▲ Volcano
• Archaeological Site

An Ancient Natural Disaster

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Recent geological and archaeological investigations in Chalchuapa, El Salvador, together have provided the probable answer to a question which has long puzzled students of the history of the Maya.

The question: Why are there throughout the Maya area numerous instances of the sudden appearance of a full-blown Maya Protoclassic civilization, whereas a more normal, progressive development of the Protoclassic is found at other sites?

The evidence: Geologists have discovered that there was a violent eruption of Ilopango Volcano in approximately the second century A.D., which deposited a thick layer of volcanic ash over much of the surrounding countryside, making hitherto productive farm lands unusable. Archaeologists have found such a layer of ash immediately overlying the Protoclassic strata at Lake Cuzcachapa and elsewhere in Chalchuapa.

The answer: After the eruption, the area could not sustain its entire population and therefore groups of Protoclassic people emigrated to sites where they might hope to establish new homes.

During the past few years the University Museum has been excavating at Chalchuapa under the direction of William R. Coe and Robert J. Sharer, focusing its attention on what happened in that area during a 2500-year time span, beginning before 1000 B.C. and leading up to the Spanish Conquest by Alvarado in 1524.

The earliest sedentary peoples occupying the Chalchuapa area evidently were an extension of the general lowland early agricultural societies who inhabited the Pacific littoral of Guatemala and the tropical lowland areas of southern Mexico. Between 900 and 500 B.C. the influence of the precocious Olmec state waxed and waned, leaving evidence of its presence in terms of pottery, monumental bas-relief sculpture, and figurines. During the succeeding six or seven centuries, Chalchuapa was a part of the general cultural evolution of the Guatemalan highlands.

By the first century A.D., El Salvador appears to have been densely settled, with the major ceremonial centers and sustaining populations located in the middle of broad, fertile, alluvial valleys. The term "Protoclassic" is used in this article to denote a particular complex of formal

and stylistic attributes which are characteristic of El Salvador at this time, although the term was first defined elsewhere. (See *Expedition,* Winter 1969.)

The hallmark of the Protoclassic is a shallow bowl with an outcurved rim and four bulbous feet, generally called a mammiform tetrapod on a Z-angle bowl. Other elements of the Protoclassic include a proliferation of Usulutan decorative techniques, orange monochrome pottery, a painted post-firing white slip, potstands, and other artifacts and techniques beyond the scope of this article. The gradual development of this package of traits was unveiled by excavations conducted by Bruce Anderson in finely-stratified deposits on the shore of Lake Cuzcachapa in Chalchuapa.

Immediately overlying the uppermost levels containing the Protoclassic at Lake Cuzcachapa and elsewhere in Chalchuapa is a layer of volcanic ash. Its placid appearance—it looks like a fine-grained beach sand—belies the violence of the eruption which deposited it, and what it would have been like to have experienced such an event. An inkling of what this eruption may have been like may be gained from the eyewitness account of a similar but less violent eruption in 1835. Vicente Romero, the Commandant of the Salvadorian port of La Unión, describes the eruption of nearby Coseguina Volcano, in Nicaragua:

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On the 20th (January 1835), the day having dawned with the usual serenity, at 8 o'clock, towards the southeast, a dense cloud was perceived of a pyramidal figure, preceded by a rumbling noise, and it continued rising until it covered the sun, at which elevation, about 10, it separated to the north and south accompanied by thunder and lightning; the cloud finally covered the whole firmament, about 11, and enveloped everything in the greatest darkness, so that the nearest objects were imperceptible. The melancholy howling of beasts, the flocks of birds of all species, that came to seek, as it were, an asylum amongst men, the terror which assailed the latter, the cries of women and children, and the uncertainty of the issue of so rare a phenomenon, everything combined to overcome the stoutest soul and fill it with apprehension, and the more so when at 4 P.M., the earth began to quake and continued in a perpetual undulation which generally increased.

This was followed by a shower of phosphoric sand, which lasted until 8 P.M., on the same day, when there began a heavy fall of a fine powder-like flour. The thunder and lightning continued the whole night and the following day (the 21st), and at eight minutes past 3 P.M. there was so long and violent an earthquake that many men, who were walking in a penitential procession, were thrown down. The darkness lasted forty-three hours, making it indispensable for everyone to carry a light, and even those were not sufficient to see with.

On the 22nd it was somewhat less dark, although the sun was not visible. And towards the morning of the 23rd, the tremendously loud thunder claps were heard in succession like the firing of pieces of artillery of the largest calibre, and this fresh occurrence was accompanied by increased showers of dust.

From dawn of the 23rd until 10 A.M., a dim light only served to show the most melancholy spectacle. The streets which, from the rocky nature of the soil are full of inequalities and stones, appeared quite level, being covered with dust. Men, women and children were so disfigured that it was not easy to recognize anyone except by the sound of their voices or other circumstances. Houses and trees, not to be distinguished through the dust which covered them, had the most horrible appearance, yet in spite of these appalling sights, they were preferable to the darkness into which we were again plunged from after the said hour of 10, as during the preceding days.

The general distress, which had been assuaged, was renewed and although leaving the place was attended by imminent peril from the wild beasts that sallied forth from the forests and sought the towns and the high roads (as happened in the neighboring village of Conchagua and this town), into which tigers (jaguars) thrust themselves; yet another terror was superior, and more than half the inhabitants of Unión emigrated on foot, abandoning their houses, well persuaded that they should never return to them; since they prognosticated the total destruction of the town, and fled with dismay for refuge to the mountains.

At half past 3 on the morning of the 24th, the moon and a few stars were visible, as if through a curtain, and the day was clear although the sun could not be seen, since the dust continued falling, having covered the ground all around to a thickness of five inches (13 cm.).

The 25th and 26th were like the 24th, with frequent though not violent earthquakes . . . and the showers of dust lasted till the 27th.

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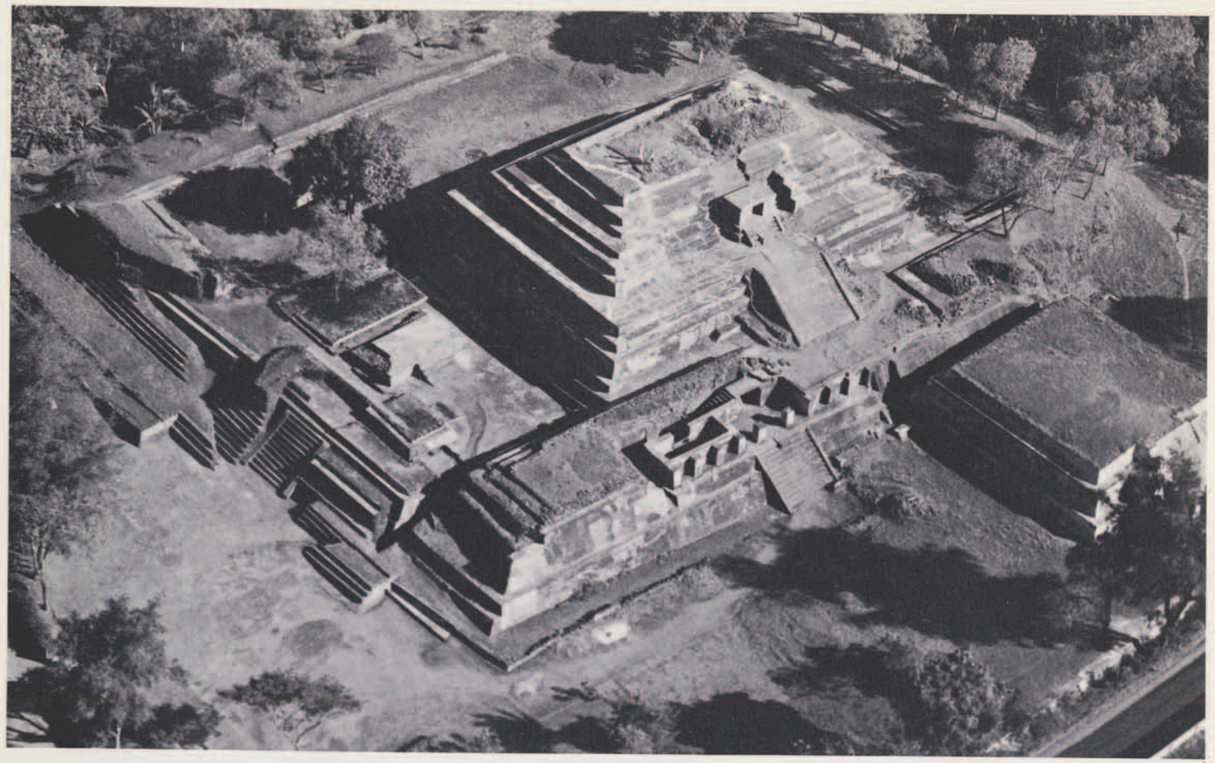
Mammiform tetrapod vessel encountered in the deposit immediately underlying the volcanic ash at Lake Cuzcachapa. Note faint lines of Usulutan decoration. Diameter, 19 cm.



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According to recent investigations by Siegfried Weber and his colleagues of the German Geological Mission in El Salvador, the source of the ash burying Protoclassic materials in that area was the eruption of Ilopango Volcano sometime between A.D. 100 and 200. What evidently happened is that such tremendous pressures built up on a very hot and gas-laden acidic magma inside Ilopango Volcano that, when the pressure was suddenly released, the magma exploded high into the air. The explosion was sufficiently violent to take a major portion of the volcanic cone with it, depositing this material as a layer of ash and pumice over the countryside. Then, the hot magmas left at the base of the volcano subsided, leaving a depression which subsequently cooled and now holds Lake Ilopango.

As one would expect, the ash and pumice deposit is extremely thick near the source, and tapers out to almost nothing at a distance of about one hundred kilometers. The prevailing surface wind direction does not seem to have had much effect in pushing the ejecta to the downwind side of the volcano. A relatively uniform distribution of materials is common with violent eruptions, evidently because the ash is blown upward through many layers of the atmosphere to as high as fifteen kilometers.

Studies of the effects of recent eruptions, such as Paricutín in Mexico, may shed much light on the repercussions of the Ilopango eruption. All vegetation, with the exception of a few large trees, is killed by ash deposition of only fifty centimeters (twenty inches). No vegetation at all survives ashfalls of over one meter in thickness. The ashfall at Chalchuapa was slightly thicker than fifty centimeters, while at San Salvador, ten kilometers west of Ilopango, the deposits are more than twelve meters (forty feet) thick. Virtually overnight, the lush, tropical vegetation of much of El Salvador must have changed into a white desert devoid of almost all life.

Animals suffer greatly under these conditions, not only from the removal of plant food, but from the breathing of the angular glassy particles of the ash. Most fish are killed when the tiny glassy shards damage their gills.

Most people would probably have survived the eruption if they were not living too close to Ilopango. However, the decimation of agricultural lands must have been extensive. It is a common misconception that volcanic ash is extremely nutritious for plants. It *can* be very fertile, but only under certain conditions. It must be chemically and mechanically weathered before its nutriments become available. Further, the lack of nitrogen in ash stifles plant growth.

Different types of volcanic ashes vary greatly in chemical composition. The darker, mafic ashes weather more rapidly and are richer in plant nutriments. The lighter colored, acidic ashes, such as that produced by Ilopango, may take as much as two hundred years before a sufficiently rich humic horizon has developed for intense agriculture.

There are a number of choices open to any human society that foresees a condition of agricultural deprivation. The actual choice taken to alleviate the condition depends on the nature of the stress, the complexity and size of the society, the agricultural technology available,

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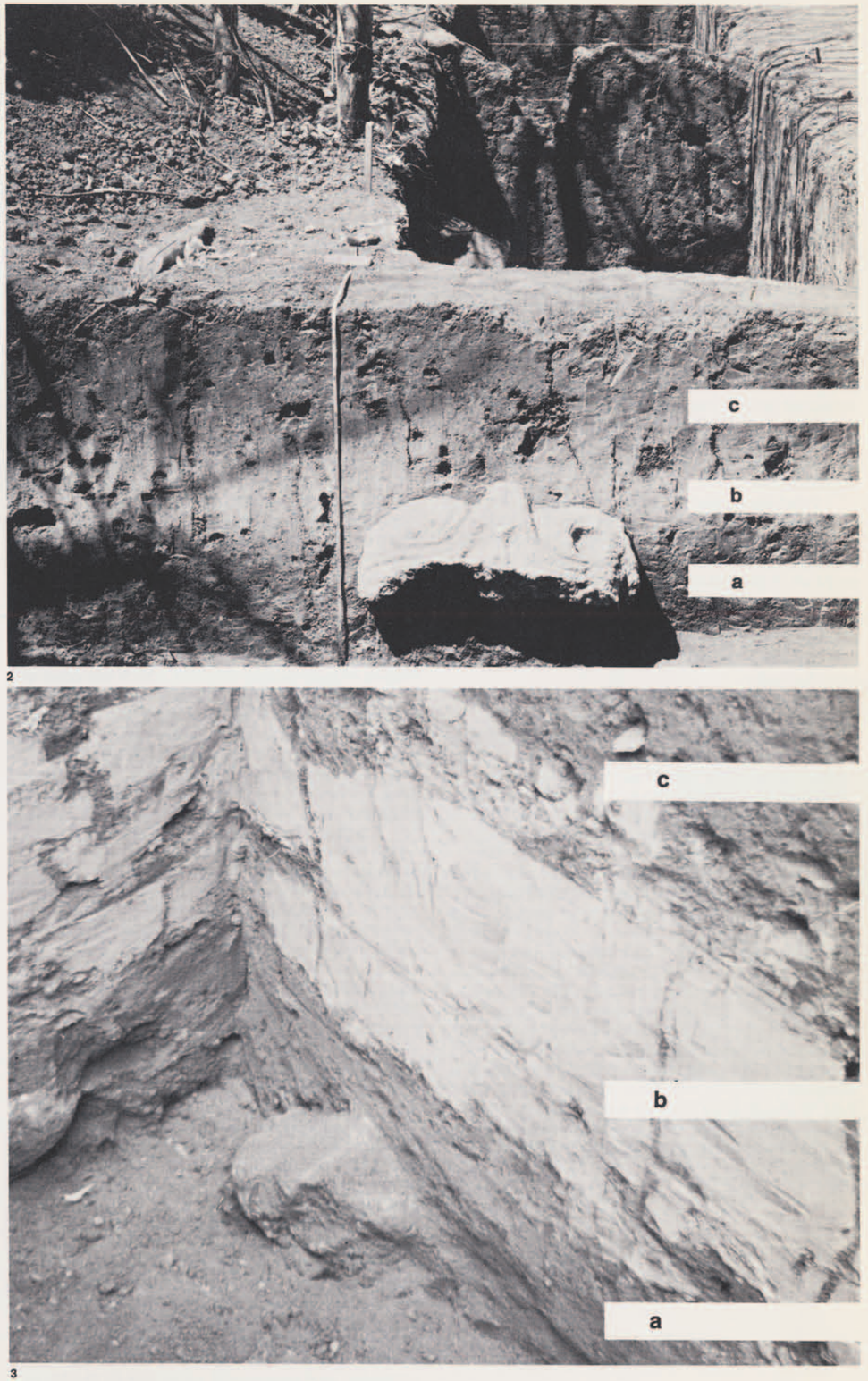
Tazumal, southernmost major structure in the Chalchuapa zone, was excavated by Stanley Boggs in the early 1940s. The Maya evidently had just begun construction here when the volcano erupted in the first or second century A.D. All of the oft-remodeled architecture visible in this aerial photograph dates to the Middle or Late Classic to Postclassic, approximately A.D. 400 to 1200.

2
The ash layer at the northernmost major structure of the Chalchuapa zone, El Trapiche. This photograph, taken during Sharer's 1967 excavations, shows the pre-eruption humic horizon (a), the volcanic ash layer (b), and the present humic horizon (c). The ash is weathered and disturbed at this location. This pyramid evidently was not remodeled after the eruption and reoccupation of the area.

3
The ash layer at Casa Blanca in the central area of the Chalchuapa zone. The humic horizon before the eruption (a), the volcanic ash (b), and the present humic horizon (c) are seen in a corner of the 1969 excavations. The ash layer, although disturbed by tree roots, is less weathered because this area was partially protected by construction during the Classic period.



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relationships with surrounding groups, and other factors. Possible solutions include (1) aggression against neighbors to increase the society's contiguous productive lands, (2) intensification of agricultural procedures to increase the yield per unit area, and (3) migration of a sufficient percentage of the society to lands outside their prior control, thereby rebalancing population size and land productivity. The Salvadorian case seems to be an extreme example of the third solution.

Given the natural propensity toward population growth in agricultural societies, at least limited competition for arable lands is common. With competition generally comes animosity, so we would not expect the beleaguered disaster victims to find ready sanctuary among adjacent peoples. Rather, they would find it expedient to migrate to a distance. We would also expect them not to migrate to an area governed by an already powerful state, where they could expect to be accepted only at the very bottom of the social hierarchy, if at all. Rather, it is far more likely that they would head for a region of lower population density and less powerful political organization.

What we do see in the archaeological record of Guatemala, Honduras, and British Honduras is the apparently sudden appearance of Protoclassic characteristics at about the same time as the eruption in Salvador. These traits appear en masse in certain areas, with scattered elements showing up in other regions, and little or no change in still other areas. The intensity of "Protoclassic impact" is not a function of distance from Salvador.

Barton Ramie, British Honduras, is the most carefully excavated site where the full Protoclassic arrived all at one time. Sharer and Gifford, the ceramicists at Chalchuapa and Barton Ramie respectively, find a virtual identity of Aguacate orange pottery from both sites, Aguacate orange being the major type-variety constituent of their respective ceramic complexes. Further, the Harvard archaeologists who excavated Barton Ramie feel there was a major population increase at this time, along with changes in burial customs and a number of other segments of culture. They proposed a migration as the most likely explanation of the Protoclassic phenomenon, but they were not able to answer the questions, where did the migration come from, and why. We now seem to be much closer to answering those questions.

The Protoclassic evidently arrived in force at a number of other lowland sites, such as Holmul, Poptun, Nohmul, and Mountain Cow, and perhaps Douglas, Pomona, and Altar de Sacrificios. However, in the already densely-settled and powerful Tikal-Uaxactun area, only scattered elements of the Protoclassic appear, evidently the result of trade.

The likely effect of such a sudden population increase on the peripheries of Lowland Maya Civilization would be an acceleration in the process of political centralization. It clearly cannot be considered a *sufficient* cause for the Maya Classic state; the University Museum's Tikal Project has amply demonstrated that the gradual rise of Lowland Maya Civilization was well underway by the time of Christ. The added population probably acted more as a catalyst in increasing the rate of political centralization, a sort of gadfly to the Maya state.

Due to the dearth of scientific excavation in the southeastern Guatemalan highlands and Honduras, we can only guess what happened in these areas. Scattered clues point toward some migration to eastern Honduras. There seems to have been little or no migration into the central or eastern Guatemalan highlands.

Given the devastation brought by the eruption, the question then becomes, what happened in Salvador after most of the survivors had left? Slopes of over twenty degrees which are covered by volcanic ash experience very rapid erosion. Therefore it would have been possible for a few people to reoccupy hilly country and begin farming exposed steep slopes in the first few years after the disaster. I doubt that many would have done so, however, particularly in areas buried by more than one meter of ash.

Certainly the broad, flat, alluvial valleys which have traditionally supported the majority of sedentary populations were rendered infertile for agriculture for a long time. Geologists have informed me that one to two hundred years may have been necessary to develop a humic horizon on the Ilopango ash sufficient for agriculture. It takes time to first chemically and mechanically weather the ash, while the first few pioneer plants, largely algae and ferns, begin the gradual process of humic soil formation.

Archaeological evidence from central and western El Salvador indicates that reoccupation, when it did come, was from the north, not from the Guatemalan highlands or central Honduras. The new occupants, perhaps Chorti or Pokomam Maya speakers, appear to be closely connected with Lowland Maya Early Classic groups. This reoccupation, at about A.D. 400 or 500, may have had a clear purpose behind it. At about this time a bold group of people from Teotihuacan, in central Mexico, took over the key site in the central Guatemalan highlands, Kaminaljuyu. It is possible that they had in mind the monopolization of the obsidian trade with the Lowland Maya, since Kaminaljuyu is located near one of the major natural outcrops of obsidian, the natural volcanic glass which was highly valued for utilitarian and ceremonial purposes by the Maya.

However, the Teotihuacanos may not have realized that another massive outcrop of obsidian is located just fifty kilometers north of Chalchuapa, at Papalhuapa, Guatemala. The architecture and artifacts of Papalhuapa, and nearby Asunción Mita and Igualtepeque, indicate that this Middle to Late Classic occupation is by peoples closely connected with the Maya lowlands. The suggestion is that some Maya were able to break the attempted Teotihuacan obsidian monopoly by obtaining their obsidian from Papalhuapa.

The above reconstruction of the nature and effects of the Ilopango eruption is part data and part speculation. It is hoped that the speculative aspects of this reconstruction will be turned into hypotheses which will be tested by an archaeological and geological project within the next few years. It is becoming increasingly clear that the eruption had widespread effects, although its severity and the duration of the depopulation of Salvador are not yet certain. We also need to know more about pre-eruption conditions, particularly the population density and nature of adaptation, so as to better estimate the number of people migrating. These and other facets of what was a major natural disaster bear further investigation •

Payson D. Sheets received his B.A. and M.A. from the University of Colorado and is working at the University of Pennsylvania towards his Ph.D. degree in Anthropology. His dissertation will be based on the University Museum excavations at Chalchuapa, El Salvador. He has done both geological and archaeological field work in Meso-America.