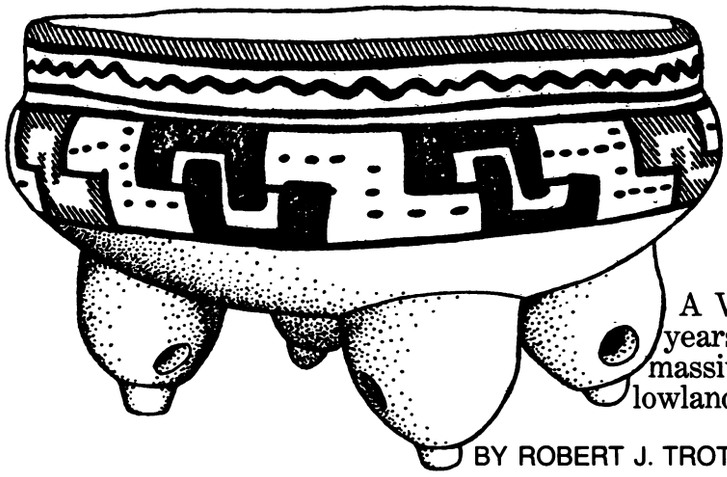


Unraveling a Mayan Mystery

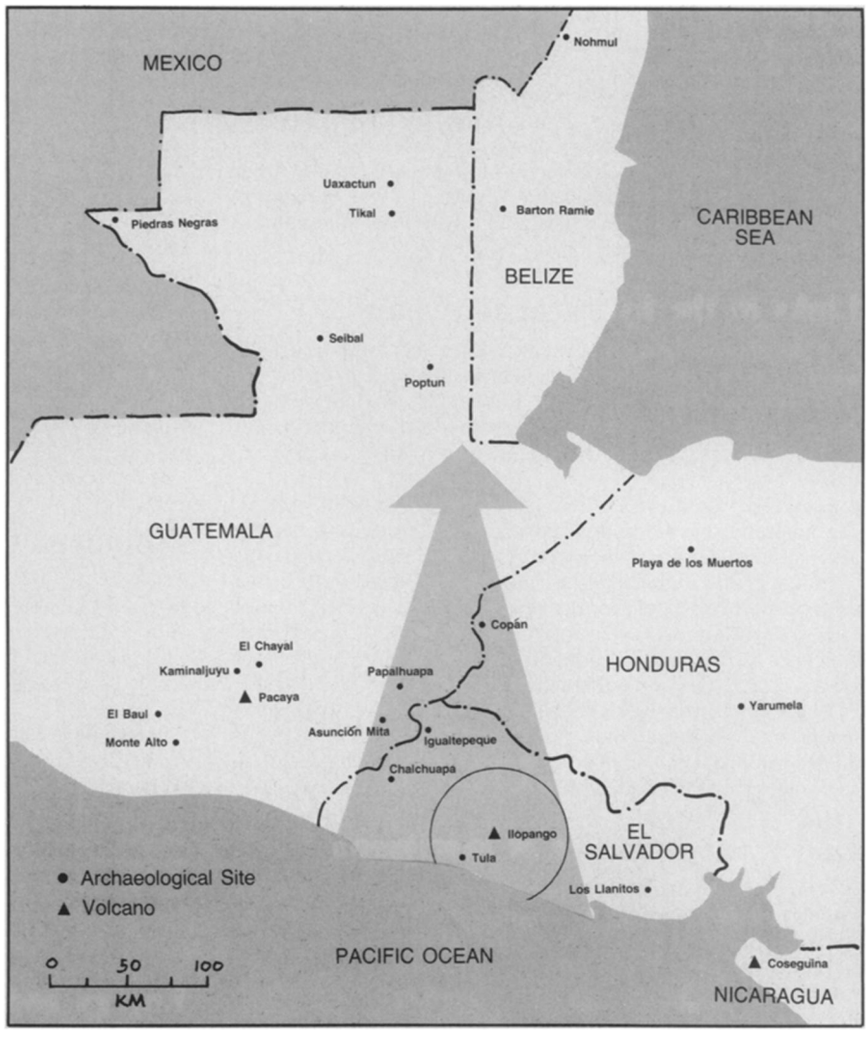
A Vesuviuslike eruption in El Salvador, 2,000 years ago, may have been the impetus for a massive migration out of the highlands and into the lowlands, the cradle of Maya civilization

BY ROBERT J. TROTTER

In the year 500, when Rome and its empire had disintegrated and when things looked dark all across Europe, a bright spot of civilization was just beginning to glow in the New World. The Maya civilization enjoyed its peak or so-called Classic period from the fourth to ninth centuries A.D. Maya intellectuals, builders, artists, astronomers and mathemeticians flourished. Maya temple pyramids, religious courts and calendar stones (stelae) dotted the landscape of southern Mesoamerica. The area known as the Maya Lowlands, where the civilization reached its height, covers parts of Guatemala, Mexico and Belize (formerly British Honduras). Although much archaeological research has been conducted and many artifacts and monuments remain, the Maya are much more of a mystery to us than the ancient Romans, and a complete history of the Maya civilization has yet to be written. Now, however, at least one of the long-standing riddles of Maya research may have been solved.

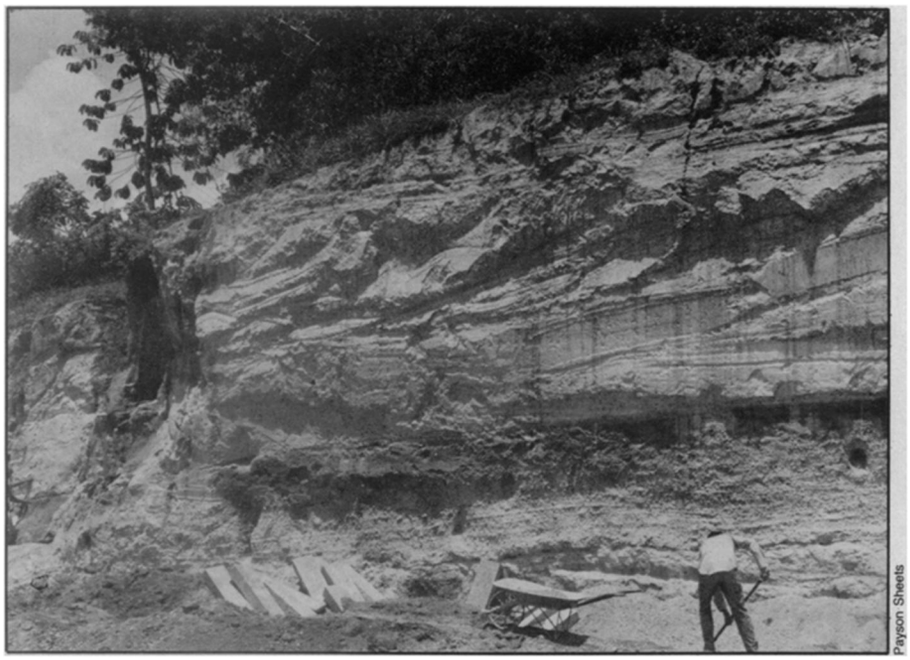
Numerous Maya excavations during the past 70 years have noted the sudden appearance of new styles of artifacts in Maya Lowland sites at about the time of Christ. What could account for such oddities in the midst of a developing civilization? Several explanations have been offered. Perhaps a new trade connection had opened up, resulting in a sudden importation of foreign goods. Perhaps a migration had occurred, with the migrants bringing in their artifacts or at least their standards regarding what their artifacts must look like and how to make them. Uncertain as to the source of the trade goods or the migrants, Mayanists have suggested two areas as the most likely: the Southeast Maya Highlands (Guatemala and El Salvador) or the Eastern Highlands (Honduras).

Research in El Salvador has now provided a clue to both aspects of the problem. Volcanic ash deposits in the highlands of El Salvador have been found to bury Preclassic Maya artifacts (the style immediately preceding the Classic Maya) similar to those found in the lowlands. It appears likely that the densely populated Southeast Maya Highlands were devastated by a massive natural disaster, a complex volcanic eruption, some 2,000 years ago. The eruption may have laid to waste several thousand square kilometers of the highlands and started a major migration toward the lowlands. Recent data on the ancient volcanic explosion and its effects on the ecology and culture of the area were described in a report to the National Science Foundation by Payson Sheets of the department of anthropology at the University of Colorado in Boulder.



Ilopango, an extinct volcano (now a lake) in the Southeast Maya Highlands, erupted 2,000 years ago, devastating a vast area and sending perhaps as many as 30,000 inhabitants northward into the Maya Lowlands (northern Guatemala and Belize).

Documenting volcanic activity in El Salvador is not difficult. A visitor there in 1855 commented that the country "comprehends more volcanoes, and has within its limits more marked results of volcanic action, than probably any other equal extent of the earth." The country is, in fact, dominated by some 20 major



Preclassic artifacts have been found beneath 9-meter-thick ashflows in El Salvador.

volcanoes, so it is not at all surprising to find artifacts buried under ash. The first such artifacts were uncovered in the 1920s, and numerous finds have been recorded since, some dating perhaps back to 1000 B.C.

One of the more recent highland excavations indicating volcanic activity is that done at Chalchuapa, which was a large ritual, trade and residential center characterized by formal groups of pyramids located on massive, artificially leveled plazas. Deposits of white volcanic ash capping Preclassic archaeological materials have been found in numerous places in Chalchuapa. Excavation (sponsored by the University of Pennsylvania Museum) showed that an architectural renovation and expansion program was interrupted by an eruption and that the city was then abandoned for some time. The inhabitants were actually in the process of surfacing (plastering with a clay-pumice mixture) one of the pyramids when the eruption occurred. Preclassic pottery from the site has been compared with and found to be extremely close stylistically to that found in Barton Ramie, Belize, and other sites in the lowlands.

The source of the volcanic activity that brought Chalchuapa to a standstill was not determined at the time of the excavation, but the eruption has been dated at sometime between A.D. 1 and 300. There is a hiatus in the archaeological data of Chalchuapa between the end of the Preclassic and the Early Mid-Classic Maya period, explains Sheets, which evidently was due to volcanic disaster. The city's desertion could have been as brief as a generation or as long as 200 or 300 years. Other investigators have concluded that Chalchuapa and the Southern Maya Highlands never recovered the prominent political and cultural position they occupied during the Preclassic.

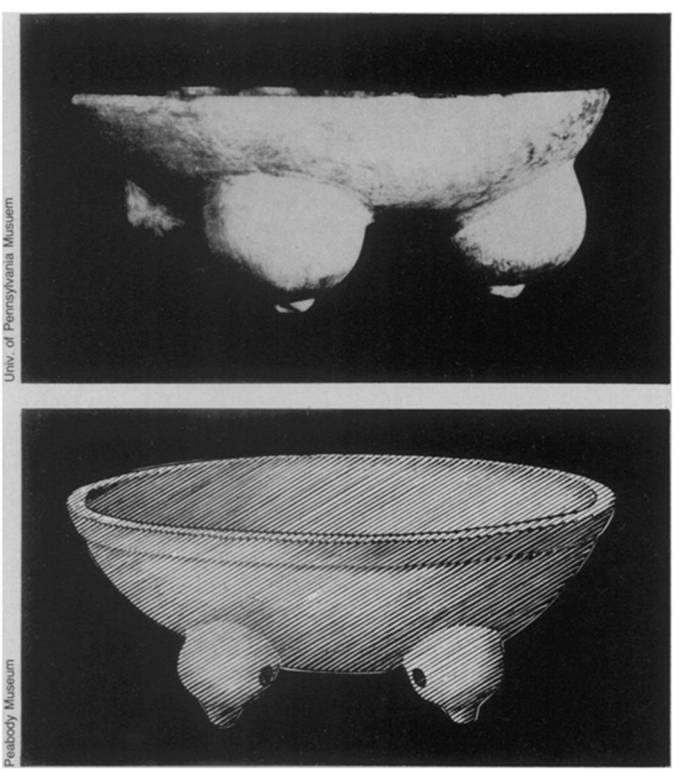
Volcanic activity almost certainly destroyed Chalchuapa, but one or even a series of small eruptions may not have been sufficient to cause a mass migration out of the highlands. One major eruption probably would have been necessary.

In order to prove the hypothesis that the introduction of Preclassic artifacts into the Maya Lowlands was directly related to a major eruption in the highlands, several questions had to be answered: Are all of the ash deposits from the same eruption, what was the total area affected, do the artifacts made just prior to the eruption in the devastated area match those that showed up in the lowlands, what was the date of the eruption, what was the population density prior to the eruption and, most importantly, was the eruption of sufficient magnitude to render a substantial area of the highlands uninhabitable for at least a generation and to cause a mass migration? Several lines of research have been applied in attempts to answer these questions.

The geological source, or sources, of the volcanic ash burying the Preclassic materials has been much debated. This ash layer, referred to locally as the "tierra blanca," has been attributed to at least three separate volcanoes, but recent work by a team of German geologists indicates that the source was the caldera of Volcan Ilopango. (A caldera is a large crater formed by volcanic explosion or by the collapse of a volcanic cone.) The German geologists found the thickest deposits of "tierra blanca" to be 50 meters near Lake Ilopango and conclude that the ash derived from a center within the Lake Ilopango depression.

Sheets and his team set out to collect archaeological materials in association with tephra (volcanic ash or pumice) deposits in the hope that the tephra could be definitely related to the Ilopango eruption. "Like an individual's fingerprint," explains Sheets, "each eruption has its own chemical identity." Samples were taken from 14 sites, and a geological analysis (conducted by Virginia Steen-McIntyre of the United States Geological Survey in Denver) showed that the tephra shroud that blanketed the Southeast Maya Highlands "is not a series of local, unre-

Continued on page 78



Mammiform tetrapod vessels from Highlands (top) and Lowlands (below): The obvious resemblance posed a problem that now seems to have been solved.

. . . Supernovas

yield values that are typical of those from hydrostatic nuclear burning late in the life of a massive star. This could mean that Cas A was a rather unusual supernova, a star whose nuclear burning had stopped before the supernova happened.

Finally there is question of supernovas and pulsars. Do supernovas leave pulsars behind? If so, in what proportion? If supernovas make pulsars, is that the only way to make pulsars? Theorists can make plausible scenarios for this or that answer, but the only observational data we have are statistical, and as Joseph Taylor of the University of Massachusetts puts it, this "direct evidence is weak." There are only two definite, completely accepted identifications of pulsars with supernova remnants, the Crab nebula and the Vela pulsars. There are many ways to explain the lack of coincidence, and Taylor's talk was devoted to examining their plausibility. It could be that most supernova remnants do not glow for very long, so that pulsars outlast them. It could be that the explosion gives the pulsar a velocity that usually shoots it out of the supernova remnant. Those are two reasons for pulsars without known supernova remnants. To explain supernova remnants without pulsars one can say that pulsars do not live very long, and there is in fact an example of a seemingly very short-lived pulsar that can be cited in support of this point, PSR 0904, which was discovered six years ago, but is no longer observable. Again one can say that pulsar emissions are too weak for us to see most of them at our distance from the supernova remnants. Another possible argument is based on the theorists' assumption that pulsar radiation is emitted in a narrow pencil beam from a spot on the rotating surface of the body. If that pencil beam doesn't cross our line of sight, we don't see the pulsar.

Many of these arguments seem plausible when examined in detail. The questions therefore remain open. What we need is to see a supernova explode and leave a pulsar behind or to see a pulsar appear by some other process, or both. And we may wait a long time for the chance of seeing either. □

. . . Maya

lated events separated in space and time, but a massive, complex eruption." As far as we presently know, continues Sheets, the eruption occurred in three stages, two ashflows (glowing avalanche) and an airfall ash. The ashflows, consisting of incandescent clouds of pumice, ash and gases, rolled downhill and buried villages and forests in their paths as far as 45 kilometers from their source. Shortly thereafter, perhaps hours to weeks, the airfall ash was deposited in a more uniform blanket over the countryside.

How would the ecology have been affected by such a calamity? Comparative geology provides some answers. Parícutin Volcano, 320 kilometers west of Mexico City, erupted in 1943 and continued active for nine years. The case of Parícutin, though a much smaller eruption than Ilopango, is fortunate for our comparison with the El Salvador eruption, says Sheets, owing to Ken Segerstrom's exhaustive study (USGS Bulletin 965A) and to the fortuitous situation of a high degree of climatic similarity between the Parícutin area and highland El Salvador.

The Mexican eruption wreaked havoc with critical human resources. Radical alterations in surface and groundwater flow were noted. Many springs either dramatically increased or decreased their flow; some new springs appeared and some old springs completely dried up. Large areas of land were deforested, along with all crops, shrubs, grasses and other plants. Plants are quite vulnerable to ashfalls, owing to smothering and structural overloading as well as to chemical attack. Animals die from inhalation and from ingestion of chemical-laden ash on plants they try to eat. Plant and animal life in both fresh and salt water is very sensitive to damage by tephra. In areas on land where plants were not killed by the actual ashfall, windblown ash, with its extremely sharp edges, has been known to "mow down" plants.

During the first year after the ashflow from Parícutin, no land covered by more than 10 centimeters of ash could be cultivated. Schemes were devised to counteract the effects of the ash, but few were successful during the next four years. It has been estimated that 200 years will be necessary to reestablish normal forest growth near Parícutin, and an even longer time period to recover from the severe erosional effects. "From this," concludes Sheets, "a 200-year devastation and abandonment of much of the Southeast Maya Highlands would not be unrealistic, in that the Ilopango ash was more damaging, more extensive and more voluminous." Virtually overnight, he says, the lush, tropical vegetation of much of El Salvador must have changed into a white desert devoid of almost all life.

Even in areas of southern Mesoamerica not directly damaged by ashfall, indirect effects may have been felt in a number of ways. Long-range floods and migrations of survivors may have been the most common repercussions, says Sheets. Extensive deposits of mud in north and central Belize and northwestern Honduras suggest that flooding did take place toward the end of the Preclassic era. Flooding in the lowlands could have been caused by ash damage to plant cover in the headwaters of the lowland rivers, resulting in increased runoff.

What happened to the people while all of this was taking place? Sheets estimates (conservatively, he says) that the environmental impact of the tephra-fall was greater than the Preclassic Mayan technological capacity to adjust and continue their agricultural adaptation over an area of 3,000 square kilometers. The density of settlement was high in the late Preclassic, because the Southeast Maya Highlands had been settled by agriculturists for more than a thousand years preceding the eruption, and archaeological evidence indicates a steady population growth throughout the Preclassic. Even so, says Sheets, if we use a minimal population density figure of 10 people per square kilometer, some 30,000 people would not have been able to continue living in the highlands. Did they actually migrate to the lowlands? Several lines of investigation suggest they did.

At Barton Ramie during the late Preclassic (between 100 B.C. and A.D. 300) a number of cultural and material events occurred at approximately the same time, and Sheets suggests that they may have been interconnected. These changes include a more than doubling of population as evidenced by a more than twofold increase in house occupations, as well as new ceramic characteristics. Among the ceramic changes several types appear (including the distinctive mammiform tetrapod vessels) that are so similar to sub-ash ceramics in El Salvador as to be indistinguishable by ceramicists working at Barton Ramie and Chalchuapa. These, as well as several other types of artifacts, all occur developmentally at Chalchuapa but suddenly at Barton Ramie.

With such evidence to go on, it appears that one intriguing question about the Maya has been answered. The fact that the lowlands received a major cultural input from the highlands in late Preclassic times does not imply that the sophisticated Classic civilization derived from the highland culture, but it does offer clues to the eventual development of one of the most highly evolved pre-Columbian civilizations. It is likely, for instance, that the sudden arrival of large numbers of people on the peripheries of the "core area" necessitated an intensification of social and political mechanisms, therefore accelerating the rate of cultural development.

"Right now," concludes Sheets, "we have the framework. We know that there was a massive natural disaster. Now we need to work out the details." Having been fascinated with the whole question for at least the past eight years, Sheets is eager to get back to El Salvador with a full team (including geologists and pollen and soil experts) in order to more completely study the ancient eruption and its effects. As these and other details are worked out, we may eventually come to know (and learn from) the ancient civilizations of the New World as we have from those of the Old World. □