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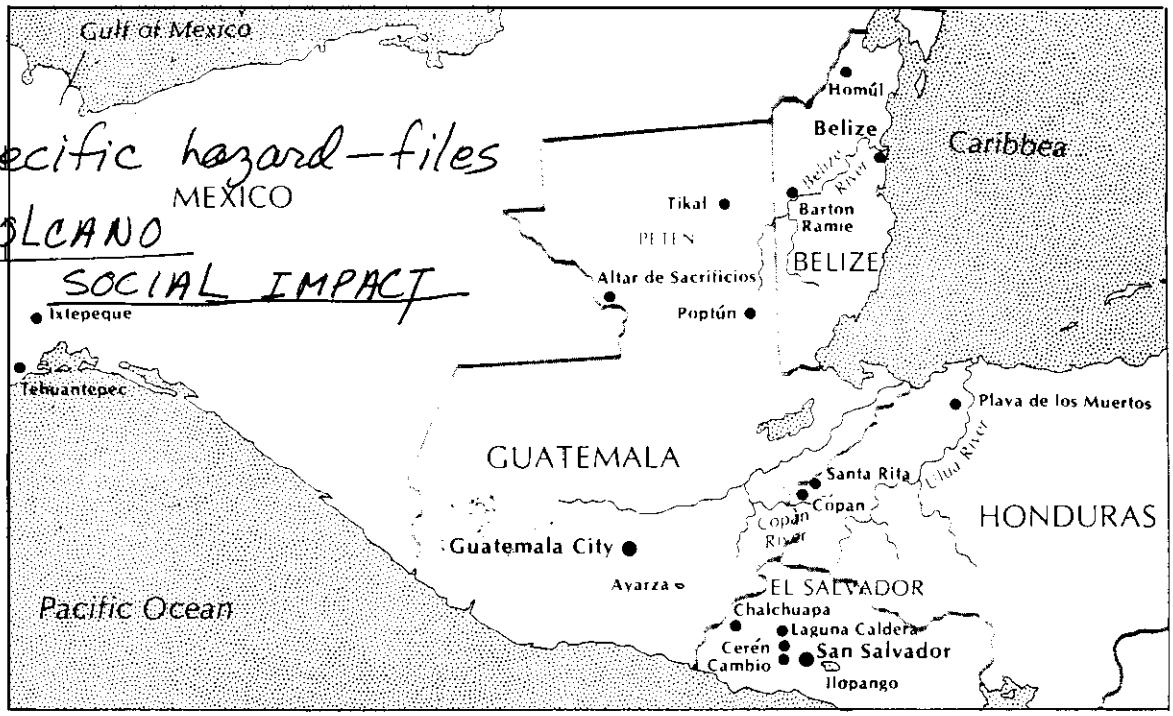


specific hazard—files
VOLCANO
SOCIAL IMPACT

Maya Recovery from Volcanic Disasters

Ilopango and Cerén

by PAYSON D. SHEETS

By the third century after Christ the highlands of El Salvador were squarely part of the southeastern Maya culture which had developed a complex, fairly sophisticated society based on dryland and irrigated farming. The tropical, volcanic countryside was fertile and the landscape was dotted with agricultural villages and towns. Here and there a larger town with a stratified class system dominated a valley or basin. Chalchuapa, for example, had become a dynamic city comprised of farmers, craft specialists, traders and chief priests. Its urban center consisted of a two kilometer-long ritual zone of tall pyramids, temples and plazas; the residences of the elite surrounded this zone and the artisans and farmers who formed the bulk of the population lived somewhat farther out from the center. Trade was conducted with other societies as far away as central and northern Guatemala and Belize. Commodities varied and included large quantities of obsidian and jade.

But El Salvador is a country dominated by volcanoes; a central chain of them runs the length of the land from northeast to southwest. They have been anything but quiescent during the past two millennia and during the third century disaster suddenly struck. In two separate stages, the volcano at Ilopango erupted with such violence that whole forests were uprooted and carbonized in an instant. Trees flew like matchsticks in the fierce, hot wind which caught up immense amounts of ash in its turbulence. By the time the eruption was over, thousands of people were dead and land within a radius of 100 kilometers had been rendered uninhabitable. In the area immediately surrounding the eruption, volcanic materials ejected through the air called "tephra" lay as much as 50 meters deep.

Scholars during the nineteenth century referred to these remarkably abstract signs as "pictographs," reasoning that all systems of writing had to evolve from an initial stage when signs were first pictures of specific items. In this case however, the signs are not actual pictures or representations of the objects themselves, as one might expect, but of the clay tokens previously used. In this way the newly developed writing system was able to draw upon a pool of the already widely used symbols of the token recording system—only adding a second step of abstraction. In time the markings became more simplified and conventionalized. The use of special styluses with triangular ends is responsible for the characters of the Sumerian script and its name—cuneiform—which means wedge-shaped.

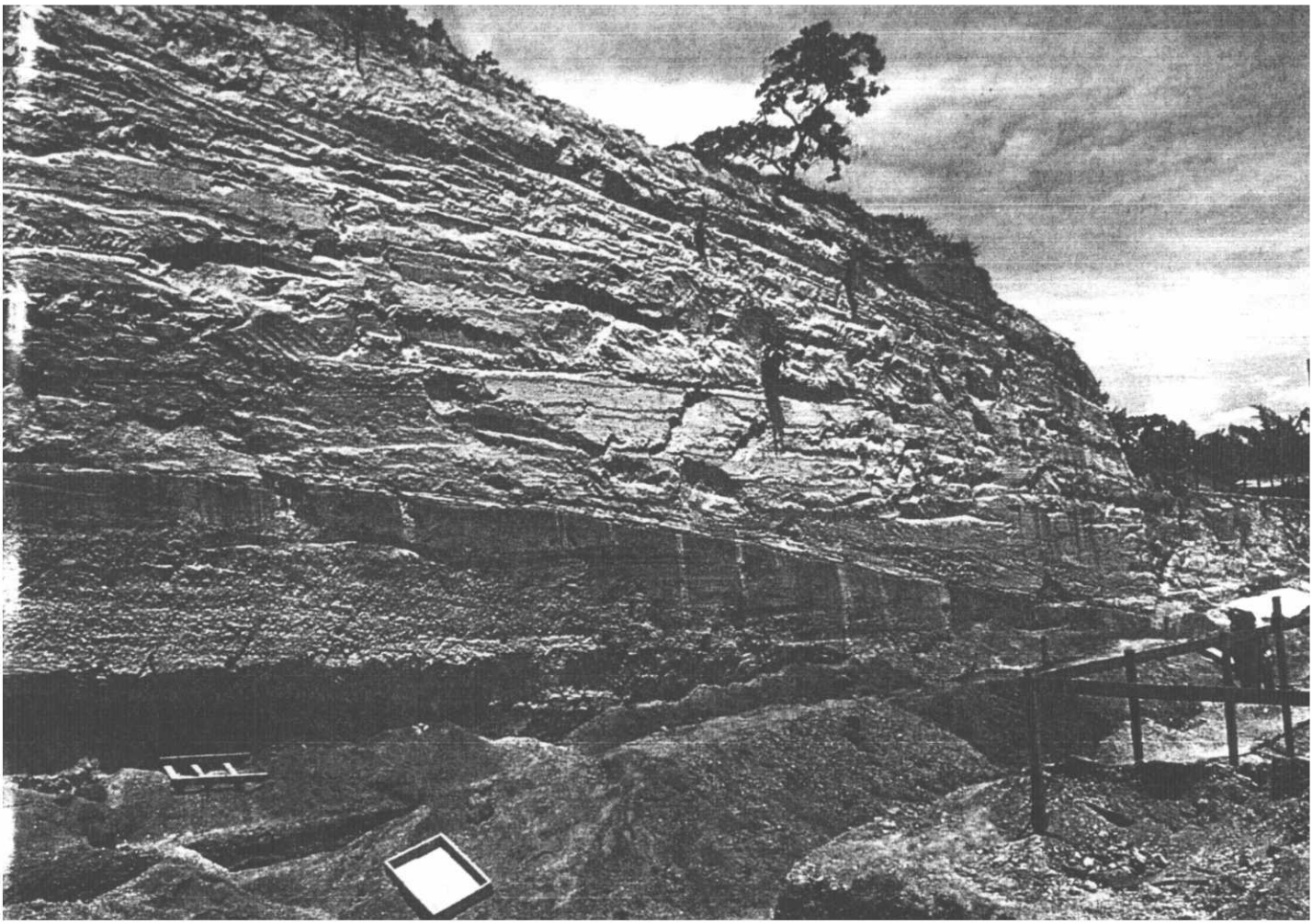
The early stages of Sumerian writing are still enigmatic and the "pictographs" are still mostly undeciphered, but cuneiform writing is now well understood by epigraphists. One of the methods used to identify the meaning of pictographs is to try to trace the evolution of particular signs from the known cuneiform signs to the original pictograph through various intermediary stages. By this method we can, with a reasonable degree of confidence, assume that an ovoid with an incised line along the broad end meant "oil"; the disc with an incised cross stood for "sheep"; a cone represented the numeral "one"; a sphere meant "ten" and large cone "60." The token system and writing must have coexisted for a time, but each developed to its own destiny. Around 4700 B.P. the token system, relieved from all pressures imposed by urban demands, reverted to its former use in household and market computations. Later it continued to be used as a corollary of writing and was simplified into tokens of a single shape as in the modern abacus. Writing modeled itself more closely to language and became phonetic. The cuneiform system of writing impressed on clay tablets continued unchallenged in most parts of the ancient Middle East until 2500 B.P. when the Persians adopted Aramaic as the official language of their empire. Aramaic used a cursive script that allowed more rapid recording because letters were connected. Eventually, the use of clay tablets and stylus were replaced by papyri or parchment and pen and ink.

In most cultures the invention of writing is considered to be an event of the greatest significance and its origin is often surrounded by fabulous legends. The ancient Egyptians believed that writing had been taught to them by the God Thoth, the dog-headed baboon who was also the god of Wisdom, Science and Medicine. In Sumer, it was known as the revelation of the Goddess Nisaba, the wife of the lord wind Enlil. In our own society writing is viewed as the landmark for civilization and history. Until today its invention has been fancied as the intellectual achievement of a group of wise men in Sumer who systematically decided upon a number of pictographs to represent desired concepts. My research demonstrates that, like all other human achievements, the origins of writing are humble and fortuitous. Writing did not come *ex nihilo*, but rather was a step in the evolution of a previous recording system based on small clay tokens which had been in use for millennia in the ancient Middle East.

FOR FURTHER READING on the theory of clay tokens as the precursor of writing: Denise Schmandt-Besserat, "The Earliest Precursor of Writing," *Scientific American* 238(1978):50-59; "An Archaic Recording System and the Origin of Writing," *Syro-Mesopotamian Studies* 1(1977):1-32; "An Archaic Recording System in the Uruk-Jemdet Nasr Period," *American Journal of Archaeology* 83(1979):19-48. "The Earliest Uses of Clay in Anatolia," *Anatolian Studies* 27(1977):133-150; "The Earliest Uses of Clay in Syria," *Expedition* 19(1977):28-42; "The Beginnings of the Use of Clay in the Zagros," *Expedition* 16(1974).11-17.

On the history of writing: Robert Claiborne, *The Birth of Writing* (Time-Life Books, New York 1974), the most recent book on the topic which still includes the old theory of writing deriving from pictures; Alexander Marschack, *The Roots of Civilization* (New York 1972), presents his bold interpretation of incised Palaeolithic artifacts as sophisticated lunar calendars; J.M. Pullan, *The History of the Abacus* (Praeger, New York 1970), documents the major role played by the abacus for computation dating from classical times to the French revolution.

On related excavations: Pierre Amiet, "Glyptique Susienne," *Memoires de la Delegation Archaeologique en Iran*, Vol. XLIII (Paul Geuthner, Paris 1972): Vol. I, 60ff and Vol. II, PL. 61ff. R.J. Braidwood, Bruce Howe and Charles Reed, "The Iranian Prehistoric Project," *Science* 133(1961):2008-2010; H.J. Lenzen, "New Discoveries at Warka in Southern Iraq," *Archaeology* 17(1964):122-131; Ernest MacKay, *Report on Excavations at Jemdet Nasr, Iraq* (Field Museum of Natural History, Anthropology Memoirs 1 [1931]:278).



Cartografia in the northeastern corner of San Salvador, 15 kilometers from Ilopango. Visible from bottom are: Preclassic soil layer with artifacts; basal coarse pumiceous layer from Ilopango, thick beds of ash flow and airfall material from Ilopango; and the weakly-developed contemporary soil horizon. A bulldozer exposed the site in 1974 while making a platform for housing

The vitality of southeastern Maya highland society had ended. In the aftermath, the survivors left the outer ashfall areas and sought new ground. Refugees showed up in villages in the lowlands of northern Guatemala and Belize, a phenomenon which accelerated the cultural developments already underway in the lowland areas. Perhaps even more important, the Ilopango disaster had a decisive, long-lasting economic impact on lowland Maya society: it disrupted the major Preclassic trade route which connected the Maya area with Central Mexico. By cutting off the southeastern end of this route, Ilopango gave the rulers of Tikal the opportunity to seize control of commerce—and they did so aggressively by redirecting the trade route through their own city.

Catastrophic for some, inconvenient for others, the eruption also had its profiteers.

Ironically, modern archaeologists are among them. The natural richness of the central Maya highlands had itself been a byproduct of an earlier eruption in the volcanic chain, one of major proportions which deposited a light-colored tephra across El Salvador some time between 40,000 and 10,000 years ago. Over the thousands of years prior to the early agricultural settlement of the region around 1200 B.C. this tephra had weathered to the very fertile soil which eventually supported Maya civilization. According to analyses conducted by Gerald Olson of Cornell University, this old soil was more fertile than any that has covered the highland region since. Three centuries after the Ilopango eruption another volcano devastated a small part of the area and laid down an additional layer of tephra. This catastrophe, too, has had its archaeological benefits, for the four meters of airfall material it deposited have preserved intact a farmhouse, an outbuilding and a cultivated field. The Cerén site, located in the Zapotitan Valley, was excavated in 1978 by the Protoclassic Project of the University of Colorado. It represents the first Maya house ever to be unearthed with evidence of a burned and collapsed thatched roof. The site as a whole is so generally well preserved that it yields valuable information about post-Ilopango or Classic Maya society—and it is a testimony to the recovery from the earlier Ilopango disaster.

The portrait now emerging of Maya civilization before and after the eruption of Ilopango is a complex one, relying on a wide range of evidence including ceramic, stratigraphic, demographic and geological. As early as 1917, a Salvadorian scholar by the name of Jorge Lardé had noted ancient artifacts buried in white volcanic ash in the San Salvador region. A decade later the American archaeologist Samuel Lothrop was shown the sites. He expanded on Lardé's findings in a small monograph published in 1927 which has proved prophetic for Protoclassic Maya studies. Over the 50 year period from the 1920's until today, many more early artifacts have been found buried under just such a white volcanic ash, with Classic Period (A.D. 300-900) artifacts occasionally located above the ash layer. These discoveries have been made throughout El Salvador, although most have been concentrated in the central and western regions. Over the decades speculations have revolved around the source or sources of the ash, the nature and date of the eruption and its effects on the local population.

The University of Colorado Protoclassic Project—named for the epoch in which Ilopango erupted—began its field investigations in 1975 to resolve some of these questions. Interestingly, many of Lothrop's findings have been confirmed despite the fact that his methodology was sometimes mistaken. It was he who first realized that a very large volcanic eruption had occurred; that this eruption had "rendered Central Salvador uninhabitable" for a considerable length of time; and that the artifacts derived in El Salvador from the Preclassic or Formative Period, then called the "Archaic" Period, dated from 1200 B.C. to A.D. 300. He was even correct regarding the source of the tephra, which he may have deduced from the relative thickness of the ash as one approaches Ilopango. Lothrop also understood that the recolonization of the ash-covered areas was probably effected primarily from the north.

Data collected during the 1978 season enabled members of the Protoclassic Project to assemble a much more detailed picture of the eruption. Stratigraphic, granulometric (the study of grain size) and petrographic analyses were conducted by Virginia Steen-McIntyre and William Hart, Jr., staff geologists for the Project, and by German geologists. These researchers discovered that the first phase of the massive eruption began with fairly coarse pumice which was deposited within a 50 kilometer radius of Ilopango. It was a relatively thin layer varying from one to two centimeters in thickness at its most distant exposures and thickening to 40 centimeters near Ilopango. This early stage was quickly followed by an airfall and ash flow deposit called the "T2" deposit—an "ash flow" being a turbulent cloud of volcanic tephra and gasses that moves downhill at tremendous speeds, causing thorough devastation. The temperatures of ash flows vary considerably; while most are very hot, the "T2" flow was relatively cool. The "T2" deposits in the vicinity of Chalchuapa, located 77 kilometers from Ilopango, are about 20 centimeters thick. These same deposits increase to over six meters near the source of the eruption. The basal pumice layer which was deposited as airfall would have caused problems only for those people living within a radius of a few kilometers from Ilopango; but the combination of the airfall ash and ash flow would have caused considerable adaptive problems even for people living more than 100 kilometers away. In short, "T2," while mild compared to the second phase, "T1," had some very major damaging consequences.

But, once again, "T1" was catastrophic—a major eruption by geological standards. Almost as soon as the "T2" tephra had settled, another vent or series of vents opened with incredible violence. Remnants of trees still standing after the initial damage attest to the energy unleashed by the second explosion: even as far away as 30 kilometers from the source, trees one meter thick were hurled skyward and charred to their core. The deposits which fell on Chalchuapa from "T1" were over half a meter thick; nearer to the source, they were nine meters thick, and right by the vents they were almost 50 meters deep. Yet, remarkably, the tephra laid down by "T1" is extremely fine-grained—so much so that even near to the source it looks like fine white flour. The tephra ordinarily resulting from such an explosion is usually much more coarse in texture. Steen-McIntyre has conjectured that much of this tephra may have been released through vents beneath Lake Ilopango and that the sudden chilling effect of the water on the magma would have fractured it into unusually fine-grained particles.

What would have been the specific effects of such a disaster on the Maya in the highlands as well as more distant peoples? What archaeological evidence exists to explain and illuminate these effects? The ecological damage done by the tephra to agricultural fields in most of El Salvador would have made continued use of the old soil impossible; ash depths of more than roughly 15 centimeters would have exceeded the Maya's technological capacities to continue farming. While volcanic ash, once weathered, is among the most

Large tree, tumbled and carbonized by the Ilopango eruption during the "T1" phase, located west of Santa Tecla.

productive of soils, freshly fallen tephra—ash, pumice, scoria or any airfall material—lacks many of the elements essential for plant growth. As a general rule, darker tephra weathers faster than light-colored tephra and contains more of the nutrients requisite for plant growth. Since the tephra from Ilopango was light-colored, it was all that much more damaging to the El Salvador highland soil.

Additionally, the tephra also had a poorer structure and water retention capacity, a quality that contributed to the unfortunate consequences which followed Ilopango. Gordon Willey of Harvard University found evidence of flooding of the Belize River at about the same time as the Protoclassic arrival of immigrants into the area, which would also have been the time shortly after Ilopango. Torrential rainfall is a common occurrence after large volcanic eruptions: the fine ash particles suspended in the air act as nuclei for water droplet formation and the eruption itself adds moisture to the air. Worse yet, the damage to vegetation eliminates the major normal check to rapid runoff. When one adds to this the relative nonporousness and impermeability of the fine-grained ash deposited by Ilopango, it is scarcely any wonder that major flooding would have occurred. Willey also noted the virtual disappearance of freshwater mussels and univalves from Barton Ramie at the time of the floods in the Belize River. The probable explanation for this is that volcanic ash is lethal to many aquatic plants