Lost in the vastness of the southern Pacific Ocean, Easter Island is the most isolated inhabited place on the face of the earth. To its original Polynesian settlers, this was simply “the land,” the center of the world, Te Pito te Henua. The first European to set foot on the island was the Dutch admiral, Jacob Roggeveen, who paid it a single day’s visit on Easter Sunday in 1722. An expedition dispatched by the Spanish viceroy of Peru rediscovered the island in 1770, calling it San Carlos. Today it is called Isla de Pascua in the Spanish of Chile, the country that annexed it in 1888, or Rapa Nui in its natives’ language.

By any name, Easter Island is known today for the ring of enormous stone statues, or moai, that dot its coastline (see Figure 1).

Though occupied by humans for only 1,600 years, this short period of habitation produced significant cultural remains that rival the monuments of older and more established societies.

The island’s abundant archeological sites give the impression of a vast outdoor museum in a setting of breathtaking beauty. Three mountains rise nearly 2,000 feet. Between the mountains, smaller volcanic cones create a rolling, hilly, rugged landscape. On these cones are found the distinctive stone of the island, the brownish tuff of the stone quarry at Rano Raraku, the red scoria of Puna Pau where the topknots or pukao for statues were obtained, and the spectacular boulders at the ceremonial site of Orongo.

The Birdman of Orongo

Perched high above the South Pacific surf on a promontory formed by the partially collapsed wall of the volcanic crater Rano Kau, 1,785 petroglyphs are carved into the boulders of Orongo. Symbols of the life and culture of the people of Easter Island, 375 of these carvings are associated with the Birdman cult and show a praying man with a bird’s head.1

As Alan Drake says in his book, “Easter Island, the Ceremonial Center of Orongo”:

This new myth and cult of birdman which replaced Rapa Nui’s traditional religious practices and beliefs, contains powerful symbolic elements of death and rebirth. These include the symbolism inherent in birds, eggs, figures in praying or fetal positions, descent into the great ocean, re-climbing the cliff with a sacred egg, spring renewal rites, the shaving of the head, taking on a new name, undergoing ordeal and confinement. The motif of Birdman appears to be an archetypal symbol which arose from necessity out of the collective unconscious of the Rapanui, a response to extreme societal stress and the deeply felt needs of the island’s population.2

At the scared precinct of Orongo known as Mata Magaru, the Birdman ceremonies took place.

The ritual revolved around the competition to obtain the first egg upon the return of great
flocks of sea birds to the islet of Motu Nui each September. Contestants were men of importance, men who probably selected servants called hopu to represent them. The hopu descended Orongo’s sheer cliffs and using reed bundles for floats swam to Motu Nui where they secreted themselves in hiding places to await the laying of the egg. The hopu would scoop the egg into a small reed basket tied to his neck, swim back, climb the cliff, and present the egg to his employer who would then become the new Birdman.

The news of the event would be signaled with fires that marked the start of a celebration. The new Birdman shaved his head, eyebrows and eyelashes, and painted his head white. Taking the egg in his palm on a piece of tapa cloth, the Birdman and his companions danced down the mountain to Rano Raraku, near the statue quarry, his home for the coming year. Living under strict tapu, the Birdman was not allowed to associate with his family, wash, shave, or cut his nails for a full year until there was a new Birdman. At the end of his tenure, the Birdman returned to ordinary life but was considered sacred throughout his lifetime and given special honors at death.

The boulders that tell the Birdman story are on the southwestern end of the island and the petroglyphs are completely exposed to erosion by wind and rain. Situated on the very edge of a sheer cliff (see Figure 2), the boulders also are threatened by any weakening of the underlying soil, which could send them tumbling into the sea.

Over the years, since work was done on this site by the archeologist William Mulloy, concern has arisen about the stability of some of the carved boulders at the Mata Ngarau ceremonial center. Surveys of the site were conducted in August and December 1995 and in March 1996.

In 2001, the World Monuments Fund sponsored an expedition by members of U.S. National Committee of the International Council on Monuments and Sites to Easter Island. One objective of the expedition was to establish the exact location of the boulders using a system of measurements that could be replicated to determine any movement. The work was conducted under an agreement between the National Park Service and its Chilean counterpart, the Corporación Nacional Forestal, El Servicio Forestal de Chile.

The survey team consisted of an engineer in private practice, Michael Schuller with Atkinson-Noland & Associates, and two architects from the National Park Service’s Historic American Buildings Survey/Historic American Engineering Record (HABS/HAER), Raul Vazquez and the author. We brought digital cameras and the total station system necessary to record accurately the positions of the carved boulders deemed most susceptible to movement.

Conducting the Survey
To locate precisely the positions of the selected boulders and to be able to measure any future displacement, at least two points on each boulder had to be located with three spatial coordinates. Also, several points, or benchmarks, were needed in positions not subject to movement so that the points on the boulders could be related to stable points of reference in a future survey.

Since the island did not have its own total station system, the points on the boulders also had to be located so that hand tape measurements – slope dimensions – could be taken. In addition, the points had to be placed so that they could be located in the future.

With these parameters in place, the method of establishing points on the soft alkali basalt boulders was addressed. The Mata Ngarau site is unprotected, subject to weathering, and visited by tourists. This meant that the points needed to be permanent. Also, because the boulders containing the petroglyphs are of great cultural importance and could not be marred or have the carvings damaged, the material used to establish the points had to be unobtrusive and benign.

Several approaches were considered. Any topical application would rely on the surface condition for permanence. Since this surface was granular and friable, any adhesive-applied target would need a large surface area to achieve permanence — approximately 1 square inch — and
would still be subject to being peeled off by
hand. Smaller targets were tested when the points
were being measured but were easily removed by
wind as well as by hand. An applied liquid
marker faced the same problems of surface condi-
tion and would have to be large enough to be dis-
tinguished from the variations in the boulder sur-
face. The ultimate solution was to place small
pins in the boulder surface that would be perma-
nent, distinguishable from the surrounding stone,
and as noninvasive as possible.

The survey team determined that small,
0.12-inch-diameter austenitic stainless steel pins
could be inserted into an area of the boulder void
of petroglyphs without causing future damage to
the surface. The pins would be permanent, held
in place with epoxy, and nearly imperceptible.
Reference points of larger 0.25-inch diameter
stainless steel pins would be installed within
approximately 200 yards in stable ledges and
other large rock formations devoid of petro-
glyphs. Also, it was anticipated that unobtrusive
concrete posts containing steel pins could be used
as reference points if installed in stable locations.
(A number of these were placed along the edge of
the soil slope to monitor erosion of the soil and
movement of the slope inward.)

Field Work

Prior to drilling any holes, the team tested
the procedures at a site across the crater Rano
Kau where there are similar boulders that have no
petroglyphs and are not located in a culturally
sensitive context. Drilling was done with cordless
electric drills using masonry bits of the same
diameter as the pins. No flaking or spalling
occurred when the stone was drilled; and neat,
clean holes resulted. A small amount of epoxy
was placed on the end of the pin before inserting
the pin in the hole.8

Measurements taken of the test pin loca-
tions with the theodolite and compared to hand
measurements taken with a steel measuring tape
showed that, by using reflectors on the pins, mea-
surements precise to within a few millimeters
were possible.

On site at Mata Ngarau, station points for
the theodolite were determined beforehand
(Figure 3) so that pin positions avoided the petro-
glyphs, were visible from at least one station
point (or two if possible), and had unobstructed
slope dimensions (line-of-sight) in the majority
of positions allowing park staff to take periodic
hand measurements.

Drafting tape was placed on the boulder
surface and a mark seen through the theodolite
put on the tape to indicate were the hole was to
be drilled. The holes were drilled through the
drafting tape with a 0.125-inch drill, and pins of
the same diameter were epoxied into the hole.

Two pins were placed in each of five
selected boulders. In two cases, three pins were
set; and in one boulder, only one pin was placed.
It was felt that a minimum of two points was
needed to determine any displacement or direc-
tion of movement in the boulder. Three pins
were also placed in the surrounding non-cultur-
ally-sensitive ledge to act as reference points.
These pins were larger — 0.25 inch in diameter
— so that they could be found more easily in the
future.

After all the pins were installed, the location
of each was surveyed with total station and its
position located in space using the pins placed in
the ledge. In addition, the concrete monuments
were also surveyed with the same points of refer-
ence. To take these readings accurately, small
pieces of reflecting tape were adhered to the top
of each pin. However, after taking readings from
all points it was discovered that the oblique angle
at which the laser sometimes hit the reflector was
causing distortion. A second set of readings was
made using a small hand-held reflector placed
perpendicular to the surface of the pin and at its
center so that the laser hit the reflector surface
more directly at its point of contact with the pin.
This second method increased the accuracy of the
measurements.

Table 1 shows a comparison of dimensions
between points taken by hand measurement and
with total station. Table 2 is a comparison of
slope measurements (point-to-point) of those points surveyed from more than one station point (not all points could be seen from more than one station point). As can be seen from Table 2, these measurements have standard deviations of less than 0.25 inch. The comparison of hand measurements with those taken using the instrument, Table 1, shows that most are quite close, differing less than 6 millimeters. Three of the measurements differ by about 16 millimeters or, about 0.64 inch. Because of the close correlations found in Table 2, it is assumed that these differences result from tape curvature (sag) in the hand measurement or from the fact that the pins in the bench marks did not have the center points marked and, therefore, could have a variance of about a centimeter — the diameter of the pin.

In addition to the total station measurements, the scenes in several photographs taken by Mulloy in 1974 and found at the local museum were replicated. Comparable views were obtained for nine of the photographs. No major displacement is evident in their position from 1974 to 2001. It should be noted that while the photos do not offer evidence of any appreciable displacement over 27 years, small changes might not be detectable in the scale of the photographic images given the differences in focal length, lens type, camera elevation, and shadow.

The survey team recommended taking measurements every 6 months; to date, this has not revealed any movement. If these measurements begin to vary by 0.75 inch, then a new total station survey should be done. The three-dimensional coordinates for each pin can be compared with the benchmark coordinates to determine the direction of movement. Absent the need for it earlier, a second total station survey should be undertaken in 2006.

**Conclusion**

No evidence has been uncovered of discernible movement in the boulders of Mata Ngarau CRM No. 5—2002

<table>
<thead>
<tr>
<th>Points</th>
<th>X Diff</th>
<th>Y Diff</th>
<th>Z Diff</th>
<th>Slope Distance</th>
<th>Diff. in mm.</th>
<th>Measured Slope</th>
</tr>
</thead>
<tbody>
<tr>
<td>4N - 18N</td>
<td>1.208</td>
<td>9.506</td>
<td>0.043</td>
<td>9.582</td>
<td>0.084</td>
<td>9.582</td>
</tr>
<tr>
<td>22N - 18S</td>
<td>0.558</td>
<td>2.730</td>
<td>1.985</td>
<td>3.421</td>
<td>16.269</td>
<td>3.437</td>
</tr>
<tr>
<td>22S - 18S</td>
<td>2.371</td>
<td>3.188</td>
<td>2.165</td>
<td>4.524</td>
<td>15.771</td>
<td>4.540</td>
</tr>
<tr>
<td>4aN - 6aS</td>
<td>0.509</td>
<td>1.526</td>
<td>0.255</td>
<td>1.629</td>
<td>0.863</td>
<td>1.630</td>
</tr>
<tr>
<td>4aW - 6aS</td>
<td>1.197</td>
<td>0.892</td>
<td>0.420</td>
<td>1.551</td>
<td>0.865</td>
<td>1.550</td>
</tr>
<tr>
<td>6aW - 16</td>
<td>1.613</td>
<td>2.178</td>
<td>0.485</td>
<td>2.753</td>
<td>2.071</td>
<td>2.755</td>
</tr>
<tr>
<td>6aW - 9E</td>
<td>0.270</td>
<td>2.788</td>
<td>0.601</td>
<td>2.864</td>
<td>5.539</td>
<td>2.870</td>
</tr>
<tr>
<td>9W - 22N</td>
<td>1.185</td>
<td>5.376</td>
<td>1.797</td>
<td>5.971</td>
<td>3.376</td>
<td>5.794</td>
</tr>
<tr>
<td>BM5 - BM3</td>
<td>7.718</td>
<td>6.600</td>
<td>1.005</td>
<td>10.205</td>
<td>15.064</td>
<td>10.220</td>
</tr>
<tr>
<td>BM2 - BM1</td>
<td>1.700</td>
<td>9.034</td>
<td>0.543</td>
<td>9.208</td>
<td>2.817</td>
<td>9.211</td>
</tr>
</tbody>
</table>

**Table 1**

(Note: Point designations are based on the numbering system developed for the Mata Ngarau petroglyphs as found in “The Rock Art of Easter Island,” by Georgia Lee, p. 137.)

<table>
<thead>
<tr>
<th>Measurements Between Points (meters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Points</td>
</tr>
<tr>
<td>--------</td>
</tr>
<tr>
<td>4N - 18N</td>
</tr>
<tr>
<td>22N - 18S</td>
</tr>
<tr>
<td>22S - 18S</td>
</tr>
<tr>
<td>4aN - 6aS</td>
</tr>
<tr>
<td>4aW - 6aS</td>
</tr>
<tr>
<td>6aW - 16</td>
</tr>
<tr>
<td>6aW - 9E</td>
</tr>
<tr>
<td>9W - 22N</td>
</tr>
<tr>
<td>BM5 - BM3</td>
</tr>
<tr>
<td>BM2 - BM1</td>
</tr>
</tbody>
</table>

**Table 2**

<table>
<thead>
<tr>
<th>Slope Distance from Pin 1, 0 at Pin 2, to Points with Common Station Points (in meters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Point</td>
</tr>
<tr>
<td>--------</td>
</tr>
<tr>
<td>Pin 2</td>
</tr>
<tr>
<td>Pin 3</td>
</tr>
<tr>
<td>4N</td>
</tr>
<tr>
<td>18S</td>
</tr>
</tbody>
</table>
Ngarau at Orongo—at least not within the past 25 years. However, this does not mean the site is not in danger. Sitting precariously as it does above the sea, Orongo is a site waiting for a landslide (see Figure 4).

The stability of the petroglyphs at Mata Ngarau is endangered by the weathering and erosion of the supporting rocks and soil that make up the crater rim. Clearly portions of the crater have already collapsed, reducing the height of the rim. This weathering of the rock formations has produced a 30-degree slope (see Figure 2) that comes to within 3 feet of the lower boulders.10

An earlier expedition evaluating the hydrogeology of Mata Ngarau reported that the site was threatened by erosional processes of both wind and wave action more than 300 yards below, causing the cliff face to fall away at an angle of 70 degrees:11

A secondary erosion mechanism is creep and sliding of surface soils (about 30 to 60 cm thick) on which the boulders rest. Repeated wetting and drying of soils can result in a gradual movement down the 30° slope towards the cliff face. Periods of heavy rain could, however, saturate the thin soil layer, which could lead to sudden slides and rapid movement.12

Moisture collects on site in puddles where foot traffic compacts the soil or soaks in underneath the boulders and exits at the cliff face. Increasing the vegetation throughout the area would increase soil stability as well as the ability of the area to carry and release moisture back to the atmosphere.13

The petroglyphs are carved into the boulders that have eroded and will continue to do so until they no longer exhibit evidence of the Birdman. Stabilization of the site through the use of concrete shoring is possible but such intervention can be as destructive as a landslide to the integrity of the site. We should enjoy the petroglyphs and the austerity and seclusion of Orongo as it is for now. Ultimately, relocating the boulders to a museum might be a better fate than their loss. In this way, the petroglyphs would be protected in a way they never would be in situ.

Notes
3 Ibid., p. 41.
4 Lee, op.cit., 44.
6 Total station is a system consisting of a theodolite with laser distance-measuring capacity.
8 In the tests, a small amount of epoxy had oozed onto the boulder surface. This was addressed in the final placements by leaving the drafting tape in place until the pins were set and the epoxy had begun to harden. When the tape was removed, the excess epoxy went with it.
11 Charola, op.cit., p. 2.
13 Ibid.

E. Blaine Cliver is the manager of the National Park Service’s Historic American Buildings Survey/Historic American Engineering Record/Historic American Landscape Survey in Washington, DC.

Photos by the author.