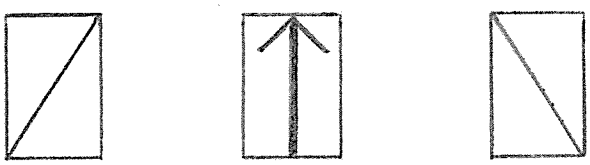
A PRELIMINARY STUDY OF THE POSSIBLE ASTRONOMICAL ALIGNMENT OF "EL OBSERVATORIO," ISLA MUJERES, QUINTANA ROO, MEXICO



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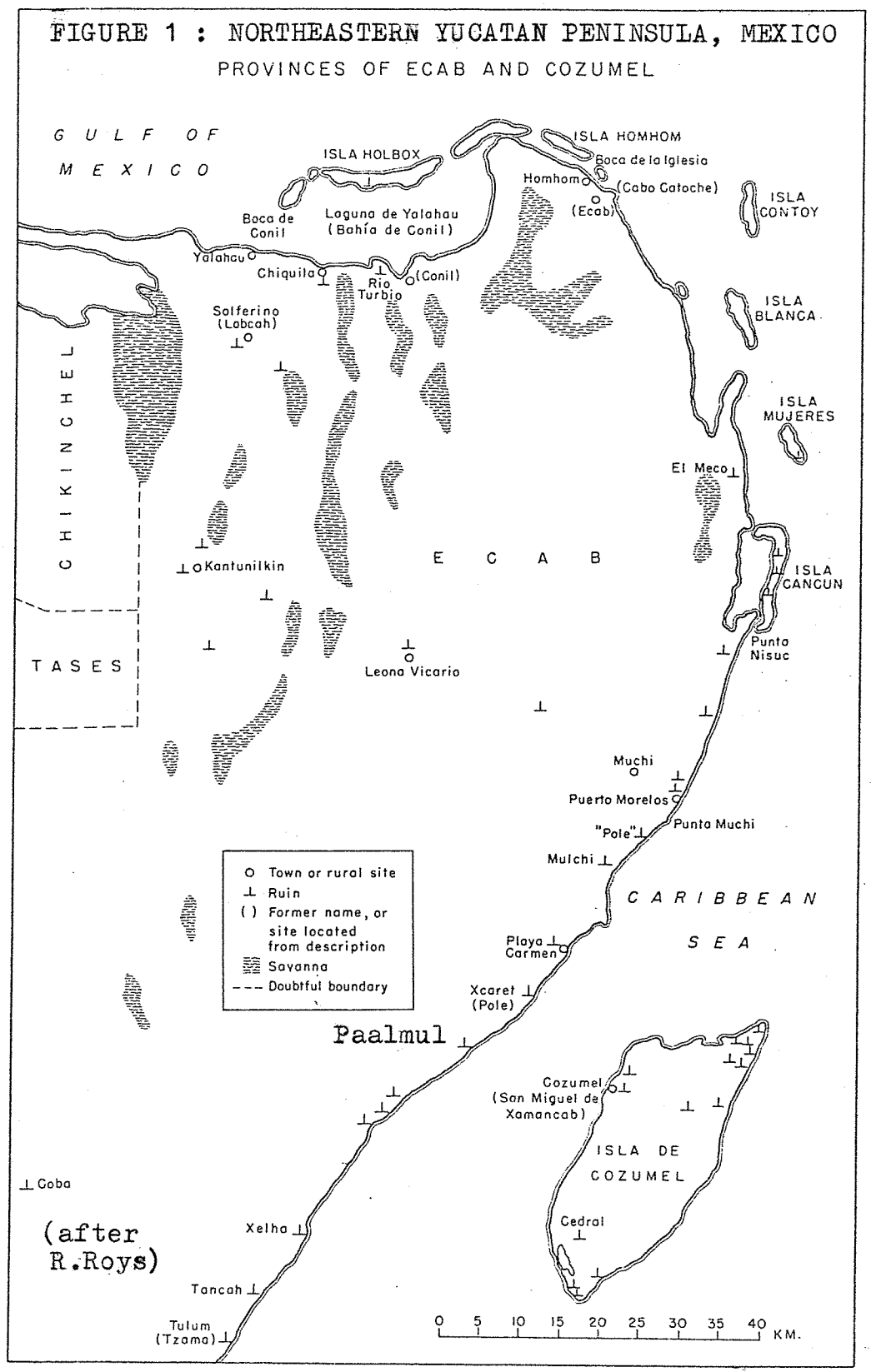


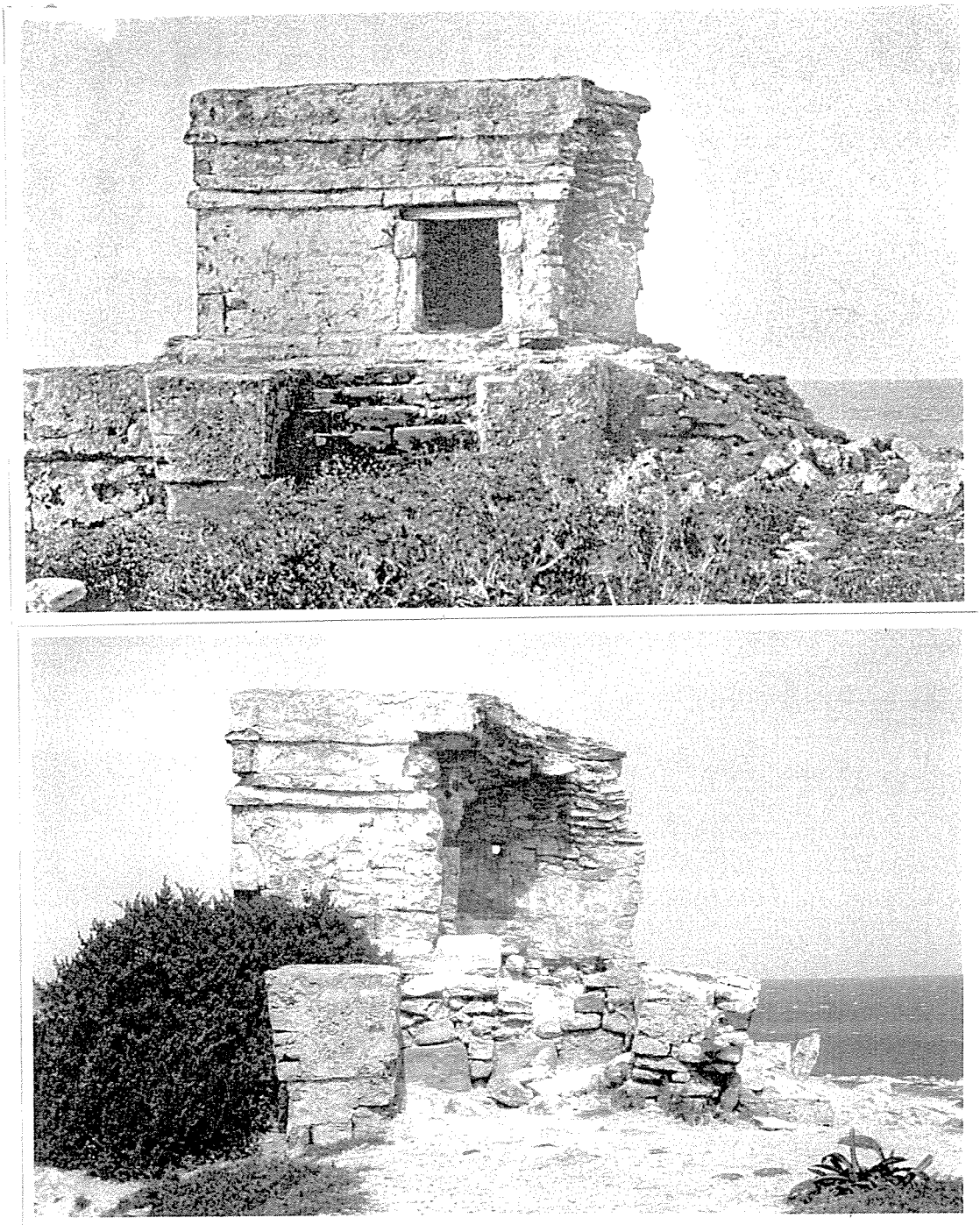
FIGURE 1 : NORTHEASTERN YUCATAN PENINSULA, MEXICO
PROVINCES OF ECAB AND COZUMEL
GULF OF MEXICO
ISLA HOLBOX
ISLA HOMHOM
Boca de la Iglesia
Homhom
(Cabo Catoche)
(Ecab)
ISLA CONTOY
Boca de Conil
Laguna de Yalahau (Bahía de Conil)
Yalahau
Chiquila
Rio Turbio
(Conil)
Solferino (Labcah)
ISLA BLANCA
CHIKINCHEL
ISLA MUJERES
El Meco
Kantunilkin
E C A B
ISLA CANCUN
Punta Nisuc
TASES
Leona Vicario
Muchi
Puerto Morelos
"Pole"
Punta Muchi
Mulchi
C A R I B B E A N
S E A
Playa Carmen
Xcaret (Pole)
Paalmul
Cozumel (San Miguel de Xamancab)
ISLA DE COZUMEL
Cedral
Coba
(after R.Roys)
Xelha
Tancah
Tulum (Tzama)
Town or rural site
Ruin
( ) Former name, or site located from description
Savanna
Doubtful boundary
0 5 10 15 20 25 30 35 40 KM.

A PRELIMINARY STUDY OF THE POSSIBLE ASTRONOMICAL ALIGNMENT OF "EL OBSERVATORIO," ISLA MUJERES, QUINTANA ROO, MÉXICO

The lone structure of Maya origin which remains standing on Isla Mujeres, located off the Yucatán coast as shown in figure 1, was visited in January, 1979. The purpose of the study was to seek to determine if the building popularly known as "El Observatorio" deserves such a title. The origin of this name is unknown to the author, although, to be sure, the "Observatory" is situated dramatically, commanding a fine unobstructed view of more than 270° of the horizon. Given the Maya propensity for aligning their buildings to important positions in the cycles of the heavenly bodies (Ricketson, 1928; Aveni, 1978), however, the preliminary field research reported here was designed to determine whether the structure could have been used as an astronomical observatory.

Sanders' (1960:218) Quintana Roo Maya architectural typology provides an excellent description of "El Observatorio": "The second type of site consists of an isolated shrine, including one or two temples..., situated within a few hundred meters of a beach or on a rocky headlands... overlooking the sea." The Isla Mujeres temple is precariously perched on a narrow promontory at the island's extreme southern tip some fifty or sixty feet above the sea. Figure 2 illustrates the extent of what the Caribbean is doing to the temple and the coralline limestone formation upon which it rests. Granting proof to the sound

FIGURE 2

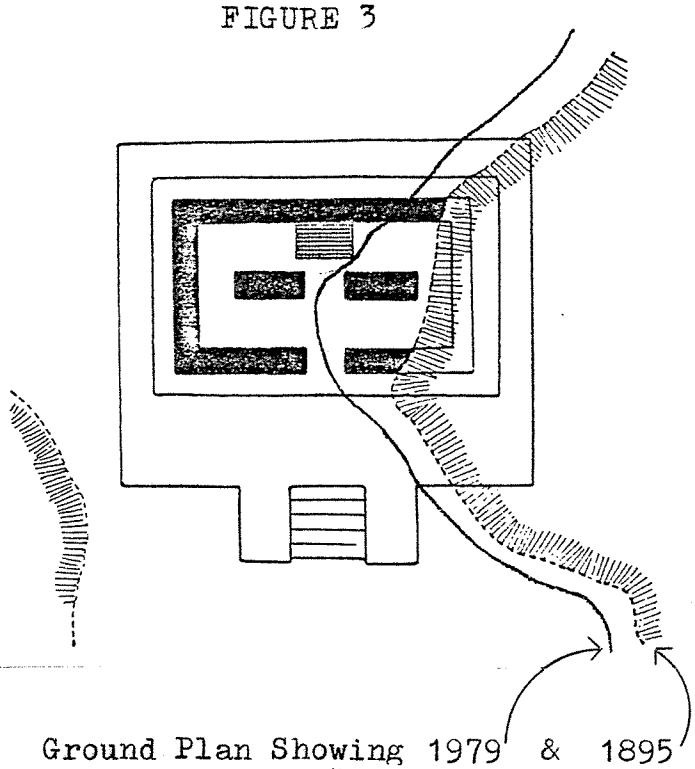


"El Observatorio": 1895 (above - Holmes)
1979 (below - Sletteland)

archeological assumption that the building's original plan was symmetrical (Holmes, 1895), the top photograph, taken by Holmes, shows it one-third destroyed, while the bottom photo, taken by the present author 84 years later, shows it halfway fallen into the sea. Figure 3 makes this same comparison by updating Holmes' ground plan to the present. His prediction (1895:60) that "it does not seem unlikely that one hundred years from now the ruin and the whole point beyond it will have forever disappeared from view" seems at present to have fallen perhaps only a few decades short of the mark.

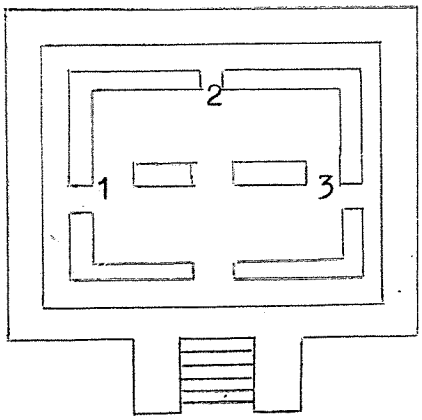
The archeological record provides scant data upon which to base hypotheses about the activities in which the Maya were engaged at this site. The subsistence strategy of the island's inhabitants no doubt involved a primary reliance upon seafood. They also likely entered into a Mesoamerican trade network where salt, which was still being exploited there by the Maya in 1549, and other products of the sea were traded for jade and igneous rocks such as obsidian. This network, then, provided not only the utilitarian goods such as manos, metates, and knives needed for survival by all members of the society, but also luxury goods needed by the elite to enhance their prestige (Thompson, 1970; Roys, 1957:145). Astronomical knowledge was a non-material commodity to which great power was attached in the Maya theocracy, and it is to the possibility of finding evidence of this in the ancient architecture of Isla Mujeres that this paper will now be addressed.

FIGURE 3



Ground Plan Showing 1979 & 1895 Destruction of "El Observatorio," (After Holmes)

FIGURE 5



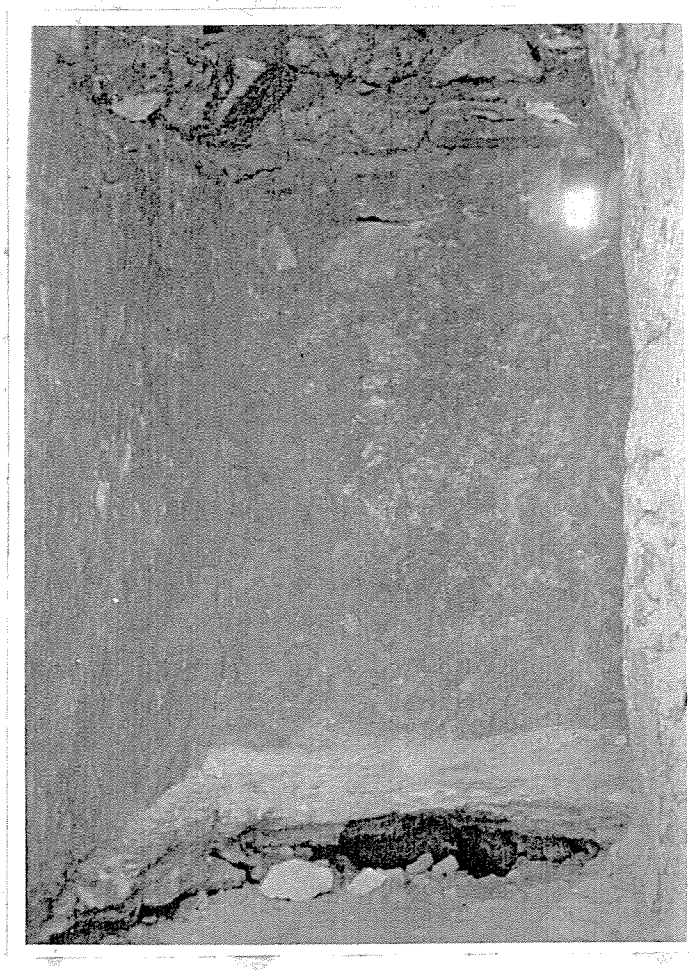
Plan of Proposed Reconstruction of "El Observatorio" ; 1 and 2: existing windows , 3: proposed location of additional window.

Measurements were made of the orientations of the temple's windows with a Brunton Pocket Transit. Figure 4 illustrates window 1, which measures approximately 8 inches in length by 6 inches in width by 3 feet in depth, and window 2, which is greater than window 1 by 2 inches in length, but otherwise roughly identical in its dimensions. Several readings were taken of the orientations of each line of sight and their mean reading was then computed. Although archeological excavation of the site has been done by Le Plongeon (Salisbury, 1877) and possibly Martínez Cantón (1920), there is no evidence of any stabilization or reconstruction of the temple which would alter these measurements from their original directions.

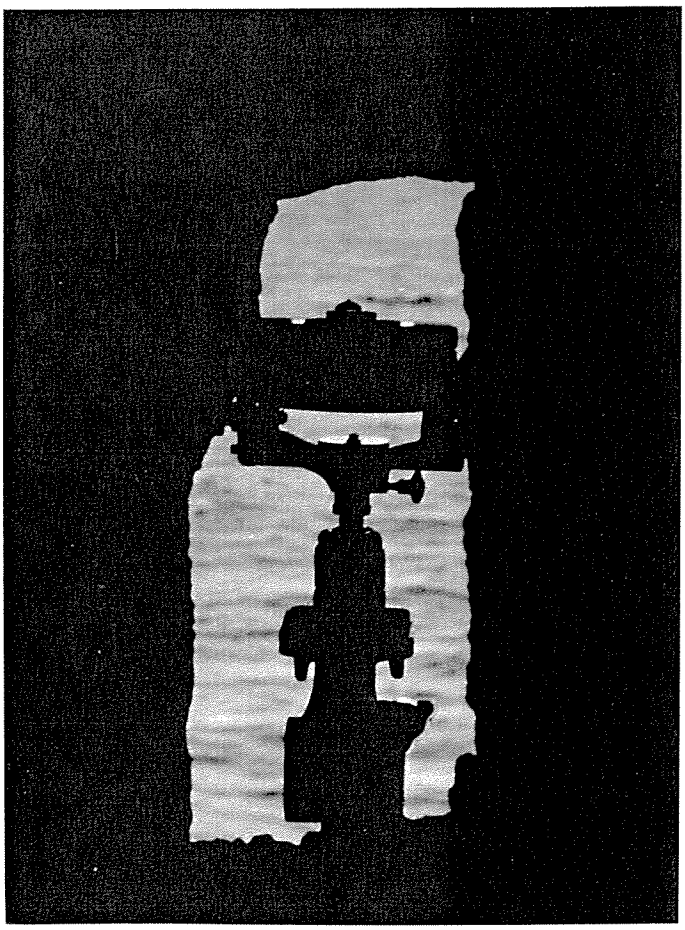
The lines of sight established fall into two categories: views taken directly and views taken diagonally through the windows. Lines were sighted in the first category along the window's left and right edges, inside to outside, and through the approximate centers of the windows, in the same direction. The compass position for the center window reading is shown in figure 4b, next page. Those lines established by the window sides were parallel to this center line 3 inches in either direction. Lines in the second category, taken diagonally from the edge of an inside window jamb to the horizon along the edge of the opposite outside jamb, included only the inside left to outside right views. The inside right to outside left line was not used for window 1 since an interior beam interfered with setting up the instrument and for window 2 since the resulting view was of the island itself and thus did not permit the unobstructed sight to the horizon allowed by the other lines.

FIGURE 4

a



b



"El Observatorio" Window 1

Table 1 presents the averaged orientations recorded, along with possible astronomical alignment correlations. Due to methodological considerations, it was decided to adopt a very wide error tolerance of 3^{o} for the purposes of this preliminary discussion: a combination of a small local magnetic declination variation and an insufficiently accurate magnetic compass reading could easily add up to an error of this magnitude, and this fact should sound a warning to those considering the use of a compass in archeoastronomical studies. Although the magnetic compass is convenient in providing "ballpark" orientation estimates for early hypothesis formation, it is clearly no substitute for a surveyor's transit when a final product is being sought.

Bearing this caveat in mind, we may now proceed with the discussion of the possible astronomical alignment of "El Observatorio." A wide range of solar, lunar, and stellar orientations are or may be present there and may have been alignments intended by the Maya of Late Classic times.

The line of sight through the inside left to outside right jambs of window 1 is well within a degree of azimuth of the setting point of Sirius in AD 750. Sirius is not only the brightest star in the sky (magnitude -1.58), but the present day Lacandon Maya single it out as a "large species of woodpecker". (Bruce, et al, 1971). Based on studies elsewhere in Mesoamerica, Dow (1967) has suggested the possibility that Teotihuacan was built to face the rising point of Sirius

TABLE 1: "EL OBSERVATORIO" WINDOW ORIENTATIONS AND POSSIBLE ASTRONOMICAL ALIGNMENTS

Alignment[1]	Orientation[2]	Closest Astronomical Event[3]	Error[4]
DIRECT			
Window 1	247½°	Moonset, lower tangent, at S extreme, minor standstill	2°
		Sunset, lower tangent, at winter solstice	2°
Window 2	342½°	Capella set	24°
Window 3	67½°	Sunrise, first gleam, at zenith passage	½°
		Moonrise, bisected, at N extreme, minor standstill	2½°
		Sunrise, first gleam, at summer solstice	3°
II-OR[5]			
Window 1	254°	Sirius set	½°
Window 2	351½°	Capella set	33°
Window 3	74°	Aldebaran rise	2°

[1]Windows 1 and 2 existed as of January, 1979; Window 3 did not, and its orientations are merely postulated as the exact opposites of Window 1's.

[2]The magnetic declination at Isla Mujeres (Lat 21°25'N, Long 86°53'W) during January, 1979 was 2° 45'E (National Geophysical and Solar-Terrestial Data Center, personal communication); 3° was added to the compass measurements in arriving at these orientations, which represent rough approximations, given to the nearest ½°.

[3]Values taken from Aveni's (1972) tables for latitudes 21° N and 22°N, horizon altitude 0°, interpolated for AD 750. (Due to the height of the temple above sea level, the distance to the mainland, and the flat topography and vegetation of the local horizon, the altitude correction is negligible.)

[4]The error is the azimuth difference between the orientation and the position of the horizon phenomenon.

[5]The Inside Left to Outside Right diagonal sight lines produced by opposite window jambs were measured with uncertain confidence in the results, since the depth establishing them is only about a meter (Hartung, personal communication).

and Aveni (1975) noted that Building O at Caballito Blanco points to the set position of the same "dog" star. The above notwithstanding, see Table 1, footnote 5.

An azimuth of 247½° was recorded for the view perpendicular to the plane of window 1, which faces the mainland of Quintana Roo four miles distant. This orientation to the local horizon falls almost exactly midway between the points of the winter solstice sunset and the southern extreme moonset at minor standstill. The existence of possible solar observatories has been documented at cities and villages that existed throughout the Pre-Columbian Americas. In the Maya area, possible solstice and/or equinox alignments have been proposed for Uaxactún (Ricketson, 1928), Chichén Itzá (Ruppert, 1935), Copan (Fuson, 1969), Uxmal (Aveni, 1975), and Tikal (Hartung, 1975). The same possibilities exist for a host of lesser Maya sites, including "El Observatorio."

Since possible lunar alignments have been rarely noted (Aveni, 1975; Aveni and Hartung, 1978) in the literature of Maya astronomy, and since, as will be shown, a major concern with the moon seems to have been a likely feature of East Coast Maya astronomy, particular attention will now be focused on the possibility that the Isla Mujeres temple was built to function as a lunar observatory. Among the arguments that may be advanced in support of this hypothesis, the first is that a culture which was involved in both maritime and land subsistence could be expected to have recorded contrasting astronomical data within the contexts of the differing subsistence strategies and associated settlement patterns. If the coastal Maya

associated the moon with the sea; lunar alignments, glyphs, or iconographic motifs might provide evidence of this association in the same way that they attest to the importance of the sun in inland Maya culture. Moreover, few Maya sites of the isolated shrine type have been tested for possible astronomical alignments.

Among the Yucatec Maya, the goddess of medicine, childbirth, and divination was Ix Chel. Based on ethnohistoric and ethnographic data, Thompson (1939:133) concluded that "one would expect a lunar deity to have been the patroness of generation and birth, particularly in view of the lunar association of menstruation." "It is (also) known from ethnohistoric accounts that Ix Chel, the goddess of the moon, childbirth, procreation, and medicine, was an important deity for the East Coast Maya" (Miller, 1974:46). Landa (1938) observed that pilgrims worshipped at her shrine on Cozumel, an island about 65 miles south of Mujeres along the coast. The conquerer of México, Hernando Cortés, named the point of his landfall in 1519 after the ceramic female figurines he found at "El Observatorio," and Miller (1974:47) has referred to Mujeres as "the island of the Ix Chel idols."

Another conceivable motive for the placement of window 1 in such a way as to permit calibration of the 18.61 year lunar standstill cycle has to do with the well documented Maya preoccupation with eclipse prediction. (Martínez Hernández, 1930; Makemson, 1943; Smiley, 1975; Spinden, 1930). Since the maximum positive displacement of the moon's inclination perturbation occurs during eclipse seasons and can only be

observed at a lunar standstill (Krupp, 1978:31), observation of the standstill cycle could have contributed to or corroborated the calculations of the Maya solar and lunar eclipse calendars. What Aveni, Gibbs, and Hartung (1975:977) said in their discussion of the Caracol at Chichén Itzá could as well apply here: "The flat Yucatecan landscape, free of natural horizon markers for charting the course of the setting sun, moon, and stars, would render sight lines taken through a permanent man-made structure a likely way of keeping a calendar... to warn the population of impending events of religious, civil, or agricultural importance".

There is a link between the cult of Ix Chel and the occurrence of eclipses which is interesting to note. The ethnographic record states that for the Chorti Maya of the highlands, "the moon deity is the patroness of childbirth" and further that "she is said to lose partially her powers of fecundity during an eclipse, for which reason women fear an eclipse during pregnancy" (Wisdom, 1940:400). Pregnant women are known to have consulted the famous idol of Ix Chel on Cozumel (Miller, 1974). It is thus possible that Ix Chel was thought by the ancient Maya to control or at least influence both the possibilities of eclipse and the conditions of pregnancy, as that knowledge of eclipses could have been used to safeguard the lives of those giving birth and being born. Precise knowledge of the lunar cycle by the Maya can be theoretically viewed as an adaptation which was consciously designed to ensure cultural renewal and continuity.

In his discussion of the significance of Tulum and the east coast in relation to Palenque and the west as symbols of birth (or rebirth) and death within the Maya empire, Miller (1974:47) found it fitting that the lunar association of Ix Chel seemed most important in the eastern area of the realm, "where the moon rises and appears to be born (or reborn) out of the eastern sea." As a test of lunar alignment hypothesis of window 1, keeping in mind the association of the moon, the east, and birth, one would expect to find a corresponding moonrise standstill alignment through a window in the east wall of "El Observatorio". The wall, of course, was long ago claimed by the sea, but the observer, lining his sight directly through window 1, from the outside in, is now free to view the position of the maximum northerly first gleam of moonrise at minor standstill within 2½° of arc. Taking into account the orderly, symmetrical, and precise nature of the Maya architecture, would it be taking too much for granted to assume that the opposite east and west walls and windows of the temple were parallel? The same assumption was made by Ruppert (1935:234) in his reconstruction of the Caracol at Chichén Itzá, where preexisting windows were postulated in positions exactly opposite those that remained. Hartung (personal communication) is "inclined to suppose a formerly existing similar window in the opposite east wall" of "El Observatorio." Figure 5 (on page 5) shows the hypothetical location of window 3, which could have been placed anywhere along the east temple wall and still have produced the same orientations.

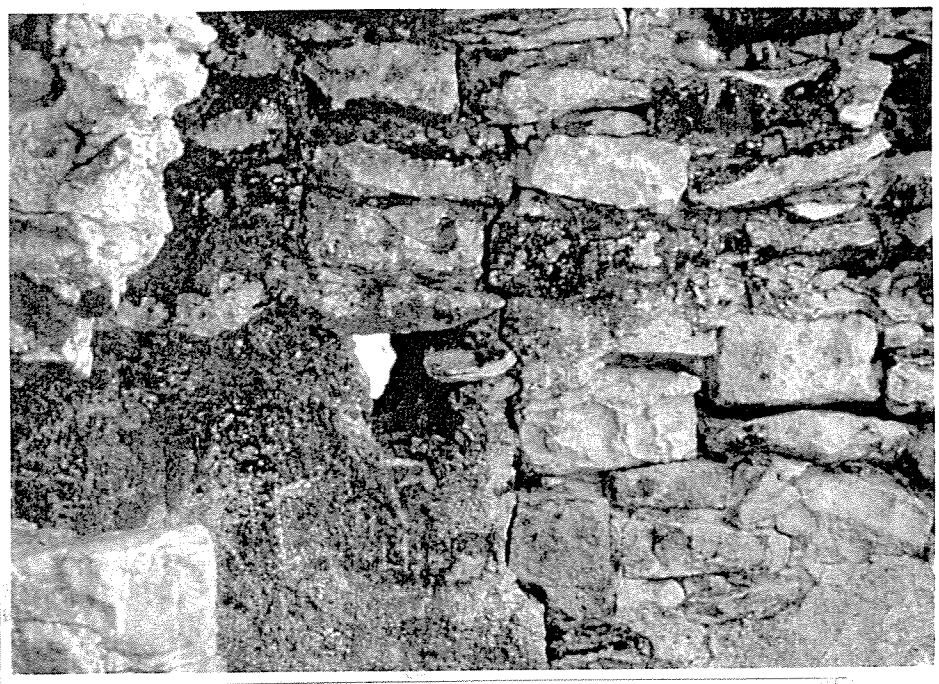
Other alignment possibilities exist for the postulated window 3, however. Aldebaran rose within 2^{o} of what may have been the line from the inside left to outside right window jamb. Although an intentional alignment of the brilliant red first-magnitude star cannot be ruled out, the historical and archaeological data do not provide much support.

The line perpendicular to window 3, as suggested, would also have struck within a degree of the point of first gleam of sunrise on the day the sun passed through the local zenith... The importance to the Maya of the position of sunrise on the days of its zenith passage has been documented ethnographically (Stephens, 1963; Girard, 1966), and postulated on the basis of archaeoastronomical evidence as well (Aveni et al, 1975; Aveni and Hartung, 1976). Since Isla Mujeres is located little more than 2^{o} south of the Tropic of Cancer, there is less than 3^{o} of the local horizon separating the points of sunrise on the days of the solar zenith passages and the summer solstice. Thus, although the zenithal sun is the better fit, the solstitial sun is also within the realm of possibilities.

All of the above arguments for the intention astronomical alignments of window 1 notwithstanding, the problem of the nonalignment of window 2 with key positions of the sun, moon planets or 20 brightest stars must be mentioned. The averaged value of the line of sight straight through window 2 is azimuth 342.5^{o}. Whether these apertures can even be considered as windows is open to question. Lothrop (1924:32), in his survey of the ancient Maya architecture of eastern Yucatán, notes the presence of windows in almost every building, describing them as "small

FIGURE 4

c



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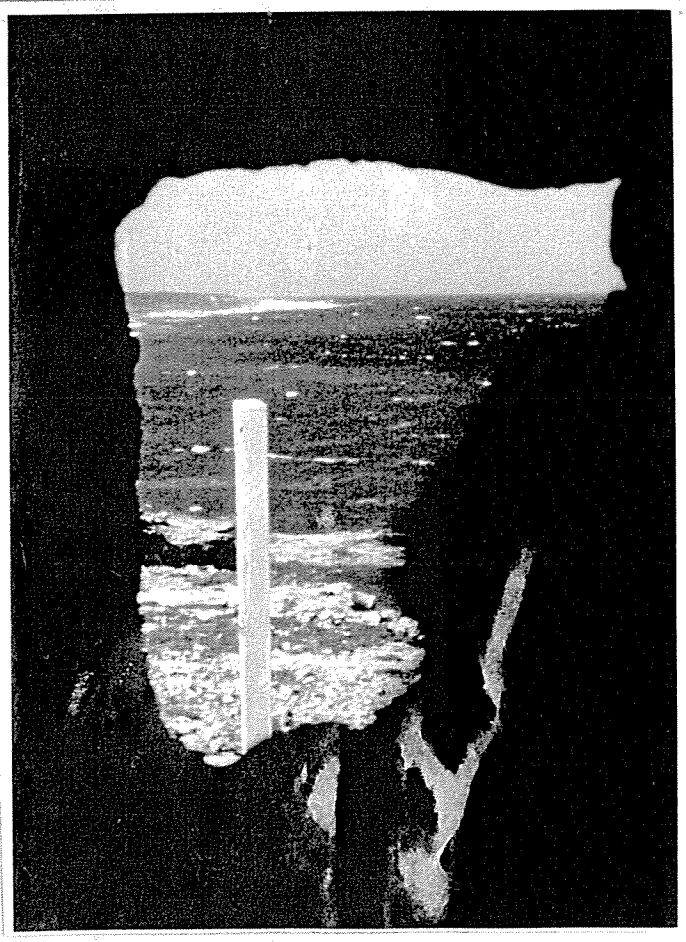


"El Observatorio" Window 2

rectangular openings, usually about 6 inches square." That they are a common East Coast Maya architectural feature underscores the need for the orientations of these windows to be tested for possible astronomical alignments. The windows in the Isla Mujeres temple walls fit Lothrop's description, but Holmes' (1895:62) report on his work there speaks of "small rude openings" and "holes in the wall". Clearly, neither of the windows could have let much light into the temple, as the openings are small and the walls some three feet thick. The possibility that they could have been used to let in air, however, has been proposed by an engineer (L. Roys, 1934:48) who also noted the frequent occurrence of the "small window or ventilator" openings he saw in the Deer House at Chichén Itzá as a common feature of Maya architecture throughout Yucatán. The hypothesis that window 2 was used to ventilate the Isla Mjueres temple receives support from two further bits of evidence.

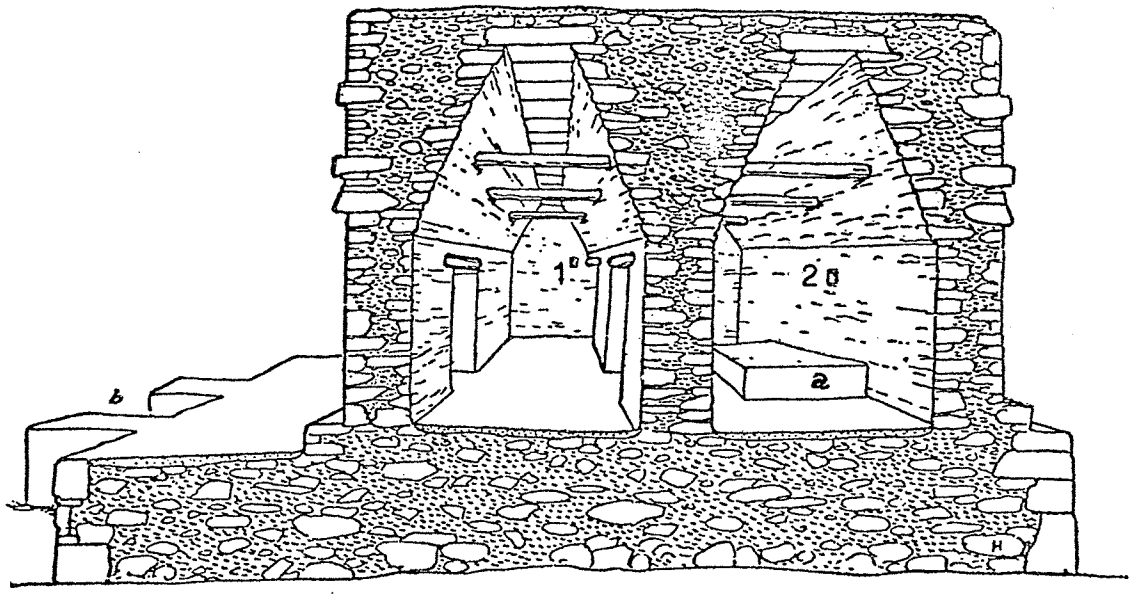
Explorers from Cortés (Díaz del Castillo, 1956), through Stephens (1963), down to the present day have noted the presence of strong winds in their sails in the immediate area; indeed, the island's harbor of Dolores served as a stronghold of the pirate Lafitte. Frequent fresh breezes from the northeast, which blow through window 2, were noted by Landa (1978). Easterly winds are also frequent along the coast, but westerlies, which would permit use of window 1 for air intake, were noted by the author neither during his ten days in the area nor anywhere in the literature. The size of window 2 and thickness of the wall serve to regulate the volume of air needed for the purpose of ventilation.

The altar which rests squarely beneath window 2 (see figure 6) is a feature commonly found against the back walls of Quintana Roo coastal Maya temples (Lothrop, 1924:32). Since the burning of incense was noted by Landa (1978) in virtually all of his descriptions of the festivals of the Yucatecan calendar, it is fair to assume that copal was burned on this altar, the smoke from which the breeze through the window above would have served to disperse. A further description is given by Landa (p. 72) of the Maya priests, during the festival of Ix Chel, offering incense to the goddess, with the physicians and sorcerers carrying small idols made in her image. Furthermore, the use of the isolated shrine, in Sanders' (1960) opinion, was probably for traveling merchants or fishermen, and "even travelers carried incense with them," praying to Ekchuah, the recognized god of the merchants and "so called" North Star god," that he bring them safely back home" (Landa, 1978:46 and translator's note).

The arguments for possible uses of the best preserved ancient structure on Isla Mujeres having been made, it remains only to suggest some courses for further study and action.

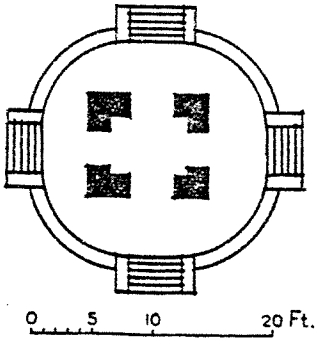
Díaz del Castillo (1956:47) tells us that the 1519 expedition of Cortés counted a group of four temples on Isla Mujeres. The next description we have of the site, given by Stephens in 1834, mentions only two. The plan of this second building is given in figure 7. No compass readings could be taken from what remains of this temple and this is particularly unfortunate

FIGURE 6



Section View of "El Observatorio" from ENE
(After Holmes) Windows: 1&2 Altar: a

FIGURE 7



Ground Plan,
Temple 2
(After Lothrop)

in view of its circular plan, which places it in a special assemblage of Maya structures. Last year Aveni suggested that it "appears that the Maya, in attempting to extend their calendar to remote regions of the Yucatan peninsula established a network of astronomical observatories. Round structures reported in other parts of Mesoamerica should be carefully measured and examined in order to determine how widespread this practice became" (1978:142). This suggestion could be expanded to include circular substructures in the same part of Mesoamerica, along the Quintana Roo coast at Isla Mujeres, Tancah, Tulum, Xelhá, on Cozumel at Santo Tomás, and inland at Kantunil Kin. In the case of at least Isla Mujeres, the measurements of the orientations of the square temple built upon a circular substructure will likely require archeological excavation.

Of greater importance to the expansion of what is known about the subject of this paper, it is hoped that the modest research reported here will also stimulate an interest in the study of other isolated Maya shrines for possible lunar and other astronomical alignments. The author plans to enlarge the scope and significance of the present study by undertaking further closely related work in Quintana Roo during 1980. In conclusion, a plea must be made to the Mexican government and anthropological community for the preservation of what remains of this dramatically beautiful and in some ways important Classic Maya site. Of course it cannot be compared in size to Cobá nor in the precision of its construction to Uxmal, but what it lacks in these areas is compensated for by the larger than life quality of its setting, into which it is as artfully integrated as the

temples of Palenque or Copan, and more agreeably, in the author's opinion, than those of Tulum or any other Maya temples along the sea that he has seen. It is the ultimate irony of "El Observatorio" that the very harmony with which it reflects a rare Maya acceptance of man's dominance by the earthly forces of nature is threatened with extinction by the angry Caribbean Sea.

ACKNOWLEDGEMENTS

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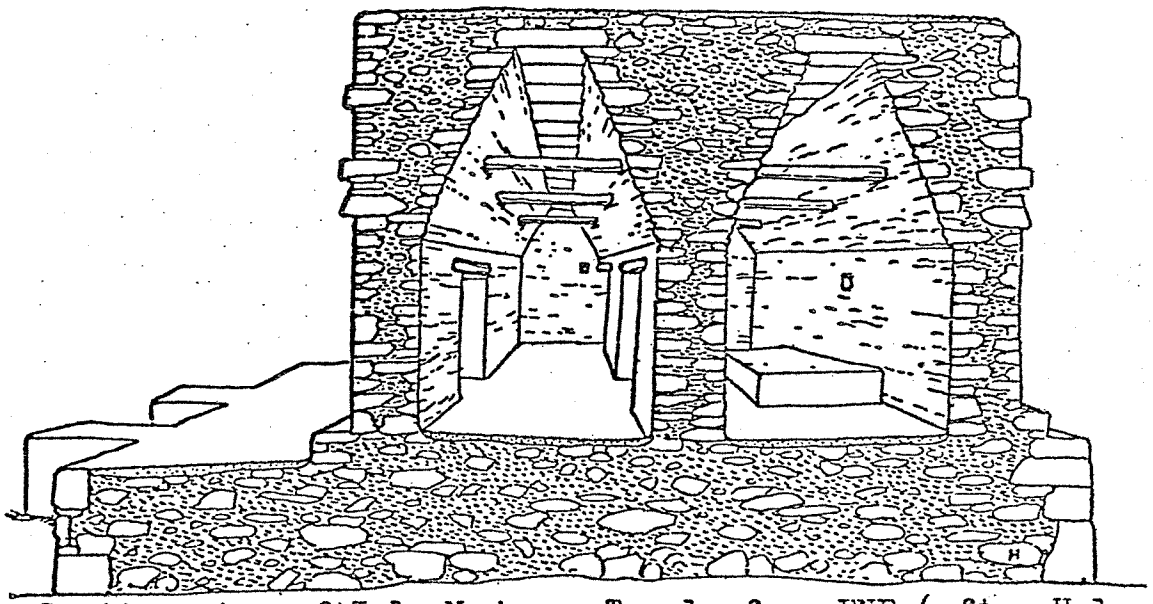
ABSTRACT

ASTRONOMICAL ALIGNMENT OF "EL OBSERVATORIO"

Trygve B. Sletteland (California State U., Sacramento)

Many ancient Maya sites have been tested for astronomical alignments. Among the most convincing of the architectural features thought to have been built to produce these hypothetical alignments in the "window." The best known of the Maya or Toltec Maya "observatories" with windows which have been measured for orientation is the Caracol at Chichen Itza. The present paper discusses the orientations and possible astronomical alignments recorded through the windows of a Late Classic Maya temple on Isla Mujeres. The building is located on a promontory at the extreme southern tip of the island, is in danger of what at present seems imminent destruction by the Caribbean, and has never before had the orientations of its windows included in a published archaeological study. The results of fieldwork undertaken earlier this year in Quintana Roo indicate that one window of "El Observatorio" may have been aligned to the moon, Venus, Sirius, and/or Rigel. Each of these possibilities is explored, the first providing the best fit with the archaeological and astronomical data.



Section view of Isla Mujeres Temple from ENE (after Holmes)

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ARCHAEOLOGY

Kendrick Frazier reports from Santa Fe at the Conference on Archaeoastronomy in the Americas

Solstice sites in Southern California

Winter solstice was a major crisis time for early Indian groups in California. They held ceremonies to ensure the sun's return from its southward progression along the horizon. A recent survey of widely scattered ethnographic literature shows that 40 California tribes are known to have recognized and observed the solstices. Two archaeological sites have been found that appear to mark solstice observatories or the locations of solstice ceremonies. The most common method used was that consisting of the direct observation of sunrise with reference to horizon markers.

Ken Hedges of the San Diego Museum of Man now reports documentation of two more apparent winter solstice observatory sites. They are in the territory of the Kumeyaay Indians in San Diego County. Ethnographic literature provided clues that led to the two sites and observations of winter solstice in 1978 demonstrated that a horizon marker exists for each. From the first location, a cross-shaped rock alignment on the summit of Viejas Mountain, the winter solstice sun rises directly behind the prominent Buckman Peak, 14 miles away. The second location, a stone circle with a bisecting line, is on Cowles Mountain, within the San Diego city limits. From this point, the first gleam of winter solstice sunrise is dramatically bisected by a small rocky peak 16 miles away.

Concludes Hedges: "The specific association of unequivocal horizon markers with winter solstice sunrise leaves little doubt that these sites functioned as observatories for the solstice event."

Sun-sighting posts in Ohio

On the flood plain of the Great Miami River in Dayton, Ohio, archaeologists have been excavating an Indian stockade of the Fort Ancient culture consisting of rings of houses surrounding a central plaza. In the plaza is an unusual pattern of four vertical posts positioned in a parallelogram with a large red cedar post in the center. J. M. Heilman and Roger R. Hoefer of the Dayton Museum of Natural History have now shown that the posts apparently were used to chart the position of the sun at key times of the year. As viewed from various dwellings and pole structures on the periphery of the settlement, alignment with the post structure in the plaza appears to define the solstices, the equinox and May corn planting time. In fact, the combination of these features seems to have strongly influenced the entire village layout. "The alignments are tight," says Hoefer. "We feel we are onto something that no one has had on this particular culture before."

Lunar-watch window on Mujeres

On the southern tip of the island of Mujeres off the Yucatan coast is a dramatically situated but fast-deteriorating small Maya temple known locally as El Observatorio. In January Trygve B. Sletteland of California State University checked its narrow windows for possible astronomical alignment. He found that the line of sight through window 1 in the mainland-facing wall is at the azimuth of 249° 30′. This is within 25 minutes of arc of the southern extreme of moonset at minor standstill, one of the four points that defines the moon's 18.61-year cycle of north-south movement. The opposite, seaward wall long ago crumbled into the Caribbean, but a window placed exactly opposite window 1 would align within 20 minutes of arc of maximum northerly extreme of moonrise at minor standstill. That the temple was used to chart the lunar standstill cycle can't be proved, but Sletteland points to ethnohistorical evidence that the moon had special associations for the East Coast Maya.

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COVER: Can you find four points within this closed curve that form the vertices of a square? Even if you can, can you prove that every closed curve contains the vertices of a square? This is only one of the as yet unsolved problems in geometry. For more see p. 412. (Drawing by Dale Appleman)

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