the lagoon.

The entire chinampa zone, then, represented a gigantic hydraulic scheme based on land drainage and the manipulation of water resources. The Aztecs refined and exploited it to establish a vast empire for the glory of their gods and the profit of their rulers. Defeated peoples were quickly organized as tributaries under the watchful eye of a local Aztec garrison and military governor. Twice a year they had to render a huge tribute to Tenochtitlán-Tlatelolco. The Aztec tribute list records that every year the capital received 7,000 tons of maize, 4,000 tons of beans and other foods in like quantity, as well as two million cotton cloaks and large amounts of more precious materials such as gold, amber and quetzal feathers. In fact, in supporting the dense population of the capital, variously estimated at 100,000 to 700,000 (the latter figure is highly unlikely), tribute greatly outstripped local production in importance.

It would probably be no exaggeration to say that the chinampas gave the ancient peoples of the Valley of Mexico intermittent sway over most of the country for 1,500 years before the arrival of the Spaniards. For this reason a detailed study of all aspects of this unique system as it now operates should be made before the chinampas disappear altogether in the name of progress.

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