where were represented. Included were four scientists from China who had quickly made plans to attend after receiving invitations from Seaborg in Peking less than a month earlier.

Most participants seemed to delight in this meeting and the chance to meet colleagues from throughout the hemisphere. A session on volcanism in Mexico and Central America was the first chance for many of the volcanologists to get together. A session on archaeoastronomy in pre-Columbian Mesoamerica was the first such meeting ever held. Sessions on nutrition and new food technology and on earthquakes and earthquake engineering ended in congratulations over their success.

Not everyone was happy with the meetings. Half a dozen or so persons from the Science for the People organization in the United States set up a small table with literature branding the conference "a perpetuation of U.S. economic and cultural expansion into Latin America." Their presence was low-keyed, however, and they made no attempt, at least during the meeting the first week, to disrupt sessions as they had at previous AAAS meetings.

One irony was that the meeting itself contained sessions related to such matters. There was an entire four-day session devoted in part to a critical examination of the role of multinational corporations in the economies of foreign nations, a timely and politically important issue in Latin America.

CONACYT's Bueno spoke out on a related matter: "Up to now, technology transferred from rich countries to poor nations . . . often has been uneven for the latter. . . . Generally, technologies have not been adapted to the standards of the developing countries. . . . Science and technology in the Third World should be used for their own interests and be independent of those followed by industralized countries. This implies the adoption of a different pattern, with little or no importance to expensive research with military goals and those devoted to encourage a consumption society."

Other sessions dealt with such important matters in Latin American countries as population, ocean resources, the development of arid land and energy for development.

In a major address to the conference, Seaborg called for putting "science and technology to work more constructively and humanely on an international scale." He suggested that AAAS might join with its sister associations of science in Latin America "to create a *true American* Association for the Advancement of Science—an association in which the term American represents a broader and true meaning."

Reiser, the current AAAS president, has also proposed such a move. He told SCIENCE NEWS he hoped the AAAS could have a special meeting in Canada in the next few years and then plan inter-American meetings every two to five years. "I think the AAAS would make a greater contribution to science if we interpreted 'American' broadly."

This and the following article and the articles on page 423 open our coverage of the meeting in Mexico City. Further reports will appear in later issues.

A calendar mosaic from 1000 B.C.

Almost two years ago Alexander Marshack's book *The Roots of Civilization* burst upon the archaeological world with its thesis, based on detailed analysis of markings on bone artifacts, that paleolithic peoples in Europe had highly developed skills of cognition and of lunar notation (SN: 2/19/72, p. 124).

Now Marshack, who is a research associate at Harvard's Peabody Museum of Archaeology and Ethnology, has turned this analytic method to a New World artifact and found that it "documents the presence of prehistoric arithmetical, geometrical and technical skills of surprisingly high order. He believes it probably represents the symbolic lunar year, perhaps a particular year in some astronomical or ritual conjunction.

Marshack's subject is a unique mosaic pendant made of precisely shaped pieces of pyrite arranged in a geometrical pattern over a ceramic base. The mosaic was excavated illegally about nine years ago from the Olmec site of Las Bocas in West Puebla, Mexico. It is now in the St. Louis Museum of Art.

The mosaic has been dated at about 1000 B.C., making it the earliest Mesoamerican mosaic excavated so far. It is the most complex mosaic to come from Mesoamerica and is, surprisingly, also one of the most complex artifacts to come from a prehistoric context.

Olmec skill in carving and sculpting

New treaty facilitates joint atomic installations

A new, 10-year treaty of atomic energy cooperation signed last week by President Nixon and Secretary Brezhnev provides for construction of jointly administered installations and greatly expanded technology and personnel exchanges between the United States and the Soviet Union.

Taking the place of a series of two-year, ad hoc agreements between the two countries, the new treaty emphasizes cooperation in the areas of controlled thermonuclear fusion, breeder reactors and fundamental particle research.

Previously, joint atomic projects have been administered solely by the Atomic Energy Commission and its Soviet counterpart, but now the National Science Foundation, the National Bureau of Standards, universities and private, nonprofit organizations will also play an active role.

AEC Chairman Dixy Lee Ray briefed newsmen in Washington on the treaty's implications, calling it a "significant milestone" in cooperation between the two countries. The magnitude and expense of conducting atomic and high-energy physics research has become too great for any one country to bear, she said, adding that joint, permanent installations, such as particle accelerators or reactors, could help ease the burden.

She was particularly optimistic about cooperation in the field of controlled thermonuclear fusion where both the United States and the Soviet Union can learn from each other's experience. "Scientific feasibility" of the fusion process may be demonstrated within a matter of months, she said, but cautioned that even with international cooperation, thermonuclear reactors would probably not go on-line until after the turn of the century.

(By "scientific feasibility" is meant the point at which more energy comes out of a controlled fusion reaction than was put into it to get it started. Several generations of successively larger-scale experiments will lie between the feasibility demonstration and a practical thermonuclear reactor.)

Laser-induced fusion research was pointedly left out of the treaty. Though some scientists believe this approach would be faster in attaining a workable fusion reactor, some of the technology involved has serious military implications and is highly classified. Some informal information exchange between American and Soviet experts in the field has taken place, however.

The Soviet Union is considered to be far ahead of the United States in some aspects of breeder reactor technology, having constructed a 600-megawatt prototype in the Urals. Ray explained that the American approach has been to conduct development in sequential steps while the Russians have tried—apparently successfully—to solve the numerous engineering problems involved while actually constructing the reactors. Britain and France also have plants in operation.

At present, 10 American and Soviet scientists are working on atomic projects in each other's country. The new treaty should increase that number by a factor of four or five. □

stone is well known, but according to Marshack precision of the kind evidenced in the mosaic has not until now been documented in prehistoric Mesoamerica.

Examination of the mosaic by low-powered microscope revealed that no two of the 325 pieces of pyrite still in place were the same size or shape. Yet they fit precisely. There is not enough space between pieces for cement or the insertion of so much as a razor's edge.

Analysis of the manner in which these pieces were put together, Marshack told the American Association for the Advancement of Science meeting on Science and Man in the Americas in Mexico City, "revealed an extraordinary arithmetical sequence and pattern."

Each two pieces meet or join along a horizontal straight line. These two, forming a unit, are then joined to another two, along a vertical straight line. These four are joined to another similarly formed set of four below, along a horizontal. This set of eight forms the basic unit of the mosaic, it is joined to a similar set of eight, and in similar ways sets of 16, 32, 64 and 128 are established. All the evidence indicates preplanning and control counting and adjustment in the inlay process, observes Marshack.

The right margin of each section of 128 divides the width of the mosaic into three precisely equal parts. The edge of the third part, unlike the others, is a curve, whose arc begins at precisely the two-third point. Reconstruction of missing pieces along the arc gives a sum for the third section of 98. The total number of pieces in the original mosaic thus totals 354. This, Marshack notes, is the number of days in 12 observational lunar months ($12 \times 29.5 = 354$).

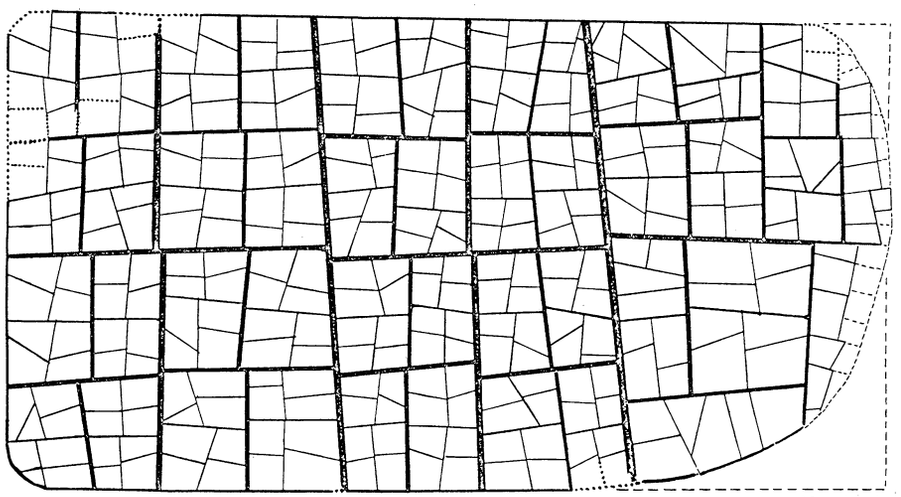
He further notes that if the third section had been a rectangle like the others, the pieces would have totaled 384. This is the number of days in an observational 13-month "long" lunar year.

Such a year of 13 moons encompasses either two solsticial or two equinoctial solar observations at an interval of 365 days.

Such a long year, Marshack suggests, could also represent the intercalary year needed to bring solar and lunar years into phase.

Study of several anomalies in the pattern, especially seven triangular-shaped pieces, produced evidence that they also are related to the lunar notation. By determining the probable sequence in which the inlays were emplaced and by numbering each piece in sequence, Marshack found that the numbers assigned to the triangles indicate particular events during the lunar year.

Three of the triangles, for instance, are numbers 60, 267 and 324. They are the days of the moon's last crescent or first invisibility following the second, ninth and eleventh lunar months.



Marshack

The 354 stones in this 3,000-year-old mosaic count the days of a lunar year.

"If the arithmetical, geometrical and sequential data here presented are calendric," states Marshack, "the Las Bocas mosaic documents a constellation of cultural skills and strategies that could be used in the maintenance of astronomical and calendric alignments, observations and notations."

Marshack's presentation provoked lively interest from the participants in the session on archaeoastronomy in pre-Columbian Mesoamerica. There were many questions about particular points of his analytical technique, but no frontal attack on his basic interpretation. Privately, however, several participants said they disagreed that the mosaic was a lunar calendar. Marshack agrees that the mosaic poses many questions.

"Where is the evidence for the development of a tradition this complex? The development of a calendar requires record keeping. Was there a pre-classic form of calendric record keeping?

"The origins of the technology and the lore supporting this highly complex piece, circa 1000 B.C., remain unknown." □

Hollister quake expected imminently

Stanford University geophysicist Robert Kovach has ventured the most precise scientific earthquake prediction yet, by telling colleagues at the San Andreas Fault Conference at Stanford last week that a 5.8 magnitude quake can be expected "in the next two weeks" near Hollister, Calif.

Kovach's expectation—he dislikes the word "prediction"—follows the announcement in March by a U.S. Geological Survey team that a moderate (4.0-5.0 on the Richter scale) quake was probable in the region within a few months (SN: 3/31/73, p. 207). That prediction resulted from observation of increasing numbers of tiny "microquakes" around Hollister.

Kovach bases his guess on the theory of "dilatancy," which has recently attracted much attention among earthquake watchers (SN: 4/21/73, p. 255). According to this theory, abrupt changes in the level of groundwater should just precede a quake. Though the process by which this takes place is not fully understood, some geophysicists suggest that shattering of rocks at the strain center of a fault increases their porosity (dilatancy). The groundwater level lowers at first due to the increased volume, but slowly rises again to its old level. This, in turn, may lubricate the fault, allowing it to slip.

Kovach and his associates have been monitoring the water level in a 600-foot well near a winery south of Hollister for two years. On Sept. 1, 1972 the water level began to drop and took until June 1, 1973 to return to its normal level. The longer this period, the larger the quake, according to dilatancy theory, so from the 280-day duration, Kovach estimates the strength of the expected quake to be around 5.8 on the Richter scale, somewhat larger than that predicted by the Geological Survey Team.

(Energy release from a quake increases 30-fold for each point on the scale. A 5.6 Richter quake in Hollister in 1961 damaged the courthouse badly enough so that it had to be replaced.)

Kovach said his measurements will constitute an "interesting test" of the dilatancy theory, and may have prepared the 8,500 residents of Hollister for what he calls "a healthy jolt." □