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3. The Angkor Monuments: Excavation of a Kiln Site for Khmer Ceramics

Report of the Fourth Investigation of Kiln B1, Tani Kiln Complex

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1. Introduction

Remains of ceramic kilns are situated to the east of the Angkor monumental complex within the Angkor region, located northeast of the Tonle Sap lake in Siem Reap Province, northwestern Cambodia. The Tani kiln complex lies seventeen kilometers east of the Bayon, the monument at the heart of Angkor Thom. It is six kilometers northeast of the Northeast Stele in the East Baray. It lies three kilometers north-northeast of the low, freestanding hill known as Phnom Bok. The Bakaong kiln complex is located nine kilometers west-southwest of the Tani kiln complex. The existence of a kiln site within Cambodia atop Phnom Kulen, the mountain located thirty to forty kilometers northeast of the Angkor monuments, has been known since the late nineteenth century, but its actual circumstances are unclear. The discovery of a kiln complex on the plains between Phnom Kulen and the Angkor monuments is of great historical significance. The purpose of the present investigation is to clarify the situation and structure of the kiln through an ongoing archaeological investigation.

2. History of the investigation of the Tani kiln complex

Area A and Area B of the Tani kiln complex are located atop a long, low dike built of sandy earth and running north-south. The northern portion of the kiln complex, designated Tani Kiln Site Area B, contains vestiges of seven kilns. Five are clustered close together, but not overlapping, while a low mound standing separately at a little distance to the north of that group holds two more. The five are clustered close together as though built one after another. At present each of the kiln mounds measures two to three meters high and close to fifteen meters in diameter.

The B1 kiln was investigated with exploratory trenches in August, 1996, clarifying that the mound was composed of earth used to construct the foundation for the kiln, debris from the collapsed kiln structure, and products of the kiln. The mound in the center of which the kiln foundation was built was constructed of stacks of balls of clay containing lumps of red and white sand about ten centimeters in diameter. The three trenches showed layers of material from the collapsed kiln walls and fired ceramics. At that point it was unclear whether the plan of the kiln structure took the form of a circle or a rectangle, but the excavations that followed in September, 1998, and March, 1999, clarified that issue.

In 1996 mapping was based on sea level; when joined to the contour mapping carried out by the Nara National Research Institute of Cultural Properties, the result was plus 2.5 meters. The zero point of the 1996 B1 measured drawing (the trench intersection) was moved from 37.3 meters to 39.8 meters. In 1998, Mound 1 was divided into four sectors, and the intersection was moved one meter to the east of the zero point for the 1996 investigation. As a result, sector IA constituted the west side of trench IA,

including trench IA itself; sector IB constituted the west side of trench IB including trench IB itself; sector IIA constituted the north side of trench II, and sector IIB constituted the south side of trench II including trench II.

The stratification of the portion containing the kiln structure consisted of surface earth (layer 1) and earth mixed with burnt earth (layers 2 and 3). The second layer was a mixture of clay from the collapsed kiln structure and soil that had filled in, while the third layer appeared to consist of clay from the kiln structure that had fallen into the kiln interior.

3. The structure of Kiln B1, Area B, Tani kiln complex

1) Overall shape

In plan, the kiln structure was an elongated oval with a slightly swollen midsection, and it was composed of three areas consisting of the smoke passage, the ware chamber, and the fuel combustion chamber. The fuel combustion chamber was lower than the sloping floor of the ware chamber. The floor surface of the ware chamber was essentially uniform in grade, but there was a possibility that repair of the floor surface had resulted in providing three gentle steps. A considerable variation in level separated the fuel combustion chamber from the ware chamber, with the fuel combustion chamber situated considerably lower than the ware chamber. The kiln structure showed numerous points of resemblance to the kilns of Northeast Thailand.

The kiln was built on a mound that itself was constructed from stacks of balls of clay containing red and white sand. At the time of its construction the mound of clay balls rose about 3.2 to 3.5 meters at its greatest height above the natural surface of sandy soil. One side of the mound sloped in accordance with the requirements of the kiln plan. There is no evidence that bricks were used to construct the kiln walls or the ceiling, and no bricks were excavated from the site.

Where the side walls survive, the interior width of the ware chamber is roughly 2.84 meters, while traces of foundations of the walls suggest that the greatest interior width of the kiln was three meters and the overall length of the kiln (from fuel combustion chamber to smoke passage) was eight meters. At least once Kiln B1 underwent extensive renovation and repair. As a result, two layers are apparent in most of the ware chamber floor, and the fuel combustion chamber also shows two periods of use, before the major renovation and afterwards. In the lower portion of the ware chamber survives an area where two layers of interior walls met: these made clear that the kiln had been replastered and the manner in which it had been done. In the rebuilt fuel combustion chamber, it seems possible to detect two fuel ports side-by-side to left and right, creating a new problem to be explored.

In this report we will refer to the new kiln after it underwent major renovation as the B1 new kiln (new kiln for short) and to the previous structure prior to renovation as the B1 old kiln (or old kiln). In the old kiln, the angle of the slope of the ware chamber floor was steeper close to the fuel combustion chamber. In the new kiln, the floor had been plastered with clay to create a more-or-less even grade of slope right down to the fuel combustion chamber, while this process also raised the height of the vertical back wall of the fuel combustion chamber.

2) The Ware Chamber

The layering of hard-fired red earth on the floor of the ware chamber showed that the floor underwent replastering several times. The uppermost layer of floor was some five centimeters thick; the layer was reddish toward the top and gradually turned yellowish and finally whitish. Beneath this was the red surface of the previous floor layer. We will refer to the upper layer as floor surface A and the lower surface as floor surface B, but in addition we discovered traces of an additional floor surface beneath these. This seems to be a partial coating, but we will designate it floor surface C. The two basic overall floor surfaces are A and B. Floor surface A belongs to the new kiln, while floor surface B and below belongs to the old kiln. The major portion of the floor surface of the ware chamber has a uniform grade of 18-22 degrees, but the portion closest to the fuel combustion chamber is steeper. That gradient was nearly 50 degrees in the case of floor surface B and about 33 degrees for floor surface A. Perhaps it is more accurate to think of the steep slope of floor surface B as the upper portion of the fuel combustion chamber rather than the lower portion of the ware chamber. In that area closest to the fuel combustion chamber, the floor surface is thoroughly fired, to the point that in that area we excavated some fragments of the kiln wall coated with natural glaze. In the main area of the ware chamber with its gentler grade the floor surface was fired only reddish-brown and the surface was still soft.

At the point where the grade of the floor changed the line of the side walls also curved. It appears possible that the wall was built after the floor was made, conforming to the shape of the floor area. That may be the reason the wall is not straight. Only a low section of the side walls of the ware chamber survives, but almost all that does remain rises vertically from the floor. Only the wall at the boundary between the ware chamber and the fuel combustion chamber rises upward on a diagonal toward the outside of the kiln.

In addition, a portion of the ware chamber floor can be seen to pass beneath the side wall. This shows that the walls were constructed after the floor was built. Repair of such a wall took place at the same time as the floor was repaired.

There is a possibility that a doorway existed in the ware chamber, but we found no trace of one although we searched the floor surface and the foundation structure of the wall. It will be necessary to keep this issue in mind when excavating other kiln sites.

Long, narrow sections of kiln structural material were excavated from the layer of earth inside the kiln in the fuel combustion chamber (layer 2). Their original position is unclear. Did they divide the ware chamber into sections, or did they serve as a flame-baffle between the fuel combustion chamber and the ware chamber? Both are possible explanations. This point will also require careful observation during future excavations.

3) Fuel combustion chamber

In plan the fuel combustion chamber formed a semicircle. The rear wall of the fuel combustion chamber in the new kiln rose vertically from the more or less level floor surface to a height of 90 to 110 centimeters, merging into the steeply-sloping portion of the ware chamber floor. The lower portion of the side walls is nearly vertical, while the upper portion does not survive. The rear wall of the fuel

combustion chamber of the old kiln has not yet been excavated, but the floor level was lower than the fuel combustion chamber of the new kiln, and the angle of the back wall was gentler than that of the new kiln, curving as a continuous surface into the floor of the ware chamber. The floor of the fuel combustion chamber is divided into surfaces A, B, and C representing differences in time. The height of the lowest level, surface C, to the fire-passage hole in the rear wall is 100 centimeters, while that of the uppermost level, floor A, is 90 centimeters. The width of the rear wall is 250 centimeters. The upper surface of floor A is a thin blackish layer including ash and in certain areas forms a hard black surface. Beneath this are clumps of fired clay, and the lowest portion includes brownish-red clay. Charcoal fragments are mixed in floor B. The surface of floor C is not very clear. The lower level of floor C consists of the same red and white clay of which the mound is constructed.

Not only the ware chamber but also the fuel combustion chamber underwent major reconstruction. Floor C represents the surface before reconstruction, while B and A are post-reconstruction surfaces. The floor surfaces A, B, and C of the fuel combustion chamber do not necessarily correspond exactly to the replastered surfaces A, B, and C of the ware chamber floor, but each was extensively redone one time. It is probable that the floor of the ware chamber was replastered in spots as required. Since major repairs to the fuel combustion chamber floor probably took place less often, it is likely that the major repairs of both areas occurred at the same time. However, it is clear that the areas of the wall around the fuel ports in the fuel combustion chamber of the new kiln were also replastered several times. The surface of the floor is hard and black, but in disturbed areas is visible clay of the same red and white color as that of the clay forming the mound, indicating that the fuel combustion chamber was also built on top of the artificially-constructed mound. It appears that a baffle wall stood on the steeply-sloping floor at the divide between the fuel combustion chamber and the ware chamber. On that surface, at the midpoint between the two side walls, can be seen traces of a cylindrical clay column that once stood there. The cylindrical clay column broke and fell onto the flame-hardened floor of the fuel combustion chamber, and the longest surviving portion measures 70 centimeters. The narrowest section is 36 centimeters in diameter. Since about 10 centimeters of the column survives in place on the steeply-sloping floor, the original column was at minimum 80 centimeters high. The surface of the cylindrical column is gray and not very thoroughly fired. It can be estimated that there was a distance of more than 170 centimeters from the floor of the fuel combustion chamber to the upper portion of the cylindrical column. Viewed from the fuel combustion chamber, this created two openings of a size that a person could pass through. This column also served as a flame-dividing pillar. But since this passage was high off the surface of the fuel combustion chamber floor and extremely difficult to enter, it is impossible to reject the possibility of a separate entrance into the ware chamber where the pottery was fired.

In the right rear corner of the fuel combustion chamber, a portion of the rear wall surface to a height of about 26 centimeters above the surface of floor C consists of the unaltered old rear wall. From there the rear wall of the fuel combustion chamber of the new kiln rises more or less vertically or is even plastered so as to overhang the old wall, and the rear wall of the old kiln cannot be seen in the present condition. Judging from the portion of the rear wall of the old kiln visible in the right rear corner, the slope rose

rather gently to the height of about 26 centimeters, suggesting that it formed a continuum with the floor (floor B) of the old kiln. Accordingly, it is highly likely that the original form and the final state of the fuel combustion chamber in this kiln were different. At the time of preservation, it will be important to expose one portion of it.

The surface of the rear wall of the fuel combustion chamber of the new kiln bears numerous fingerprints. They are traces left by smearing on clay in a diagonal—downward to the left or upward to the left. The rear wall is nearly vertical, but a portion of the right side is overhanging. Some small firing stands are attached beneath the flame-passage holes in the interior wall—that is, in the angle of the rear wall that meets the floor surface of the ware chamber. On the left side is a single row of only the square portions, but on the right side several rows are lined up extending into the interior. Some have already come off, but their traces are visible. Since this area received the direct impact of the flames, it was not a good place for stacking wares. Were wares really placed here or not? Probably they were, but they did not fire successfully.

A portion of the right-hand side wall of the fuel combustion chamber of the old kiln was replastered. At the point where the side and the rear walls meet, it is clear that the rear wall was also replastered. On the lefthand side, only the lower portion of the old wall survives. On top of it was built the new floor (floor surfaces B, A), and the left-hand wall of the fuel combustion chamber of the new kiln was rebuilt rather than replastered. It appears that the fuel combustion chamber had one fuel port each on the left and the right, for a total of two. If that was indeed the case, at the time of repair the two fuel ports were moved somewhat to the left. The area in front of the fuel combustion chamber has not yet been investigated, however, and it will be necessary to confirm whether two fuel ports really existed. Floor C of the fuel combustion chamber of the old kiln is at approximately the same level as the level beneath the clumps of fired clay lying outside the chamber at the front. Floor A of the fuel combustion chamber in the new kiln lies above the layer of fired clay and other material outside the chamber, indicating that the new floor surface and the surface outside the chamber were approximately the same.

4) Smoke passageway

Only one portion of a surface covered by scorched red clay that can be assumed to be the floor of the smoke passageway survives on the uppermost surface of the mound. It was constructed at the peak of the artificial mound made of balls of clay containing red and white sand. The slope of the smoke passageway at the tip of the mound is almost level, and the portion that seems to slope down to the floor of the ware chamber has a gradient of about 36 degrees. There was no evidence of major renovation to this area such as was conducted for the ware chamber and the fuel combustion chamber.

5) Kiln furniture

Several types of kiln setting tools were excavated, but both varieties and quantity were extremely limited, and all were types of stacking supports made from clay. During the third investigation we had excavated just shallow round bowl-shaped setters and cylindrical tubular setters, and during the fourth investigation as well we excavated very few kiln tools, consisting only of a small quantity of stacking devices. These included round, flat disks with diameters of 11, 9, 7, or 5 centimeters, of which the middle

size with a diameter of 9 centimeters was most numerous. In most cases, the disks were round in plan; in cross-section with the upper surface more or less level, the edge was slightly mounded and the lower surface was graded to match the slope of the chamber floor. When the disks were placed on the sloping floor of the ware chamber, the upper surface would be level. A few pieces were almost dish shaped. We found several rows of small stands with a diameter of about 5 centimeters attached directly to the floor, starting at the angle where the wall at the rear of the fuel chamber changed to the ware chamber. Scars on the chamber floor showed where others had been removed. Round scars filled the upper surfaces of all the supports, with the perimeter slightly mounded from pressing down the round object on the stand.

6) Artefacts

The excavated artefacts consisted of ash-glazed pottery, unglazed pottery, and unglazed tiles. Among the ash-glazed pottery lidded boxes were most numerous, and there were also some bowls. In the fourth investigation small bottles with dish mouths were rare, and the number of them remaining within the kiln was very small. Among the unglazed pottery, sherds of jars were numerous. Among tiles, the ornamental eaves tiles were very few in number, and most were semi-cylindrical tiles.

Locations where artefacts were recovered: Sherds of grayish-black unglazed pottery were found in the layer between floor surface A and floor surface B. From the third layer of the fuel combustion chamber was recovered a sherd of grayish-black unglazed pottery fused to a sherd of ash-glazed pottery. Also from the third layer of the fuel combustion chamber was recovered the lid of an ash-glazed box with a knob in the shape of a four-petal flower.

During the earlier investigation of the upper half of this kiln, we had uncovered numerous tiles from the interior of the kiln (layer three), but this time during the investigation of the kiln's lower half we found very few. Possibly the type of object fired varied with the location in the kiln.

The clay in the layers of the floor of the fuel combustion chamber consisted of balls of fired clay and red fired clay of a sandy consistency. Very little other material was mixed in, although some setting tools and fragments of pottery were recovered.

Characteristics of the excavated artefacts. Many of the grayish-black unglazed pottery jars (or vats) bore everted mouth rims. The same type of rim was found on many jar sherds that were underfired and still soft.

7) Samples for radioactive carbon dating.

Carbon for use in dating was collected from three locations:

- (1) A small quantity from the layer between floor A and floor B of the ware chamber.
- (2) A large quantity from the layer of carbonized material immediately below floor A. This material resulted from combustion at the time of the final use of floor B.
- (3) A small quantity from the third level in the fuel combustion chamber.

8) Condition of the kiln site

After completing the excavation, we carried out preservation of the site by filling the kiln cavity with earth, over which additional earth and sand were mounded, completely refilling the excavated kiln and recreating the present shape of the mound. In the future, a decision on how to preserve the excavated kilns

or make them accessible to the public will need to be taken at the conclusion of the investigation of the site as a whole, as one of the consequences of the excavation.

9) The state of the kiln's preservation

In later times the sloping surfaces of the mound was extensively dug away. Nonetheless, the portion of the kiln lying beneath the present surface of the mound, including the fuel combustion chamber and the ware chamber floor and side walls, is in fairly good condition. This can be estimated to be more or less the case for the kiln structures within the other mounds.

This situation suggests that it will be difficult in future excavations, just as it was in this one, to determine the structure of the smoke passage at the rear of the kiln. In cases where the kiln was built on an artificially constructed mound rather than making use of a natural slope, it can be expected that the smoke passage was constructed at the very top of the mound, as a result of which it was unlikely to survive.

10) Dating

This investigation focused on the kiln. Excavation of the wast heap remains to be done. Accordingly we are not yet at a point where we can make a judgement concerning the dating of the artefacts. According to Bernard Groslier, ash-glazed pottery made its first appearance [in excavated sites] in the last quarter of the ninth century, while it became quite rare from the beginning of the twelfth century onward. Furthermore, Tsuda Takenori proposes that, based on the similarities to Chinese ceramics, the early Khmer ash-glazed ceramics date no earlier than the Northern Song period (960-1127). He suggests that the ash-glazed pottery from the Tani site is no earlier than the second half of the tenth century and (based on Groslier's opinion) no later than the second half of the eleventh century.

11) Problems for Future Consideration

The next excavation should make use of trench investigation to reexamine issues regarding the structure of the various parts of the fuel combustion chamber, to determine the position of a wast dump for the failed wares in the vicinity of the fuel combustion chamber, to locate the position of the workshop, and to try to recover tools used in production. Moreover, in order to try to solve the various puzzles raised by excavation of a simple kiln structure, we feel it is unavoidably necessary to investigate the adjacent mounds. In order to recover basic materials to serve in a consideration of how to preserve and utilize the Tani kiln complex site as a whole, we think that excavations of the mounds adjoining Kiln B1 are essential.

(Translated by Louise Allison Cort)