CANNIBALS AND KINGS

The Origins of Cultures

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process no one could foresee the end result. "Tribal equalitarianism would gradually vanish even as it was being appended, without awareness of the nature of the change, and the final achievement of absolute control would at that point seem merely a minor alteration of established custom. The consolidation of governmental power would have taken place as a series of natural, beneficial, and only slightly (if at all) extra-legal responses to current conditions, with each new acquisition of state power representing only a small departure from contemporary practice." By the time the remnants of the old council finally sank into impotence before the rising power of the king, no one would remember the time when the king had been only a glorified *mumi* whose exalted status rested on the charity of his friends and relatives.

I urge those who feel that my explanation of the evolution of culture is too deterministic and too mechanical to consider the possibility that at this very moment we are again passing by slow degrees through a series of "natural, beneficial, and only slightly . . . extra-legal" changes which will transform social life in ways that few alive today would consciously wish to inflict upon future generations. Clearly, the remedy for that situation cannot lie in the denial of a deterministic component in social processes; rather, it must lie in bringing that component into the arena of popular comprehension.

But more about the moral implications of this tale later on. The immediate task before us is to trace out the further consequences of the rise of the state in the context of different regional patterns of intensifications, depletions, and ecological crises. I turn first to the tragic history of Mesoamerica.

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The Pre-Columbian States of Mesoamerica

Some archaeologists claim that ecology and reproductive pressure had little to do with the rise of the state in Mesoamerica. They believe that the transition to statehood occurred first among the Olmec and Maya, who lived in lowland swamps and jungles where there was neither an opportunity to practice intensive forms of agriculture nor barriers to the dispersion of population. Supposedly these jungle states evolved as a result of spiritual impulses peculiar to the Olmec and Maya conception of the world. Believing that the rains, crops, and continuity of life were dispensations of the gods, the Olmec and Maya felt the urge to build ceremonial centers and to house and provision a priestly class of non–food producers. Because they happened to be more religious than other pre-state village peoples, they built larger temples and showed uncommonly great respect and devotion to their priests and officials. Cost benefits were irrelevant. Their political organization did not result from population growth, declining efficiencies, warfare, impaction—or anything else so crass. Rather, it evolved from voluntary submission to a benevolent theocracy.

Archaeologists who advance this kind of explanation for the origin of the state in Mesoamerica seem to be exhilarated by the notion that human faith and ingenuity triumphed over adverse ecological conditions. While I sympathize with the sentiment that lies behind this celebration of the creative achievements of cultures like the Olmec and Maya, I think it is far more urgent that we understand the limitations placed by ecological and reproductive factors on even the most inspired forms of human activity.

The Olmec are indeed a puzzling case. Described by the Mexican archaeologist Covarrubias as the "mother civilization" of the New World, the Olmec inhabited the humid lowlands and coastal plains of the Mexican

Gulf Coast states of Vera Cruz and Tabasco. Between 1200 and 800 B.C. they erected a number of widely separated temple centers—the earliest in the New World—on top of artificial mounds two or three acres in extent. The best-known site is La Venta in Tabasco, on an island in the middle of a swamp. La Venta's most imposing structure is an earthen cone 420 feet in diameter and about 105 feet high. Monumental sculptures consisting of fifty-ton carved stone slabs called stelae, altars, and huge, round human heads that appear to be wearing football helmets lie strewn about the site.

While the Olmec ceremonial centers contain impressive evidence of the ability of redistributor-chiefs to organize cooperative projects and to support artisans skilled in sculpture, masonry, and the making of jade jewelry and fine ceramics, the scale of their endeavors falls short of what one would expect of a state-level polity. Each site could easily have been constructed by a population of no more than two or three thousand people and each is too far from the others to constitute a single interconnected political system.

To keep the Olmec in perspective, one must consider the scale of construction characteristic of sites that are historically known to have reached the threshold of state formation. When the first French explorers ascended the Mississippi Valley, for example, they found populous "towns" and huge earthen platforms supporting wooden temples and the houses of priests and nobles. A remnant of the largest of these structures, the Cahokia mound, still exists on the outskirts of east St. Louis. Before being chewed up by bulldozers, it was over a hundred feet high and covered fifteen acres, as compared with the two or three acres typical of the Olmec sites. Moreover, we know that impressive feats of construction can be carried out under the auspices of "big man" redistributor-chiefs who lack the capacity to tax, conscript, and punish their followers. Even the nonagricultural Kwakiutl and Haida of the Pacific Northwest, led by redistributor-chiefs, were capable of a certain amount of monument-making in the form of totem poles and carved house posts. At Stonehenge and other early ceremonial centers in Europe associated with the spread of farming, pre-state chieftainships managed to erect elaborate astronomically oriented monuments out of blocks of stone that weighed considerably more than those found at La Venta. And the Olmec sites are actually puny by comparison with the great highland centers of the central plateau of Mexico. At best they represent a stage of development which was arrested at the level of incipient statehood. Their failure to develop further was clearly related to the fact that because of ecological circumstances their regional population densities remained low and unimpacted.

I should also mention the possibility that ceremonial structures indicative of incipient statehood older than the Olmec may yet be discovered in the central plateau highlands. Recent excavations by Ronald Grennes-Ravitz and G. Coleman indicate that Olmec-type figurines found in Morelos and the Valley of Mexico are as old as those found in Vera Cruz and

Tabasco. Moreover, at these highland sites Olmec artifacts occur above strata containing indigenous highland ceramic traditions that predate the Olmec period by as much as 400 years. Olmec temple centers may therefore yet be shown to have been partially dependent on the growth of the first highland states. It is even possible that the Olmec sites represent colonial outposts—perhaps pilgrimage centers, as Grennes-Ravitz and Coleman have suggested—around which trade between the tropical lowlands and the arid central plateau was organized.

To the east of the Olmec heartland lies the Yucatán Peninsula, another region in which the path toward statehood seems to flout ecological principles. Here lived the Maya, a people who invented a complex system of hieroglyphic writing and mathematical numeration, wrote their history in accordion-shaped books, made precise astronomical observations, developed a highly accurate solar calendar, and were masters of the arts of stone sculpture and masonry.

And yet the lower half of the Yucatán Peninsula is covered by a dense jungle region called the Petén. From A.D. 300 to A.D. 900 the Maya busied themselves with the construction of numerous ceremonial centers right in the middle of this region. Norman Hammond has counted eighty-three major sites in the southern portion of the Yucatán, separated by an average distance of only 15 kilometers (9.3 miles). In these centers are elaborately ornamented multi-room buildings grouped symmetrically about paved central plazas; ball courts for ritual games; stone slab stelae with commemorative dates, genealogies of the rulers, and other historical information not yet decoded; altars incised with additional hieroglyphic texts; and massive statues of the gods and the nobility. Towering over all are great truncated pyramids faced with cut stone and topped by stone temples. The largest site is Tikal, whose temple pyramids rise precipitously 190 feet above the plaza floor. At its maximum, during the 9th century A.D., Tikal may have had as many as 40,000 inhabitants in its rural perimeter while the overall regional density has been estimated at 250 people per square mile. This would make the Petén as thickly populated as modern-day Europe. There is no doubt that the largest of the Maya centers were the administrative capitals of small states. But there is no chance that the Maya achieved statehood entirely independently of preexisting states in the highland region. Teotihuacán, which I'll describe in a moment, already contained several tens of thousands of inhabitants when Tikal was just beginning to rise above the treetops. Teotihuacán is more than 600 miles from Tikal, but the military and economic shock waves sent out by the great highland empires regularly reached even more remote regions. We know that by A.D. 300 Kaminaljuyú, a Maya city in the Guatemalan highlands overlooking the Petén, had come under the influence of Teotihuacán. Kaminaljuyú probably contained a military garrison which controlled the trade routes between the Petén, the Pacific Coast, and the Central Mexican Plateau.

After A.D. 300 trade goods, painting styles, and architectural motifs in the Petén centers themselves leave no doubt that the Maya were being affected by events in the central plateau highlands. Actual military engagements between late formative or early classic highland states and incipient Maya states in the Petén are not to be ruled out.

Trade between the Maya and their highland neighbors may also have moved the Maya closer to statehood. The Petén region lacks indigenous sources of rocks suitable for making *metates* and *manos* or knives and projectile points. These items were crucial for grinding corn and for military weaponry. Along with salt, they were obtained through trade with the highlands. This trade may have widened the distance between the early Maya redistributor-chiefs and commoners in two ways: more effective terms of trade could be obtained by more powerful individuals who were the equals of the state-level nobility with whom they had to deal, and the control over these additional strategic resources could have added to the potential for controlling the incipient peasant food producers. In general, the larger the volume of trade, the greater the flow through the redistributive system and the greater the power of the individuals who are in charge of the redistributive process.

The evidence allowing for an interpretation of the Maya centers as secondary states does not rule out the possibility that reproductive and ecological pressures generated within the Petén region itself might also have contributed to the process of state formation. The Petén "jungle," on close inspection, turns out to be full of surprises. The first aspect that needs to be clarified is its size—only 30,000 square miles, compared with 2 million square miles for the Amazon-Orinoco. Next, there is its peculiar pattern of rainfall. As one moves northward from the Petén to the tip of the Yucatán Peninsula, annual rainfall decreases and forests are replaced by thorny shrubs, cactus, and other drought-resistant plants. Within the central Petén forest itself, annual precipitation is only about half that of the Amazon-Orinoco. The Petén dry season is exceptionally severe, and both the annual and seasonal totals are subject to extreme variations. A single drop of rain may not fall during the months of March and April. Drought conditions frequently prevail during February and May, and even during the rainy season itself. In the words of C. L. Lundell:

> The vegetation does not have the luxuriance of true rain forest, hence it may be designated a quasi–rain forest. The rainfall averages less than 1800 mm. [71 in], a maximum not sufficient to maintain true rain forest in a region with a pronounced dry season.

Many of the Petén trees shed their leaves every dry season, a tendency that is accentuated during droughts. This "jungle," in fact, sometimes gets so dry that farmers don't even have to "slash" in order to clear next season's garden plots by setting fire to the underbrush. Preventing fires from spreading is the major preoccupation on such occasions.

And now we come to the fact that the Yucatán Peninsula has a peculiar geological structure. Its bedrock consists almost exclusively of porous limestone (hence the need to import rocks for grinding corn from the highlands). This results in there being few permanent rivers and lakes since most of the rainfall percolates rapidly down through the limestone and disappears entirely without any surface runoff. During the dry season there is even a shortage of drinking water except where there are natural clay-bottomed water holes or holes in the limestone whose interior drainage has gotten clogged.

As one might expect, the earliest Maya villages were located near the only two permanent rivers on the Yucatán Peninsula: The Usumacinta on the southwest and the Belize on the southeast. Around 600 B.C. the region surrounding Tikal appears to have been uninhabited, suggesting that it was only after the favorable riverine locales had filled up that farmers began to colonize the interior of the forest. These colonists must have resembled the Yanomamo and other canoe-less "foot Indians" who live in the protein-deficient zones of the Amazon-Orinoco basin away from the main rivers. But in a short while the peculiar geomorphology and climate of the Petén region would have created a situation which has no parallel in Amazonia.

The early Petén farmers were not free to spread out evenly through the forest. Settlements would have had to be located near water holes which could be counted on not to dry up during a severe drought. We know that later on entirely artificial cisterns called *chultuns* were dug as deep as sixty-six feet into the limestone bedrock and plastered with lime cement in order to assure supplies of fresh water. Some *chultuns* were built under the paved plazas of ceremonial centers, which acted as catchment basins during rainstorms. At one modern village in Campeche, dry-season drinking water had to be obtained by descending 450 feet below the surface through an underground cavern. All of the classic Maya sites, including Tikal and other Petén centers, were built next to artificial or natural storage wells or reservoirs. The most famous of the natural water holes, or *cenotes,* is located next to Chichén Itzá, a late Maya center in northern Yucatán. Large quantities of human bones and gold artifacts dredged up from its bottom suggest that people and ritual objects were thrown into it to appease the water gods. And so the lively possibility exists that the early settlements in the Petén tended to increase beyond the normal breaking-up point of tropical forest villages. This theory removes the problem of the initial growth of Maya ceremonial centers from the realm of heaven to the realm of earth and water. The Maya farmers had a very practical reason for not fleeing into the forests when their redistributor-chiefs started acting like kings instead of like *mumis*.

The next question to be confronted is how the Maya under the direction of their redistributor-chiefs managed to raise their population density

to a level that was 250 times greater than that achieved in the interfluvial zones of the Amazon-Orinoco. Archaeologists have generally assumed that the ancient Maya farmed the Petén the way their modern descendants do —by means of the system known as slash-and-burn. But this is clearly an impossibility.

Slash-and-burn is a form of agriculture that is well-suited for regions that have abundant forest cover and high rates of regeneration. The object of the slash-and-burn system is to use a section of forest for a few years, let it lie fallow long enough for trees to grow back, and then use it again. "Slash" refers to the practice of cutting down small trees, vines, and shrubs and letting them dry before setting fire to them. The burning, usually carried out just before the onset of the rainy season, creates a layer of ash that acts as fertilizer. Crops are planted directly into the ash-covered soil in holes or small mounds without the need for tillage. High yields of corn, beans, squash, and other crops can be obtained for two or three seasons. Thereafter weeds spread from the surrounding uncut forest and infest the field; at the same time the ash fertilizer is leached away by rainfall. Soon a new plot must be found. Slash-and-burn agriculture is capable of high returns per acre and man-hour provided that an interval sufficient to permit a substantial regrowth of trees and shrubs is maintained between successive burnings. The greater the quantity of ash, the higher the yields. The longer the interval during which a forest is left fallow, the more wood there is to make ashes with. For this reason, slash-and-burn farmers in Southeast Asia think of themselves as "the people who eat forests." The shorter the fallow period, the lower the yields. In tropical forests the decline can be precipitous not only because the concentrated heavy rainfall rapidly leaches away the soil nutrients but because weeds grow thicker each year the field remains in continuous use.

Slash-and-burn was undoubtedly the system used by the earliest farming peoples who entered the Petén, but it could not have remained the principal mode of subsistence during and after the transition to the state. By counting the ruins of house sites, Dennis Puleston of the University of Minnesota estimates that there were 2,250 persons per square mile in the residential zone around Tikal and 750 persons per square mile in the zone between Tikal and its neighbor, Uaxactun. It is impossible for slash-and-burn systems to support such densities. Considering the entire Petén area, Sherburne Cook shows that enough maize, beans, and squash could have been grown with slash-and-burn techniques to support the estimated overall population of 1.5 million. But these calculations assume that the farmers were evenly spread throughout the forest and that they were free to move to new clearings as the old ones were exhausted. Neither of these assumptions is valid since the limiting effect of the dry season on the availability of drinking water is not taken into account. Furthermore, during the rainy season low-lying areas face the opposite problems—too much water—and

are too swampy to be used without digging drainage ditches.

On theoretical grounds, the picture of what must have happened seems clear. As the population of the Petén increased, the slash-and-burn cycle must have been intensified, resulting in shorter fallows between burning and hence declining efficiency. This set the stage for the adoption and spread of a more efficient system involving higher start-up costs, which in turn provided the basis for still higher population densities and the emergence of the first statelets. But what was the nature of the new and more productive system? I fear that my theory has run ahead of the archaeological facts, but there are some hopeful signs that the facts are about to catch up.

One of the measures taken by the Maya when the efficiency of slash-and-burn declined was to plant groves of breadnut trees *(Brosimum alicastrum).* As C. L. Lundell pointed out back in the 1930's, the breadnut is the most common tree covering the ruins of the Petén ceremonial centers. When archaeologists speak dramatically of having to hack away the jungle in order to expose the wonders of Maya architecture and sculpture, they generally neglect to say that they were hacking away at an overgrown orchard. Tree crops, of course, do have high start-up costs—one must wait several years before they begin to return the labor invested in them—but they are highly productive per acre and per man-hour. Recently, Dennis Puleston, having discovered that each house site at Tikal was surrounded by a grove of breadnut trees, reached the conclusion that breadnuts provided 80 percent of the calories consumed by the people of Tikal during the ninth century A.D. There are other alternatives, however, which may simply have been overlooked by the generation of archaeologists who preferred to think the Maya temples were let down from heaven on golden threads rather than built on the backs of people who wanted to know where the next meal was coming from. In this connection, one of the most important discoveries ever made about the Maya may prove to be the one made in 1975 by Ray Mathenay at Edzná in Campeche. Working with aerial photographs taken during the rainy season (others had limited their aerial photography to the dry season, when conditions were "better"), Mathenay detected a network of canals, moats, and reservoirs radiating out from the ceremonial center. Because of the dense foliage covering them during the rainy season and the fact that the water in them dries up during the dry season, these constructions are difficult to detect from ground surveys alone.

The canals range up to a mile or so in length, a hundred feet in width and about ten feet in depth. Mathenay's suggestion is that they were used for drinking water, for hand-watering adjacent gardens, and as a source of mud for renewing the fertility of fallow fields. I would add the implication that they enabled some regions to grow two crops a year, one based on draining low-lying areas during the rainy season and the second planted on wet mud during the dry season. While Edzná lies outside the central Petén area, the fact that its water control system remained undetected for so long

means that all judgments concerning the absence of intensive systems within the Petén itself must be held in abeyance.

And this brings us to the most spectacular aspect of the Petén Maya. After A.D. 800, in center after center, construction ceased, no more commemorative inscriptions were made, temples became littered with household rubbish, and all governmental and ecclesiastical activity in the Petén came to a more or less abrupt end. Authorities differ concerning how fast the population declined. But by the time of the arrival of the Spanish, the Petén area had long since returned to population densities at or below those characteristic of pre-state times and to this day the area remains virtually depopulated. Many other Mesoamerican pre-Columbian state systems, including Teotihuacán, suffered equally abrupt collapses at one time or another. What is unique about the Petén Maya is that not only did the states permanently disappear but so did their entire populations. In the central plateau highlands political collapse was usually followed by the rise of new and larger states and empires embracing the territory and population of their predecessors. The implication of the Maya collapse, therefore, is that the Petén state developed on an unusually vulnerable ecological base which could not be regenerated once it broke down.

Exactly how the Maya destroyed their ecological base cannot be known until we have a better understanding of how the various components in their agricultural system fitted together. The best one can do for the moment is to say that each component had a limit to which it could be pushed, after which it would push back with devastating consequences. Short-fallow slash-and-burn can turn jungles into permanent grasslands. At the very middle of the Petén area is a huge, grassy savanna that was probably created by excessive burning. Deforestation leads in turn to erosion on hillsides. In the Petén the upland soil cover is extremely shallow and readily lost when not protected by plant cover. Erosion can also damage lowland water control systems since it leads to the build-up of excessive silt in canals and reservoirs. Finally, tampering with forest cover over an area as large as that of the Petén can easily change the regional pattern of annual precipitation, lengthening the dry season and increasing the frequency and severity of droughts.

The actual demise of each Petén center may have involved a slightly different scenario—crop failure and famine in some, rebellion in others, military defeat in still others, or various combinations depending on local events. But the underlying process undoubtedly involved the depletion of fragile soil and forest resources to a point so low that centuries of disuse were required for their regeneration.

Whatever the precise cause of the Maya collapse, the reason for the preeminence of the highlands in Mesoamerica seems clear. The capacity of the semiarid valleys of the central plateau to undergo successive agricultural intensifications exceeded that of the Maya's quasi-tropical forest. Let me

show how this process of intensification operated in the history of the Teotihuacán empire.

The Teotihuacán Valley is a branch of the Valley of Mexico lying some twenty-five miles northeast of downtown Mexico City. Like the Tehuacán Valley, where the earliest domesticated plants were found by Richard MacNeish, the Teotihuacán Valley had no permanent villages until the first millennium B.C. Between 900 B.C. and 600 B.C. villages were confined to the forested upper slopes of the valley, below the early frost line but high enough up to take advantage of the extra precipitation which falls on the hillsides. The kind of agriculture practiced by these first villagers was undoubtedly some form of long-fallow slash-and-burn. By 600–300 B.C. several larger villages had formed at lower altitudes at the edge of the valley floor, presumably to take advantage of the alluvial soils and to practice a rudimentary form of irrigation. During the next period, 300–100 B.C., settlements grew up squarely on the valley floor, and one of them—the nucleus of what was to become the city of Teotihuacán—already contained thousands of people. The movement from the slopes to the valley floor strongly suggests increasing reproductive pressures resulting from the intensification and depletion of the slash-and-burn system, especially from deforestation and erosion. As the labor efficiency of slash-and-burn farming declined, it became worthwhile to expend start-up and construction labor on irrigation facilities. Numerous large springs fed by water percolating through the porous volcanic hillside to the valley floor formed the basis for the Teotihuacán irrigation system and are still in use today. As the population of the central settlement increased, the network of river-sized spring-fed canals was eventually used to water about 14,000 acres of highly productive double-crop farmlands.

The city of Teotihuacán grew rapidly after A.D. 100, reaching a peak population of perhaps 125,000 people in the eighth century A.D. Careful mapping by René Millon of the University of Rochester shows that the city was divided into planned quarters and districts, each with its craft specialities, ethnic enclaves, temples, markets, palatial stone and plaster dwellings for the rich and powerful, and dark multi-family apartment houses for the populace—some 2,200 apartment houses in all. Millon has counted more than 400 workshops specializing in the manufacture of obsidian tools and more than 100 ceramic workshops. The largest and most ornamented buildings lined the huge stepped avenue which ran the length of the city almost two miles from north to south. The central monument—the so-called Pyramid of the Sun, built of stone-faced rubble—measures 700 feet to a side and rises to a height of 200 feet.

Around A.D. 700 Teotihuacán suffered a cataclysmic collapse, possibly due to burning and sacking, associated with the rise of a new imperial power —the Toltec, whose capital was located a scant twenty miles away in the Tula Valley. The evidence is incomplete, but I propose that environmental

depletion was primarily responsible. The volume of water issuing from the springs fluctuates in relation to rainfall. A slight permanent drop in the volume of spring-fed water and in the water table underlying the valley floor would have compelled many people to move out of the city. We know that there was deforestation over an ever-widening perimeter as the city grew and consumed increasing quantities of wood for house beams and rafters, cooking fuel, and the manufacture of lime plaster. This deforestation was carried out on a sufficiently large scale to have altered the pattern of precipitation and runoff on the upper slopes of the valley.

There was one technical solution to the water problem which the people of Teotihuacán did not try except on a very limited basis. This consisted of using the shallow lake and swamplands that bordered the Teotihuacán Valley on the southwest and that in those days were probably linked to Lake Texcoco, a large, partly brackish body of water that filled most of the adjacent Valley of Mexico. To utilize the margins of the lake, it was necessary to dig drainage ditches and to pile up the excavated soil on ridges—a procedure which was much more costly than other forms of irrigation. Beginning about A.D. 1100 the high start-up costs of this form of agriculture could no longer be avoided by the people living in the Valley of Mexico. A network of drainage canals and highly productive ridges, whose fertility was constantly augmented by new dredgings, spread along the margin of the lake and provided the subsistence base for a half-dozen warring polities. One of these was the Aztec state, which would become the last American Indian imperial power in North America. Since the Aztec capital, Tenochtitlán, was located on an island connected to the shore by a causeway, the Aztecs enjoyed a military advantage over their neighbors and were soon in control of the entire lake region. As the population grew to unprecedented densities, the ridged mounds were extended out into the lake itself by dumping mud on top of brush, corn stalks, and tree branches, resulting in fabulously productive *chinampas,* or "floating gardens" (which, of course, did not float).

At first, only the freshwater arms of the lake were used in this manner. But as the areas occupied by the *chinampas* increased, Aztec engineers tried to reduce the salinity of the brackish portions by diking them off and flushing them with fresh water channeled through a complicated system of aqueducts and sluice gates.

Looking back, then, on the developmental sequence in the Teotihuacán Valley and the Valley of Mexico during the millennium from A.D. 200 to A.D. 1200, we can discern three broad phases of agricultural intensifications followed by three shifts in the mode of production: first, the intensification of hillside slash-and-burn farming; second, spring-fed canal irrigation; and third, *chinampa* construction. Each of these involved progressively greater start-up and construction outlays, but each ultimately sustained greater population densities and larger and more powerful states. In those thousand

years the population of the Valley of Mexico rose from a few tens of thousands to 2 million, while the scope of political control grew from one to two valleys to a whole subcontinent. By the old onwards-and-upwards theory of progress, the steady augmentation of agricultural production should have meant that the Aztecs and their neighbors increasingly enjoyed the benefits of "high civilization"—a phrase anthropologists have not hesitated to apply to them. But the phrase is wildly inappropriate.