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Relations between man and environment in the development of precolonial settlements in the basin of Mexico*

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For about 25,000 years, the basin of Mexico has been a scenary for human activities. Only the two last millenia of this period have been trascendental in the form of clear traces of such activities. The balance of the time, which make up the proto and prehistory of human settlements in the basin is not well known.

The present breakthroughs of archaeological research prove the human presence since the late Pleistocene, that is to say, 20,000 years B.C. The findings of Tlapacoya belong to this cultural horizon, called "archaeolitic" by J. L. Lorenzo.

These first testimonies exemplify cultural remains of lithic industries and their related Pleistocene fauna. They contain chips, scrapers, and scalers, as well as knives that provide information on carving of hunted animals and work performed on hides and furs.

The first settlements on the basin were small temporary campings. They were followed, many thousands of years later, by more permanent settlements, such as San Vicente Chicoloapan, and fixed locations, such as El Arbolillo, Zacatenco, Tlatilco, Ticoman, Cuicuilco, Chimalhuacan, Copilco, which, even with certain intermittence, left clear signals to trace the history of the life in the basin since some 4,000 years ago.

The analysis of this cultural evolution shows us that the transition from savagery to barbarism, and from barbarism to civilization was very slow, as a derivation from cultural practices from hunters to hunter-pickers, an finally, to picker-farmers. The latter paved the way to the development of urban nucleuses. Thus, the temporary campings of the pickers and hunters from the Pleistocene, are followed by the first permanent settlements, between the years 7,000 and 2,000 B.C. These setlements were composed by groups that could cultivate several vegetal species such as amaranth, pumpkin, a small tomato *(Physalis sp.),* pulpy leaf plants of Portulacaceae family, *e.g.* teosinte *(Zea mexicana),* very similar to maize. By studying the pollen grains, it is assumed that they practiced certain degree of an incipient gardening activity with some of these plants. This fact gave a great boost to population and even so, and despite the importance of this cultural stage, we have to acknowledge that it is the less known in the history of the valley.

The traces collected in the beaches of Tlapacoya-Zohapilco date back to this stage, and prove that human communities settled around the lakes somewhere in the year 5,000 B.C. during the Playa cultural phase, and with a sedentary life either pre o pro-toagricultural. The remains of these sites are made up by bones of *Cervidae,* birds, dogs and fish scales.

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The development of these first villages and the boom achieved by some of them, at the end of the first millenium B. C. allows us to assume the consistency of a settlement system not only adapted to the ecologic conditions of the valley, but also capable of rationally using and exploiting the agricultural and fishery resources that marked the transition from subsistence activities to production tasks.

That is why this stage, known as Manantial (spring water) phase, was characterized by an outstanding development of agricultural production and population growth, as well as by the intensification of inter-regional trade and irreversible colonization in the central and southern parts of the basin.

The colonizing expansion placed itself within a corridor located in Lake Chalco, and the lower slope of the Sierra Nevada range, as well as in the valleys pouring to San Juan Teotihuacan river. Important settlements were also established on the river-lacustrian plains of Azcapotzalco and the lower slopes of Sierra de Guadalupe. Cuicuilco belongs to this stage; this city is located to the southwest of the basin, and reached an exceptional development towards the year 300 B. C. We may still see its remains, in spite of the layer of lava that destroyed the old city around the years 100 or 200 B.C. due to the eruption of the Xitle volcano.

The first expressions of the monumental architecture took place in Cuicuilco. The truncated cone pyramid represents the remains of a ceremonial architecture complex, whose shapes were inspired and adapted within the surrounding natural environment.

Simultaneously with the end of Cuicuilco, the development of Teotihuacan started in the center-northeast section of the basin. This city delimited the foundation for the cultural development of Central America. In its initial stage, the city was erected on the fertile lowlands of San Juan river, but it soon exceeded these limits and extended troughout the valley on land with less agricultural possibilities -little more than 700 mm of average anual rainfall, which meant a risk for rain-fed crops. This resulted in the development of elaborated irrigation patterns, which allowed the growth and evolution of the metropolitan area of the city of Teotihuacan. The phenomenon was also spurred by the domain and exploitation of the vast deposits of obsidian in Otumba, which allowed the urban center to handle strategically the trade of such valuable raw material in the pre-Spanish world.

For about one thousand years, since 200-100 B. C. to 650-700 A. D., Teotihuacan was the major metropolis, not only in the basin of Mexico, but in all Central America. Its cultural spread reached the high lands of Guatemala, the Gulf coast, Oaxaca, and the west, center and north of Mexico.

Since year 0 of our age, with the erection of its largest monuments: the pyramid of the Sun and the pyramid of the Moon, Teotihuacan was the core of a great urban and ceremonial center. The population estimated for this stage amount 30,000 inhabitants throughout a suface of 17 km2. During the following years and up to 650 A. D., Teotihuacan kept a salient population growth: for the late classic, 450-650 A. D. the population is calculated in 100,000 inhabitants, and the urban extension in more than 25 km^2. The existence of a city with such dimensions proves the strength of the socio-political and economic system that sustained this urban population, which brought about the blossoming of Teotihuacan culture.

We may infer, then, that rural population, whose work sustained the great urban center, must have amounted several hundreds of inhabitants subject to a theocratic political system. Economy was then based on intensive agriculture with irrigation and

terracing, and rain-fed extensive crops. Besides, the city counted upon handcraft specialization and an important commercial system.

As the settlement network became more dense and complex, population growth exercised a strong pressure on the environment, only bearable and explicable by the adaptation of a rational and consistent technology of appropiation and exploitation of the natural environment.

Thus, the population growth meant the intensification of food production, which in turn, brought about labor division among the population and favored the selection of settlements on those sites with larger potential resources.

Nevertheless, in the late classic, this growth overcame the optimum capacity of support of the environment, and thus generated its slow and progressive degradation, worsened by the aridity created by minor climatic changes. This critical factor put too much stress on the stability of the productive systems and as a consequence, the political stability collapsed.

The food crisis was the bone of contention among social classes, who struggled to treasure more food and to own more and better productive spaces. With the loss of the political authority, community production forms were often abandoned and most of the rational techniques were left aside, resulting in serious and irreversible deterioration processes in agricultural and forestry lands. In turn, this meant a substantial reduction of land capacity to sustain population.

These population and ecologic phenomena and their political and economic consequences were the seed of the social crisis that eventually, in the middle of the VIIth century, caused the destruction and exodus of Teotihuacan.

The former crisis implied that during the early post-classic no centers were established outside the limits of the basin of Mexico. The flourish of two cities: Tula in the northwest and Cholula in the southeast, rescue the importance of the basin's urban and ceremonial centers, and they would exercise an outstanding influence within the country. In this way, though Tula was smaller than Teotihuacan, either in population and in surface, its cultural influence spread to the center of the country and reached the Yucatan peninsula, on the east, as well as to the southwest of United States towards the north. Cholula on the other hand was less important than Tula and its influence sphere only reached the villages settled in the center-south of the national territory.

Again, during the XIIth and XIIIth centuries, the erratic rainfalls and the progressive sequence of the climatic change to more arid phases, curb the development of Tula and take it to a crisis. Tula is gradually abandoned and later occupied and destroyed by new Barbarian groups that came through the central section of the plateau from the north. Otomis, Culhuaques, Cuitlahuacas, Xochimilcas, Chalcas, Mixquicas, Tepanecas, Acolhuacas, and finally, Mexicas, occupied the basin, dominated local peoples and settled around the great lake. Some years later, the development or decline of these peoples and their towns and cities was conditioned to the military triumph or defeat.

And this is how during the two centuries prior to the conquest, a social structure evolved, fitting within a theocratic-military system that reached its highest point in the Mexica empire. This was the last to achieve a political, economic, and cultural penetration in a major portion of the present national territory and part of Central America. The Mexica city of Tenochtitlan, center of the empire, was founded around 1324 A. D. on a small islet. At the beginning, life conditions of Mexicas were rather precarious;

their development depended on fishery, hunting, dugout manufacture, and mainly, on warfare.

Since the vital space was very limited for this people, they resorted to "chinampas" (large woven basquest filled with dirt) to increase their territory. This land, artifically claimed, was devoted to housing and to crops. Nevertheless, agriculture was not a major activity, because the tributes paid by conquered peoples and trade were the main ingredients of the total splendor of the Mexicas.

In such a way, from the initial shelter for Mexicas, the city of Tenochtitlan became the strategic site from where this people expanded their conquest throughout the valle of Mexico, and, later, to all the Meso-American zone.

The micro-climatic adversity of the basin and its surrounding favored the existence of a great variety of products for trade. The settlements established on the basin availed themselves of a permanent source of biological and mineral products for construction, household, transportation, medicine, and food.

The blossoming of the Mexica empire was intimately related to the climatic change that favored adequate humid periods for the regeneration of rain-fed agricultural areas, lost time ago. Likewise, this condition was determinant for the regeneration of forests, and lakes. That is why, the panorama was magnificent at the arrival of the Spaniards. A huge lake extended from Chalco to Zumpango, with a maximum width of 30 km. Small villages were found around the lake, and even larger towns such as Tenochtitlan, Tlatelolco, Texcoco, Tacuba, etc., all of them organized within a complex settlement and natural resource exploitation system.

From the hills to the plain lands, right to the border of the lake, human activities flourished in different uses of the land, hunting, fishing, and picking up forestry and lacustrian products, as well as in the delivery of various goods and services and productive, consumption, and management activities. All this action took place within an ecologic environment that did not suffer from any irreversible deterioration.

Salient hydraulic works were also part of the scenary -dams, gates, reservoirs, aqueducts- and improved life, despite the limitations imposed by the virtually neolithic technology.

Communications were done by means of roads and channels running east-west or north-south, in different sizes according to their importance and function. The possibility of navigating on rafts favored trade within the basin, being Tlatelolco the most importante and wealthiest marketplace of the region.

From the onset, and during the history of Tenochtitlan, Mexicas had to struggle against flood of salt water from Lake Texcoco, particularly during rainy seasons, and thus, great dikes were built, such as the earthen barricade of Nezahualcoyotl, cutting through one end of the lake. At the end of this work, Lake Texcoco was divided into two sections: one to the east with salt water, and one to the west with fresh water. These dikes were also used as roads, and their bridges were strategically raised to cut off the entrance to the metropolis. Since the aquatic communication system was so important, besides a great amount of boats, strategically located wharves were abundant.

The drinking water was obtained from water springs and was brought to the city, from Chapultepec, by aqueducts. The wells and gutters provided the water for land irrigation purposes.

The compressible nature of the soil and

subsoil forced this people to execute special foundation works and correction of sinking sections of the urban area.

Society was clearly divided into strata, with nobility and pesantry. The state was authoritarian. The administration and political control was exercised from a power center that prevailed over others of the kind. The state, in turn, exercised absolute control over land granting and exploitation, water usage, and labor. This control played a paramount role in the development of the empire, since possession of land, water, and labor allowed the State a total control of production means.

With the conquest, economic, political, and ideological institutions were broken, and thus the hegemonic production mode collapsed. It was substituted by the colonial system of production, that was a vital factor for the irrational exploitation of the basin's natural resources, resulting in an irreversible ecologic unbalance. This unbalance put an end to the magnificiency of the natural framework in which pre-colonial peoples lived.

CONCLUSIONS

During pre-colonial times, the mountain area of the basin was covered by dense forests; the lower slopes of inner valleys and part of plain lands were areas of high agricultural fertility. It is noteworthy to point out that palynologic record data do not show any indication that pre-Spanish cultural practices have created a negative impact on forestry biotic communities; rather, their degradation starts after the conquest. That is why, the oak and pine tree mixed forest still in existence in the basin represent only the remains of huge forestry zones, whose destruction, though started before the XVIth century, was a very violent one from the onset.

In 1870, Manuel Payno estimated that just during the first century of the Colony (1524-1624), some 80 million trees of the basin were used in construction works, mining, charcoal production, and as fuel. As a consequence, the altitude strip between 7,600 and 9,500 ft which used to be an important area of forests and housing, in now a cleared and eroded zone.

The depressed central sections were covered by shallow and vast lakes, crowded with rich aquatic flora and fauna. Though colonial documents some times refer to three lakes and others to six (based on artifical divisions or dikes), during the rainy season all lakes made up a single body with different levels. Lake Xochimilco's level was three meters higher than that of Texcoco, and poured on the latter. The numerous streams flowing into this section of the basin kept the water fresh and covered by vegetation, and they were the major supply of water during the dry season.

Even during the XIXth century, the lakes covered an area of about 1,000 km^2, that is, a ninth part of the total surface of the basin. They were all shallow lakes, one to three meters deep.

The impressive richness and variety of biotic resources from the fresh water lakes marked, since its original colonization, the location of settlements on the plains of the lacustrian environment. Naturalists from the last century wrote that free navigation was impossible in certain areas, and that waterways had to be opened through the vegetation. This gigantic vegetal mass was used as base material for the construction of "chinampas", as well as to coat house walls and roofs; for improvement of agricultural land, as raw material for the manufacture of basquets and mats, as fuel, and as a source of medicine substances and a miriad of edible plants.

The lacustrian fauna abunded in fish, reptiles, amphibians, and invertebrated and was also an important food resource. The most representative group of fish in the basin are

the atherines and "charales" *(Chirostoma sp.).* A second group was made up by cyprinids, such as the "xohuil" *(Algansea sp.)* that used to be sold in the marketplaces of Mexico City until the beginning of this century. Thirdly, it should be mentioned the yellow fish *(Girardinichthys sp.).*

Sahagun left picturesque descriptions of the lacustrian fauna composed by reptiles, amphibians and invertebrated which served as food for the inhabitants of the basin. The fresh-water shrimps, the tadpoles, the different species of frogs, the aquatic "worms" such as the "ocuiliztac" - today identified as the larvae of coleopterus from the family of disticidous -the "water toy" or axolotl *(Ambystoma sp.)*- curios neotenic amphibian, very tasty, described by Sahagun as a gourmet's delight. Besides all this variety, it should be mentioned the different species of aquatic snakes and fresh water turtles of the *Kinosternon* gender.

The first settlements were conditioned to the existence of farming land, water supply, nearness of fuel, and they separated and differentiated functions as a consequence of the different exploitation of resources. The population was spread in sites of several categories, though the lake system did not allow a regular distribution of population centers throughout the valley. Nevertheless, nowadays it is possible to identify, in the space distribution, certain distance constants linked to their hierarchy.

Other constants in certain sections of the valley show us that all high density, compact settlements were established at the edge of the fertile aluvial plains; those of low density dispersed in less productive hills and in marginal areas. Settlements on the hill slopes are more spread than those on the edge of the plains. The good agricultural lands were seldom used for dwelling and villages were erected on poor soil.

From the pre-classic, the economy of these groups was founded on the practice of an intensive agriculture whose major feature was the "chinampa" system. In those times, the plain lands to the south of Lakes Chalco and Xochimilco were completely inhabited, and therefor people devoted to "chinampa" crops with an irrigation and drainage system, by taking advantage of the periferic lacustrian areas. The construction of "chinampas" was possible thanks to a network of drainage dikes, that gradually reduced the amount of water and so the big woven basquets filled with earth settled on the ground. The expansion process started at natural islets and solid ground peninsulas. The largests dikes, used to drain the area, were also used as roads. At the end, huge dikes were built to regulate water distribution and probably to reduce floods during the rainy season.

The "chinampa" crop system is probably the most intensive and productive agricultural technique during pre-Spanish times, and covered -in the late post-classic horizon- an extension of 12,000 hectares: 9,000 of them as farm land and 3,000 as water.

In other sites of the alluvial plains, agriculture evolved on fertile soils and farming land -using neolithic tools- that were able to support permanent crops with simple restoration techniques such as animal and vegetal fertilization, crop rotation, floodings, permanente irrigation, terracing, etc. On the plain lands, the fragile topsoil was easily controlled by means of rustic tools. In areas where water was available, a permanent irrigation system was established and many of the gorges allowed irrigation by flooding, which was a major solution to solve problems of frost and lack of rain.

In the alluvial plain, where the water table was rather high, drainage was a serious problem. It was solved by means of the construction of gutters linked with the natural streams of the area.

In those lands with a marked slope, erosion -which was a relevant problem- was alleviated with retaining walls, banks, and terraces.

Finally, during the apogee of Tenochtitlan, the Aztecs performed great hydraulic engineering works based on a system of gutters, dikes, earthen walls, roads and aqueducts that allowed them a proper hydraulic control of the basin: thus they increased the construction of "chinampas" within the city, either for housing or for gardening; they could retain and regulate, by means of gates, the water level and its movement from one lakelet to the other, according to its seasonal inflow; they guided fresh water from Chapultepec to the city in better conditions, as well as the water from Coyoacan and Churubusco; they laid out ample navigation channels for the internal transportation of goods towards ports that delivered them into several regions, and this was a basic feature in the economic development of the Mexica (Aztec) empire.