

Excavations at Ban Tamyae and Non Ban Kham, Phimai Region, Northeast Thailand

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INTRODUCTION

DURING 1979 AND 1980 the Khorat Basin Archaeological Project (KBAP)—a co-operative project involving researchers from the University of Hawaii, the Fine Arts Department of Thailand, and Chulalongkorn University—conducted survey and excavation of sites in the vicinity of the town of Phimai in northeast Thailand. Phimai formerly served as a regional Khmer sacred, administrative, and commercial center from about A.D. 1000 to 1300. Archaeological and historical evidence indicated that Phimai might have been an important center before its integration into the Khmer state. The approach taken in the research was regional, investigating the development of Phimai as a major center by focusing upon the towns that formed alternative or minor centers and upon the villages and farms that constituted the hinterland for Phimai and supported its development. The primary focus of the investigations was on the fortified or moated sites, sites surrounded with earth walls and moats, first identified on aerial photographs by Peter Williams-Hunt (1950). The goals of the research included the location, mapping, and dating of the moated sites in the Phimai region and determination of the function, date of construction, and present condition of the earthworks at these sites. Two hypotheses were proposed for testing: (1) the concentration of population into these moated sites was associated with the practice of intensive wet rice agriculture, and (2) these sites were centers for long-distance exchange.

In a previous paper, Welch (1983) presented preliminary results based primarily on in-the-field analysis of the data. A later paper (Welch 1984) provided a more thorough analysis of the site survey data and their implications in terms of settlement, subsistence, and political organization during the late prehistoric period in the Phimai region. The present paper furnishes detailed information on the excavations conducted at two sites, Ban Tamyae and Non Ban Kham. In particular, this paper

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presents data regarding the stratification of the cultural deposits at these sites and their dating, proposes a regional ceramic phase sequence, and discusses the implications of these data for the chronology of late prehistoric and early historic settlement on the Khorat Plateau. The radiocarbon dates will also be published by Bronson and White (n.d.) in their list of Southeast Asian radiocarbon dates, but it is important to discuss these dates in relation to the stratigraphic contexts from which they were derived. This information is discussed in more detail in Welch's University of Hawaii dissertation (1985), but it is summarized here because of its relation to issues of wider concern.

RESEARCH AREA

The town of Phimai is located along the Mun River in Nakhon Ratchasima Province, northeast Thailand, near the southwestern edge of the block-like uplifted structural basin called the Khorat Plateau (Fig. 1). This portion of the plateau, the upper Mun River valley, is drained by the Mun River and several of its tributaries which originate in the mountains that form the southwest edge of the plateau. These rivers flow northeastward toward Phimai, where they have created a large alluvial plain, approximately 60 km long and 20 km wide. The town lies near the center of this plain, which forms the core of what will be referred to as the Phimai region.

To the southwest and northeast the floodplain is much constricted; thus the Phimai alluvial plain forms something of a natural unit. This level plain contains one of the largest continuous stretches of land well suited for wet rice agriculture on the Khorat Plateau. To the northwest is the terrace zone, an area of low, undulating plains, composed mainly of alluvial terraces. The uplands, southeast of the alluvial plain, consist primarily of old high alluvial terraces that have been eroded to rolling hills by the rivers and streams that dissect the region.

A reconnaissance field survey of possible moated sites was conducted within a rectangular 300 km² survey area extending 5 km north and south and 15 km east and west of Phimai. Most of the survey area falls within the alluvial plain, and all sites investigated lie upon the alluvial plain. The survey revealed the presence of at least ten sites with earthworks that may have previously been moats or walls around the site perimeters (Fig. 2). Excavations were conducted at two of these sites: Non Ban Kham and Ban Tamyae.

THE EXCAVATIONS

Excavations at Non Ban Kham (NR-A-10)

The first site selected for excavation was a small unoccupied mound, about 3 km northeast of Phimai. This site, designated NR-A-10, is nearly square, 160 m N-S by 150 m E-W, 2.3 ha in area, and 1.6 m high. In conversation with an elderly monk in Phimai, we learned that the mound (*non*) had been the location of a village named Ban Kham (Tamarind Tree Village), which had been abandoned early in this century, apparently due to an epidemic.

Surface survey and excavation of five cores with a soil auger revealed the presence of both late prehistoric and historic potsherds. Several factors favored selection of

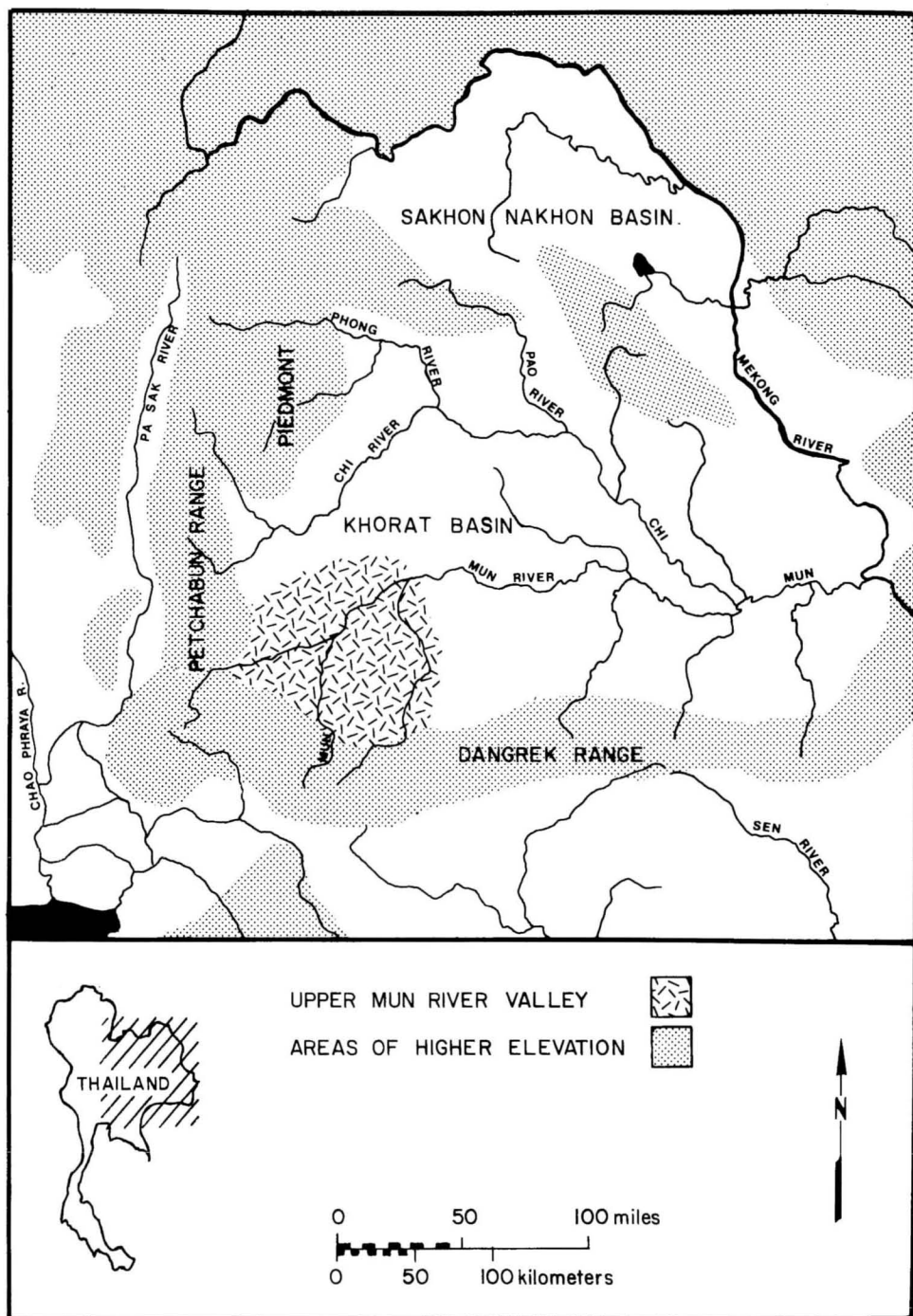


Fig. 1. The Khorat Plateau and the upper Mun River valley. The Phimai region research area is located in the northeast section of the upper Mun River valley.

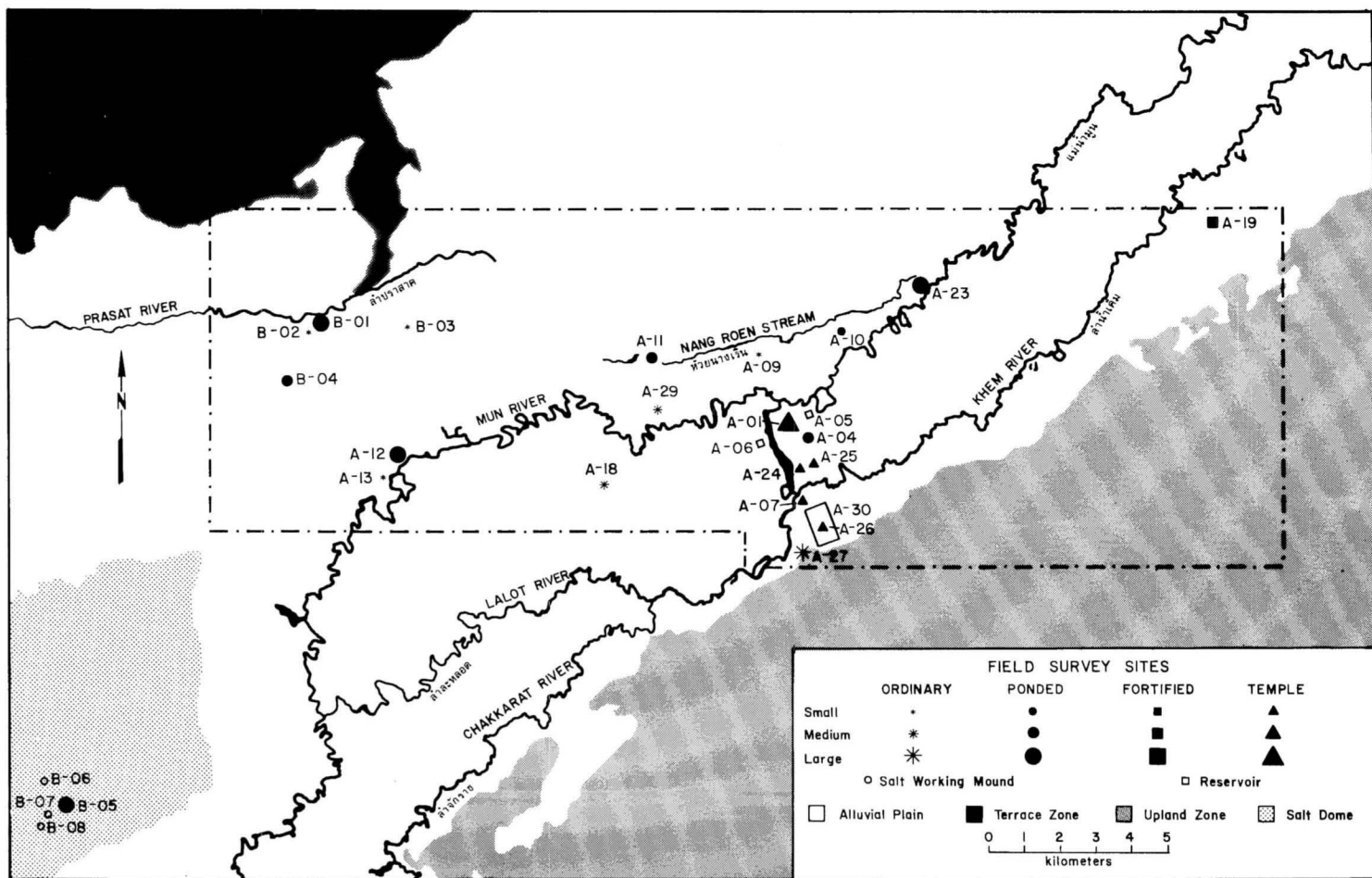


Fig. 2. Field survey area with the location of archaeological sites surveyed.

the site for excavation: proximity to Phimai, absence of current occupation, small size and low height making possible excavation of a representative sample, and presence of a small but typical earth wall segment.

Excavation at Non Ban Kham and subsequently at Ban Tamyae began with the laying out of excavation units aligned in cardinal directions along grid coordinates centered on a datum point near the center of the mound. The original 1 m² in each test pit was excavated in 10 cm arbitrary levels, except where boundaries of natural layers or cultural features were easily discerned. Subsequent squares were excavated sequentially, adjacent to already open squares, and dug by natural soil layers or cultural units, following the stratification observed in the previously excavated area. Layers and features more than 10 cm thick were excavated in 10 cm or occasionally 5 cm spits. The hard, dry clay of the uppermost layer generally required removal by pick or hoe, but lower loamy layers and layers with abundant cultural material were excavated by trowel, while relatively hard, plastic clay layers with little or no cultural material were dug with spades. All soil, except hard clay peds, which had to be broken with a trowel and sorted by hand, was sieved through 6 mm mesh screen, and 3–5 liter soil samples for fine screening and flotation were collected from each stratigraphic unit.

Five test pits (TP), covering 7 m² and involving removal of 11 m³ of soil, were excavated at Non Ban Kham, three along the central north–south axis of the site (TP1–3), one on the east slope (TP4), and one on the earth wall (TP5) (Fig. 3). TP 1 and TP 2, near the center of the mound, located 10 m south and north of datum respectively, were each 1 × 2 m test pits. TP1 (Fig. 4), excavated to a depth of 190 cm below surface (b.s.), possessed six clay loam and sandy clay loam soil layers containing cultural material, overlying the sandy clay alluvium at the base of the mound. TP2, excavated to a depth of 210 cm b.s., contained six similar, but not identical, layers with cultural material. Both TP3 and TP4 were 1 × 1 m pits excavated to a depth of about 120 cm b.s.; they were located on the lower slopes of the mound, and each contained four cultural layers. TP5, 1 × 1 m, on the 80 cm high earth wall, dug to a depth of 110 cm b.s., consisted of six generally sandy soil horizons, but contained no cultural or other datable materials.

Only a few cultural features were found in the deposits. A trash pit in Layer 3 of TP1, probably dating from early in the Ayutthaya era, contained two cylindrical clay tubes, a bead, and abundant mollusc shells, bones, and sherds. In TP2, Layer 2, a concentration of very large freshwater molluscs, probably of the genus *Chamberlainia*, formed an upright circle, perhaps intentional. In Layer 5 four small postholes were found near one another.

The excavations at Non Ban Kham revealed a series of historic deposits, apparently little disturbed and useful for defining the historic regional ceramic sequence. However, the mound was apparently not settled until late in the prehistoric period and only one or at most two layers with prehistoric materials were found at the base of the test pits. No premodern metal or agricultural implements were found; the quantity of midden was slight, except in three cultural features; and no charcoal was found for dating the prehistoric layers. Excavation on the earth wall produced no data relevant to determining its date or function. Therefore we decided to cease excavation at Non Ban Kham and turn our attention to another site that might be more productive of data relating to the project objectives.

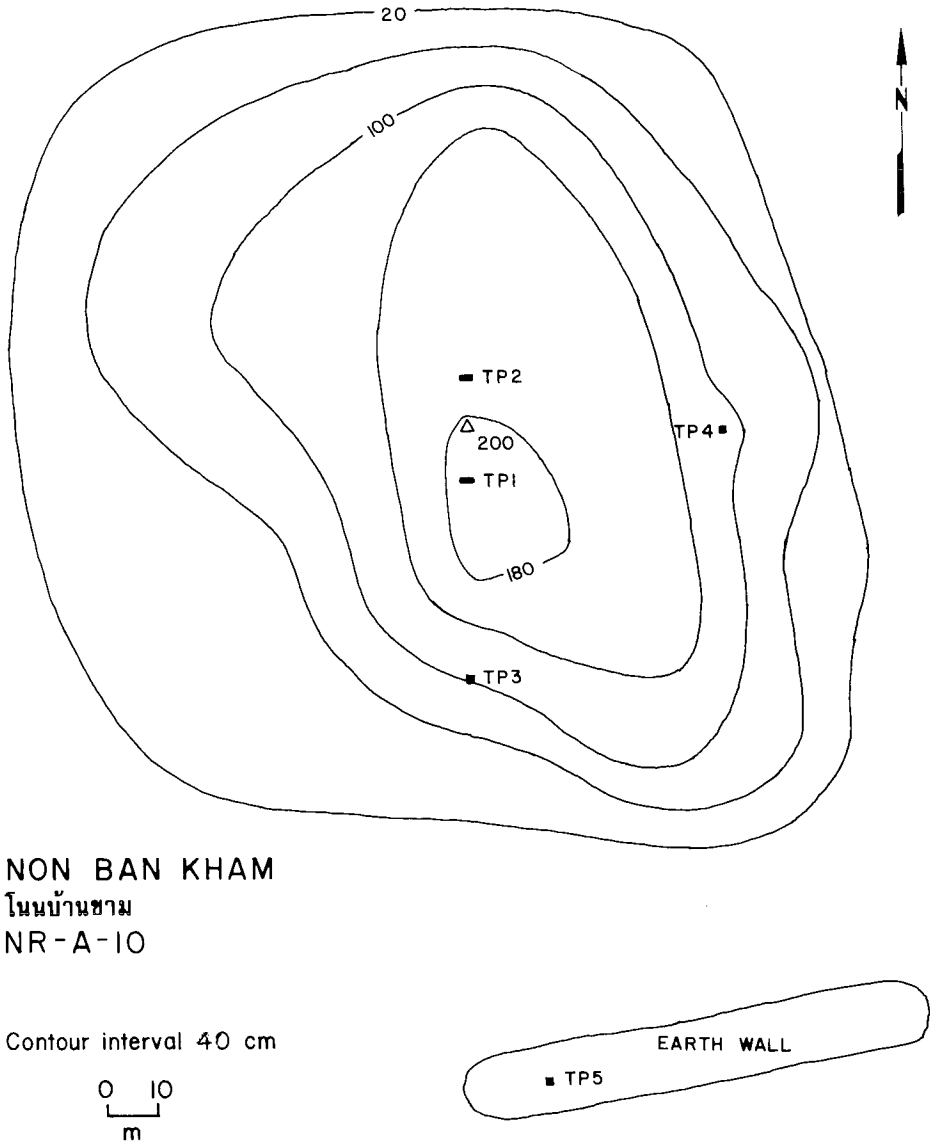


Fig. 3. Plan of Non Ban Kham (NR-A-10), showing location of test pits (TP).

Excavations at Ban Tamyae (NR-A-11)

Ban Tamyae is a village located on a mound about 5 km west-northwest of Phimai, 2 km north of the Mun River, along the Phimai–Talat Khae highway. The nearly circular mound, designated NR-A-11, measures 460 m in diameter, covering an area of about 17 ha, and stands approximately 4.5 m above the surrounding plain (Fig. 5). A seasonal stream, the Lam Nang Roen, runs along the north side of the site; closer in, at the mound edge is a series of narrow, discontinuous ditches. On the west side of the mound, at its edge, are a few short possible earth wall remnants.

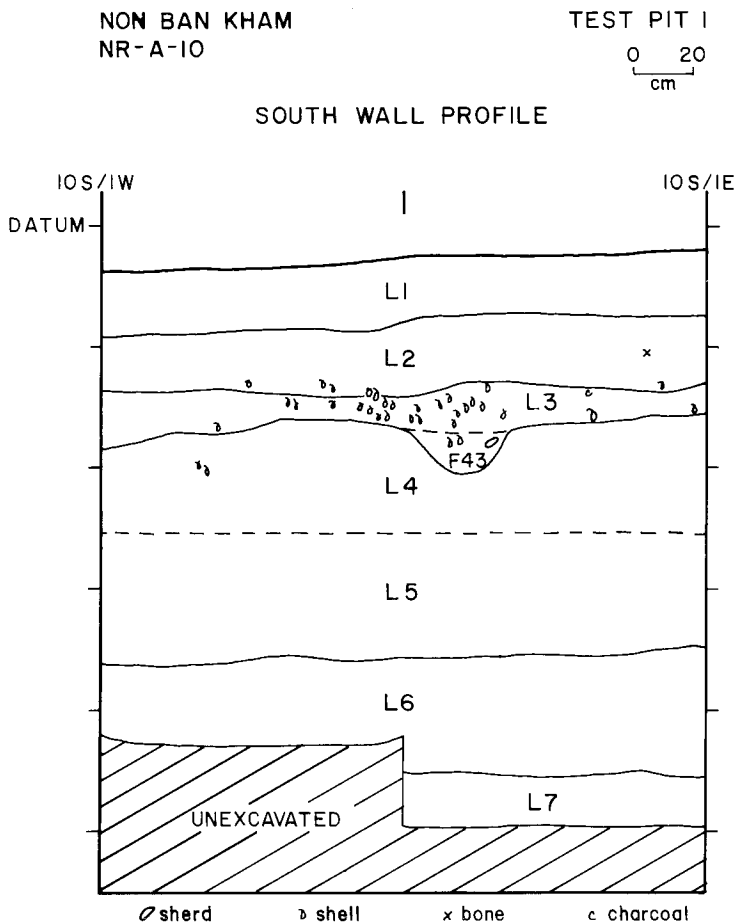


Fig. 4. Non Ban Kham TP1 south wall profile.

At the time of the excavations a village of 135 households, numbering 700–800 persons, occupied the mound. Each household resided in a rectangular compound of about 1000–1500 m², containing a house, small utility buildings, and gardens, generally enclosed within a wooden fence or line of tall plants. The villagers were all rice farmers, but some also worked in the dry season at a large salt-mining station about 2 km west of the village operated by one of the wealthier villagers. The focus of village life was a small *wat* (Buddhist monastery) located on the south side. The village received its name because a popular legend widespread in the upper Mun River valley holds that the midwife (*mo tanyae*) who delivered the Khmer heroine, Nang Oraphim, lived in this village. Villagers reported that a Khmer temple (Wat Kao) once stood on the north edge.

The site was chosen for excavation because of its large size, suggesting its possible former function as a center; presence of typical wall and moat remnants; and abundant surface evidence of prehistoric occupation in the form of sherds in road cuts, at the mound edge, and in open fields, especially in the *wat* compound. Easy transport

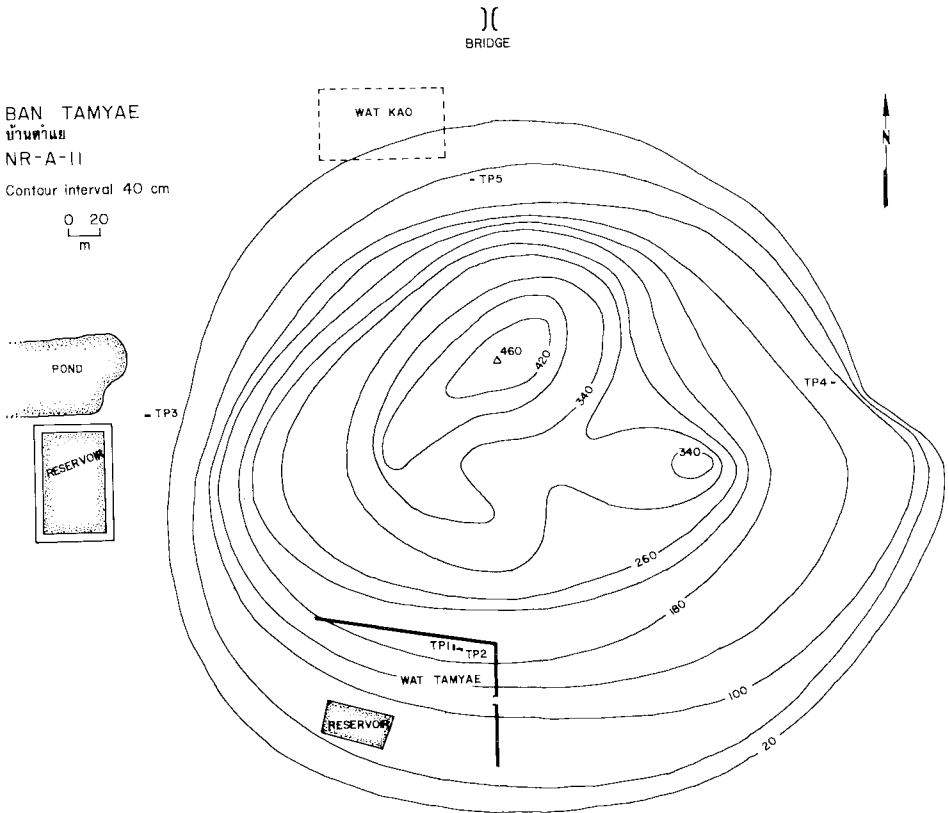


Fig. 5. Plan of Ban Tamyae (NR-A-11), showing location of test pits (TP).

to the site from Phimai, the ready cooperation of the headman, and the willingness of the abbot to permit excavation at the *wat* provided additional advantages.

Because of the height of the mound, test pits were confined to the peripheries where wide areal excavation units were not necessary to permit excavation to the base of the cultural deposits. Five test pits were excavated, covering 17m² and involving removal of about 28 m³ of soil. The first two test pits were opened in the *wat* compound. Surface collection of a randomly selected 10 percent sample of 5 × 5 m grid units identified areas of heaviest concentration of prehistoric sherds. In one of these areas, north of the *bot* (sacred *wat* structure), two test pits were excavated.

TP1, a 1 × 4 m test trench, was excavated to a depth of 230 cm b.s., and to 250 cm b.s. in one square. TP2, a 1 × 4 m trench with a 1 × 1 m extension, was excavated to a depth of 220 cm b.s. These test pits were located in close proximity to one another; each contained ten main soil layers (L), numbered L1 to L10 from the top down (Figs. 6 and 7). These layers, with the exception of L6 in each pit, could be confidently correlated with one another. In addition to the main soil layers, TP1 contained 12 soil zones of limited extent and 13 cultural features, while TP2 contained 13 minor soil zones and 16 cultural features.

L10 is the basal sandy clay alluvium, while L9 may be a buried soil that had been

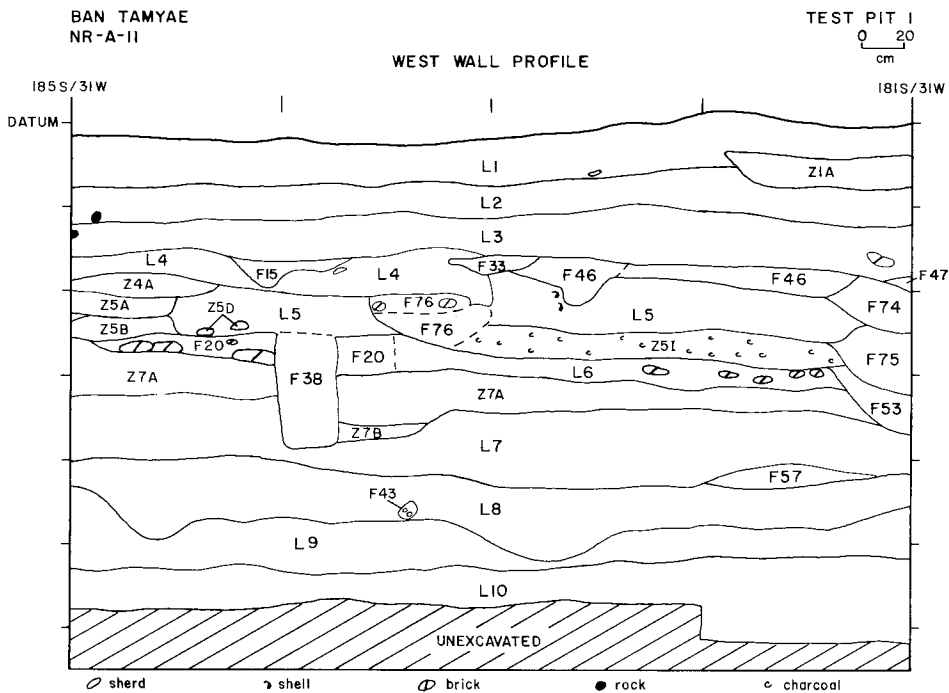


Fig. 6. Ban Tamyae TP1 west wall profile.

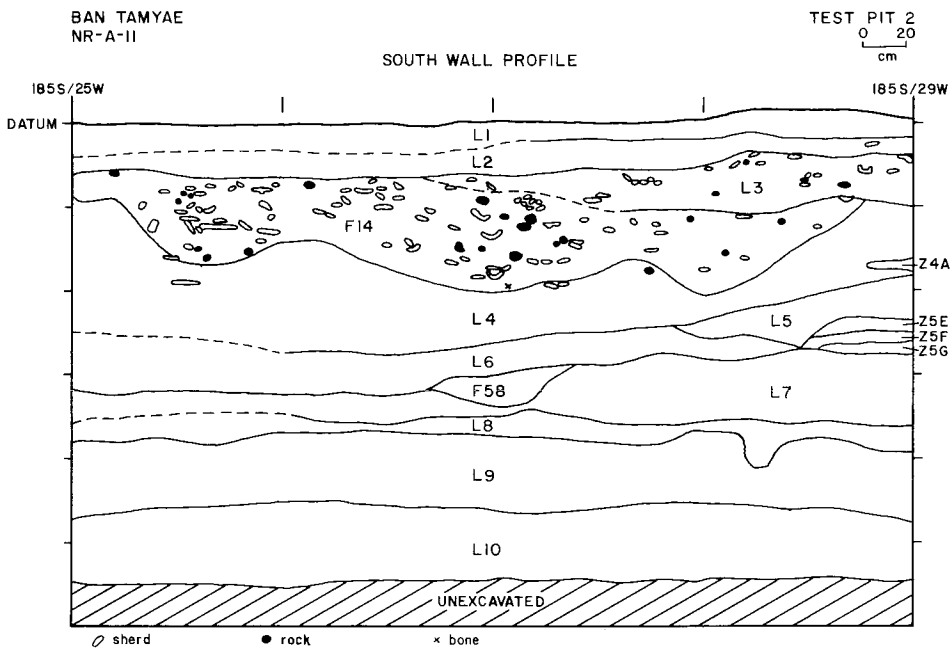


Fig. 7. Ban Tamyae TP2 south wall profile.

forming from the sediments when the site was first occupied. L9 contained very few sherds, perhaps intrusive from the above layers. However, L8 with its dense midden accumulation of freshwater bivalve and gastropod shells mixed with sherds is clearly the result of regular human use of the area. L8–L1 are generally clay loams or soils that have a texture close to clay loam, are subangular blocky in structure, and appear to be the result of refuse disposal, aeolian deposits, and soil brought in intentionally and accidentally by humans and animals and deposited on the mound. These layers all contained abundant cultural material, including features, artifacts, and faunal remains.

The ten main soil layers can be described briefly as follows:

- L1 Moderate-structured, very hard, pale to grayish brown silty clay, with sherds common in TP2 but few in TP1.
- L2 Strong-structured, hard, brown silty clay, with sherds common.
- L3 Moderate-structured, hard, dark brown clay loam; bricks and animal bones common and sherds abundant.
- L4 Moderate-structured, friable, brown clay loam; sherds and bones common.
- L5 Hard, brown clay loam with very hard gray clay intermixed; little cultural material.
- L6 In TP1, weak-structured, firm, dark brown clay loam, with sherds and bones common; in TP2, weak-structured, friable, brown clay loam with sandy clay mottles, with sherds and bones common at the top of the layer, but few at the base.
- L7 Friable, dark to very dark brown clay loam; numerous cultural features and abundant artifacts.
- L8 Weak-structured, friable, very dark brown clay loam; sherds common and nonmarine aquatic molluscs abundant.
- L9 Weak-structured, firm, dark brown to reddish brown sandy clay loam; very little cultural material.
- L10 Reddish yellow, very firm, plastic sandy clay, with limestone concretions common; natural alluvial sediment.

Prehistoric earthenware sherds, of which an estimated 50,000 were recovered from TP1 and TP2, dominated the artifact inventory through all layers. A few historic-period artifacts, including stoneware sherds and a clay votive tablet with a Buddha image identified as Ayutthaya style, were present in the uppermost layer. Fired bricks were common, especially in a group of similar features termed burnt brick features. Other, less common, clay artifacts included spindle whorls, pellets, and hollow tubed cylinders that were probably used as amulets. Pieces from eight well smoothed and polished bone bracelets were recovered. Three lenticular stone adze blades were found in L6 and L7. A copper/bronze bracelet was found in L8, and bronze was present in several layers above. A spike-shaped iron artifact, probably a chisel, and iron fragments were recovered from L7, and fragments were also found in the layers above. The corrosion of the chisel precluded metallographic analysis, but examination by Vincent Pigott (University of Pennsylvania MASCA) revealed that the artifact had in fact been socketed around a piece of bone.

Preservation of faunal remains—bone, antler, and shell—was quite good; the alkaline soil effected rapid mineralization of bone. Bones were especially abundant in two trash pit features (F14 and F47) and mollusc shells in F47 and in L8, a dense

midden layer. On the other hand, the alkalinity appears to have been destructive of plant remains. No seeds, nut shell fragments, or other plant parts were recovered through flotation or fine screening. The only preserved plant materials were rice chaff and chaff impressions included in potsherds and charcoal fragments.

Features (F) encountered during the excavation included fire pits, a few trash pits, numerous postholes, especially in L6 and L7, and the burnt brick features. The last were large circular features of hard, light colored soil containing numerous fragments of burnt brick, charcoal, and other evidence of intense heat. Parts of three human burials were encountered, one in L6, one overlapping L7 and L8, and one in L8, but burial cuts could not be discerned. A trash pit (F47) in TP1, L4 contained abundant sherds and midden, and two overlapping trash pits (F14) in TP2, L3 contained the densest accumulation of sherds (approximately 100 kg/m³) and bones recovered at the site.

Much less information was obtained from the excavation of the remaining three test pits. TP3, 1 × 4 m, was excavated through a possible moat and embankment remnant on the west edge of the site, but the soil layers in the embankment were extensively disturbed. The moat fill from 10 to 70 cm b.s.—at which depth excavation was terminated before reaching the base of the layer or the cultural material—consisted of a thick, homogeneous layer of clay containing very worn sherds of indeterminable age. Plans to excavate another possible moat remnant proved unfeasible, so TP4, 1 × 2 m, was opened on the east slope, and TP5, also 1 × 2 m, on the north slope in an attempt to determine the spatial extent of prehistoric occupation. We excavated TP4 to the base of the cultural material at a depth of 170 cm b.s., but were forced to cease excavation of TP5 at 80 cm b.s. with cultural material still present. Thin layers of prehistoric materials were found at each location, overlain by early historic or disturbed deposits.

DATING

The proposed dating of the deposits at Non Ban Kham and Ban Tamyae is based both on analysis of the ceramics and other artifacts recovered in the excavation and upon eight radiocarbon dates from the sites.

Radiocarbon Dates

Eight samples of wood and/or bamboo charcoal were submitted to Beta Analytic, Inc., for radiocarbon dating. Sample provenience and resultant age determinations are presented in Table 1. All calendrical dates from radiocarbon samples in this table and elsewhere in the paper have been corrected using the Klein et al. (1982) 2 σ calibration tables. Two samples, Beta-2750 and Beta-2757, were found to contain small amounts of carbon and were subjected to long counting times, but the standard deviations are still greater than normal. The seven dates from Ban Tamyae TP1 and TP2 fall generally within the expected time range, but their chronological order does not correspond with their stratigraphic position. We will discuss the dates from the most secure contexts first, and then we will interpret the remaining dates in relation to these.

Beta-2752 and Beta-2755. Sample Beta-2752, consisting of charcoal collected from beneath a brick along the perimeter of F20, a burnt brick feature in TP1, was clearly

TABLE 1. RADIOCARBON DATES

BETA #	TP-SQ	LAYER	FEATURE	DEPTH (cm b.s.)	^{14}C YEARS $\pm 1\sigma$	YEARS B.C./A.D. $\pm 2\sigma$
Site NR-A-10						
2750	2-B	5	—	106–120	1180 \pm 100	A.D. 660–905
Site NR-A-11						
2757	1-D	7	57	156–160	2520 \pm 130	1010–390 B.C.
2753	2-A	6/7	37	152–154	2050 \pm 60	360 B.C.–A.D. 45
2754	2-A	6/7	37	171–172	2170 \pm 70	395–25 B.C.
2752	1-B	6	20	103–106	2100 \pm 70	380 B.C.–A.D. 15
2755	1-C	6	—	114–117	2100 \pm 60	380 B.C.–A.D. 15
2751	2-B	3	14	53–54	2350 \pm 60	750–265 B.C.
2756	2-C	3	14	63–64	2390 \pm 60	765–390 B.C.

Years B.C./A.D. calibrated using tables in Klein et al. 1982.

associated with that feature. An identical date was obtained from sample Beta-2755, found near a group of bricks in L6, confirming the association of F20 and L6.

Beta-2757. Charcoal for this sample was found within the TP1, F57 burnt brick feature, which appeared to be a pit cut from near the base of L7. Both the feature and the lowest level of L7 contained a comparable mixture of Phimai and Tamyae tradition sherds, and therefore the date should apply to the materials at the base of L7.

Beta-2753 and Beta-2754. These samples were recovered at the edge of the F37 posthole in TP2 near the top and base respectively of L8. They were found in what appeared to be L8 soil and were submitted, even though the provenience was questionable, in the hope that one or both would date the earliest occupation level in the site. The dates are similar enough for it to be highly probable that both came from a single context. Both are much later than the L7 Beta-2757 date and quite close to the L6 Beta-2752 and Beta-2755 dates. It seems clear that the charcoal for these samples is derived not from L8 but from the fill of F37, which was cut from near the L6/L7 interface.

Beta-2751 and Beta-2756. Similar dates were produced by two large pieces of charcoal from within the west F14 refuse pit in TP2, L3. These dates are in close agreement and produce a date of 2370 \pm 50 B.P. when combined—a date that, even at the extreme end of the 2σ range, is earlier than any of the L6 and F37 dates and thus poses a serious chronological problem. Unlike the charcoal from F20 and F57, which probably derived from the actual use of the wood during the functioning of the features, these pieces of charcoal were part of trash pit fill. The possibility that the cultural materials in the trash pit were derived from an earlier depositional context was considered, especially in light of the scattered human bone found in the pit. The charcoal might then date the materials in the fill, but not the infilling of the pit. However, the ceramic assemblage is very similar to those from the adjacent layers (L2, L3, and L4) and is unlikely to have come from an earlier context that was later disturbed. It is more likely that the charcoal came from old wood, which much later

became incorporated in the F14 pit along with a few, clearly intrusive, Tamyae sherds through bioturbation or some other disturbance. We conclude that these samples date neither the filling in of F14 nor the materials in the pit, and we interpret F14 as dating later than the dates suggested for L7 and L6 by the above five radiocarbon samples (that is, less than 2200 years ago).

Beta-2750. The only sample submitted from Non Ban Kham consisted of charcoal pieces scattered throughout one square of TP2 and through 15 cm of depth within L5. Even then, the sample proved to contain insufficient carbon for standard counting. Although not an ideal sample, the 2σ range of A.D. 660–905 corresponds well with the dating that would be predicted based on the finding of early historic sherds, similar to the Se complex at Chan Sen, in a layer overlying late prehistoric Phimai-tradition sherds and beneath Lopburi-style Khmer sherds.

Ceramic Analysis

A preliminary type analysis of ceramics from the survey and a few excavated units at Ban Tamyae, coupled with inspection of all the excavated materials, resulted in the definition of four major ceramic traditions in the Phimai region: Tamyae, Phimai, early historic, and recent historic (Welch 1983). The traditions were defined on the basis of variation in extent of firing, temper, surface finish, and decorative pattern. The chief criterion used in defining traditions was similarity in technological attributes, although stylistic traits proved to be closely correlated with technological traits.

Coding of attribute states for 20 attributes, and frequency and covariation analysis of these using a sample of 1890 sherds, primarily from TP2 at Ban Tamyae, were subsequently conducted to create a finer ceramic sequence and to interpret patterns of exchange. The analyses resulted in the delineation of three components in TP1 and TP2 at Ban Tamyae.

Component A, consisting of materials from L8 and L9, contains primarily Tamyae-tradition sherds, distinguished by the use of sand and grog as temper, thin vessel walls, and relatively high firing temperatures that produced fine, hard, partially vitrified wares.

Component B, found in L6 and L7 and associated features, contains predominantly chaff-tempered Phimai-tradition sherds, although several Tamyae-tradition sherds were present in the lowest level. Rice chaff was used as temper in most sherds (85 percent), but sand, laterite, both sand and laterite, or both grog and sand were frequently also added with the chaff as tempering agents. Vessels were not fired to as high a temperature as the Tamyae vessels. The presence of a high percentage of red, reddish brown, or reddish yellow slipped and pattern burnished thin-walled bowls with simple rim forms (Fig. 8) characterizes this component. Several very thin cord-marked jars with thick everted rims are also found as part of this component.

Component C, in L1 through L4 (L5 was not included in this analysis), consists mainly of Phimai-tradition sherds, predominantly derived from cord-marked jars with restricted necks and everted rims. These were probably mostly cooking vessels, as suggested by the shape, the frequent application of resins (reducing permeability), the presence of smudge marks, and the use of organic temper, which would have reduced thermal shock. Most of the bowls are plain, fairly thick, angled,

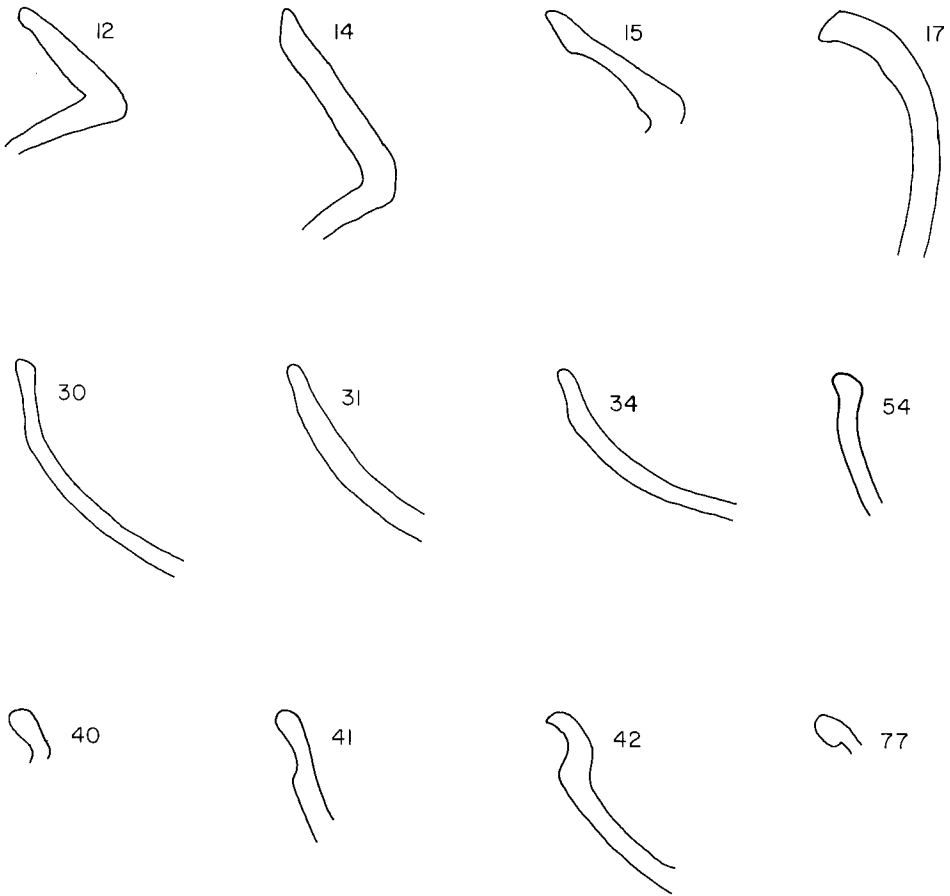


Fig. 8. Ban Tamyae pottery: common rim forms.

and only occasionally slipped (usually with a reddish yellow slip) and burnished. Rice chaff alone is the predominant temper, although chaff- and laterite-tempered vessels are also common.

Phase Sequence

Figure 9 presents a tentative ceramic phase sequence for the Phimai region. The sequence is based on the analysis of the ceramics from Ban Tamyae and Non Ban Kham, comparisons with ceramics from Ban Suai (NR-A-04) at Phimai excavated by Solheim and Parker (1966), the stratification of deposits at these sites, and the associated radiocarbon dates. The probable placement of the excavated layers at Non Ban Kham, Ban Tamyae, and Ban Suai is indicated. Dates are of course approximate, and as discussed by Welch (1985:230-232) correlations between sites and even between test pits at a single site could not always be satisfactorily determined. Recent examination by the authors of sherds from excavations in 1983 and 1984 by the

PHASE	BAN TAMYAE					BAN SUAI	NON BAN KHAM				DATE
	TP1	TP2	TP3	TP4	TP5		TP1	TP2	TP3	TP4	
MODERN			1-2	1-3			1	1	1	1	A.D. 1850-1980
RECENT HISTORIC					1-2		2-3	2	2	2-3	A.D. 1300-1850
LOPBURI							4	3	3?		A.D. 950-1300
SEMA					3	1 2 3	5	4-5	4		A.D. 600-950
LATE PHIMAI			3?	4			5	6-7		4?	A.D. 300-600
CLASSIC PHIMAI	1-5?	1-5?		5?		4-8	6?				200 B.C. - A.D. 300
PRASAT	6-7	6-7									600-200 B.C.
TAMYAE	8-9	8-9			4						1000-600 B.C.
? = Placement not certain											

Fig. 9. Regional phase sequence and placement of excavated layers at Phimai region sites in this sequence.

Fine Arts Department at Ban Prasat (NR-B-01), 13 km west of Phimai, has further confirmed the validity of the sequence.

Tamyae-tradition sherds predominate in the Tamyae-phase deposits. Stratigraphically these are the earliest deposits, forming Component A underlying Phimai-tradition sherds in the lowest layers at Ban Tamyae. Tamyae-tradition sherds make up a high percentage of sherds found in the lowest two excavation levels at Ban Prasat. The Beta-2757 radiocarbon sample from Ban Tamyae F57, a feature at the base of TP1, L7, which contained about 50 percent Tamyae and 50 percent Phimai-tradition sherds, dates the transition from the Tamyae to the Prasat phase. This probably fell between 800 and 400 B.C., and the midpoint of these dates, 600 B.C., has been chosen as the approximate end of this phase. The Tamyae-phase occupation layers themselves have not been dated, so the beginning date remains uncertain, with 1000 B.C. simply an estimate.

The Prasat-phase ceramic assemblages contain high percentages of early Phimai-tradition ceramics; Component B pottery at Ban Tamyae is typical of these. The Prasat phase was originally so named because numerous red-slipped sherds similar to those of Ban Tamyae Component B were found during surface survey and coring at Ban Prasat. The excavations by the Fine Arts Department (1984) uncovered large quantities of such early Phimai-tradition pottery stratified beneath Phimai black (classic Phimai-phase) pottery. One class of Ban Prasat burial bowl (FAD type complex 8) includes vessels that are similar in form, paste, and decoration to Ban Tamyae Component B bowls, although the remainder of the burial pottery consists of grog- and sand-tempered red-slipped jars, suggesting the presence of a second tradition of pottery making during the Prasat phase. However, the stratigraphic position of the burials was not reported, nor are radiocarbon dates available from

Ban Prasat. There are five radiocarbon dates for this phase at Ban Tamyae. The Beta-2757 date of approximately 600 B.C. dates the beginning of this phase. The end of the 2σ range, A.D. 45, for the Beta-2753 date seems too late, given comparable dates for the succeeding classic Phimai-phase pottery. The median of the four later radiocarbon dates, approximately 200 B.C., has therefore been chosen as a likely ending date for this phase.

During the classic Phimai phase the streak-burnished chaff-tempered Phimai black ceramics, originally reported by Solheim (1965; Solheim and Ayres 1979), were manufactured. These are best documented from Ban Suai, but are also present in thick deposits at Ban Samrit (NR-A-12) and at Ban Prasat, where they clearly overlie the Prasat-phase sherds. They were predominant in L8 through L4 at Ban Suai, forming a single component at that site. Charcoal from Ban Suai L6 was dated to 1930 ± 100 B.P. (165 B.C.–A.D. 240), and a sherd was dated by thermoluminescence as 330 ± 250 B.C. (Solheim and Ayres 1979). A few sherds of this type were found at Non Ban Kham in the basal cultural layer and at Ban Tamyae in the Component C assemblage and in surface collections. A few similarities, beyond the common Phimai-tradition attributes, tie Component C with the Ban Suai materials, primarily the presence of angled bowls. The reversals in the Ban Tamyae radiocarbon dates make independent dating of Component C impossible. The angled bowls may represent a chronologically identical, but functionally distinct, facet of Phimai-tradition pottery manufacture during this phase, but their chronological placement is not certain.

The late Phimai phase is defined on the basis of the presence of Phimai-tradition sherds, including wide lipped and carinated forms, which are distinct from classic Phimai black sherds. These underlay Sema-phase sherds in the lowest layers of the Non Ban Kham test pits and in the lowest layer of TP4 at Ban Tamyae. They were also found in the upper levels at Ban Prasat and in disturbed layers (L2 and L3) at Ban Suai, overlying the classic Phimai-phase pottery. Their stratigraphic position thus indicates a dating between these phases, but no radiocarbon dates are available.

Sema-phase pottery consists of early historic-tradition ceramics, which are related to the Period V Se type complex at Chan Sen (Bronson 1976). One or two layers containing this pottery were found in each of the test pits at Non Ban Kham and one layer in TP5 at Ban Tamyae. One layer at Non Ban Kham was radiocarbon dated to A.D. 660–905, a date similar to those obtained for this type of pottery at Chan Sen and one that corresponds well with this pottery's frequent association with Dvaravati-style art.

Lopburi-phase deposits are those with pottery similar to the Le complex at Chan Sen and with Khmer earthenwares and stonewares. Most of the specifically Khmer-style pottery (that is, pottery of the types found at the Ban Kruat kiln site) in the Phimai region appear to date from the reigns of Jayavarman VI through Jayavarman VII (c. A.D. 1080–1220) based on Groslier's chronology (Groslier 1981, Brown 1977). The other Lopburi-phase pottery is more similar to that of the preceding phase and, based on its presence in fill under the Khmer sanctuary at Phimai (Bronson 1976: 709–712), first came into use earlier than the Khmer-style pottery.

The more recent pottery has not yet been analyzed in any detail, and the ceramics have simply been classified as recent historic, which includes pottery from the Ayutthaya (c. 1350–1750) and early Ratanakosin (c. 1750–1850) eras, and modern (c. 1850–present), consisting of types still in use today.

SETTLEMENT AND ADAPTATION AT BAN TAMYAE AND NON BAN KHAM

Ban Tamyae

The small sample size (c. 0.1 percent of the site area was excavated) precludes much discussion of the general nature of the occupation at Ban Tamyae. While the ceramic assemblage is adequate for the establishment of a tentative ceramic sequence, the cultural materials are unlikely to be representative of site activities as a whole. Many excavated features are difficult to interpret. Nevertheless, we can draw certain inferences about the history of Ban Tamyae and the adaptations of its inhabitants to their environment.

Initial site settlement probably occurred early in the first millennium B.C. The settlers chose a location on a recent alluvial terrace, slightly higher than the floodplain between the site and the Mun River. The excavations produced no evidence that the site was a natural mound; the base of the cultural deposits is approximately level with the current surface of the surrounding rice fields. A small, probably seasonal, stream flowed by the north edge of the site. The surrounding land was well suited or moderately well suited for growing wet rice. Tamyae-phase deposits were found both at the south and north ends of the site, although it seems unlikely that the site had already achieved its present size.

During this early pioneer phase of settlement, subsistence strategies incorporated extensive use of aquatic resources, especially freshwater molluscs, including gastropods of the genera *Pila* and *Filopaludina* and bivalves, as well as frogs, turtles, and several species of fish. Cattle and pigs were probably kept as domesticates or possibly were hunted wild along with deer. The inhabitants participated in the prehistoric networks for exchanging bronze artifacts and the bronze-forming ores, as evidenced by the recovery of a bronze bracelet fragment.

The introduction of iron tools and a new tradition of pottery making mark the beginning of a new phase, the Prasat phase. Potters began to use rice chaff as the primary temper. While there is no proof that rice was domesticated, the extensive use of rice chaff suggests the ready availability of rice and its probable great importance in the diet. Given the permanence of Ban Tamyae and other villages dating from this period onwards, their nearly universal location in proximity to land suited for wet rice, the great increase in their sizes during the classic Phimai phase, and the presence of domesticated animals, rice was almost certainly cultivated as a domesticated crop. The villagers kept domesticated cattle, pigs, and dogs, they hunted deer, and they caught turtles and fish.

Nine pit features dug during this phase include several narrow sand-filled cylindrical pits with an outer casing of clay. These were probably postholes, and it might be speculated that the sand, which was clearly not part of the natural site fill, was added ceremonially when the posts were first inserted, as is still done today when a new house is blessed (Temiyabandha 1978:60). However, no pattern that might form a house foundation could be distinguished in the excavated area.

The use of the burnt brick features dates from both this phase and the succeeding classic Phimai phase. These are concentrations of lumps of fired clay—some apparently pieces of bricks, others simply fragments of fired earth, sometimes heat blackened—with associated evidence of burning, such as charcoal, hard white soil,

and greasy black soil. Boundaries are rounded and ill defined, with no discernible purposeful arrangement of bricks. Circular pits covered with a clay roof, which becomes baked and blackened with heat, are used today as charcoal kilns; these features may be the collapsed remains of charcoal-making pits. Alternatively, although two features are rather large, they may be remains of fire pits, similar to those Solheim and Bayard (n.d.) report in use in Phu Wiang. Two circular features, containing fire-hardened soil, burnt fibrous material, and charcoal, but no pieces of fired clay, may be subsurface hearths. White (1986) discusses the ethnographic use in northeast Thailand of such features for large cooking tasks, such as preparation of food for feasts. One of these, F29 in TP2, L6, contained some warped sherds, suggesting an alternative possible use as a small, simple earthen pottery kiln.

Later minor changes occurred in the manufacturing techniques and style of the Phimai-tradition pottery. This Component C pottery, probably dating to the classic Phimai phase, is found in L1–L4 in TP1 and TP2. Several trash pits with dense accumulations of sherds and animal bones and a burnt brick feature were present in these layers.

Pig, cattle, water buffalo, and possibly chickens were raised, but hunting of wild animals remained an important source of meat. Bones of nondomesticated animals are nearly as common in the faunal assemblage as those of domesticates, and the presence of a tiger tooth indicates a not completely domesticated environment. A bovine bone from the TP2, L4 deposit was definitely identified as water buffalo, although robust bovine bones from earlier layers could also be from water buffalo. The L4 bone is a third phalanx (hoof), which possesses an exostosis (abnormal bony spur) on the proximal volar surface. This is similar to the exostoses on water buffalo phalanges from Ban Chiang, which have been interpreted as evidence of the use of water buffalo in traction, probably for pulling a plow (Higham et al. 1981).

The excavation of TP3 near the possible wall and moat remnant failed to reveal data concerning the age and construction of these features. The moat incorporated the stream flowing past the site, and water from the stream as well as runoff from the mound kept the moat filled. The presence of classic Phimai-phase sherds in most areas of the site, both on the surface and in the excavated pits (except TP4), suggests that the site may have attained full size by that time, so the construction of the moat could very possibly date from that period. The situation is similar at other large moated sites in the survey area, where classic Phimai-phase sherds are found in abundance over large areas of the sites both on the surface and in road cuts. However, we were not successful, either at Ban Tamyae or Non Ban Kham, in meeting the objective of dating the moats and walls.

For the latter phases, little archaeological evidence beyond the pottery itself is available. Very few historic-period artifacts were recovered from the main TP1 and TP2 excavation area. While there is evidence of continued occupation, it is possible that site population diminished in the early historic Sema and Lopburi phases. However, erosion and purposeful earth removal may also be responsible for the relative scarcity of more recent materials. While the oral traditions concerning the presence of a Khmer temple on the north side of the village suggest a continued importance for this site, we found no surface evidence of such a temple, nor did we find much evidence, in terms of pottery, of a dense Lopburi-phase occupation. This is also true of the recent historic phase, but the presence of Ayutthaya-era *sema*

stones at the *wat* and the excavated votive tablet suggest that the present *wat* may have had its origin at that time.

Non Ban Kham

Original settlement at Non Ban Kham occurred much later than at Ban Tamyae, probably near the end of the classic Phimai phase or during the late Phimai phase. Thereafter, the site was occupied during all phases until its abandonment in this century. The founding of Non Ban Kham appears to have been part of a more general shift toward dispersal of population into smaller hamlet-size settlements at the end of the prehistoric period.

With limited excavation (c. 0.6 percent of the site area) and the discovery of only a few features, even less can be said concerning the Non Ban Kham occupation than the Tamyae occupation. The most interesting feature, F43 in TP1, was a trash pit, which probably dated from early in the Ayutthaya era, as it included Sawankhalok celadon and Ming dynasty blue and white porcelain sherds. It provided evidence of the exploitation of molluscs, primarily freshwater gastropods; fish, especially catfish; turtles; and deer. The pit also gave evidence of the use of cattle, water buffalo, and pigs. Bones of domesticates, including pig, definitely domesticated cattle, and water buffalo, make up a larger percentage of the faunal assemblage than in any features at Ban Tamyae. This suggests a shift toward more reliance on domesticated animals, but this will have to be substantiated by a larger sample. Fish bones were more common in this feature and in L2 than in any other excavated context except TP2, L8 at Ban Tamyae.

The presence of a gun flint and Ratanakosin-era sherds indicates that the site was in fact occupied until fairly recently, as had been reported. Freshwater molluscs and turtles were still being collected, fish caught, and deer hunted through the most recent occupation.

THE PHIMAI REGION AND THE CULTURAL CHRONOLOGY OF THE KHORAT PLATEAU

The excavations at Non Ban Kham and Ban Tamyae have produced data with important implications for the more general chronological sequence of events in northeast Thailand during the late prehistoric and early historic periods.

The excavations failed to produce any evidence of occupation of the Phimai region before 1000 B.C. and offer no support for the hypothesis that agricultural settlement of the Khorat Basin began before that time. Only a single occupational component preceded the stratigraphically and chronologically earliest radiocarbon date of 2520 ± 130 B.P. However, given the absence of the earliest recognizable materials, the Tamyae tradition pottery, in the surface collections, it remains possible that early settlements may be present but not archaeologically visible on the surface. The problem of discovering any such early settlements—most of which are probably buried beneath alluvial sediments or more recent habitation sites—remains a serious one that must be solved by future research. The evidence from Ban Chiang Hian (Chantaratiyakarn 1984b) suggests the possibility of settlement of the Chi River valley before 1000 B.C., but the radiocarbon date associated with the earliest mate-

rials has a wide standard deviation: 2190 ± 180 B.P. (i.e., 1405–825 B.C. [2σ calibration, Klein et al. 1982]), so it is quite possible that the materials may not date earlier than 1000 B.C. Whatever may be the case for earlier settlement, it seems clear that widespread settlement of the Khorat Basin took place in the early part of the first millennium B.C. with the founding of agricultural communities on the recent and low terraces at locations that would remain village settlements to the present. These pioneer settlements formed the basis for the great acceleration in the growth and expansion of agricultural settlements, which began to take place perhaps as early as 800 B.C. and certainly by 500 B.C.

Dense shell middens, such as the one found at Ban Tamyae, appear in the early occupation deposits at several other sites on the Khorat Plateau, including Ban Prasat and Non Chai (Bayard et al. 1982). Their frequent appearance and widespread distribution suggest that their presence may have some general significance and is not simply fortuitous or the result of sampling error (as we originally thought and as Bayard et al. [1982] suggest). Their presence may result from activities related to initial settlement of these sites, perhaps the clearing of fields for permanent cultivation of wet rice or taro.

The Beta-2557 radiocarbon date (2520 ± 130 B.P.) from Ban Tamyae TP1 is of importance because the charcoal came from a feature in which almost equal numbers of Tamyae- and Phimai-tradition sherds were found. Not only does it provide a date for the transition from one ceramic tradition to another, but it also gives a likely date for the earliest appearance of iron at this site. The spike-shaped iron artifact was recovered from a stratigraphically equivalent layer in TP2 with a similar mixture of sherds. It is unfortunate that the standard deviation for this date is so large, but the range for the date does fall within the range of other early iron dates in northeast Thailand. The 1σ range for this date is 820–415 B.C. Other well-dated early finds of iron from northeast Thailand fall within this same time range. At Ban Chiang iron artifacts underlay burials that have been radiocarbon dated 2520 ± 50 B.P. (795–585 B.C.) and 2300 ± 50 B.P. (420–380 B.C.). A date of 2440 ± 50 B.P. (630–415 B.C.) appears to be stratigraphically equivalent with the earliest iron artifact at Ban Puan Phu. At Ban Na Di dates of 2370 ± 70 B.P. (760–385 B.C.) and 2600 ± 60 B.P. (850–605 B.C.) are reported from the same layer as that in which a fragment of iron was found, but the charcoal samples underlay the iron.¹ It appears almost certain that iron came into use within the 800–400 B.C. time range, but given the radiocarbon dates available, we are not yet in a position to date the beginning of its use in the area more precisely. Because of the perturbation in the quantity of atmospheric carbon-14 from 750–400 B.C. (Klein et al. 1982), it may not be possible to date the advent of iron in northeast Thailand any more precisely by means of radiocarbon dating, and at present no alternative adequate dating method exists.

The appearance of iron is only one of several changes that mark the transition from the Tamyae to the Prasat phase. The technology and style of pottery manufacture underwent significant changes. Settlement expanded rapidly, as new villages were founded during this phase, many of which had grown into sizeable settlements by the classic Phimai phase. These changes mark the beginning of what Bayard (1984) terms General Period C. The causes of these changes remain obscure, but intensification of wet rice agricultural production involving the use of the plow, systems of water control, and transplanting may have been a significant factor. The

adoption of intensive techniques may have been favored because of the increased reliability that control of water would have provided in counteracting the climatic unpredictability that characterizes the Khorat Plateau.

The evidence of such intensification admittedly remains slight. The finding of iron from the beginning of the Prasat phase signals the presence of the ability to manufacture (or obtain through trade) iron plowshares capable of piercing the heavy clay soils of the alluvial plain. Nevertheless, neither locally made nor imported prehistoric plowshares have been recovered on the Khorat Plateau, although bronze plowshares have been found at sites in Viet Nam (Davidson 1975). The stress marks on a water buffalo third phalanx that came from a probable classic Phimai-phase context at Ban Tamyae might indicate its use in traction, possibly pulling a plow. In their early papers, Higham and Kijngam (1979, 1982; Higham et al. 1981) argued that the evidence of such exostoses on water buffalo phalanges from Ban Chiang and of changes in the faunal spectrum during what is now called the Middle Period at Ban Chiang indicated the transition to intensive wet rice agriculture. In a later monograph (1984), they questioned their own conclusion because of the failure of excavation so far to produce prehistoric plowshares, but we would argue that the evidence from Ban Tamyae tends to support their earlier conclusion.

The changes in the system of food production marked by intensification of the agricultural system and expansion of fields on the alluvial plain precluded or made much more costly and difficult access to resources in other zones. Specialization in aquatic crops, such as rice and taro, was favored, and production diversity—which we suggest was a strategy favored by Tamyae-phase settlers and other earlier agricultural populations on the Khorat Plateau—was reduced. Intensification, by providing better control of water resources, helped mitigate the effects of environmental unpredictability, while exchange of products among producers in different environments may have served as an additional buffer against unpredictability by providing access to goods not locally available. Intergroup exchange came to replace intragroup diversification.

Evidence of such exchange was found in the presence at Ban Tamyae of stone adzes of fine-grained basalt and metamorphic stone, the closest sources of which are the basalt outcrops along the southern part and the hills at the west edge of the Khorat Plateau. Iron slag found at Ban Suai suggests the presence of iron smelting at Phimai, probably involving the excavation and transport of iron ores from the uplands south of Phimai and the distribution of iron artifacts to other sites in the Phimai region. The great similarity in the paste, form, and decoration of the Phimai black bowls found at numerous sites suggests centralized manufacture of Phimai black bowls and their subsequent distribution over much of the upper Mun River valley.

The Phimai black pottery has a widespread distribution in the upper Mun River valley, where it is found at Khorat (50 km southwest of Phimai), Ban Thamen Chai (40 km southeast), and Ban Krabuang (32 km northeast), but none has been found elsewhere in the Khorat Basin. Similar black burnished sherds found at Ban Chiang Hian (Chantaratiyakarn 1984a, 1984b) in the middle Chi River valley are distinctive in terms of paste and temper, and were clearly not manufactured in the Phimai region, where all Phimai black sherds include chaff as the primary temper. The only evidence of these sherds beyond the Phimai region is the few sherds from the ex-

cavations at Chan Sen in the Chao Phraya basin, identified as Phimai black by Bronson (1976). In turn, Ban Chiang, Roi Et, and Ban Chiang Hian sherds have not been found in the Phimai region.

The Phimai tradition remained fairly stable in terms of the technology employed in pottery manufacture over a rather long period, perhaps as long as 1200 years. Although the latter end of this time range, approximately A.D. 300–600, remains ill defined and lacking in chronometric dates, a long period of stability is still indicated. Classic Phimai-phase materials at Ban Suai, Ban Prasat, and Ban Samrit were found in situ in deposits frequently ranging from 1.5 m to 3 m thick and extending over the entire site area. This stability in ceramics is in keeping with the situation in other regions on the Khorat Plateau, where during this time period similar persistent regional traditions existed. For example, Phase II ceramics at Ban Chiang Hian cover a time range from about 600 B.C. to the year 1 (Chantaratiyakarn 1984b); Non Chai vessels were made between 500 and 50 B.C. (Charoenwongsa and Bayard 1983); the Ban Chiang painted pottery was made from 300 B.C. to A.D. 200 (White 1982); and the Roi Et tradition has a suggested time period from the year 1 to A.D. 700 (Higham 1977). Penny (1984) relates the development of these regional traditions to the dispersed settlement pattern associated with rice agriculture and to the widespread availability of iron ores, which diminished the need for long-distance exchange that the procurement of bronze required. We suggest further that the regionalism these traditions display reflects the importance of regional exchange networks linking communities in each of the more or less distinct regions on the Khorat Plateau. These networks provided access to goods from a variety of environmental zones to people who were becoming increasingly specialized in their subsistence economies. Bayard et al. (1982) report evidence of a similar exchange network in the Non Chai region. Residents of Non Chai were engaged in specialized production of pottery and bronze and perhaps of salted and fermented fish. Perhaps, through an understanding of these regional networks and the political forces that manipulated them, we will begin to comprehend the economic, political, and social changes of the late prehistoric period.

During the Sema phase, contact with central Thailand's Chao Phraya basin clearly increased, with exchange either of pottery itself or, more likely, the techniques of manufacturing early historic-tradition pottery. This confirms the evidence of contact already well documented in the "Dvaravati style" Buddhist sculpture that has been found at numerous sites in the Khorat Basin and has been dated to this same time period. The beginning of written history in the region corresponds to an opening up of the Phimai region, and the Khorat Plateau in general, to increased contact with other regions. While evidence of contact with the Indian-influenced centers in the Chao Phraya basin is pervasive throughout the upper and middle reaches of the Mun and Chi rivers, the region maintained its own distinctive styles in many respects, reflecting both influences from Chenla and its own local development.

This increased contact with other areas probably resulted from the growing importance of the upper Mun River valley as a crossroads linking other major agricultural centers. This development culminated with the integration of the region into the Khmer state centered at Angkor, certainly by the reign of Suryavarman I (c. 1007–1049), at the time when Khmer involvement in long-distance trade was most extensive (Hall 1979). The extent of this trade is more evident in the historic inscriptions (Coedes 1964) and in the influences of Phimai artistic styles on the monuments

at Lopburi and on later Khmer art (Woodward 1975) than in the archaeological evidence from the small village of Non Ban Kham. However, the presence of the standard Khmer-style pottery that appears to have been manufactured at large kiln sites, such as Ban Kruat and Ban Baranae in Buriram Province, provides evidence of the integration of even small hamlets into the Khmer state during the period stretching from the reign of Jayavarman VI to that of Jayavarman VII (c. A.D. 1080–1220). The Khmer temples at many small sites in the Mun River basin and the oral tradition of the presence of such a temple at Ban Tamyae provide additional evidence of the extent to which this area was integrated into the Khmer state.

SUMMARY

The excavations at Non Ban Kham and Ban Tamyae have produced new evidence of importance in interpreting the late prehistoric and early historic periods in northeast Thailand. The analysis of the abundant potsherds excavated from these sites has made it possible to develop a preliminary ceramic sequence for the Phimai region. Tamyae pottery, stratigraphically the earliest, provides the first evidence of pre-Phimai-tradition settlement of the region, dating from earlier than 500 B.C., perhaps as early as 1000 B.C. The presence of iron in a context that can be radiocarbon dated to between 800 and 400 B.C. offers additional support for similar early dates for iron from other sites on the Khorat Plateau. Six dates in the late first millennium B.C. associated with Phimai-tradition pottery at Ban Tamyae support the dating of this pottery to as early as 500 B.C., as suggested following the excavations at Ban Suai. The appearance of iron and Phimai-tradition pottery was associated with the expansion of settlements throughout the Phimai alluvial plain and the establishment of a settlement pattern that has remained relatively stable to the present. This pattern probably reflects the practice of intensive wet rice agriculture from the beginning of the Prasat phase about 600 B.C. This period was also characterized by the presence of an extensive regional exchange network in the Phimai region, which in the early historic period, after A.D. 600, expanded to include increased contact and exchange with other regions.

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NOTE

1. Ban Chiang dates, as reported by White (1986), and the Ban Phan Phu date, as reported by Bronson and White (n.d.), were calibrated using the University of Pennsylvania MASCA calibration curve, with the date ranges expressed at the 1σ confidence level. The Ban Na Di dates, as reported by

Kijngam (1984) and Higham and Kijngam (1984), were calibrated using the Klein et al. (1982) calibration tables, with the date ranges at the 2σ confidence level.

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