

The Agency for Cultural Affairs, Nara National Cultural Properties Research Institute, Japan  
The APSARA Authority

The Nara National Cultural Properties Research Institute has been working since 1996 with the APSARA Authority and other international agencies, notably the Sophia International Angkor Mission, in research on ancient kiln sites in the Angkor area.<sup>1</sup> Training of students from the Department of Archaeology of Phnom Penh's Royal University of Fine Arts, as well as graduates of this institution, has been an integral part of this work from its inception. Research has concentrated on the kiln sites of Tani village, Banteay Srei district, some six kilometers northeast of the Eastern Baray, though prospection has also been carried out at other sites, most notably those of Khnar Po, Sotnikum district, and Thnal Mrec in the Kulen mountains. Three phases of work, partially overlapping in time, have thus far been carried out by the Nara team in conjunction with APSARA at Tani: a topographic survey of the site, geophysical prospection of selected kiln mounds and excavations of one kiln mound. The first section of the present report, drawn from one published for limited distribution in 1998,<sup>2</sup> concerns only the topographic survey. We have chosen to reproduce a version of this report here because the survey serves as the fundamental basis for all other aspects of work thus far undertaken. Reports on geophysical prospection and excavations can be consulted elsewhere.<sup>3</sup>

The second section of this report concerns a recent inspection of the Thnal Mrec (also known as Sampeou Thleay) kiln site in Anlong Thom village, situated in the Kulen mountains. We have opted to include this here in view of inciting further research by our own and other teams of this important site, the understanding of which will undoubtedly prove essential to developing our knowledge of Angkorian ceramic production as a whole.

<sup>1</sup> See also the Sophia report in the present journal.

<sup>2</sup> The Agency for Cultural Affairs, Nara National Cultural Properties Research Institute, "Report of Joint Research Project at Angkor II: Report on the Topographical Survey at the Tani Site," 1998. The 1998 report was written by Nishimura Yasushi with the assistance of Sugiyama Hiroshi. Romanization of Khmer words was done by Ea Darith and Ang Choulean. The Japanese text was translated into English by Walter Edwards. The digitalization of the survey maps, and the automatic generation of the contours, plus the editing and printing were commissioned to Kokusai Kogyo (Inc.). Ashley Thompson revised the text for publication in *Udaya*.

<sup>3</sup> See: Nishimura Yasushi, Morimoto Susumu, Sugiyama Hiroshi, "Results of Prospection at the Angkor Site," 48-49 in *Annual Research Report*, Nara National Cultural Properties Research Institute, 1998; Nishimura Yasushi, Morimoto Susumu, Sugiyama Hiroshi et al., "Geophysical Investigations of a Khmer Pottery Kiln Site in the Kingdom of Cambodia," 208-9 in *Abstracts of the 15th Annual Meeting*, Japanese Cultural Properties Scientific Research Society, 1998; Nishimura Yasushi and Dean Goodman, "Joint Research Project: The Agency of Cultural Affairs, Japan/Cambodian Government at Angkor," *Abstracts of the 63rd Annual Meeting*, Society for American Archaeology, 1998; Nishimura Yasushi, Morimoto Susumu, Sugiyama Hiroshi Ea Darith et al., "Latest Report of the Khmer Pottery Kiln Site - Topographical Survey/ Geophysical Survey/ Excavation," 28-29 in *Abstracts of the 2nd Annual Meeting*, Archaeological Prospection Society of Japan, 1999; Sugiyama Hiroshi, "Expectations for Research at the Tani Kiln Site in Cambodia," 39-40 in *Annual Research Report*, Nara National Cultural Properties Research Institute, part 1, 1999.

## **I. Topographic Survey of the Tani Kiln Site**

In 1997 and 1998 a topographic survey was conducted at the Tani kiln site. This survey was the first stage of on-going field research carried out by the Nara National Cultural Properties Research Institute under the "Cooperative Research Related to the Preservation of Angkor Cultural Heritage" program, supervised by the Japanese Government Agency for Cultural Affairs' Cultural Properties Preservation Division, Traditional Culture Section. The planning and execution of the survey was conducted jointly by a core of researchers from the Nara National Cultural Properties Research Institute (hereafter referred to by its shortened Japanese name, "Nabunken"), together with researchers and others affiliated with the APSARA Authority, and members of Sophia University's Angkor International Mission. Additional assistance was provided by the Siem Reap Cadastral Service, and students and recent graduates of the Royal University of Fine Arts in Phnom Penh.

### **1. Background and Preliminary Work**

Plans for a topographic survey of this site emerged from meetings held between Nabunken and APSARA in 1996. As the Nabunken team secured support in Japan for the proposed survey over the course of that year, APSARA began to prepare for the project in a concrete fashion in the field; this included securing funds from UNESCO for the survey, organizing a work unit including personnel from the Siem Reap Cadastral Service and architectural specialists from APSARA to carry out the survey, and arranging for mine clearance of the prospective work area: 800 m north-south by 200 m east-west along the dike running north-south through the northern sector of Tani village.

On-site survey work was first conducted in February and March 1997. During this time, points were established in view of carrying out a control point survey, and topographic mapping was conducted using a plane table. Personnel from Nabunken and Sophia University, along with others from APSARA and the Cadastral Service were involved in these activities. Due to time constraints, Nabunken participants were unable to see the plane table work through to its completion, and the bulk of the survey was carried out by the Cadastral Service and architectural specialists working in two teams. As no access was available during the Spring 1997 survey to a nearby national control point, the work had to proceed using provisional values assigned to both elevations and horizontal positions. Accordingly, the plane table survey was limited to depicting the outlines of planimetric features and recording elevations on a relative scale. It was therefore recognized that revisions would have to be made later on, as contour lines drawn on the basis of these data alone would shift when the values were converted into elevations above sea level. Plans were therefore made to read the manuscript map with a scanner and convert the data to digital form. This would eliminate the need to make manual revisions to the map, and allow for reproduction at the desired level of reduction. It also made possible automatic computer generation of the contour lines, utilizing the relative values of the plane table survey (figure 1).

During further survey work conducted in November and December of 1997, we learned that we would be able to utilize the results of leveling that had recently been conducted at a point 1.2 km to the west by the Japan International Cooperation Agency (JICA), and we accordingly transferred the elevation to the site where the kiln remains are located. This leveling allowed for conversion of the temporary relative values into absolute elevations. This task, along with the computer generation of contour lines utilizing these values, were performed after returning to Japan. The computer-generated contour lines, however,



represented a situation differing from the actual site conditions over a wide area. This was because the density of the points where relative elevations were taken, while being high in the central area containing the kiln remains, was thin elsewhere, and the number of points needed for calculating the automatically generated contour lines was therefore insufficient. Accordingly, correcting the contour lines, along with checking the planimetric features and labeling, became thereafter our main task at the site. In addition, a detailed supplementary plane table survey, focusing only on the kiln remains, was also planned. This supplementary work, undertaken in March and August 1998, and February 1999, was necessary as the survey previously carried out by the Cadastral Service did not provide an accurate depiction of the outlines of the bases of the mounds that were determined to be kiln remains, nor were the contour intervals and density of data points sufficient for detailed depictions of the mounds themselves.

## 2. Surveying Methods

The survey work described here is divided into two phases: the control point survey conducted to establish topographic control points, and the plane table survey utilizing those points. The points set up in the control point survey consist of primary points lying on the main route forming the framework of the survey, and secondary points branching out from that framework (figure 2).

### a. Control point survey

In selecting points prior to conducting the survey, control points were set up in greater density in the area containing the kiln remains, to facilitate detailed plane table survey work. Points were scattered over greater intervals in the surrounding areas of paddy, removed from the low ridge on which the kiln remains lie and where there is straight-line visibility over longer distances. Planimetric features necessary for mapping are the dikes and irrigation channels of the paddies.

Observations of angles and distances were made with a Leica Total Station TC1700. Measurement accuracy for angles is 1 sec, and for distances is 2 mm + 2 ppm. For observations made along the main route, sightings were taken using a reflective target when possible; at times a mirror was used as a substitute. For points branching off from the main route, a short pole stood upright with a miniature tripod was used as a marker, or sightings were taken directly on the nail driven into the top of the stake.

For angle measurements, as the work was being done on a limited timetable, one set of observations (normal and reverse) were used in principle, but when the observational difference exceeded 6 sec, a second set of observations was added. The upper limit on the double angle difference in the latter cases was 12 sec. Angle measurements for the points branching off the main road were made in the same manner.

For measurements of distance, a reflective mirror set atop a tripod was used for points along the main route forming the framework of the survey, although for measuring the distance to points branching off from this, observations were made using a mirror held by hand atop the stake. This method was adopted based on the assumption that the plane table survey would be conducted on a scale of 1:200; as long as the mirror was placed somewhere on top the approximately 3 cm stake, any horizontal difference in measurement would be at most around 2 cm, or only 0.1 mm as represented on the map, and thus was judged to pose no problem in practical terms.

For calculations of horizontal positions, as data from the Cambodian national control points set up in neighboring districts could not be transferred in timely fashion, the line joining Points 1 and 2 set up in the southern part of the site was taken to deviate 3 degrees from grid north as a provisional determi-

nation of direction. The grid position for control Point 1 was also set at E 1000, N 500. The nearest control point to the site, set up by JICA using GPS,<sup>4</sup> was some 3 km to the west-southwest, and as the straight-line visibility was not good, traveling to the site would not only take time, but would also involve considerable risks in terms of personal safety, and accordingly the task of converting the results of the survey work had to be left for the future.

The main route of the survey, serving as its framework, was made as a closed traverse consisting of 16 points that describe an elongated loop. Total distance along the route measured 1.495 km, with an angle measurement error of 22 sec. The error of closure was  $f^{\circ}x = 8$  mm,  $f^{\circ}y = 12$  mm, yielding a ratio of closing error of 1:7,190,000. As for the provisional grid coordinates employed in this work, as long as the stakes used for the control points remain in place, it should be possible to convert the coordinates and grid values if a link is made to a Cambodian national control point at sometime in the future.

#### b. Plane table survey

At first, as the area of the intended survey measured 800 m north-south by 200 m east-west, we decided to use a scale of 1:200; this allowed for efficiency, while still enabling depiction of the details of the mounds that were determined to be kiln remains. For the contour intervals, the index contour lines were drawn at 1 m intervals and the intermediate ones at 0.2 m, with half interval contour lines of 10 cm added when needed for detailed depiction. For the plane table survey, the nodal points obtained from the control point survey were plotted onto thick mylar-base sheets, along with their grid values. The mylar sheets were previously ruled with 10 cm squares, to make plotting easier, and each measured 120 cm by 90 cm. A total of nine such sheets were used. Among these, Sheets 1 to 6 link together in a row extending from south to north, and overlapping with this row in part on its western side, Sheets 7 to 9 cover the northernmost portion of the site. During the survey work, the sheets were not cut to fit the size of the plane table, but were used at full size.

#### c. Leveling

The leveling instrument in this survey was a Leica NA824 Autolevel, used along with an aluminum staff. The main route serving as the basis of the work formed a closed loop. In conducting the survey, the leveling instrument was placed in between nodal points where possible, but when the nodal point interval exceeded 60 m, a turning point stand was placed as needed, or tree roots or other objects were used as relay points, in order to reduce the measurement interval. Over the total route length of 1.495 km, the error of closure was 14 mm. The degree of precision was well within the acceptable limit for third order leveling, namely  $10\text{mm} \sqrt{S}$  (where  $S$  is the traversed length, in km), the goal initially set for the survey.

The secondary points were made by branching out during the traverse from at least 2 points along the main route. That is, they are the average of foresight measurements taken from two or more control points. This leveling work was conducted simultaneously with the traversing, as the first phase of work in March 1997.

As it was later learned that JICA had subsequently established a bench mark approximately 1.2 km to the west, and as indicated above, in the December 1997 survey, we transferred the level from that point; however given the extreme heat and unreliable security, we did not conduct conventional back-and-forth

<sup>4</sup> Global Positioning System, a geographical survey tool which allows for accurate determination of ground location by receiving microwaves from multiple satellites.



leveling. Instead, after the staff had been set up first on the previous point and then on the next one, and observations of the levels made, the leveling instrument was set up at a separate location and a second set of readings was taken; this effectively produced the same results as back-and-forth leveling would have. Separate logs were used to record the results of the two sets of observations. The error of closure, corresponding to the discrepancy between back-and-forth leveling, was 2 mm.

#### **d. Supplementary survey**

The stakes initially set up for the plane table survey were small locally-procured items of 5 cm or less in diameter, including some uncured wood. Only one half year later, several of the stakes were partially decomposed, and in danger of being lost altogether. Also, a number of easily visible stakes had already been removed. As the control point stakes were thus in danger of obliteration, in the summer of 1998 the team relocated and replaced the control points. Points numbering from 40 on are all new or re-established items. Accordingly, new data for the levels of these points was also recorded.

### **3. Results of the Surveys**

#### **a. Number of kiln remains**

The kiln remains in the survey area apparently form two groups - one to the south and one to the north. As five of the nine kilns in the northern half of the area cluster together, however, with the remainder in disparate locations, it does not seem appropriate to class them all as a single group. On the other hand, the six kilns in the southern half of the area all cluster closely together, and it seems possible to discern some kind of mutual relationship among them. These fifteen kiln remains constitute the entire number found to exist at the site.

The basis for judging these as kiln remains is the dispersal of numerous kiln wall fragments at each location. As will be described below, shards of pottery and roof tiles are sparse, but the kiln wall fragments are plentiful. At locations other than those judged to be kiln remains there are similarly shaped mounds. But as neither potsherds nor kiln wall fragments were detected there, it was not possible to consider them to be kilns. Among the mounds thought to be the remains of kilns, five cluster together in the northern half of the area, as already noted. But another kiln lies 60 m further north, and yet another 120 m north of these, and both can be distinguished as independent of the first five. Also, to the north again, the low ridge on which these mounds stand comes to an end and turns into paddy, on the other side of which rises another low ridge where two more mounded kiln remains are located. These two should be regarded as separate from the kilns to the south. There is therefore a total of nine kiln remains lying within a 200 m north-south stretch within the northern half of the survey area. The six kilns in the southern half concentrate within an area spreading 70 m north-south. Four small mounds exhibiting round or elliptical shapes in horizontal outline are distributed on the eastern side of this area; their placement in a straight line running north to south, and at nearly equal intervals, is notable. The remaining two kilns, on the western side, are larger in scale and roughly rectangular in shape. In this manner, the southern half is characterized by the existence of mounds differing in scale and shape, and divided accordingly to the east and west.

In order to facilitate further investigation of these kiln remains, designations such as A01 and B01 have been given. "A" indicates the group lying in the southern half of the area, and "B" those to the north. In giving the designations, numbering was started from the south and west and increased toward the north and east (figures 3-4).

**b. Observations of the present condition of the kiln remains**

The largest mound in the southern group is A01 (figure 5). It presents a nearly rectangular shape approximately 25 m in north-south length, and 18 m east-west. The highest point is on the southern side of the mound. The difference in elevation from the surrounding level area is approximately 2 m. A large tree stands at this highest point, and there are also trees on the eastern periphery and elsewhere. To the north of the central tree is a pit dug in rectangular shape, about 2.5 m east-west, 1.2 m north-south, and 1.5 m deep. This pit is said to be the result of looting, or a trench associated with military activity. Small reddened fragments thought to represent kiln walls are piled in the walls of the pit. The northwest and eastern sides of the mound were dug as a source for dirt, leaving steep banks over a small section at each location. It was also evident that in the southern and southwestern portions of the mound the base had been cut back, so that the present outline differs from the original shape. Artifacts are more densely distributed on the northwestern side, with only very small fragments apparent elsewhere. But as shards were observed only in places where the ground cover was thick, it would seem that they have been removed through human action. In this situation, study of the present state of the distribution of artifacts would probably not help us determine the position of the kiln fire-box. Kiln A06, located approximately 30 m to the north of A01, exhibits a horizontal plan that is similarly rectangular in shape. The north-south length is approximately 21 m, and the east-west width about 7 m. This kiln can also be said to resemble A01 in forming a high mound, 1.2 m above the surrounding area. There is a solitary tree standing at the center of the summit. Though thick grass cover along the base to the south and southwest inhibits sufficient observation, a thick scatter of potsherds and other artifacts could nonetheless be discerned.

To the east of these mounds that are rectangular in their horizontal outlines, kilns exhibiting a round shape, numbered from A02 to A05, are oriented on a north-south line. Among these, A02 is located in the southernmost position within the area of the current survey, approximately 160 m north of the east-west road that crosses the southern entrance to Tani village. Although they differ in detail, A02, A03, and A05 all assume a truncated cone shape and measure approximately 12 m in diameter at the base, and 1.5 m in height, at their summits.

Kiln A04, also on the same eastern side of the cluster with the others, exhibits a mound differing slightly in shape, appearing elongated in the east-west direction; this mound should perhaps not be placed in the same class as the others. While this external observation suggests that kiln A04 has a different internal structure, no detailed conjecture can be made due to the poor state of preservation of the mound.

Also, mound A03 has level rectangular surfaces from 4 to 5 m in width on its southern and western sides, but it is not clear whether the entire mound inclusive of these features, or just the conical portion, should be regarded as the kiln remains. Comparison with mounds A02 and A05, however, suggests that we should regard the entire mound, including the level surfaces, as the remains of a kiln.

At the present time, the distribution of artifacts is thin for all of these mounds. But as many potsherds were visible beneath the heavy undergrowth when the site was first inspected in 1996, it is clear that artifacts have been removed subsequent to that time.

Among the kiln remains that can be distinguished as the northern group, that located furthest to the south is labeled B01.<sup>5</sup> This mound exhibits an almost perfectly circular shape 12 m in diameter, and is

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<sup>5</sup> See report on the excavation of this mound by the Sophia International Angkor Mission in the present journal. Excavations of this and other mounds were carried out subsequent to the topographic survey presented here.



approximately 2 m high relative to the surrounding area. As there are no local irregularities in the shape apparent through surface inspection, the kiln is thought to be well preserved, with its features retaining much of their original condition. Although the distribution of artifacts is generally thin, more artifacts are apparent on the northern side. A large tree stands atop the mound.

B04, located approximately 15 m to the northeast of B01, is also circular in shape. But, perhaps because B04 sits on top of a ridge-like topographic feature extending toward the northeast, it is slightly elongated in that direction. Also, the highest point of the mound is eccentrically located toward the southwest. The mound can be said to be a circle slightly distorted to the northeast. The height is about 1.2 m. Almost no artifacts are visible, but heavy brush on the northern and eastern sides of the mound inhibit thorough observation, such that artifacts may be unevenly concentrated in those areas. A large number of trees measuring roughly 10 cm in diameter stand atop the highest part of the mound.

To the west of the midpoint between B04 and B01 is B02. This mound is so low and distorted that the outline of its base cannot be traced. While it most likely resembled the others, at present it is only 0.8 m high. Moreover, a fence, lined by a small ditch, running north-south at a position one-third across the mound from its eastern side exacerbates the mound's distortion. Nevertheless, in scale the mound can be seen to form an ellipse approximately 10 m north-south and 7 to 8 m east-west. In any case, we can assume that the original shape was not circular. Artifacts are scattered across the entire area of the mound, which is presumably the remains of a kiln, though they appear to be more heavily distributed on the southern side. A large tree stands at a point thought to lie on the western edge of the mound.

B03, which is also thought to be elliptical or perhaps rectangular in shape, lies approximately 20 m to the west of B02. The height at present is 1.2 m, and the mound appears at first glance not to have been greatly distorted in shape. But the southern third of the top of the mound is low, as if it has been leveled off. Within the low area is a hole dug out to roughly 2 m in diameter; the top of the mound may also have been cut down in conjunction with this. At present the mound is assumed to have originally had a elongated shape, such as a rectangle or an ellipse. A tree stands at the southern edge of the mound. Artifacts also appear to be concentrated more heavily in that vicinity.

Located approximately 12 m to the north northwest of B03, mound B05 appears to have a circular shape similar to those of B01 and B04, but as its size is small, estimated at only 5 m in diameter, it is preferable to reserve judgment at this point regarding its original shape.

The kiln remains of B06 and B07 respectively lie 60 m and 120 m to the north of the previously described five northern group mounds. As both are now utilized for threshing, in which domesticated animals are employed, they have accordingly been altered in shape, and now assume round forms resembling that of a Sumo ring. But the diameters differ, with B06 to the south measuring approximately 12 m, and B07 to the north about 7 m. Their heights are nearly the same at 0.8 m and 0.6 m. As each mound has been altered in shape, it is difficult to surmise original forms, but because it seems natural that in making a threshing platform one would choose a location where little labor had to be expended, namely where considerable reshaping would not be necessary, it may be possible to consider these mounds to have originally been round in shape. Nonetheless, given that the original diameter of B06 would have been great, and that the current outline of the base of the mound is not round, consideration should be given to the possibility that it was rectangular.

The northernmost kiln remains in the survey area are B08 and B09, approximately 170 m from B07 to the north. The low ridge on which these remains lie disappears at one point and is replaced by paddy, reemerging again to the north and assuming a level surface, on which these two kilns sit. Of these two, the western mound regarded as kiln B08 extends in part underneath a house. The mound has been

leveled off to a great extent, and its size and shape are no longer clear. To make a rash assessment, however, the original extent of the mound would appear to be about 8 m in diameter. Mound B09 to the east retains 0.6 m of its original height. But as damage to the mound by domesticated animals (pigs) was observed during the time the plane table survey was underway, both the present height and shape of the mound are thought to be the result of alterations. At the time of the survey, the mound was estimated to measure about 8 m in diameter. As distortions of the mounds are conspicuous for both B08 and B09, it is difficult to infer whether the original shapes were round or rectangular.

### c. Results of the survey

Information about the kiln remains gathered through ground surface observations and the plane table survey, as well as issues calling for future consideration, can be summarized as follows.

1) *Shape of the mounds.* The survey and ground observations allow us to divide the mounds of the kiln remains into two classes based on horizontal shape: round versus rectangular or elliptical. It cannot be determined at this time whether or not this relates to aspects of the kilns' structures. But assuming this does reflect structure, it is thought possible that the round mounds were shaft kilns consisting of a cylindrical chamber to which a fire-pit and its opening were attached. It is further conceivable that the rectangular or elliptical kilns were tunnel-shaped, like the Sue ware kilns known in Japan.

2) *Significance of the mounds.* As just indicated, it appears from the shapes of the mounds that kilns with different structures co-existed at this single site. On the other hand, it could be argued that the mounds themselves were built up with earth in order to obtain the proper inclination for tunnel-shaped kilns, and that the slopes of the mounds were used for that purpose. This hypothesis draws support from the fact that the same type of kiln structure was used in what is now Thailand. Accordingly, if the mounds were indeed made in order to obtain an incline for the kiln floor, then all of the kilns at this site may, quite possibly, have had a tunnel-shaped structure.

But the kiln remains are all located on a ridge, albeit low, hemmed in on the east and west sides by paddy; building the kilns on the slopes of the ridge near the fields would have sufficed to secure the necessary inclination for the kiln floor. This consideration suggests there must be some other explanation for the existence of the mounds. In this context, we should note that another group of kilns, at Khnar Po, also dating from the Angkorian period, was similarly built atop a low dike, running north-south and believed to be an artificial structure. The ridge on which the kilns at Tani Village sit also runs in a straight north-south line, a shape suggesting the possibility that it too is a man-made structure.

3) *Structure of the mounds.* Further consideration of the issues raised above can be drawn from observation of the contents of the mounds, as far as they can presently be observed. The approximately 1.5 m deep pit of mound A01, a result of looting or military activity, is filled from top to bottom with reddened kiln wall fragments. In other words, for this particular location at least, the possibility that the mound is made of kiln wall fragments is very high. In this case, the kiln taking the shape of a mound can be understood to result from the gradual building up of the mound as the roof and other parts of the kiln chamber were broken after each firing to extract the pottery, and fragments from the kiln thus accumulated in the surrounding area. At the same time, from results of a test excavation conducted in 1998 at kiln B01 by Sophia University's Team,<sup>6</sup> the dirt comprising that mound had very little admixture of other sub-

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<sup>6</sup> See the Sophia report in the present journal.



stances, reportedly indicating that the mound was built up artificially. This example supports the hypothesis that the mounds were made to obtain an incline for the kiln floor.

As summarized above, many areas of research remain to be pursued in order to learn more about the details of the kilns' structures and the actual conditions under which they operated. In particular, there is the question of whether there is a difference among the kilns in terms of structure. If there is such a difference, can any historical evaluation be made of the way that difference might link up with the kilns' distribution, or with their relative spatial relationships? Even if the differently structured kilns date from the same time, for example, there are also differences in the sizes and shapes of the mounds, as the current survey makes clear, and definite tendencies can be perceived in their distributions; characteristics such as these certainly bear some meaning.

In order to make a historical evaluation of the kiln remains at the site as a whole, some basis for temporal assessment is of course necessary. Spatial and temporal research on both artifacts and archaeological features must be synthesized. The topographic survey reported herein has constituted the first step towards a full-scale investigation. In parallel with this survey, and particularly in view of the extreme cultural value of the site, non-destructive methods of investigating subterranean features, such as applications of geophysical prospection, have also been given high priority in this program. Our excavations have been confined to specific portions of a single kiln determined from geophysical prospection.

## II. Record of a Kulen Kiln Site Inspection

In July and August of 1999, the Nabunken team conducted an excavation of kiln A06 of the Tani site; during this period APSARA proposed and planned an inspection of Thnal Mrec kiln site in the Kulen mountains to the north of the Angkor plain. In addition to the APSARA and Nabunken teams, members of the Sophia Angkor International Mission also participated in this inspection, which was carried out on August 12, 1999. The group was accompanied by a team of deminers from the Cambodian Mine Action Centre (CMAC).

Though this site, also known as Sampeou Thleay, was noted in the late 19<sup>th</sup> century, it has never been the object of systematic research; indeed, inaccessible to research teams since the early 1970s due to military activity in the region, the Kulen have only recently been reopened to the general public. This opening allows tourists, researchers and unfortunately looters easy access to the Thnal Mrec and other remarkable archaeological sites scattered throughout the region. In view of promoting future research and accompanying protection and preservation of the Kulen heritage, we take this opportunity to record the observations we were able to make during our brief excursion.<sup>7</sup>

### 1. Itinerary

The car trip from the APSARA Siem Reap office to the parking area adjacent to "Tik Thleak" waterfall atop one of the Kulen ridges took just over three hours. GPS readings taken at this parking area

<sup>7</sup> This report was compiled by Nishimura Yasushi from the results of a discussion held among the participants. It was subsequently revised by Ashley Thompson for publication in *Udaya*.

read latitude 13° 33' 59" N; longitude 104° 06' 09" E. Those of the waterfall: latitude 13° 34' 07" N; longitude 104° 06' 24" E. And finally, those of Vat Preah Ang Thom, the Buddhist pagoda from which we continued our journey on motorcycles: latitude 13° 33' 52" N; longitude 104° 06' 36" E. The motorcycle trip across the mountain plateau to Anlong Thom village took 45 minutes. The entrance path to the site gave a GPS reading of latitude 13° 31' 45" N; longitude 104° 09' 35" E. A five minute walk brought us to the kiln site itself, located at latitude 13° 31' 43" N; longitude 104° 09' 32" E. Inspections were carried out here, as well as at another site 50 m to the south.

The longitude and latitude values given above for archaeological sites and other locations were obtained using a simple GPS receiver. Considering the precision of the receiver and the presence of trees and other obstacles, the positional accuracy of the readings is estimated to range from 80 to 90 m. Given the present situation, however, in which only maps with a scale of 1:50,000 or less are available, this degree of accuracy can be said to pose no hindrance in recording a kiln site's position. Also, as it was not possible to check the current location on the map step-by-step during the passage by automobile and motorcycle, this general assessment of positionings is in and of itself significant.

Each location measured has been plotted on the maps included here (figures 6-7); it should be noted that the waterfall as we have plotted it does not lie on the main course of the river as indicated on the original map. There are three conceivable reasons for this inconsistency: (1) that the precision of the simple GPS receiver is poor, or that its measurements were rendered inaccurate by the presence of trees and other objects; (2) that the maps currently available for use are imprecise; (3) that the waterfall lies not on the main course but on a tributary. In addition, a span of 15' on the map corresponds to nearly 25 km. A circle of 1 mm drawn on a map of 1:50,000 scale becomes 50 m on the ground.

## **2. Geology**

During the passage from the foot of the Phnom Kulen range to the site, the hills that could be observed were comprised of a sandstone matrix; the soil deposits were also silts bearing large amounts of sand. There are two varieties of sandstone, one grey and the other bearing a red tinge; rock outcrops were observed. This sandstone is the same as that liberally used in the Angkor temple complexes, and the region is presumed to have produced the materials employed there.

## **3. Location and topography**

The kiln remains we observed lay near hilltop ridges, on the eastern and southern faces of the slopes. The position at a point high on the slope is notable. According to information obtained locally, kiln remains spread over a region as far as 1 km north of the site visited on this occasion, and another 500 m to the south and to the west. This extent remains of course to be examined. As stated above, the geological features and soils of the area are composed of sandstone or sandy silts; it is therefore likely that locations yielding the clay necessary for pottery production are limited. If this reasoning is correct, and special sites therefore supplied the clay, control over those sites and over distribution of the clay are points that should be kept in mind when studying conditions applying to the management of kiln productivity.

## **4. Kiln remains**

The kilns take the form of mounds, like those of Tani and Khnar Po. It should be noted that mounds were built up even though the kilns are located on a slope. This is most significant as it demonstrates a single production method involving the building of mounds both atop the mountain as well as on the plain (e.g. Tani or Khnar Po). This fact will be of prime importance in further research on the origins



and derivations of Khmer ceramic manufacturing technology.

In contrast to other kiln groups previously known, the Kulen mounds are so closely concentrated that they overlap each other. At least five or six kilns were estimated to exist over a quickly observed area extending about 50 x 100 m. As some of the mounds are irregular in shape, it is possible that kilns were enlarged in successive fashion in some cases. If this degree of concentration is typical for the Kulen site, the total number of kilns would be unimaginably large.

### **Artifacts (figure 8)**

The distribution of very large numbers of nearly intact items is characteristic of this site. The unlikely concentration of readily visible objects is however thought to be the result of the work of looters, who have discarded imperfect items, even those with minor defects, in a single location. Accordingly, the collection of artifacts we actually observed is probably unrepresentative, that is it may not indicate the general composition of vessel types for this site. Keeping this limitation in mind, the following points can still be noted.

The majority of vessels observed bore an ash glaze, though some unglazed items were also present. We have the impression that ash-glazed bottles and small bowls with fitted lids are by far the most numerous types of vessels visible on-site. There were also unglazed items of these same shapes. Unglazed vases and jars were also present, but appear to be few in number. Local inhabitants also reported having found anthropomorphic pots at the site. Glazed eave tiles in large and small dimensions are also characteristic.

Though we did not see any vessels with the typical Khmer dark brown glaze, we did see vessels with a brown clay body on which the natural ash glaze could be taken at first glance for an applied dark brown glaze. In this regard, identification of the glaze components through chemical analysis may prove an effective technique for distinguishing between various types of wares.

As the patterns on eave tiles can be of significant help in determining where these items were distributed, the exact localization within the Angkor temple complex of examples made from the Kulen mold is also likely to become a pressing issue in the future. Such work may allow us to date the Kulen kiln site, based on the ages of the sites to which tiles were distributed.

The small ash-glazed vessels seemed somewhat larger than those with similar shapes at the Tani kiln site. While the study of artifacts excavated from A06 kiln at the Tani kiln site is just now beginning in earnest, it appears that the paddle and anvil technique was not employed at Tani in making tiles and large vases and jars. This fact should be kept in mind when looking at Kulen production, and then for the possible roots of ceramic production in surrounding countries. In any case, the manufacturing techniques of the Kulen appear more refined than at Tani.

### **Preliminary Conclusions**

Given that the items produced at the Kulen kiln site are superior in terms of workmanship, it seems necessary to distinguish this site from others thus far studied in the Angkor area. If we enlarge upon this impression, it may be said that in certain aspects the Kulen site appears likely to have been a "state kiln," either directly operated or strongly influenced by the Khmer monarchy, whereas Tani and Khnar Po would seem rather to have been privately run operations. At the least, we can suppose that the two are historically different in nature. Also, it is likely that their products had different destinations.

The probability that the Kulen kiln site was associated with the ancient Khmer royalty is undoubtedly not unrelated to the geological conditions of the Kulen region. Namely, the central authorities would have been directly involved in extraction of the area's grey and red sandstone used in the Angkor temple

complexes. Also, in order to transport heavy material such as building stone, it is thought that waterways such as rivers would have been used, and it may be inferred that the procurement of such routes would have come about through the intervention of state authority. The ash-glazed tiles seen at the Kulen site are suitable for decorating the roof of a royal palace. We can hypothesize that both the building stone and glazed ceramics from the site were materials intentionally produced or obtained by the court. It is further possible that many of the ash-glazed items were manufactured specifically for royal use.

As noted at the beginning of this report, full-scale research has never been carried out at the Kulen kiln site. The extent of distribution of the kilns, and their operating period remain speculative. We urge that concerned researchers join together to expand on this and other initial surveys in view of addressing many of the issues raised in this report and, more generally, in research of Khmer ceramic production currently being undertaken on the Angkor plain. One vital result of research intervention will of course be protection of the site from further destruction by looters.



*Figure 1. Computer-generated bird's-eye view of the Tani kiln site, seen from the southwest*



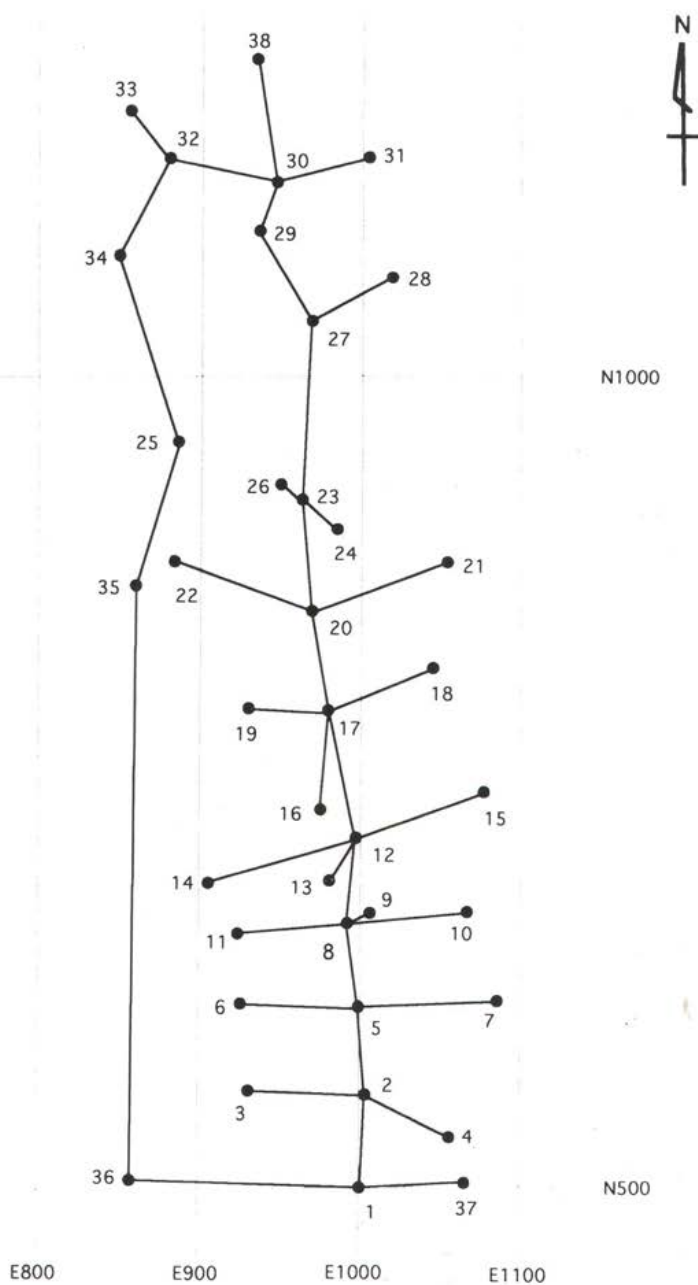


Figure 2. Lay-out of control points for the plane table survey







*Figure 4. Kiln remains and their designation (northern half of the area)*



Figure 5. Survey work at kiln A01, seen from the north

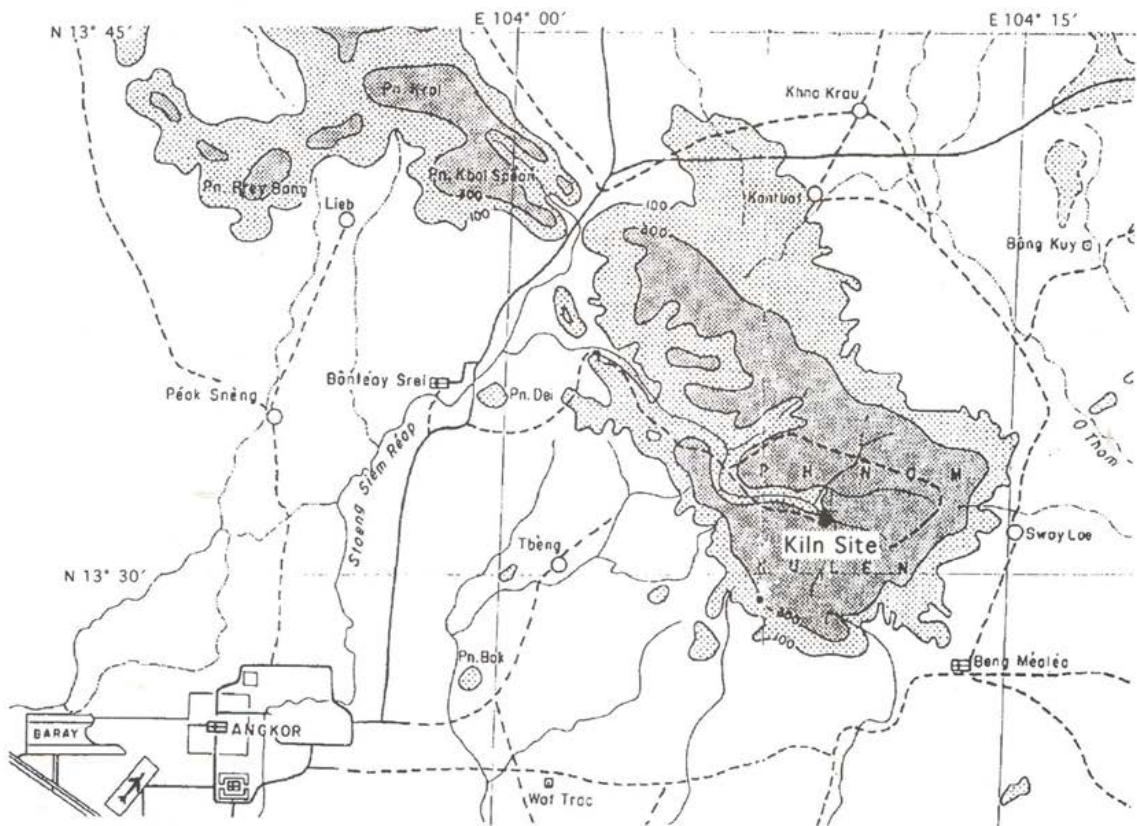


Figure 6. General view of the Thnal Mrec kiln site in the Kulen, northeast of the central Angkor complex (from J. Boulbet, *Le Phnom Kulen et sa région*, Collection de textes et documents sur l'Indochine XII, EFEO, Paris, 1979)





Figure 7. Kulen sites plotted by GPS readings on map published in J. Boulbet, *Le Phnom Kulen et sa région*, Collection de textes et documents sur l'Indochine XII, EFEO, Paris, 1979



*Figure 8. Ceramic objects recovered at the Thnal Mrec kiln site, Phnom Kulen*