Excavations at Non Chai, Northeastern Thailand, 1977–1978

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INTRODUCTION

OVER 30 YEARS AGO, Williams-Hunt's pioneering aerial photographic survey of Northeast Thailand revealed more than 200 large archaeological sites concentrated in the Middle Chi and the Middle and Upper Mun valleys in the southern two-thirds of the region. Most of these sites were circular or oval in shape, and "defended" with multiple concentric earthworks. There were also a few sites which Williams-Hunt terms "metropolises" featuring wide gaps between the ramparts. A number of irregular, more or less rectangular sites were also described. Williams-Hunt prudently eschewed speculation about the age of these remains, save to point out that "the distribution of sites here shown corresponds exactly to the present concentrations of population and lines of communication" (1950:35). In an appended note, Seidenfaden speculated that the rectangular earthworks were of Khmer origin, and the circular or oval ones pre-Khmer, "due to the Kuis, a Mon-Khmer people preceding the Khmers, while those of the most primitive form *might* be ascribed to a now vanished Melanesian people" (Williams-Hunt 1950:36). Aside from two small test pits at Muang Phet and Thamen Chai (Quaritch-Wales 1957), two decades were to pass until the study of these sites was begun again, and the vague and outmoded conclusions of Seidenfaden revised. Higham and Parker's 1969–1970 survey in the Roi Et area excavated five small test pits in and around one of these moated earthworks, now containing several villages, of which Ban Ta Nen is the largest (Higham and Parker 1970). Although the identity of the moated site with one of those mapped by Williams-Hunt was not pointed out, Higham and Parker clearly recognized the archaeological significance of the site, which

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featured deeply stratified deposits and a dated sequence beginning c. 500 B.C. and extending up to the period of Khmer occupation of the region (c. A.D. 1000) and beyond (Higham 1977).

In subsequent years, research by Higham and his students has renewed considerable interest in this class of sites, but their function and even their approximate age remain obscure. Data presented in the preliminary report of the 1979–1980 field season and two more recent articles (Kijngam, Higham, and Wiriyaromp 1980, Higham and Kijngam 1982*a*, Higham, Kijngam, and Manley 1982) are used to argue in considerable detail for the presence of a two-tiered site hierarchy in the central Mun-Chi valley, with the large earthwork sites representing the upper tier of "central places"; these conclusions have been criticized on methodological and theoretical grounds (Wilen, this issue). However, it is obvious that such sites are of crucial importance to our knowledge of the development of complex societies in the region, and the Silpakon University 1982 survey of the lower Mun and Chi valleys has further widened our sample of such sites (Vallibhotama 1984). The most revealing of all research to date in this connection is the site mapping program of Thiva Suphajanya (Suphajanya and Vanasin 1982) that identifies more than 1200 enclosed sites in Thailand, of which approximately 800 are located in the Northeast. Equally recent, further research by Higham and his students has caused a revision from an original date of the mid-first millennium A.D. for most of these sites—and the growth of distinctive regional entities—back to a late first millennium B.C. origin for at least some of them (Chantaratiyakarn 1983, Higham and Kijngam 1984), and hence a somewhat earlier date for the beginnings of complex societies in the region; these latter views agree generally with the conclusions put forth by two of us in a brief preliminary report on the upper Chi site of Non Chai (Charoenwongsa and Bayard 1983).

Hence Non Chai is of considerable relevance to the whole question of the date and nature of the rise of complex societies in the area; although apparently not moated to any significant extent or fortified with earth walls, it is nonetheless of the same general class as those described by Williams-Hunt, and was the first (and still the only) site of its type in the area to be subjected to a fairly extensive area excavation (76 m^2). Its importance is increased by its obvious relationships to the more recently excavated sites of Ban Chiang Hian (Chantaratiyakarn 1983) and Ban Na Di (Wichakana 1984; see also Higham and Kijngam 1984 for final reports and full documentation on both sites); both ceramic and non-ceramic materials from Non Chai are clearly paralleled at these other sites. Equally important, the radiocarbon chronology of Non Chai is relatively secure, straightforward, and of obvious significance to the question of increasing sociopolitical complexity in the region as a whole. Finally, and sadly, it is necessary to note that the site has since been largely quarried away for use as road metal; hence the excavation reported here represents all the data that are ever likely to be available.

ENVIRONMENTAL BACKGROUND

Several detailed geomorphological, vegetational, and climatic descriptions of Northeast Thailand as a whole and of smaller areas within it have already appeared in previous archaeological studies (Bayard 1971, Higham 1975, 1977, Rutnin 1979, Kijngam, Higham, and Wiriyaromp, 1980, Welch 1984); hence we will confine

ourselves to the vicinity of Non Chai itself. The mound of Non Chai is located some 3 km northeast of the northern end of Khon Kaen City, on a narrow strip of the Middle Terrace old alluvial deposit that separates the rolling lowland terrain of the old High Terrace deposits to the northwest from the flatter Low Terrace and recent alluvial soil complexes to the east (Fig. 1, Fig. 2). The site itself is located on Khorat type soils, one of the characteristic Middle Terrace complex and ill-suited to rice cultivation (Soil Survey Division 1973); the High Terrace Yasothon soils to the northwest are equally unsuited. However, extensive areas of Alluvial Ratchaburi and Phimai soils and Low Terrace Ubon and Roi Et soils enclose the site on three sides; these types are classified as moderately suited for paddy cultivation, and were almost certainly so used during the occupation of Non Chai.

In a paper presented in 1971, Parker first postulated a correlation between site location and soils suitable for paddy cultivation (Parker 1980:58–59). Higham has investigated this question in detail in subsequent publications (for example, Higham 1975, Kijngam, Higham, and Wiriyaromp 1980, Higham and Kijngam 1984), and he and others have gone on to use site size and area of suitable paddy land not only to demonstrate (as expected) a nonrandom distribution of sites vis-à-vis soils, but to arrive at estimates of rice production and inferences on possible population density, and cultivation methods (Higham and Kijngam 1984, Chantaratiyakarn 1983, Wichakana 1984). Welch (1984) has gone one step further and used such data to suggest that the site of prehistoric Phimai was probably too large to have been able to supply its population with rice from the available land adjoining it, and hence that its political control must have extended more widely. Macdonald (1980) utilized a similar approach to attempt to show that prehistoric Ban Chiang's population also exceeded its catchment productivity. While these approaches are surely salutary, and have in turn suggested yet more hypotheses, we feel it is necessary to add a note of caution as to the accuracy of such estimates. Without exception, the various parameters involved (soil suitability, estimated rice yield using various cultivation methods, estimated population density of prehistoric settlements) are at best means within a very wide range. Even site area is uncertain in many cases; for example, the area of prehistoric Ban Chiang (White 1982:16; Macdonald 1980, quoting Gorman pers. comm.; Chantaratiyakarn 1983:4–15); hence, with the probable exception of small, clearly bounded sites like Non Nok Tha and Ban Na Di, even this basic variable must be taken as approximate.

The situation is similar with regard to soil suitability. The group 2 soils described by Chantaratiyakarn (1983:4–4) as suitable for paddy cultivation but prone to flooding, following the Maha Sarakham soil maps (Soil Survey Division 1972) are described in the corresponding Khon Kaen maps as group 3 soils, only moderately suitable. Soil types considered as moderately suited on the Khon Kaen maps, such as Ratchaburi and the Alluvial Complex, are classified as of generally poor suitability by Welch (1984:137). Further complications also arise when we consider that the very act of cultivation itself can apparently transform unsuitable soils into moderately suitable types (Pendleton and Montrakun 1960:15, 27). Difficulties are encountered even in estimating the average population density of modern villages; the village of Ban Na Di, Khon Kaen (near Non Nok Tha) was mapped by Bayard in 1966; it is 24.5 ha in area and contains 157 households. If we assume Keyes' (1975) figure of 5.9 persons per household, we arrive at a population of 926, with a density of 38 persons/ha. On the other hand, modern Ban Chiang (estimated by us

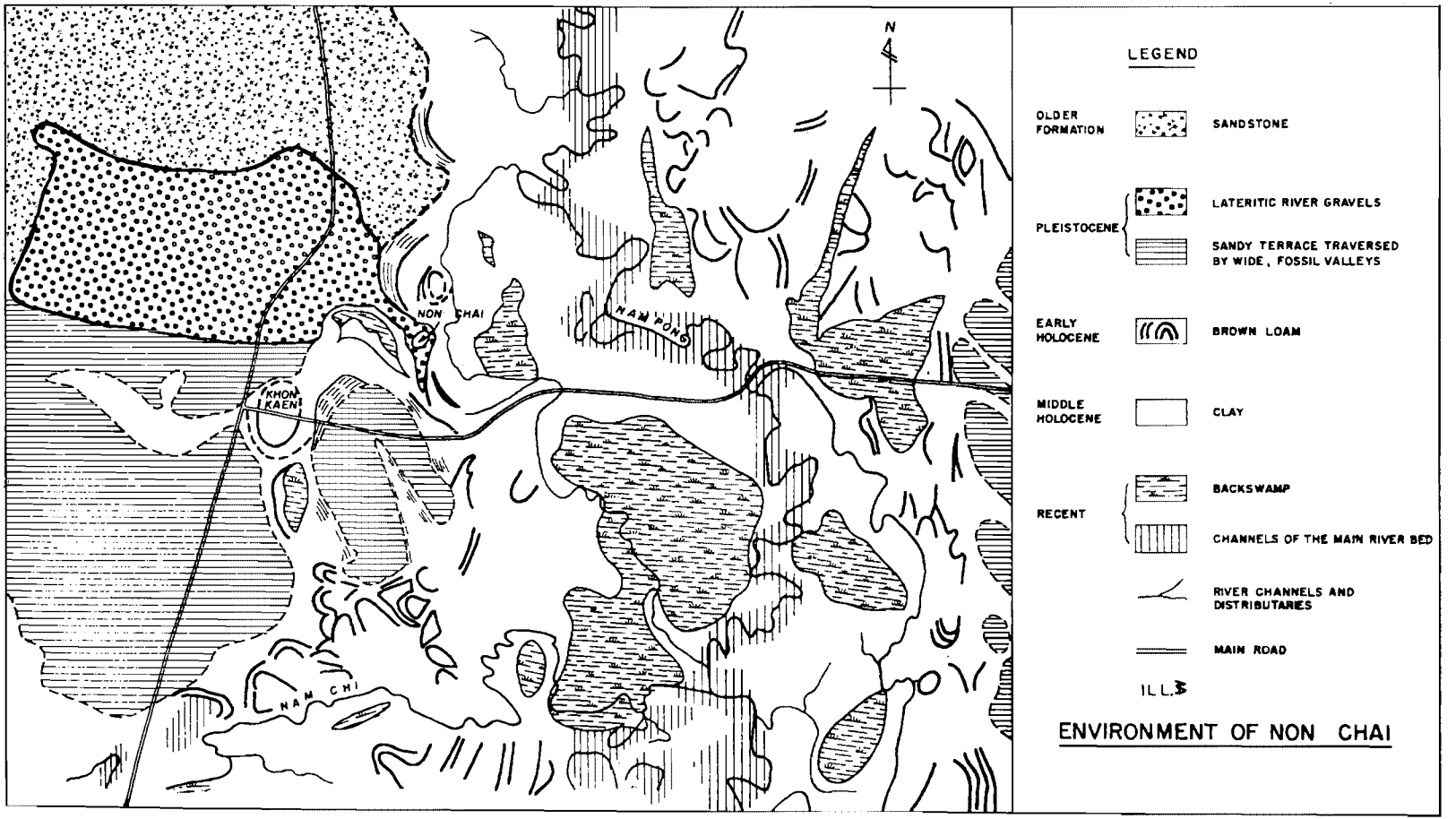


Fig. 1 Environment of Non Chai (after van Liere 1979).

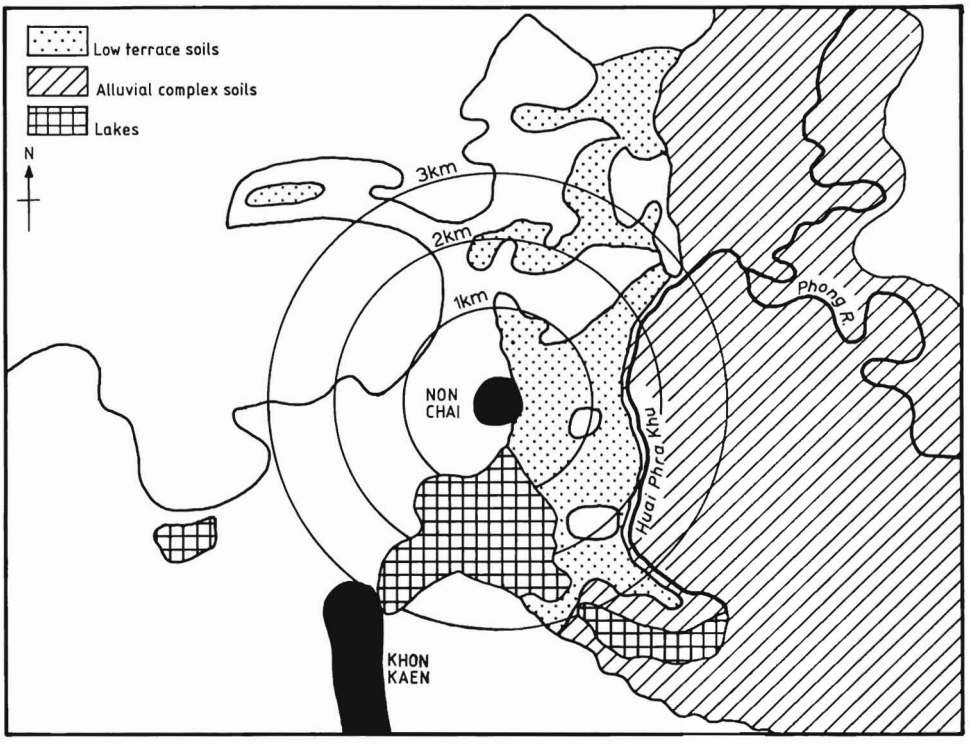


Fig. 2 The Non Chai region: soil zones.

at 55–60 ha) has a density of about 60–80 persons/ha. Chantaratiyakarn sensibly assumes a mean of 50/ha for her calculations, but caution is obviously needed in interpreting hypotheses based on this figure, particularly when Welch uses one twice as large (1984:144).

Finally, as Chantaratiyakarn notes, contemporary averages of rice production per hectare by various cultivation methods "show very wide variation" (1983:4–16). In fact, the figures she quotes from Hanks (1972) show yield *ranges* of 23 percent to 290 percent of the mean figures for the various methods. Chantaratiyakarn is prudent and cautious in her use of the different variables (for example, using the minimal range figures in the example cited), and is obviously aware of the difficulties involved; nonetheless, the hypotheses put forth by her and other workers using similar techniques are clearly reliant on a hierarchy of "if . . . then" suppositions, illustrating the primitive state of our knowledge of crucial regional variables as well as some of the possible limitations inherent in site catchment analysis methodology. The method of rice cultivation employed in the region in the first millennium B.C. is also as yet undetermined; Higham earlier (1979) postulated plowed paddy fields using the buffalo for traction; Chantaratiyakarn (1983:4–22) suggests broadcast sowing on plowed, seasonally flooded stream margins. Most recently Higham and Kijngam, following Wheatley (1983), have taken the continuing absence of plowshares in the region's sites to indicate the possibility of ratoon cultivation of floating rice, obviating the need for plowing (1984; cf.

Wichakana 1984:109–110); the tractive power of the recently domesticated buffalo would then have been presumably put to other uses.

What then are we to make of Non Chai? Was sufficient rice land available to nourish the prehistoric population, or were supplies obtained from further afield by trade or extension of political hegemony? Unfortunately agreement cannot be reached on one important variable, the area of the site itself. Higham and Kijngam estimate that it "almost certainly exceeded 18 ha" and give a figure for its maximum population "in the vicinity of one thousand" (1984). Chantaratiyakarn gives an area for terminal prehistoric occupation of 28 ha (1983:5–8). The excavators provide an area of 38.5 ha for the total mound. In point of fact, as the mound was already partially quarried away prior to excavation, and has since been largely destroyed, the true figure will never be known; nor could it have been accurately ascertained in the first instance save by very extensive test-pitting.

All this is not to say that we cannot make any assumptions about the self-sufficiency of the site; rather we wish to emphasize the tentative nature of our conclusions (and those of others). Figure 2 shows the area of land moderately suited for rice cultivation (types IIIf and IIIs; equivalent to Chantaratiyakarn's group 2 and 3 soils) present within 1, 2, and 3 km radiuses of the edge of Non Chai, assuming a site diameter of 700 m. The areas of suitable land can thus be seen to be in the vicinity of 45 percent, 40 percent, and 45 percent of the total area within each circle, or roughly 2.5, 7, and 15.5 km^2; precise digitized figures are deliberately not given, since in the light of the above discussion they would provide a false sense of accuracy. If we use Chantaratiyakarn's minimum yield figures, which seems the prudent course, these areas would yearly produce 197.5, 553, and 1224.5 metric tons respectively at .79 metric tons/ha for broadcast rice; or 122.5, 343, and 759.5 metric tons at .49 metric tons/ha for the minimum transplanting yield. If we assume that her population density value of 50/ha is correct, or at least reasonable, we arrive at a population of c. 1400 for an area of 28 ha, and 1925 for an area of 38.5 ha. Continuing our own chain of "if . . . then" suppositions, we can then insert Hanks' value of .5 kg of rice required per person per day (183 kg/year; Hanks 1972:48), and postulate a total requirement of 250 or 345 metric tons required for each of the population estimates. It thus seems fairly clear that sufficient rice land was available within about 2 km of the site to sustain the Non Chai population. Only if we use Welch's (1984) values of 100 persons/ha, and 1 metric ton yield/ha for moderately suited soils *and* the upper of the two site area values (38.5), do we arrive at a yield/need ratio under 1.0, and this is only slightly under (0.93). If we extend Welch's 2 km radius to 3 km, the prehistoric inhabitants would have encountered no difficulties in feeding themselves.

It seems we can at least rule out site catchment analysis as showing strong support for consideration of Non Chai as a central place. Indeed, using the above criteria the same conclusion could be reached for Ban Chiang Hian, with an area of 39 ha, an estimated population of c. 1950, and a rice-land requirement of about 450 ha (Chantaratiyakarn 1983:4–21); Chantaratiyakarn's table 4:1 shows that more than half the rice land required lies within 1 km of the site (no. 161 in the table); group 2 and 3 soils within a 3 km radius total some 2192 ha. Even if the flood-prone group 2 soils are excluded, some 2003 ha of group 3 soils remain, theoretically sufficient to support 5000–9000 people. Hence rather than the .4 by 11 km strip of flood plain she postulates (1983:4–22), the required rice land could very

probably be found within a 3 km radius of the site, and in fact she puts forward other more cogent arguments to justify the distinctiveness of Ban Chiang Hian as a central place (1983:4–20, 21, 27, 28). These arguments are the exceptional size of the site vis-à-vis other (presumably generally contemporary) sites in the survey area (0.7 to 5.0 ha), and the extensive moat and rampart system, which would have involved nearly 500 man-years of labor to construct (Chantaratiyakarn 1983:4–21). Unfortunately no dates are available for the construction of these earthworks.

While no certain evidence of earthworks existed at Non Chai (although van Liere [1979], mentions the "undoubted" presence of a ditch surrounding the site), the size argument can certainly be applied to it as well, as it approached or equalled that of Ban Chiang Hian. Unfortunately, as with the latter site there is no firm evidence indicating at what point in its history Non Chai attained this size prior to its abandonment in the early centuries of the present era. A final argument may be put forth for postulating that Non Chai had a regional or supravillage-level importance: its location some 2 km from what appears to be an old channel (Huai Phra Khu) of the Phong River, and 13 km from the present junction of the Phong and Chi. Accessible to Low-Terrace and Alluvial rice-growing soils and the upland resources of the Middle and High-Terrace soils to the northwest, Non Chai also adjoined a reliable year-round water source (the Nong Thung Sang), and was in a position to control trade not only on the lower Phong, but possibly on the upper Chi as well, and thus participate in the expanding network of regional trade which all current evidence indicates was developing during the latter half of the first millennium B.C.

EXCAVATION

Non Chai or "Victory Mound" was apparently originally some 500 m E-W by 1000 m N-S; at the time of excavation it rose to a maximum of 15 m above the level of the surrounding rice fields (which in turn are some 160 m above sea level). The site had been quarried for gravel to be used in road construction for some time, removing much of the center of the mound. The actual "discoverer" of the site will probably never be known, but the quarrying produced ample signs of prehistoric occupation. These materials drew the attention of Fine Arts Department officials at the Khon Kaen Museum (then under the direction of Khun Samart Sapyen) to the site in late 1974. The site was visited by Gorman, Bayard, and the Pa Mong Program trainees in January 1975, and a surface collection of sherds from the site was used for training purposes, but no excavation took place until over two years later. Convinced of the archaeological importance and potential of the site, Charoenwongsa began excavations there in June 1977.

The area selected for excavation lay some 25 m from what was then the edge of the gravel quarry (Fig. 3a); a 5 m grid was plotted, and four 4 m by 4 m squares (D1-D4) were excavated with 1 m baulks left in place until excavation in the squares reached sterile soil; the baulks were then excavated in turn. The excavation was designed to sample the maximum depth of deposits at the site, and was thus located in the approximate center of the mound. With the aid of some 30 men and women from the neighboring village of Ban Non Chai, excavation continued—with some interruptions due to budgeting problems and rain—for 14 months;

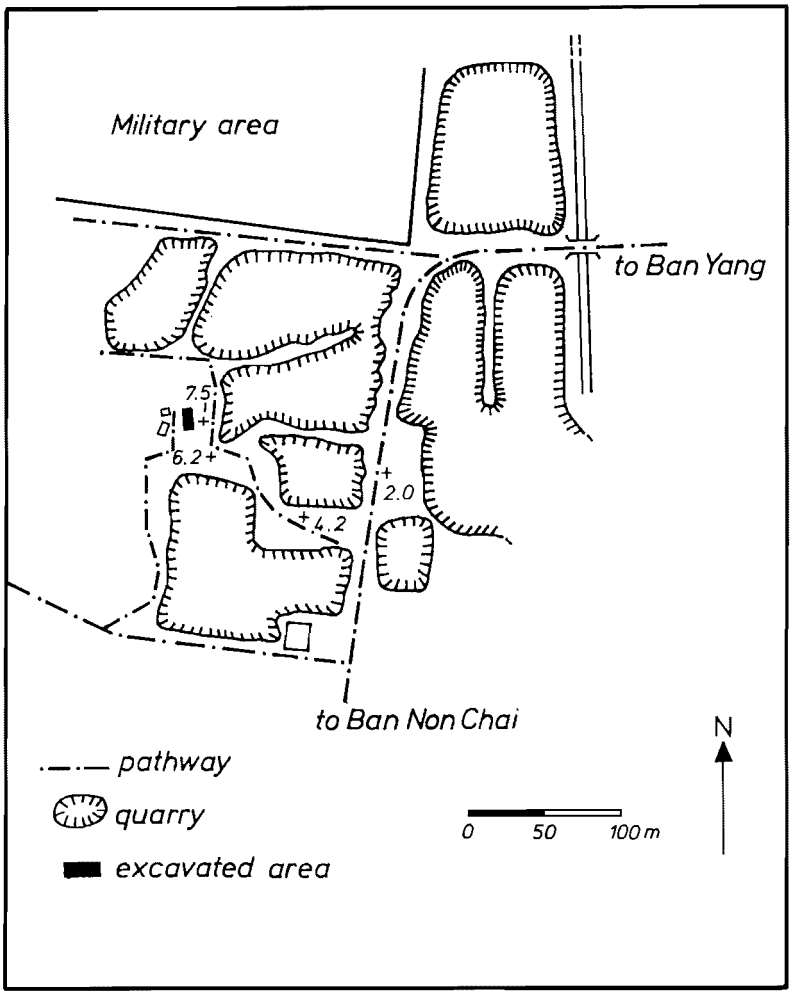


Fig. 3*a* The Non Chai site and excavation.

baulk removal and drawing of all sections was completed in September 1978. Rutnin assisted with the excavation in June–July 1978, and began analysis of the very large quantity of ceramics from the site. The total area excavated at the site was 76 m^2, with deposits averaging 4.7 m in depth and reaching a maximum of 5.5 m below the surface of the mound. A total of about 360 m^3 was removed by the expenditure of some 40 man-years of labor; Non Chai thus ranks high among Thai sites in terms of time and labor expenditure, as well as volume excavated (cf. Ban Chiang, 795 m^3; Non Nok Tha, 476 m^3; Ban Na Di, 256 m^3).

The excavation techniques employed were those used in earlier excavations at sites such as Non Nok Tha and Ban Chiang. As a few of the Non Chai workmen had had prior experience obtained at other Khon Kaen sites, it was not difficult to train the remainder in the necessary procedures. As at Ban Chiang, a thatched roof was constructed over the site, allowing work to continue during the rainy season,

although rain still slowed work during the later stages of the excavation (May–September 1978). In addition, work was slowed during this period by the more careful digging needed in clearing the disturbances in the lower levels of the site. As not all workmen could be employed in this careful excavation, the surplus manpower was devoted to washing and sorting the very large volume of pottery from the site. The soils proved easy to excavate in contrast to sites like Non Nok Tha, enabling full screening of the deposits; this resulted in the recovery of many small bone and shell fragments as well as small sherds and beads which were not noticed during excavation and recording.

While in the course of excavation some 15 natural layers were detected and recorded, these proved too thick to be removed as excavation units. Instead, excavation of both squares and baulks proceeded according to the system developed for Ban Chiang (Gorman and Charoenwongsa 1976) and since widely used in Northeast Thailand (for example, at Ban Na Di; Higham and Kijngam 1984). This involved excavation of each of the gross natural layers by 10 cm spits; the surface of each freshly excavated level was closely examined to find all detectable disturbances, and all features (pits, postholes) were assigned numbers. All such features were as well half-sectioned in 10-cm spits until all soil in a feature had been removed. A plan of each level was drawn in detail and photographs were taken before excavation continued down into the next 10-cm spit. Soil samples were taken from the 15 gross natural layers and analyzed at Khon Kaen University; all were classified as silty sand/sandy loam. Chemical analysis, of more utility in archaeological interpretation of the site, has not yet been carried out.

Toward the end of the excavation, further close examination of the soil was undertaken, and the excavators recombined the 15 layers into six cultural layers, using as criteria soil texture, color, and the quantity of artifacts (chiefly sherds) present (Fig. 3b). These six cultural layers may be described as follows:

Cultural Layer 1: (surface through 10-cm excavation level 2; average thickness 40 cm). This layer consisted of humus and was heavily root-penetrated; color grey (5 YR 2.5/2), with few artifacts.

Cultural Layer 2: (levels 3 through 13; average thickness 120 cm). This layer was more porous in texture, and brownish-grey in color (5 YR 3/4). A greater number of sherds and other artifacts was recovered from this layer.

Cultural Layer 3: (levels 14 through 24; average thickness 105 cm). This layer had a still more porous texture than layer 2, and was similar in color (5 YR 3/4 to 2.5 YR 5.5/4). Although porous, the soil was rather compact, with an ashy texture, and a further increase in the amount of cultural materials in the layer.

Cultural Layer 4: (levels 25 through 33; average thickness 110 cm). This layer contained very dense concentrations of shell, as well as other faunal remains, associated with very large concentrations of sherds; more were recovered from this layer than any other. The sherds were compacted, and lay in large lenses at the bottom of the layer. The soil was greyish in color (5 YR 3/2.5; 5 YR 3/3).

Cultural Layer 5: (levels 34 through 39; average thickness 75 cm). This was a relatively thin layer, with a somewhat lesser quantity of artifactual material than layers 3 and 4; nonetheless, the quantity recovered was still large. Starting at level 34, traces of distinct features in the form of pits and postholes began to appear, and more were encountered as excavation proceeded. A very clear feature was recovered in level 36, and special excavation of this large, deep pit was carried out,

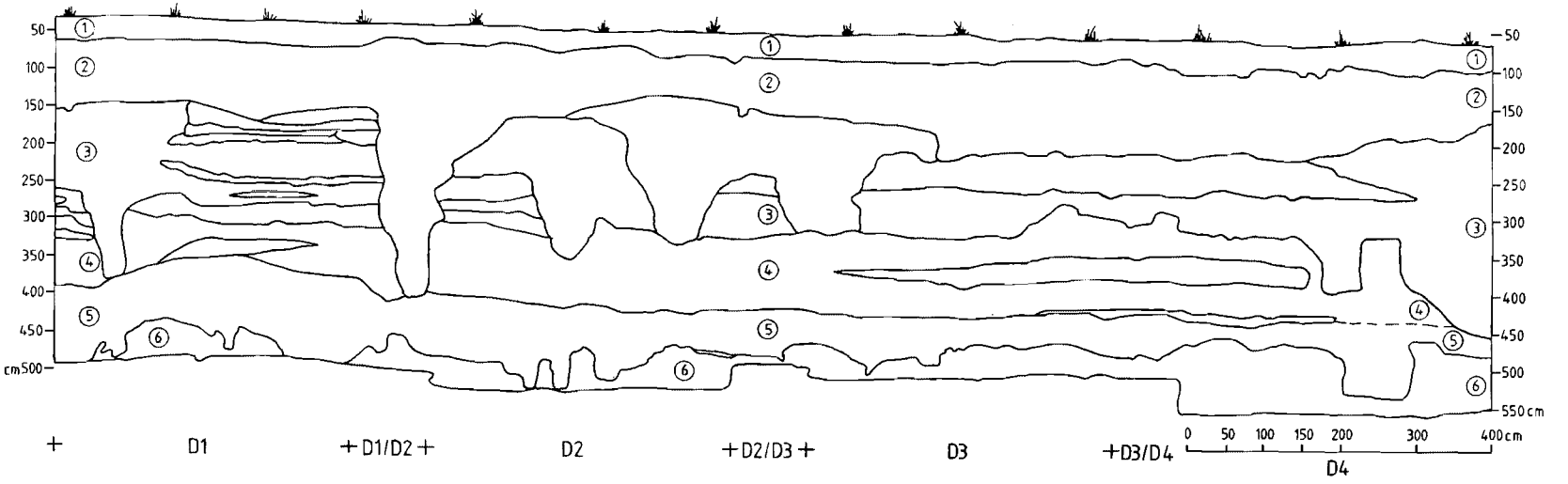


Fig. 3*b* Non Chai excavation: main N/S section looking east.

tracing it down to level 42 in Square D3 to a depth of 6.1 m below surface. This layer was reddish-brown in color (5 YR 4/6).

Cultural Layer 6: (levels 40 through 41/45, depending on square; average thickness 50 cm). By comparison with the above layers, this layer was nearly sterile; however, sherds did occur, and four concentrations of human bone were recovered in squares D2 and D4. These were scattered among sherds, and did not appear to be deliberate burial; no complete skeletons were encountered. The layer was red in color (2.5 YR 4.5/8).

Both excavation levels and cultural layers will be used in the descriptions of faunal remains and ceramic and nonceramic artifacts which follow; the ceramic analyses will further introduce a system of *phases*—apparent peaks in intensity of use of the site that are not in a one-to-one correspondence with the cultural layers. This rather complex terminology, while initially confusing, does allow for a clearer expression of the intricacies that result from the fine-grained excavation of a deeply stratified site.

ANALYSIS

Pottery

By Thai standards Non Chai was a ceramic-rich site; the 360 m^3 excavated yielded approximately 900,000 potsherds weighing about 4800 kg, giving an average sherd density of 2500 pieces or 13.3 kg per m^3. This stands in marked contrast to such sites as Non Nok Tha (0.45 kg/m^3; Bayard 1984*a*:89), and exceeds other late prehistoric sites in the area such as Ban Na Di (6.5 kg/m^3; Higham and Kijngam 1982*c*) and Ban Chiang (approximately 7.5 kg/m^3, based on rough figures given in Gorman and Charoenwongsa 1976:16–17). The analysis of the total body of material from Non Chai would thus entail considerable time and expense. It was decided to concentrate on the analysis of a representative sample from one of the four squares in order to ascertain not only the overall ceramic sequence of the site, but also which of the ceramic criteria are the most sensitive indicators of temporal variation and external contact. As Square D3 had the greatest density of ceramics, it was selected to represent the site; all rim sherds and a 10 percent sample of body sherds from the square were analyzed (11,395 and 17,557 sherds respectively). While this sample represents only 3.2 percent of the estimated excavation total, it is sufficient to provide a general picture of overall ceramic change at the site and its relations to other sites in the region, although it may of course be deficient in documenting detailed, short-term change.

Rutnin began analysis of the rim sherds in June 1978, while assisting at the excavation. Despite the help of three students from Silpakon University, the analysis was still incomplete at the time when she was required to return to Otago for further study, and the rim sherds and body sherd sample were shipped to New Zealand for further study there. The analytical methods used were in general those employed by Bayard on the Non Nok Tha pottery (1971, 1977) and subsequently modified and refined for use in other studies at the University of Otago (Buchan 1973, Higham 1977, Chantaratiyakarn 1983, Wichakana 1984). Working under Bayard's supervision, Rutnin completed the analysis of rim forms, and next classified the rim sherds according to temper (here used in the general sense of fabric

rather than strictly limited to deliberate aplastic inclusions). With the aid of three Otago students, she then classified and coded the body sherd sample according to both temper and surface finish. All data were recorded on computer coding forms giving bag number, excavation level, number of sherds, and weight, using alphanumeric codes for rimform, temper, and surface finish. The punching of some 4,000 cards and the running of programs to yield raw and percent totals by level were completed in May 1979.

Rimform

Non Chai ceramics exhibit the wide variety of rimforms characteristic of late prehistoric alluvial and low-terrace sites (cf. Higham 1977, Kijngam, Higham, and Wiriyaromp 1980, Chantaratiyakarn 1983, Wichakana 1984). While earlier sites such as Non Nok Tha feature less than 20 distinctive rimforms (cf. also layers 7 and 8 at Ban Na Di vis-à-vis the later layers; Wichakana 1984:85–86), some 167 separate rimforms were initially distinguished in the Non Chai material, although it was intended from the start to combine most of these into a smaller number of more general form categories. As might be expected of a site that apparently saw extensive occupational and industrial use, many of the rim sherds were so small and worn as to make classification impossible; these comprised 42 percent of the sample, leaving a total of 6599 classifiable sherds. These latter were grouped into the 167 form categories, as defined by cross-section drawings made during the initial analysis in Thailand. Following initial computer processing, these were recombined and grouped into three overall classes, each containing a number of more general form categories as follows:

Class I: Numerically dominant types with rim-shoulder junction clearly present; this class contains 1945 sherds in 16 form categories (Figs. 4*a,* 4*f*).

Class II: Numerically dominant types in which the lip and most of the rim are present, but which lack a clear junction with the shoulder, and are hence less accurately defined than the Class I forms; this class is made up of 19 categories containing 4222 sherds (Figs. 4*b,* 4*f*).

Class III: Contains 29 minor but distinctive types which were quite rare in the sample as a whole (a total of 432 sherds), but which are so distinct and chronologically limited as to be useful not only in defining the overall sequence, but in

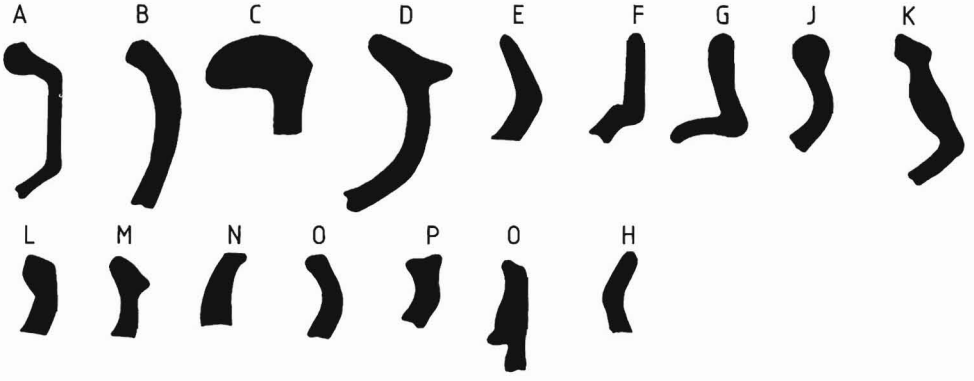


Fig. 4*a* Class I rim profiles.

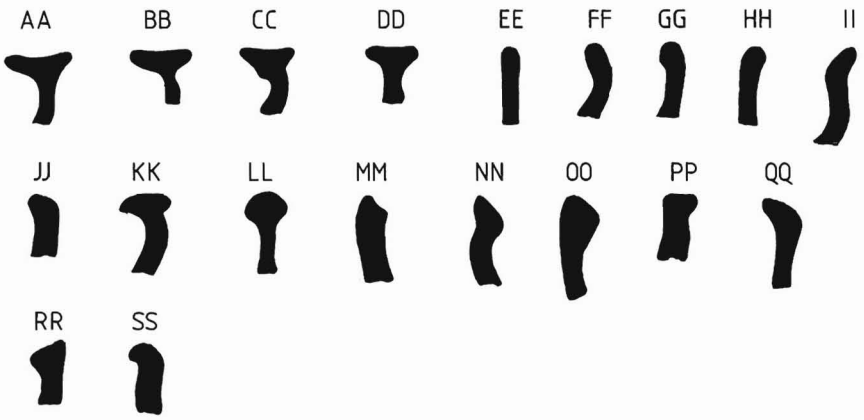


Fig. 4*b* Class II rim profiles.

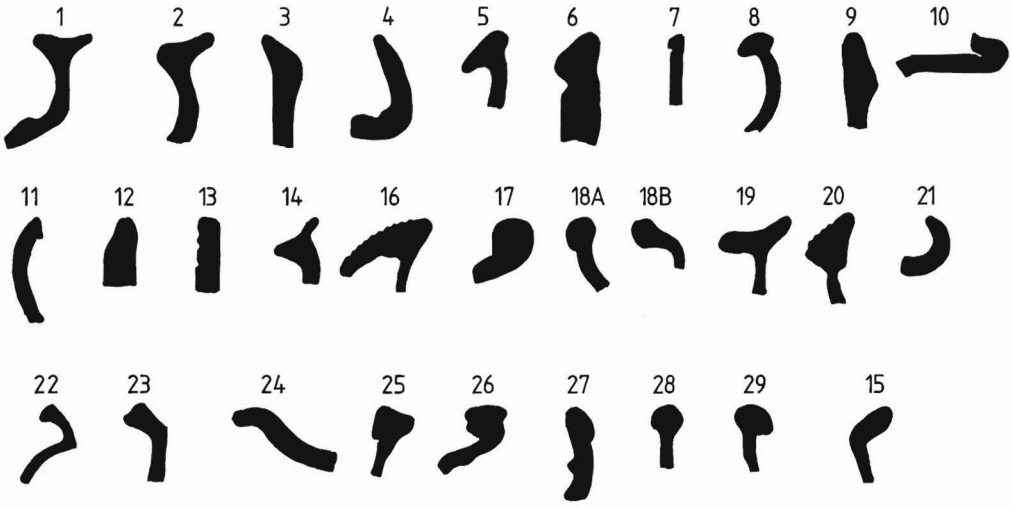


Fig. 4*c* Class III rim profiles.

relating it to other sites in the area as well (Figs. 4*c*, 4*f*). More detail in the exact procedures followed in this and the other analyses may be found in Rutnin 1979. Figures 4*d*–4*e* and Table 1 present the distribution of the three rimform classes by level (raw number data); the implications will be discussed below.

SURFACE FINISH

The analysis of surface finish focused on the sample of body sherds, where 13 types were distinguished, excluding about 10 percent which were so worn as to make their original finish indistinguishable. It should be noted that we are using the term "type" here to refer to a combination of finish attributes rather than as an overall category incorporating other attributes (paste, aplastic inclusions, and so forth). Ideally, of course, it would have been desirable to consider finish as well as

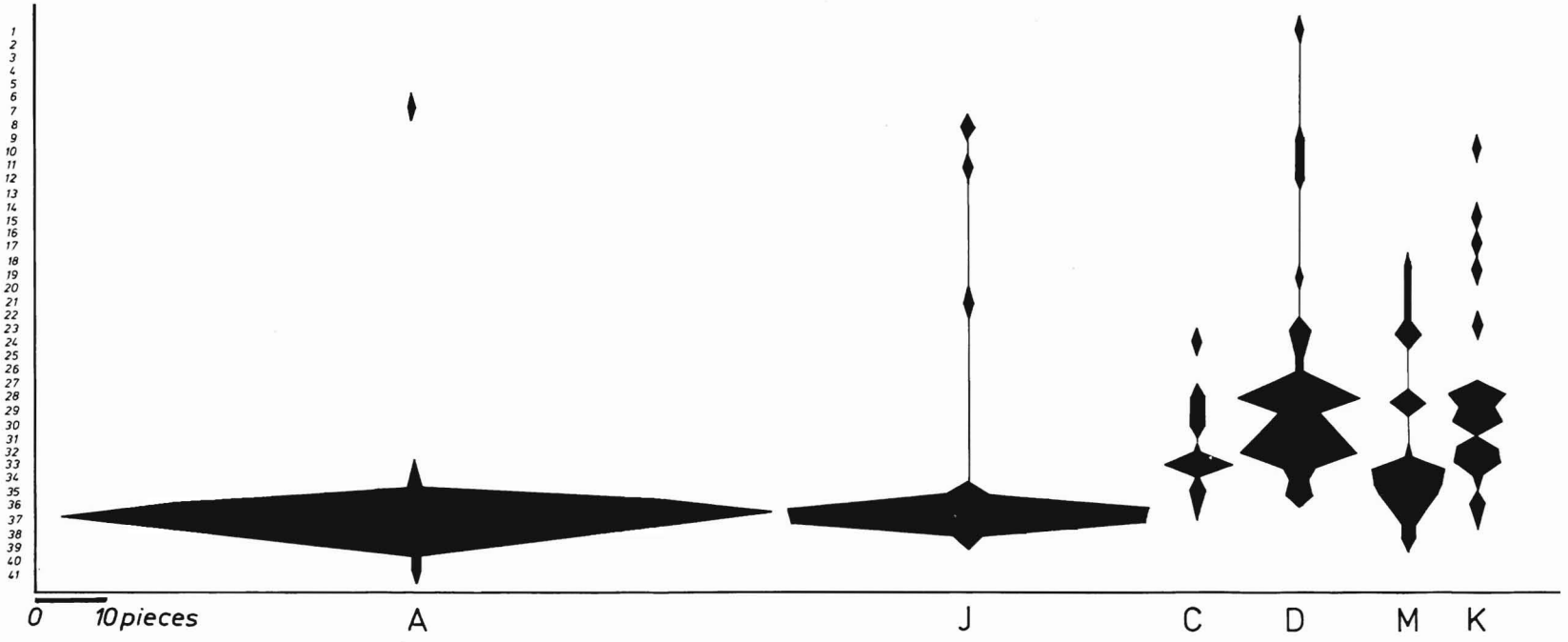
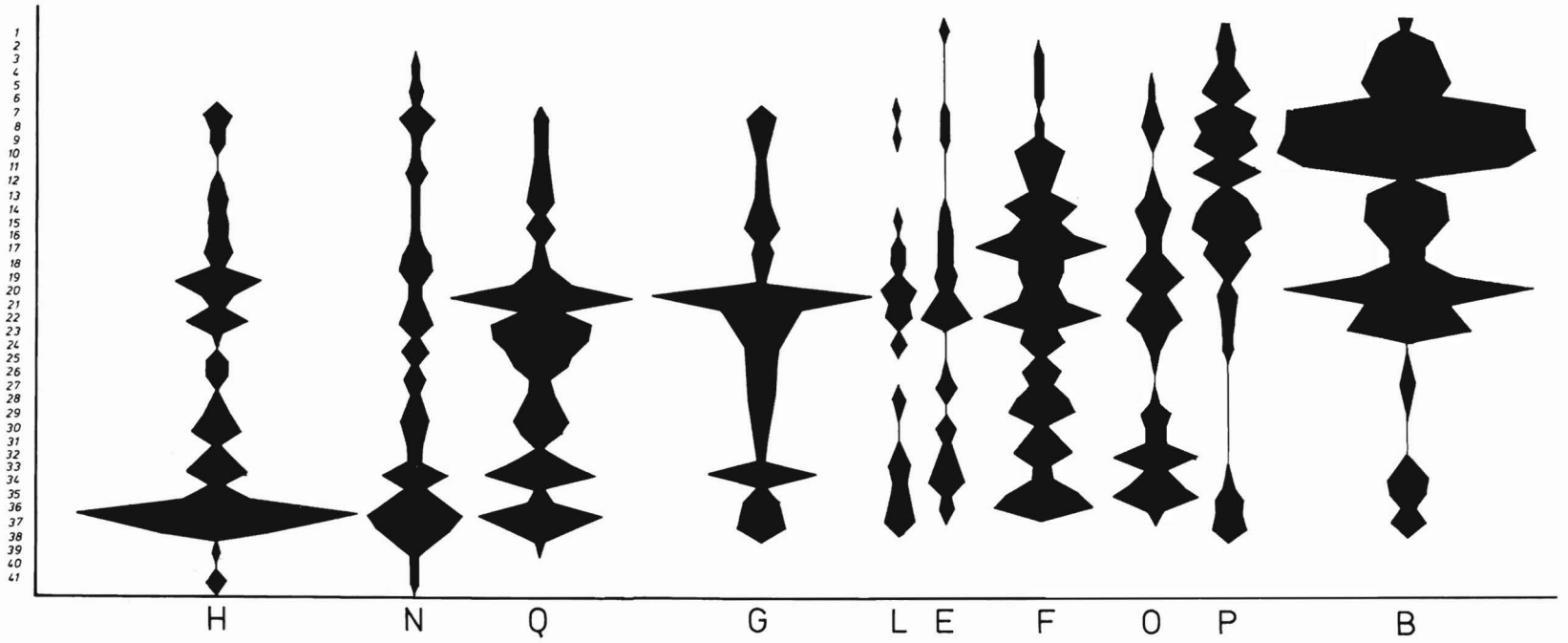


Fig. 4*d* Time-frequency histogram of Class I rims (no.).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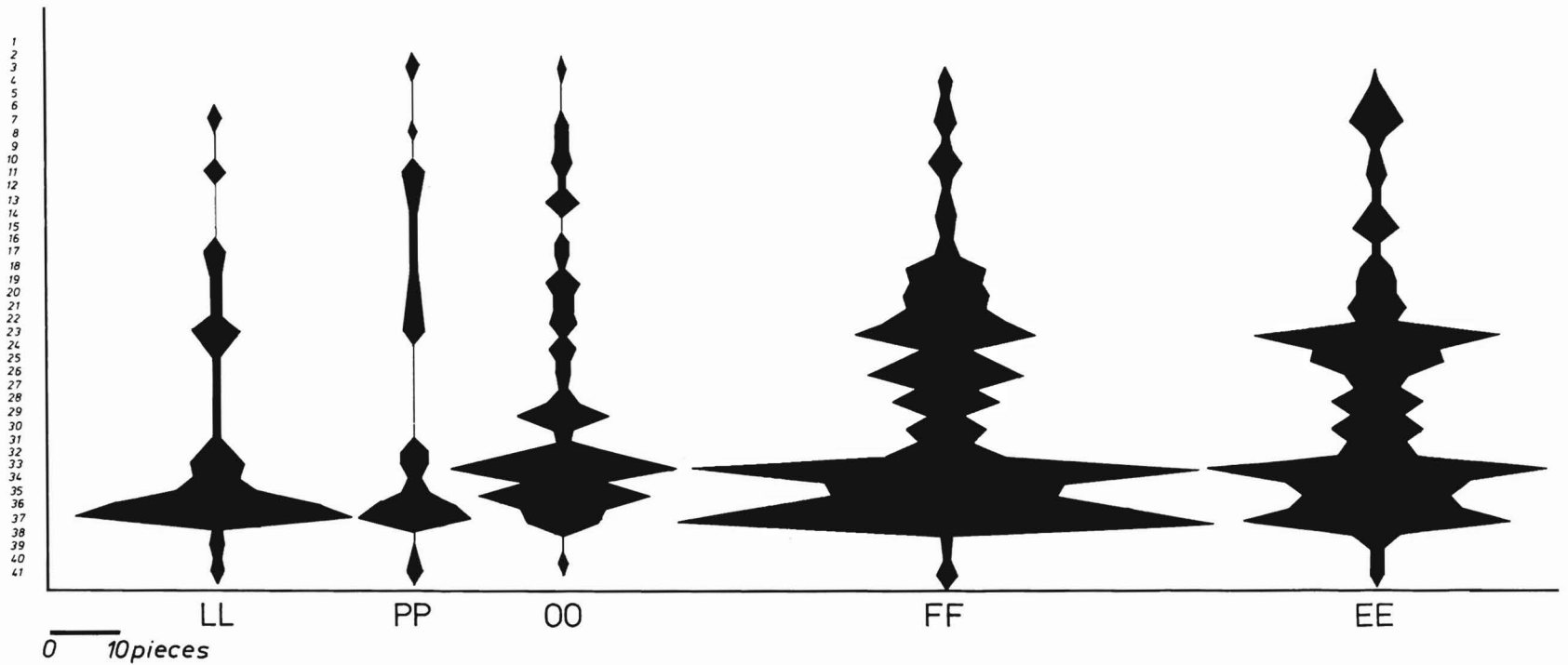
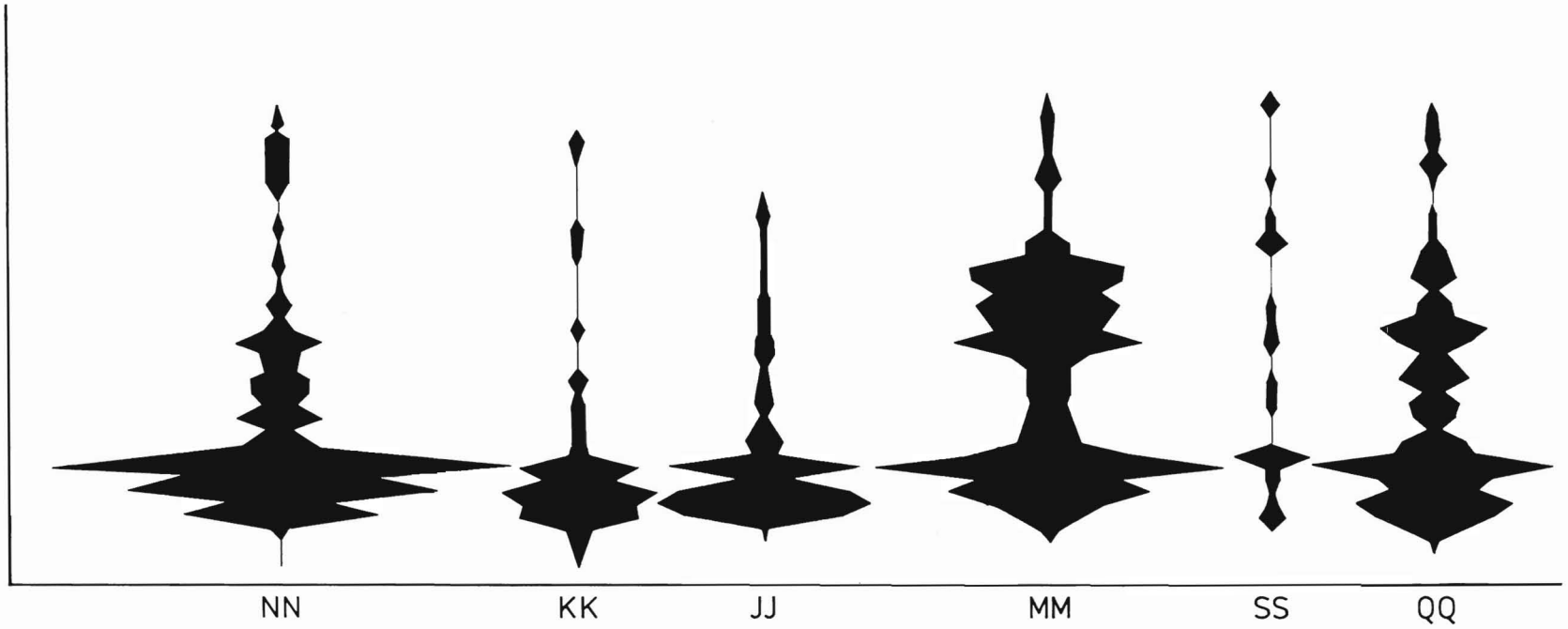


Fig. 4*e* Time-frequency histogram of Class II rims (no.).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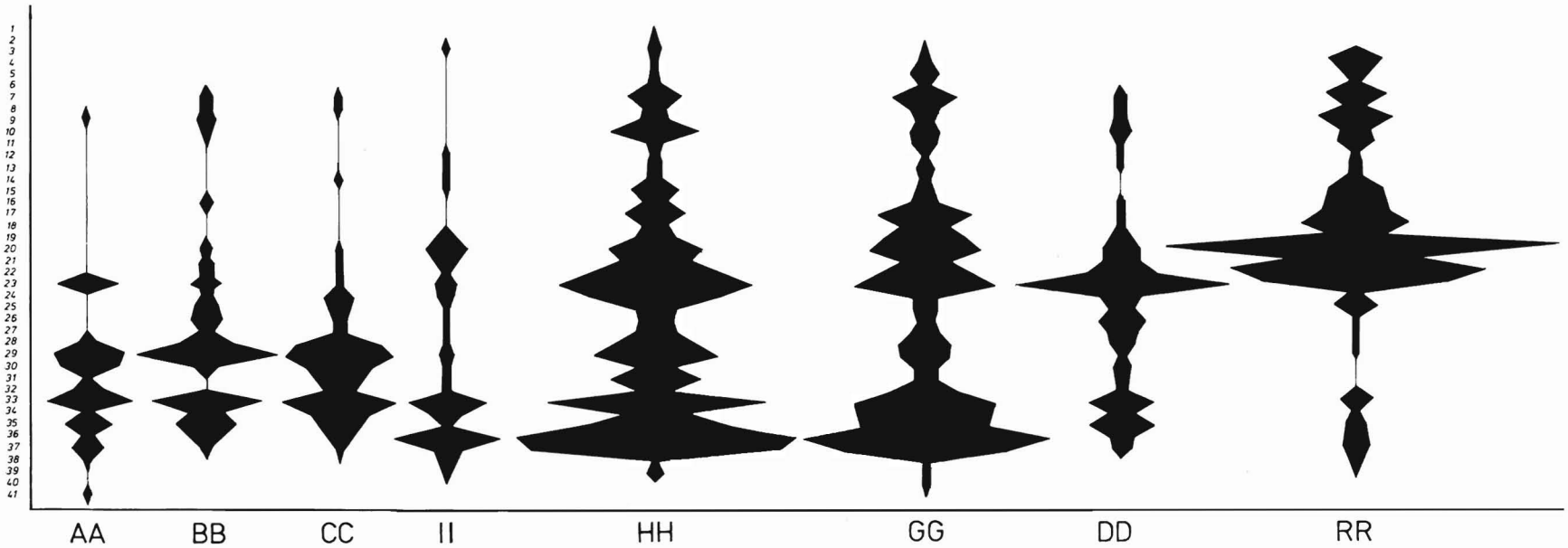
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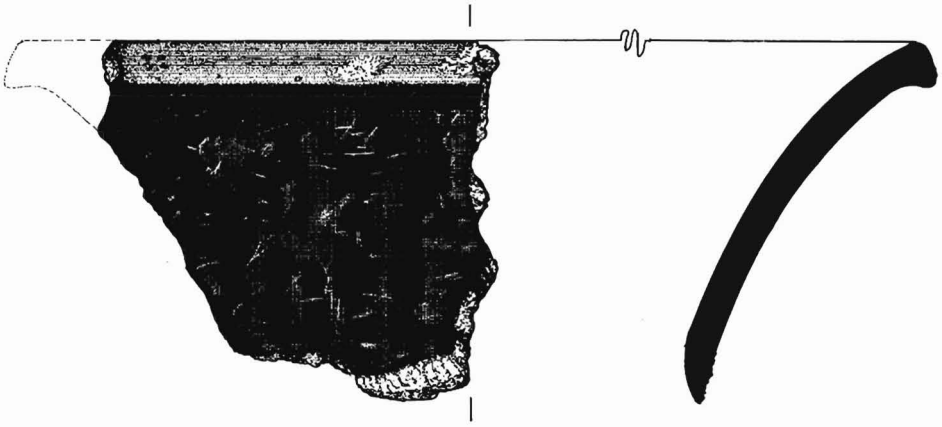
TABLE 1. CLASS III RIMS (MINOR DISTINCTIVE TYPES; RAW NUMBERS)

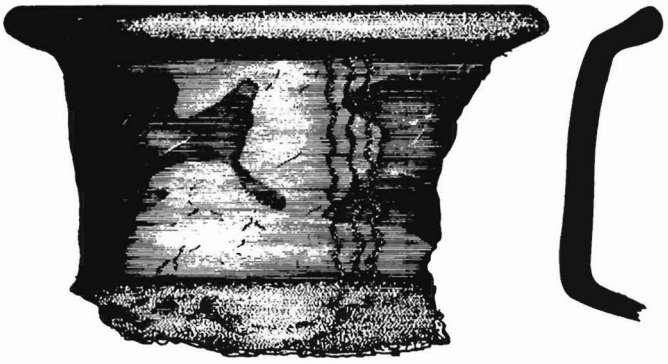
LEVEL	3	4	5	6	7	8	9	10	11	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	32	33	34	35	36	37	
PHASE	VC				VB				VA		IVC						IVB		IVA			III						II		I				
TYPE																																		TOTAL
18B	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	*5*	*11*	16
29	—	—	—	—	—	—	—	—	—	—	—	*1*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	*1*	*3*	*4*	*4*	13
28	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	*1*	—	—	—	—	*2*	*2*	—	*3*	8
9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	*3*	—	—	—	—	—	—	—	—	*8*	—	*1*	*2*	*3*	17
8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	*1*	*2*	*8*	*2*	—	13
26	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	*1*	—	—	—	—	—	—	—	*1*	*2*	—	*3*	—	*1*	8
14	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	*1*	—	—	—	—	1
3	—	—	—	—	*2*	*1*	—	—	*1*	—	—	—	*2*	*1*	—	—	—	—	—	*1*	—	—	—	*2*	—	*2*	*2*	*1*	*1*	*3*	*2*	*11*	*12*	44
4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	*1*	—	*2*	—	—	*1*	—	—	*1*	*3*	*1*	—	—	—	*9*	—	—	*6*	*4*	28
5	—	—	—	—	*2*	—	—	*1*	—	—	—	*1*	—	*1*	—	—	*1*	—	—	*1*	—	—	—	—	—	—	—	*2*	*5*	*1*	*2*	*1*	—	18
12	—	—	—	—	—	—	—	—	—	*1*	*1*	—	—	—	—	—	—	—	—	*1*	*2*	—	—	*1*	—	—	—	—	*1*	—	—	*1*	—	8
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	*1*	—	*1*	—	—	—	—	2
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	*1*	—	*1*	*2*	*2*	*2*	—	—	*1*	—	—	—	10
10	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	*4*	—	—	—	—	—	*2*	*1*	—	—	—	—	—	—	—	—	—	7
22	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	*1*	*5*	—	*3*	*6*	—	—	—	—	—	—	—	—	—	—	—	—	—	15
21	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	*2*	*11*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	13
17	—	—	—	—	—	*1*	—	—	—	—	*2*	*2*	—	*1*	—	*1*	*7*	*5*	*3*	—	—	—	—	—	—	—	—	—	—	—	—	*1*	*1*	24
18A	—	—	—	—	—	—	*1*	—	—	—	—	—	—	—	*1*	*3*	—	—	*3*	—	—	—	—	—	—	—	—	—	—	*1*	—	—	—	9
27	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	*1*	*1*	*2*	—	—	—	—	—	—	—	—	—	—	—	—	—	4
24	—	—	—	—	—	—	—	—	—	—	—	*1*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
16	—	—	*2*	*1*	*5*	*1*	*7*	*3*	*4*	*4*	*3*	—	—	*3*	—	—	*3*	—	—	—	—	—	—	—	—	—	—	—	*1*	—	—	—	—	37
25	—	—	—	—	—	—	*1*	—	—	—	—	—	—	*1*	*2*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	*1*	5
23	—	—	—	—	—	—	—	—	—	—	—	*2*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
7	*1*	—	—	*5*	*9*	*5*	*7*	*21*	*10*	*1*	*2*	*1*	*2*	—	*7*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	71
20	—	—	—	—	—	—	—	*1*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
11	—	—	—	—	*1*	—	—	—	—	—	—	—	—	*1*	—	—	—	—	—	—	—	—	*1*	—	—	—	—	—	*1*	—	—	—	—	4
15	—	—	*1*	*2*	*3*	*1*	*4*	*9*	*2*	*1*	—	*3*	—	—	*1*	—	—	—	—	—	—	*1*	—	—	—	—	—	—	—	—	—	—	—	28
13	*1*	*1*	—	*1*	*1*	*1*	*2*	*4*	*2*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	13
19	—	*1*	*1*	*4*	—	—	*3*	*2*	—	—	—	*1*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	12
LEVEL TOTAL:	2	2	4	13	23	10	25	41	19	7	8	12	4	8	12	5	22	8	21	16	2	2	4	8	4	4	6	4	31	11	21	33	40	

NOTE: Levels yielding no sherds of this class omitted; rim types in approximate chronological order. Level 31 (1 sherd) merged with level 30.

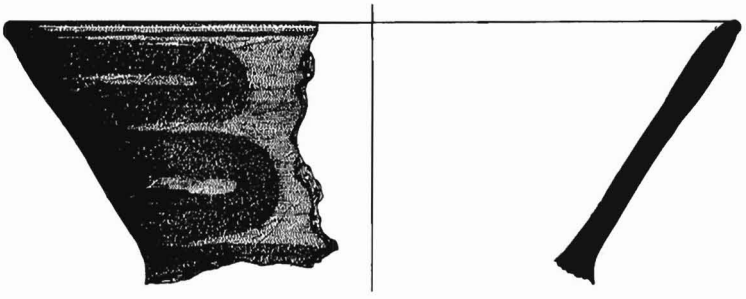
Fig. 4*f* Selected Non Chai Rim Types:



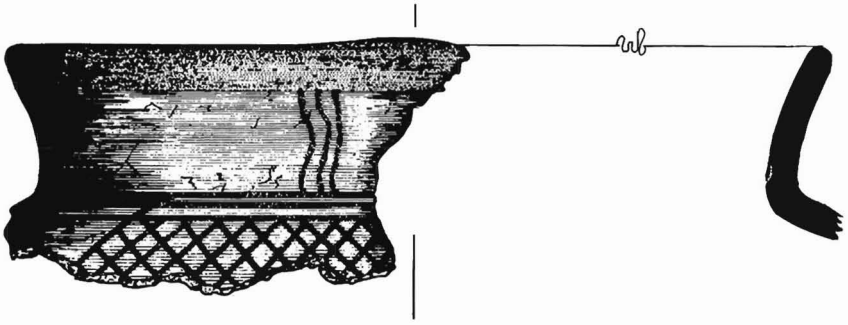
1. Class I, type A; level 37, phase I



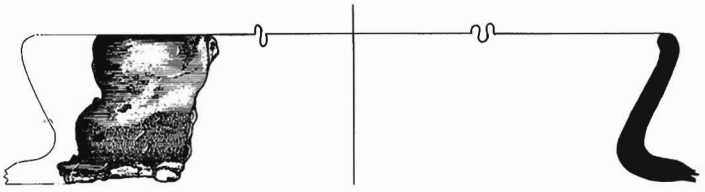
2. Class I, type B; level 15, phase IVC



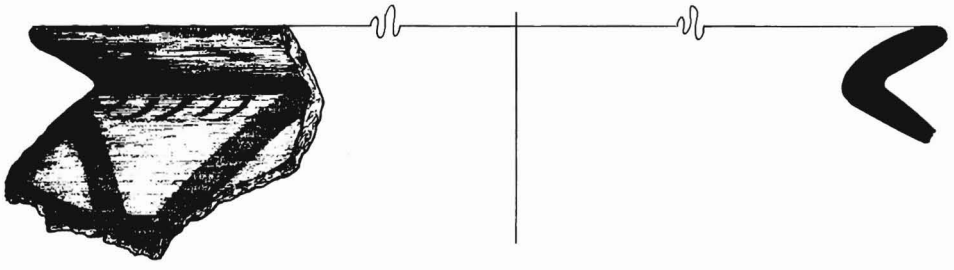
3. Class I, type E; level 30, phase III



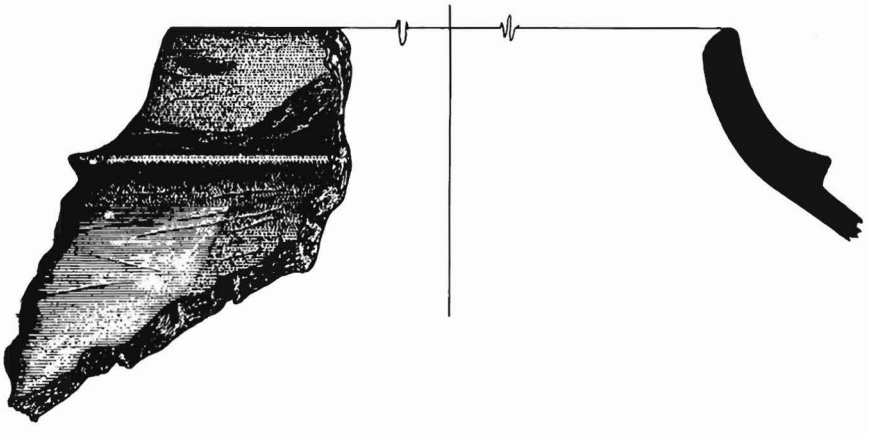
4. Class I, type F; level 37, phase I



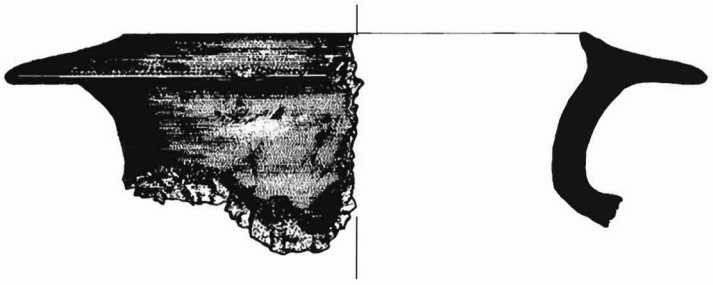
5. Class I, type G; level 20, phase IVB



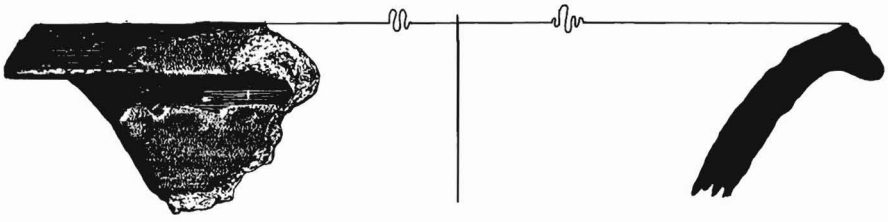
6. Class I, type K; level 23, phase IVA



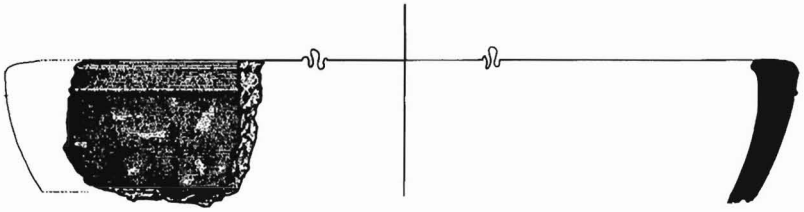
7. Class I, type Q; level 27, post-phase IV



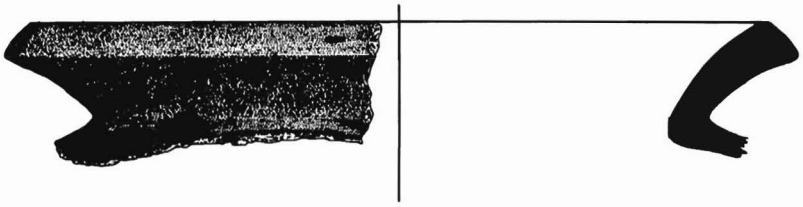
8. Class II, type AA; level 30, phase II



9. Class II, type JJ; level 15, phase IVC

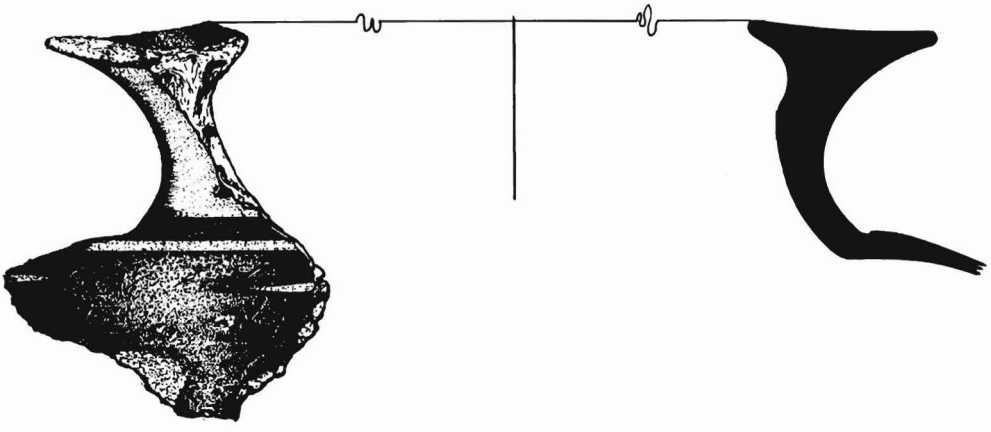


10. Class II, type OO; level 20, phase IVB

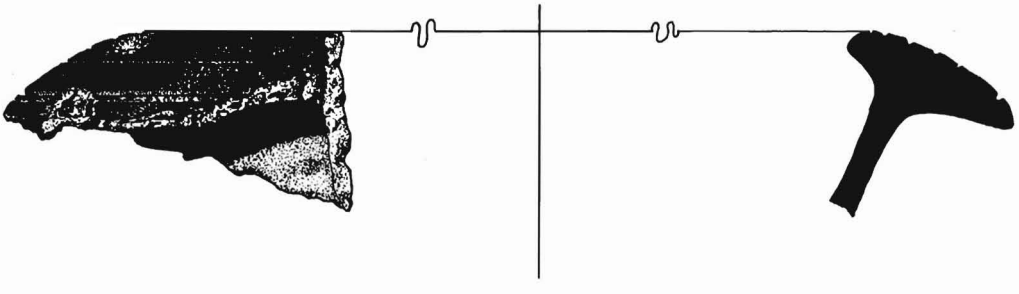


11. Class II, type RR; level 20, phase IVB

form and fabric in analyzing the rim sherds as well, as has been done in later studies by Chantaratiyakarn (1983) and Wichakana (1984) for several sites in the Middle Chi and Upper Songkhram areas respectively. However, the large size of the rim sample from Non Chai (c. ten times and four times the total analyzed from Ban Chiang Hian and Ban Na Di studies respectively) unfortunately precluded the inclusion of this variable. Had finish and fabric been taken into account along with form in establishing basic types, the number of types resulting would very likely



12. Class III, type 1; level 33, phase II



13. Class III, type 16; level 9, phase VA/B

have been so large as to be unsuited for their basic purpose of establishing a temporal sequence for the site and establishing extra-site correlations. For example, Wichakana's (1984) study of the rim sherds from Ban Na Di and related sites classed about 3650 rim sherds into over 260 types based on finish and fabric as well as form (that is, a mean of c. 14 sherds/type). Similar techniques applied to the Non Chai sample of about 6600 classifiable rim sherds would quite possibly have resulted in almost 500 types. This is not to say that the study of any ceramic attribute should be ignored. Form-finish-fabric combinations (particularly rare ones presumably of exotic origin) should, of course, be studied at a later date on this or another representative sample from the massive Non Chai database (an estimated 50,000 rim sherds).

The commonest surface finish category encountered in the present sample was clearly *red-slipped* ware (55% of total by number, 48% by weight); the term "paint" would technically be preferable to "slip," as the coloring agent appears to have contained little or no liquid clay, in contrast with the thicker slips of red wares at Non Nok Tha, for example (Bayard 1977). As used here the term refers to overall coverage as opposed to painting in designs. The paint varies in color from bright orange through to dark brown. *Plain* finish, executed with a plain wooden paddle or by hand, made up 22 percent of the body sherd sample by both number and weight. *Carved-paddle/red-slipped* ware was finished with a paddle

carved with parallel grooves; the imprints were then partially smoothed before application of the paint (7% and 9% by number and weight respectively). *Red-on-buff* ware has a smooth surface painted with designs in red. These designs are superficially similar to the well-known Ban Chiang Late Period ware (Gorman and Charoenwongsa 1976, White 1982), but are simpler geometric patterns of parallel or crosshatched lines, sometimes with dots. The elaborate curvilinear designs characteristic of the Ban Chiang ware are absent; in fact the Non Chai painted wares bear far more resemblance in decoration to those recovered from the recent excavations at Ban Chiang Hian, Maha Sarakham Province (see Chantaratiyakarn 1983: figs. 3-8, 3-9). We should also note that recovery of large sherds from the basal layers of the site make it clear that at least some of the red-on-buff sherds derive from the shoulders of vessels which have most of the body slipped in red; a similar situation occurs at Ban Chiang Hian (Chantaratiyakarn 1983:3–43). Red-on-buff wares made up 7 percent and 9 percent of the sample by number and weight. *Cord-marked* ware has been finished with a cord-wrapped paddle; cords appear to have been tightly spaced together in most cases, but evidence of loose spacing is occasionally noticeable (5% and 4% of the sample). *Red-on-black* ware is similar to red-on-buff, except for the blackish background. These could obviously represent excessively reduced examples of red-on-buff vessels; in any event, they comprise only 1.3 percent and 1.6 percent of the total sample. Average sherd weights for the above finish types range from 3.18 g to 6.01 g, with a mean of 4.87 g/sherd.

While the six finish types described above make up almost 98 percent of the total body sherd sample by number, a further seven types occurred in small quantities. *Carved-paddle/painted* ware (0.92% by number, but 2.08% by weight) has designs painted in red rather than overall slipping. It is also distinguished from the slipped variety by its greater massiveness (average sherd weight = 10.5 g as opposed to 5.6 g for carved-paddle-red-slipped). *Carved-paddle/smoothed* ware is also massive (average sherd weight 12.6 g), and made up 1.10 percent of the sample by weight but only 0.41 percent by number. *Red-slipped/polished* ware, with a surface burnished until shiny after slipping, is even heavier (only 0.29% by number, but 1.33% by weight giving an average weight of 21.4 g/sherd). *Appliqué* sherds in the main appeared to come from the shoulder portion of heavy plain-finished vessels; the appliqué motifs are simple horizontal lines (only 30 sherds: 0.17% by number, but 1.59% by weight; average weight 43.43 g/sherd). *Black-on buff* ware features simple linear black designs on a plain surface, but no clear patterns could be ascertained due to the thinness and small size of the sherds (only 24 sherds: 0.14% by number, 0.10% by weight; 3.46 g/sherd). *Appliqué and slipped* sherds probably derive from vessels similar to the plain appliquéd ones, but have red slipping below the appliqué band. Like the plain ones, they are also massive, averaging 54.70 g/sherd, although the total sample is only 10 sherds (0.06% by number, 0.67% by weight). Finally, five *incised/impressed* sherds were encountered, either having simple incised lines or what appeared to be dentate stamp impressions (0.03% by number, 0.09% by weight, 15.40 g/sherd).

Figure 4*g* presents the temporal distribution of the various body finish categories in order of their frequency at the site. As with the rimform distributions, frequency is shown by number of sherds rather than weight, as the presence of a small number of large, heavy sherds would distort the overall distribution and give undue representation to the relatively rare massive varieties; for example, the

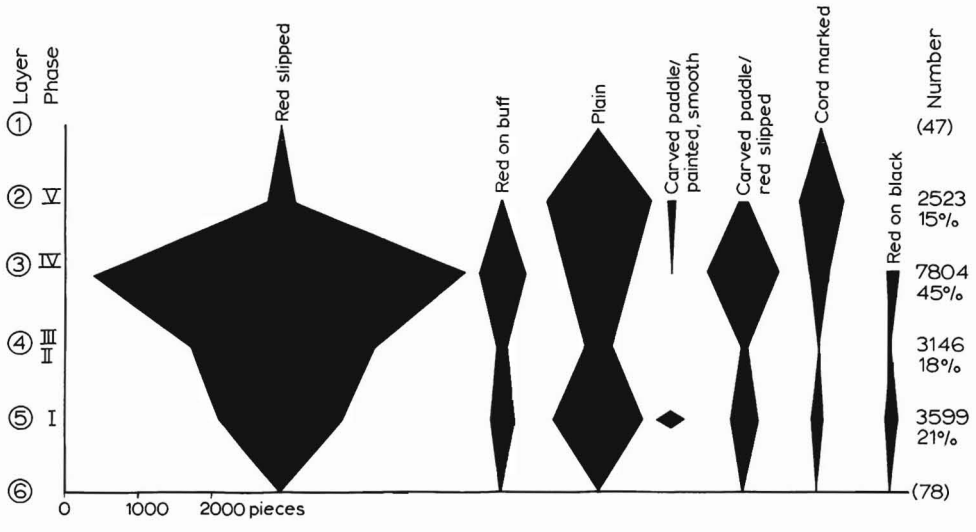


Fig. 4*g* Histogram of body finish categories (no.). Total N = 17,197.

five thick varieties described above comprise almost 7 percent of the sample by weight but only 2 percent by number. As with the rim sherd data presented below, we choose to present data in terms of raw numbers rather than percentage by number or weight. The reader may thus gain an impression of the relative abundance of material and sample size for each level. Without such data the automatic correlations produced by the use of percent data alone can often be misleading. However, to facilitate overall comparison of the sequence with other sites where pottery data have been presented by percent of weight per level (for example, Higham 1977, Higham and Kijngam 1982*c*), Figure 4*h* gives weight percentages of types comprising more than 1 percent of the total for each of the six general cultural layers.

TEMPER

The study of variation in temper (used here in the general sense, including nature of fabric as well as aplastic inclusions) has proved of considerable value at other sites in Northeast Thailand (Bayard 1977, Higham 1977, Chantaratiyakarn 1983, Wichakana 1984); both rim and body sherd samples from Non Chai were accordingly analyzed following the procedure used in all studies in the region to date, using a binocular microscope to examine fresh breaks. Obviously detailed petrographic analyses are necessary to establish specific correspondences between the necessarily rather subjective fabric labels used here with similar labels as applied to material from other sites. Vincent (1984*a, b*) has undertaken the first such scientific examination of wares from Northeast Thailand sites, and has kindly examined representative specimens of Non Chai ware. His preliminary discussion of the Non Chai material is necessarily brief (1984*b*:687–688). While awaiting the completion of his research and publication of full results, we present the temper/fabric descriptions below more as descriptive labels than as absolute statements of deliberately added aplastic content. Eight principal temper types were distinguished, one of which dominated throughout the sequence (Fig. 4*i*); these are listed below in order of descending

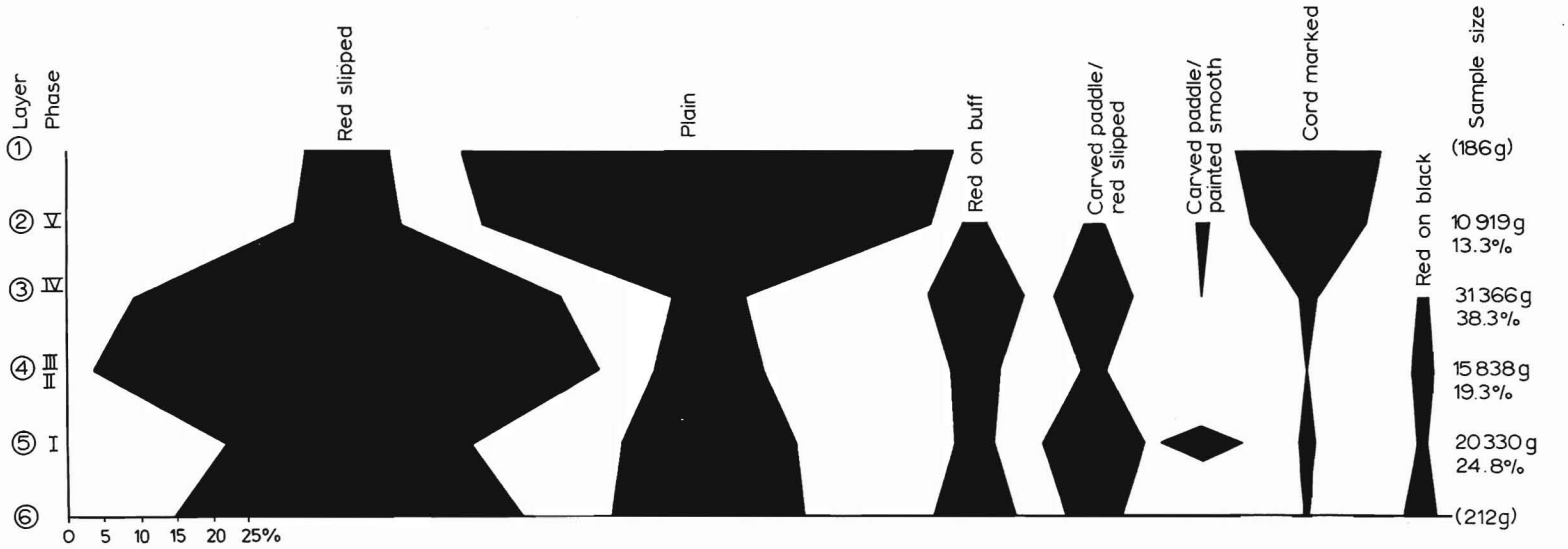


Fig. 4*h* Non Chai body sherd finish by weight percentage, excluding minor types (3.8% of total sample of 81,951g).

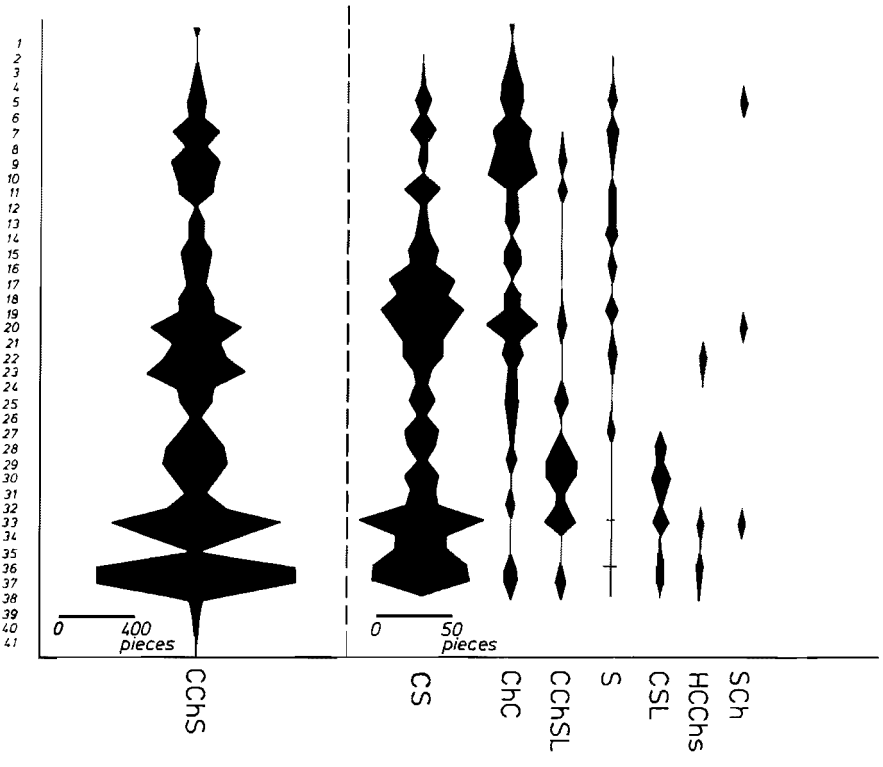
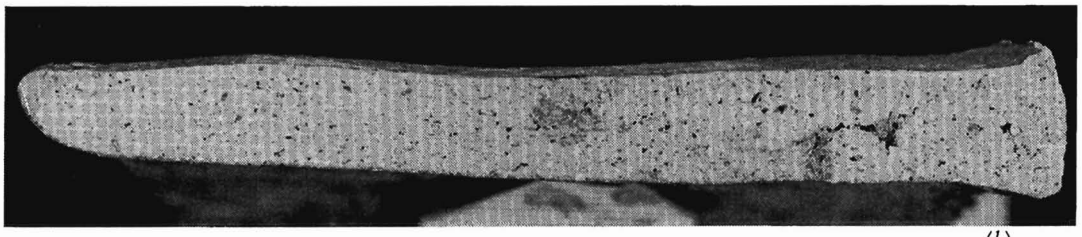


Fig. 4*i* Histogram of rim sherd temper categories (no.).

frequency in the rim sherd sample (here comprising 11,214 sherds, as 181 sherds were lost in transit from Thailand to Otago). Plate I illustrates the three major temper types; the remaining five types each comprise only 1 percent or less of the total sample by number, but may prove useful for extra-site comparisons.

Clay/chaff/and sand (CChS in Fig. 4*i*): Sherds contain a moderate to large amount of rice chaff, a small to moderate amount of fine sand, and considerable quantities of greyish clay fragments (grog); in some cases chaff imprints are visible in the crushed clay fragments themselves. These inclusions are referred to as "blebs" by Vincent, and very probably derive from specially prepared and fired balls of clay mixed with rice chaff that were then crushed and added to the plastic raw clay itself (Vincent 1984*b*:669–670). Color of this fabric ranges from light to dark buff on inner and outer surfaces shading to grey in the interior of the sherd, or remaining buff in more oxidized examples (Plate I*a*). This type includes 88.4 percent of the rim sherd sample by number (89.3% by weight; 17.7 g/sherd); it made up a massive 97.09 percent of the body sherd sample. After completion of the rim sherds and early in the analysis of body sherds, it became apparent that two variants of this fabric could be further distinguished: a hard-surfaced ware with little variation in thickness, and a softer ware (presumably resulting from a lower firing temperature) with more variable thickness. On completion of the body sherd analysis a marked contrast in temporal distribution was visible, with c. 90 percent of the soft variant limited to levels 3–13 (cultural layer 2), and a

(*a*)



(*b*)

(*c*)

Plate I: Non Chai ceramic fabrics:
a. clay/chaff/sand ware *b*. clay/sand ware *c*. chaff/clay ware

corresponding dominance of the hard form from level 15 downward. However, discrepancies between the rim and body data were also apparent; two other categories (chaff/clay and clay/sand) were grossly underrepresented in the body sherd data when compared to the rim sherd results—in fact, no chaff/clay sherds at all were recorded for the body sherd sample below level 14. Unfortunately, the body sherd bags were processed in rough chronological order from top to bottom, and it seems clear that about one-quarter of the way through the sample an unconscious shift in criteria took place (probably coinciding with the onset of assistance

from the three inexperienced students). This resulted in the assignment of all chaff/clay and many clay/sand sherds to the dominant clay/chaff/sand category. Accordingly, we felt it was necessary to discard the body sherd temper results, and await the processing of a further sample drawn from the massive number of body sherds which have not yet been analyzed. The rim sherd sample, although smaller, was clearly large enough to provide a generally representative picture of chronological variation in temper/fabric types (Fig. 4*i*).

Clay/sand (CS): Contains more fine-grained sand than the dominant clay/chaff/sand category above; also contains considerable clay, usually more finely ground than in the above fabric. Sherds have an orange to buff exterior and buff to grey interior (Plate Ib). This type comprises 6.7 percent of the rim sherd sample by number and 5.8 percent by weight (average sherd weight 15.2 g/sherd).

Chaff/clay (ChC): Contains moderate to large amounts of rice chaff and sometimes short pieces of rice straw as well, plus a moderate amount of finely ground clay. Sherds have dark buff to brownish-grey exteriors and grey-brown to black interiors (Plate Ic). Comprises 2.6 percent (number) and 1.9 percent (weight) of rim sample (12.9 g/sherd).

Clay/chaff/sand/laterite (CChSL): This ware is a coarser version of the dominant type, containing small reddish pieces of what appear to be laterite, and sometimes short pieces of rice straw, in addition to clay, chaff, and sand; the ware is normally quite thick. Makes up 1.03 percent (number) and 1.68 percent (weight) of rim sample (28.4 g/sherd).

Sand (S): Inclusions (whether deliberately added or not) are limited to moderate to large quantities of medium-grained sand; sherds are thinnish with a gritty feel, but not friable. Color varies from grey and brown to red, orange, and buff. Makes up only 0.62 percent (number) and 0.34 percent (weight) of rim sample (9.5 g/sherd).

Clay/sand/laterite (CSL): Like clay/chaff/sand/laterite above, this is a thick ware, containing small particles tentatively identified as laterite as well as clay, sand, and sometimes fine gravel, but little or no chaff. Makes up 0.40 percent (number) and 0.71 percent (weight) of the rim sample; the average sherd weight of 31.2 g was almost double the overall mean (17.54 g).

High-fired clay/chaff/sand (HCChS): As with the distinction between "hard" and "soft" variants of the dominant fabric type, this is not a variant in terms of inclusions, but rather one apparently resulting from firing at a temperature even higher than the "hard" variant. The sherds have a distinctly shiny appearance that does not seem to be the result of burnishing but rather of a higher firing temperature (this of course remains to be more objectively tested by detailed analytical studies). The sherds could perhaps have originated from fire-clouded portions of vessels of the dominant temper type, as the average sherd weight (15.8 g/sherd) is similar. In any event, the variant is represented by only 14 rim sherds (0.12% and 0.11% by number and weight).

Sand/chaff (SCh): This thick ware contains less sand than those in the sand category above, but still enough to be markedly gritty to the touch; it contains as well a moderate amount of rice chaff and occasional short pieces of straw, and is usually grey to orange in color. Only 11 sherds were present in the rim sample (0.10 percent and 0.15 percent by number and weight; average sherd weight 26.1 g).

Results and Discussion

It is obvious from inspection of the time-frequency histograms (Figs. 4*d*–4*i*) that sherds are not distributed equally throughout the 41 excavation levels. Levels 1–2 (layer 1) and 40–41 are almost sterile, as are the immediately adjoining portions of layers 2 and 5. A histogram of the percentages by number of body and rim sherds (Fig. 4*j*, Table 2) supports the division of the sequence into a number of phases of intensive industrial/occupational use; these are separated by levels of lesser sherd density. The five phases in the main correspond with layers 2–5, except that two phases (II and III) are present in layer 4, separated by a pronounced hiatus at levels 30–31. Phases IV and V appear to have three peaks of intensity each, although the massive body sherd peak at IVC may well be an artifact of sampling error, as it is not reflected by a similar peak in rim sherd numbers; the same may be true of the VA peak. It would seem preferable to rely more heavily on the rim sherd figures, as they represent the total sample from Square D3 rather than the 10 percent of the body sherd sample. The latter appear to be overrepresented in level 18 and underrepresented in levels 33 and 37.

As at other late prehistoric sites in the region, rimform has proved to be the most sensitive indicator of chronological change at Non Chai (cf. Chantaratiyakarn 1983, Wichakana 1984). Both Class I and Class III rimforms can be placed in a satisfactory order of chronological dominance, as illustrated in Fig. 4*k* and Table 1.

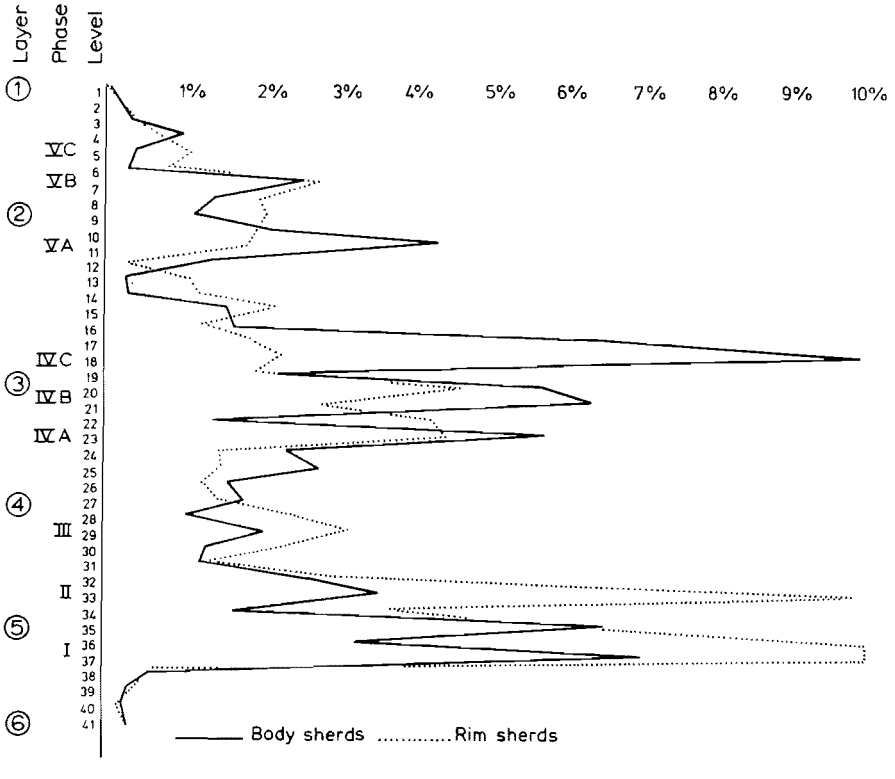


Fig. 4*j* Histogram of rim and body sherds by level, as percentage of total site sample.

TABLE 2. NUMBER AND PERCENT OF RIM AND BODY SHERDS BY LEVEL

LEVEL/PHASE		N RIM SHERDS	% RIM SHERDS	N BODY SHERDS	% BODY SHERDS
Layer 1					
(Surface				6	0.03)
1		7	0.06	13	0.07
2		25	0.22	34	0.19
Layer 2					
3		34	0.30	52	0.30
4		86	0.75	167	0.95
5	VC	119	1.04	64	0.36
6		89	0.78	45	0.26
7	VB	306	2.69	453	2.58
8		228	2.00	235	1.34
9		232	2.04	188	1.07
10		226	1.98	369	2.10
11	VA	205	1.80	742	4.23
12		20	0.18	219	1.25
13		120	1.05	33	0.19
Layer 3					
14		133	1.17	39	0.22
15		247	2.17	277	1.58
16	IVC	133	1.17	292	1.66
17		217	1.90	1156	6.58
18		256	2.25	1739	9.90
19		226	1.98	508	2.89
20	IVB	528	4.63	998	5.68
21		320	2.81	1149	6.54
22		477	4.19	248	1.41
23	IVA	498	4.37	1028	5.86
24		168	1.47	406	2.31
Layer 4					
25		166	1.46	488	2.78
26		136	1.19	285	1.62
27		162	1.42	316	1.80
28		280	2.46	184	1.05
29	III	353	3.10	361	2.06
30		252	2.21	214	1.22
31		156	1.37	204	1.16
32		343	3.01	472	2.69
33	II	1125	9.87	639	3.64
Layer 5					
34		434	3.81	302	1.72
35		669	5.87	1124	6.40
36(+42)	I	1137	9.97	568	3.24
37		1133	9.94	1222	6.96
38		68	0.60	115	0.66
39		36	0.32	63	0.36
Layer 6					
40		18	0.16	35	0.20
41		27	0.24	44	0.25
TOTAL		11,395	100%	17,557	100%

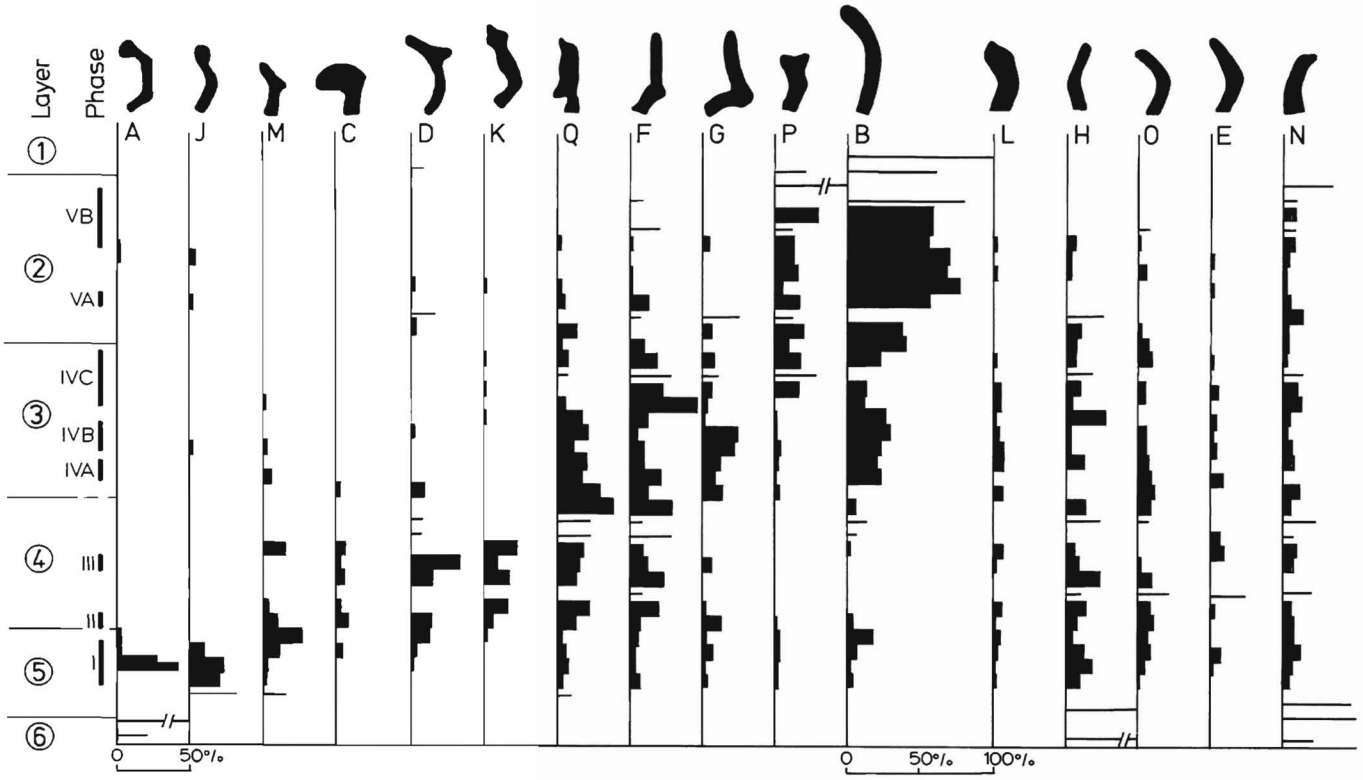


Fig. 4*k* Histogram of percent (by no.) of Class I rim sherds by level.

It is clear that Class I types A and J are almost entirely limited to phase I; type M has a peak in I and II, C in II and III, and D and K in phase III. Types Q, F, and G are most prevalent in phase IV, although occurring in small amounts in the other phases, while B and particularly P are dominant in phase V. Types L, H, O, E, and N have no clear chronological peak, but occur in small numbers throughout the sequence. These forms are simple everted rims, possibly from cooking pots (types L, O, and E), and inverted bowl-like rims (H and N); their occurrence throughout the sequence is not surprising. A similar persistence through an even longer sequence at Non Nok Tha is shown by the equivalent forms (types 13 and 05) there (Bayard 1977:77).

The distribution of the 29 Class III rims provides a close parallel to the Class I pattern, although the 432 sherds in this class comprise only 3.8 percent of the total rim sample. Some types are strictly limited in time (for example, 18B, 29, and 28 to phase I; 1 to phase III; 17 to phase IV; and 13 and 19 to phase V). Others span several phases, like type 3 (I–III), 16 (IV–V), and 7 (also IV–V). The Class II distribution also resembles Class I in that no types are uniquely associated with phase II; it appears instead as a transition between phases I and III. While types such as 3, 4, and 5 persist in small numbers into phase IV and V times, there is a clearly defined break between the earlier phases and phase IV at the layer 3/4 boundary. A second break at the layer 2/3 boundary sets off phase V from IV, although types such as 16 and 7 indicate some measure of continuity, paralleling Class I types B and P.

The temporal distribution of the Class II rim fragments presents a generally similar picture. Some types such as JJ, KK, NN, and OO are dominant during the early portion of the sequence; others such as DD and particularly RR characterize the sequence from phase IV onward. Because of the fragmentary nature of the material, divisions between phases I–III and particularly IV–V are not as apparent as with the Class I and III material, but a clear break at the layer 3/4 boundary is still apparent.

As a further check on the consistency of the sequence proposed above, factor analyses of variation in number (standardized data) by level were also performed on all three classes of rim data, using the SPSS/V8 PA2 routine to extract three factors. The results of the Class I analysis (Fig. 4*l*) indicate a fairly clear division into the layers distinguished by the excavators; the layer 2 levels form a particularly tight cluster (with the exception of levels 3 and 12), while the layer 4 levels are somewhat more loosely clustered. The layer 5 and layer 3 levels are much more scattered, but still generally distinct from each other and the other two layer clusters. The Class II analysis produced more ambiguous results, but still indicated a clear division between early (layers 4–5) and late (2–3) periods. The results of the Class III analysis were more ambiguous still, with the upper levels (down to 15) having low Factor 2 values and the lower levels (up to 17) having low Factor 1 values; nonetheless, phases I and II stand out fairly clearly, with middle to high Factor 2 values, and most of the phase V levels similarly have high Factor 1 values.

Since the foregoing analyses were run on the various classes of combined form categories, it was decided to carry out an additional factor analysis using the original 167 form categories. The results (Fig. 4*m*) corroborate the major breaks in the sequence between phases III/IV and IV/V; Factor 1 subsumes 97 percent of the variance, and together with Factor 2 (2% of the variance) produces a tight cluster

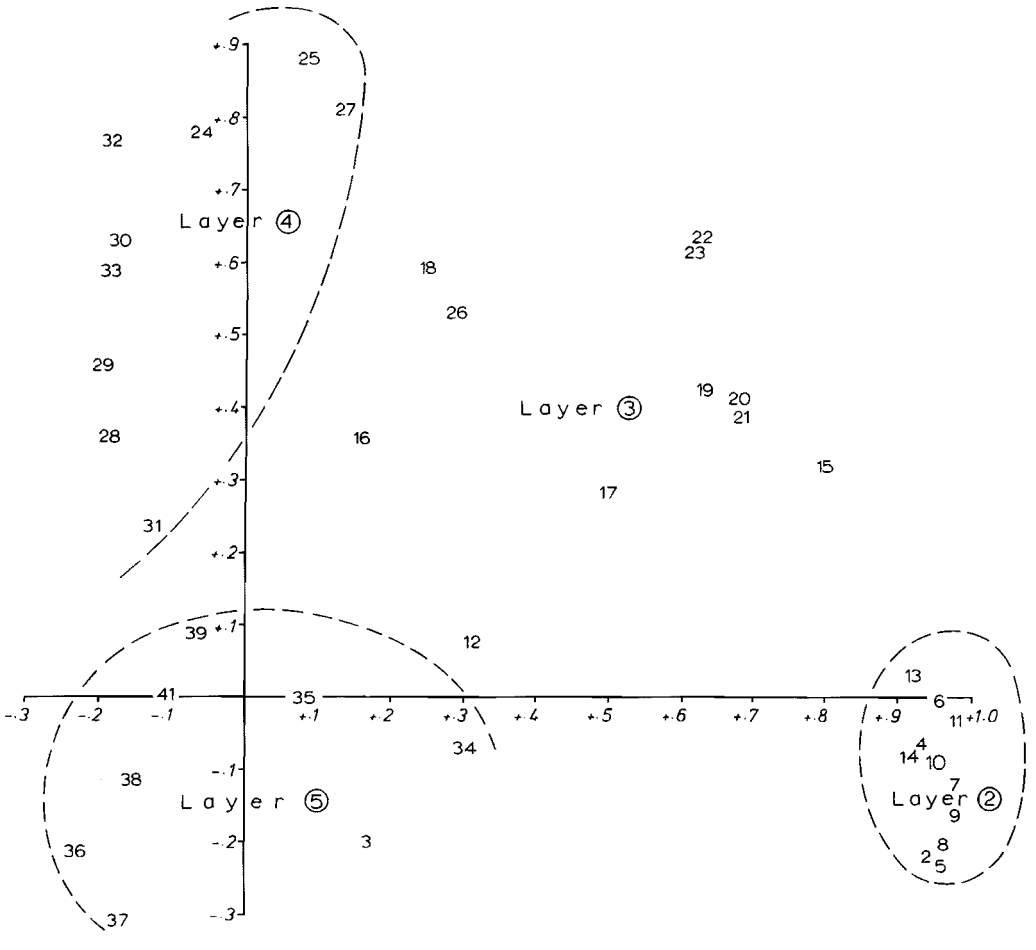


Fig. 4*i* Factor matrix: level variation of Class I rims (no.). Factor 1, 57.8 percent of variance; Factor 2, 26.8%. Levels 1 (surface) and 40 omitted.

containing all phase I–III levels. Phase IV is represented by a more diffuse cluster, while phase V is grouped in a relatively tight cluster with high Factor 2 values; only levels 2, 3, and 12 are aberrant, possibly because of the low number of sherds from these levels (25, 34, and 20 respectively), although it should be noted that other levels are represented by equally low numbers (for example, 1 [7], 39 [36], 40 [18], and 41 [27]).

Turning to body sherd finish, Figures 4*g* and 4*h* make it apparent that the greatest amount of change in the sequence occurs at the phase IV/V boundary, with a very marked decline in red-slipped and red-on-buff painted ware and a growth in plain and cord-marked finishes. (It should be noted that the proportions shown in Figure 4*h* for layers 1 and 6 are not to be relied on, since they are based on very small samples.) But it is also clear that significant changes took place in the earlier phases as well. Phase I is characterized by red-slipped and plain finishes, with notable amounts of carved-paddle/red-slipped and red-on-buff wares (the latter "ware" in all probability consists of the shoulder sherds from otherwise

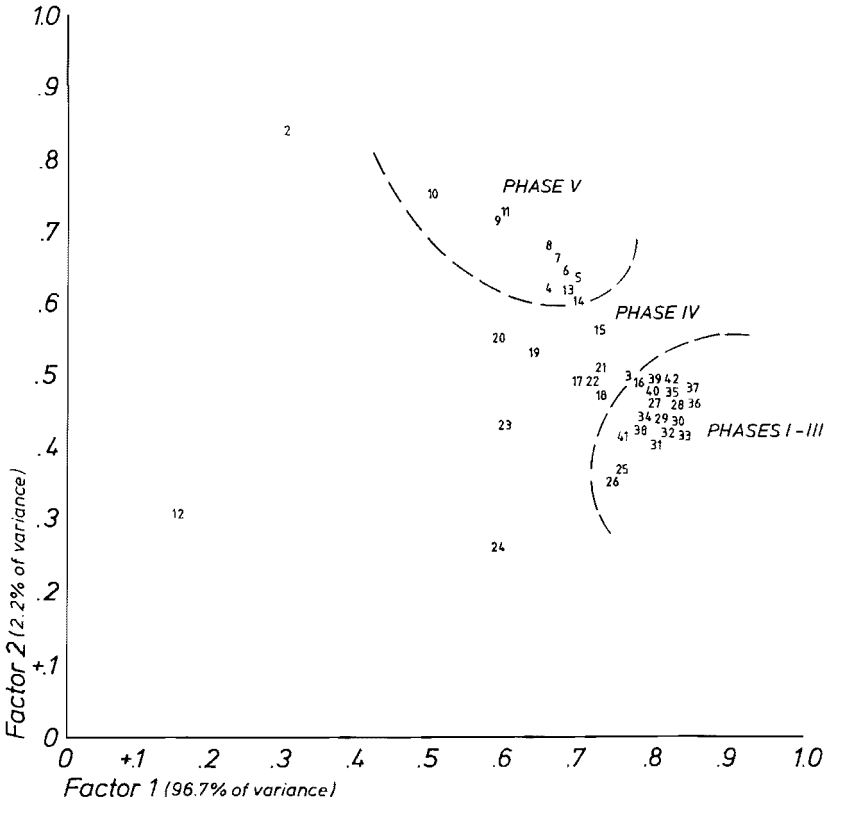


Fig. 4*m* Factor matrix: level variation of 167 original rim types (no.).

red-slipped vessels). Phase I also sees the only appearance in any quantity of the fairly massive carved-paddle-smoothed/painted wares. The transition to phase II is marked by a reduction in plain and carved-paddle/red-slipped wares; red-slipped ware continues to predominate (but not increase to the extent suggested by the percentage diagram); red-on-buff painted ware declines, suggesting an increase in wholly red-slipped vessels. Phase III in general continues the pattern of phase II, but phase IV sees a resurgence of red-on-buff and carved-paddle/red-slipped wares. Finally, in phase V (layer 2) red-slipped ware declines sharply to only 15 percent of the weight sample, while plain and cord-marked wares increase to 62 percent and 16 percent. This overall pattern is further supported by a factor analysis which tightly clusters levels 2–10 plus 12 (Factor 1 values near zero, +.90 or more in Factor 2 in a scale of −1.0–+1.0); produces a loose cluster of phase I levels (high positive Factor 1 values and +.10 to +.60 in Factor 2); and tightly clusters all the phase II–IV levels (+.90 or more in Factor 1, −.02 to −.26 in Factor 2).

In contrast to earlier analyses of Thai pottery from Non Nok Tha and the Roi Et area (Bayard 1977, Higham 1977), temper variation at Non Chai shows little apparent chronological sensitivity, although this remains to be established objectively through Vincent's (1984*b*) petrographic analyses. Such studies should be able to resolve such questions as the transition from hard to soft clay/chaff/sand at the IV/V boundary (which should be viewed with suspicion until a further sample of

body sherds is processed). Vincent equates the bleb-tempered ware with the red-slipped body finish dominant at Non Chai during phases I–IV, and suggests the Non Chai area is the point of origin for similar fabrics which appear in the upper Songkhram basin in the latter portion of this period (1984*b*:688). Hopefully this equation will be supported by examination of a larger sample of sherds, as will his equation of rice temper with the impressed and cord-marked wares, which Vincent feels appear only in phase V and replace the bleb-tempered ware at Non Chai (1984*b*:689–690). However, the necessarily rather subjective classification employed here indicates little marked chronological variation in the more reliable rim sherd sample (Fig. 4*i*). The numerically dominant clay/chaff/sand temper is somewhat more prevalent in phase I, while it is almost equalled by clay/sand in phase IVb and surpassed by the latter in IVc; chaff/clay temper increases slightly in proportion in phase V. The minor temper types show no clear chronological pattern, although the two types incorporating what appears to be laterite reach a peak in phases II–III. A factor analysis of the rim temper data succeeded only clustering out the layer 5 levels (34–39) plus level 32 as distinct from all others; this is presumably due to the relatively greater amount of clay/sand temper in layer 5.

The overall chronological variation is thus less than at earlier prehistoric sites such as Non Nok Tha (Bayard 1977), but the predominance of clay and chaff-based tempers during the time span covered by Non Chai is comparable to other alluvial sites covering approximately the same range. These include phase I of the Roi Et group of sites (Higham 1977); Ban Chiang Hian (Chantaratiyakarn 1983:3–41); and Ban Na Di upper layer 7 through layer 5 (Wichakana 1984:89). The latter two sites show a growth in chaff tempers in the upper layers; these presumably date after the abandonment of Non Chai, as does the thin white untempered Roi Et ware described for that region by Higham (1977) and present as well in layers 6 to 4 of Ban Chiang Hian (Chantaratiyakarn 1983:3–47). As Vincent notes, the presence of chaff temper seems to be late in the upper Chi and Sakon Nakhon basins, in contradistinction to the Lower Chi and Mun basins (1984*b*:688–689).

In conclusion, the body sherd finish and in particular the Class I and III rimform data provide strong internal evidence for five phases of what appears to be intensive occupational/industrial use at Non Chai; the two latest phases may be divided into three subphases each. The ceramic data also support the accuracy of the six cultural layers observed and recorded during excavation, although sparse data are present from layers 1 and 6. The greatest amount of change in the ceramics clearly seems to occur at the layer 2/3 (phase IV/V) boundary, although marked changes are also present in the transition from layer 4 to layer 3 (phase III to phase IV). Phases I–III each have distinguishing features, but clearly have much more in common with each other than they do with the later phases.

Other Artifacts

Although obviously dwarfed by the quantities of pottery, a significant number of nonceramic artifacts were also recovered from Non Chai; many of these are or will be of considerable value in establishing links between Non Chai and other sites in the area. Table 3 presents the stratigraphic distribution (by cultural layer and phase) of the main classes of nonpottery material from the excavation.

A number of interesting points are seen in this table. It is obvious that both bronze and iron were in use throughout most of the history of the site, from at

TABLE 3. NON CHAI NON-POTTERY ARTIFACTS (BY LAYER AND PHASE)

LAYER	1	2					3							4						5		6	TOTAL
PHASE	SURF.	VC	VB		VA		IVC		IVB		IVA			III		II				I			
ARTIFACTS																							
Bronze Fragments	—	—	—	—	2	—	8	3	13	10	—	15	—	1	—	2	2	—	—	6	—	—	62
Bronze art fragments	—	1	—	—	1	—	7	6	5	7	1	8	—	—	5	—	4	—	—	6	3	6	60
Bronze bells	—	—	—	—	—	—	—	—	—	1	—	—	1	—	—	—	1	—	—	—	—	—	3
Iron fragments	1	2	17	18	17	11	16	14	14	13	—	8	—	1	6	3	5	1	—	12	—	—	162 (3)[a]
Iron art fragments	1	1	1	—	—	—	1	—	2	—	—	—	—	—	—	—	1	—	—	—	—	—	7
Crucible fragments	—	—	—	1	8	—	2	2	1	1	—	—	—	—	—	—	1	—	—	—	—	—	16
Clay mold fragments	—	—	1	1	7	1	—	—	1	1	—	—	—	1	—	—	—	—	—	—	—	—	13
Iron slag	—	—	3	—	2	1	2	3	9	8	—	2	1	1	1	—	1	—	—	1	—	—	35
Glass beads	—	—	—	1	1	5	3	12	30	39	11	88	2	28	9	1	2	1	—	—	—	—	235 (2)[a,b]
Clay pellets	1	—	1	3	2	1	5	10	24	27	1	35	—	7	15	3	9	4	1	23	3	5	180
Spindle whorls	—	—	1	—	—	—	—	—	—	—	—	1	1	—	1	2	10	2	—	12	—	—	30
Thread spacers	4	3	3	13	3	4	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	30
Shell beads	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10	1	166[c]	177
Clay rollers	—	—	—	—	—	1	2	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	4

[a] Figures in parentheses indicate items of unknown provenance included in totals.
[b] Bead numbers are minimum figures; inventory entries in the plural have been counted as two beads. The actual number recovered was 264.
[c] 163 of these were recovered from the human bone concentration labelled Burial 9.

least phase I upwards; the only unresolved question is the possibility of layer 6 representing traces of a considerably earlier bronze-period occupation. Bronze artifact fragments comprised pieces of rings and bracelets, plus one perforated artifact (possibly a pendant); four small bronze bells similar to those recovered from Ban Chiang (White 1982:81) and Ban Na Di (Higham and Kijngam 1984) were found in phases II–IVB; one of these was cast onto a bracelet fragment. Amorphous bronze fragments, presumably casting spillage, and crucible fragments indicate bronze-casting activities at the site from phase II through phase V. This is further supported by finds of pieces of clay molds used for casting bells and axes in phases III–V. The clay molds apparently represent a reliance on lost-wax casting, a technique distinct from that of the preceding bronze period, where bivalve sandstone molds were used (as evidenced during the Middle Periods of Non Nok Tha and Ban Chiang); a single fragment of such a mold was recovered from a phase I context, but could have been instrusive from the shadowy bronze-period use of the site which is possibly represented by layer 6.

Iron slag occurs in small amounts in layers 4 and 5, suggesting the possibility of actual smelting as well as use of the metal at that time; however, slag becomes common only in phase IV, which may represent the beginning of actual production of the metal at the site. Iron artifact fragments included two nails from layers 1 and 2, and five fragments of unidentified tools from layers 2–4. It seems clear that by phase IV times, if not earlier, metalworking was a significant activity at the site.

Spherical or biconical blue glass beads are now recognized as important horizon markers in the region, although their origin and earliest date of appearance remain to be established. These items were particularly abundant at Non Chai, being recovered from phases II through V. The four beads from contexts earlier than phase III may be intrusive from above, but these objects were obviously common at the site from mid-layer 4 to early phase V; a total of over 260 were recovered, in marked contrast to their relative rarity at Ban Na Di (a total of four) and Ban Chiang ("few"; White 1982:76). As none of the Non Chai specimens were recovered in burial contexts, and finds were fairly evenly distributed over the four squares, it seems reasonable to assume they resulted from more than occasional accidental loss, and hence were commonly worn items at the site. A number of small shell disc beads similar to those known from pre-iron and early iron contexts at Ban Na Di (Higham 1984:76–78) and both Early and Middle Periods at Non Nok Tha (Bayard 1984*a*:100–103) were recovered from the basal levels of Non Chai; 11 of these were found in layer 5, but are probably upwardly intrusive from the ill-defined bronze-period occupation represented by layer 6. The bulk of the shell beads (163) were in fact found with one of the concentrations of human bone in layer 6. Finally, a single clay bead was recovered from the layer 2/3 interface.

Clay pellets, widely represented at sites in Northeast Thailand and adjoining areas, were also relatively common at Non Chai from layer 6 upward, although there is a marked decline in layer 2 (phase V) times. These pellets are commonly interpreted as ammunition for use with a pellet bow (illustrated in White 1982:93), a weapon used in the region from the third millennium B.C. until fairly recently. The apparent decline in phase V times thus probably reflects a change in function of the site rather than any decline in the use of the weapon. This does not seem to be the case, however, with two other classes of ceramic artifacts interpreted here as

spindle whorls and "thread spacers." The former are the standard biconical or conico-spherical pierced clay objects found at many Southeast Asian sites; the latter items are far more problematical, consisting of clay plates with multiple perforations possibly used to keep filaments (of silk?) equally separated during the spinning process. Some of the finds may represent fragments of perforated sherds which Higham and Kijngam (1984) have interpreted as the bases of rice steamers; Vincent suggests a third possibility in that these fragments could represent the filter portion of vessels used to remove alkali from water by charcoal filtration. As he states, finds of more complete vessels are necessary to settle the question (1984*b*:684). Both thread spacers and alkali filters are still in use in the region today (Calder 1972), and the marked decline in spindle whorls in phase IVA and the coincident rise in "thread spacers" in phase V *may* correspond with a possible decline in cotton and increase in silk production (now known to have been present in the region since at least 500 B.C.) (mortuary phase 1b at Ban Na Di; Higham and Kijngam 1984); this is of course merely speculation.

One further important class of clay artifact remains to be considered: the distinctive and now-famous carved clay rollers characteristic of the Late Period at Ban Chiang (see White 1982:46). One whole and three fragmentary rollers were found at Non Chai, all from the narrow range of phase IVC–VA, at an estimated date of 100–0 B.C. (see chronology below). The function of these enigmatic items has occasioned considerable debate (van Esterik and Kress 1978, Folan and Hyde 1980); whatever their function is ultimately determined to be, they provide a valuable horizon marker for the Upper Chi and Songkhram basins, occurring in layers 6–3 at Ban Na Di (c. 400 B.C.–A.D. 200+; Kijngam 1984:38), and in the range 200 B.C.–A.D. 200 at Ban Chiang. Finally, miscellaneous other objects recovered include two polished stone shouldered adzes found in layer 3; a few stone and shell bracelet fragments associated with the layer 6 human bone concentrations; a clay pestle fragment (in the large phase I pit in square D3); and four small (c. 5 by 2 cm) semilunar clay objects of unknown function. With the exception of these last items, the material culture inventory is thus quite consistent with those of other sites of the same time span in the region, and suggests a closely parallel technology.

Faunal Spectrum

The faunal remains from Non Chai were analyzed by Kijngam shortly after the conclusion of the excavation and published almost immediately (Kijngam 1979). The material examined included all identifiable bones, which were classed by species and minimum number of individuals estimated. Table 4 presents these data for Square D3, the square subjected to detailed ceramic analysis above; data for the remaining squares can be found in Kijngam's report. Species that occurred sporadically at the site, but were not found in this square, include *Hystrix hodgsoni* (porcupine), *Manis pentadactlya* (pangolin), *Varanus nebulosus* (monitor lizard), and *Rana tigrina* (frog). Otherwise the spectrum is representative of the site as a whole.

The faunal inventory is comparable to that of other sites in the region, particularly those where screening of deposits was possible (the hard clay loam soils of sites like Non Nok Tha prevented screening); thus many points of correspondence are evident between Non Chai and the later Ban Chiang sequence (Higham and Kijngam 1982*b*), and the subsequently excavated moated site of Ban Chiang Hian (Chantaratiyakarn 1983). In all cases, cattle, pig, and deer are prominent, as is dog.

TABLE 4. NON CHAI: SQUARE D3 FAUNAL SPECTRUM

LEVEL	7	8	9	10	11	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
PHASE	VB				VA				IVC				IVB		IVA						III			II			I							
MAMMALS																																		
Axis-Muntiacus	—	—	—	—	—	—	1	—	—	—	2	—	1	1	—	2	1	1	1	—	1	—	1	—	1	2	1	—	—	—	—	—	—	—
Bibos sp.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	1	—	—	1	1	1	—	1	2	1	1	—	—	1	—	—	—
Bovinae indet.	—	1	—	—	—	1	—	—	1	2	1	1	2	2	1	2	2	2	2	1	1	1	2	2	1	4	2	2	1	—	1	—	—	—
Bubalus bubalis	—	—	—	—	—	1	—	—	1	—	2	2	—	1	—	2	—	1	2	1	1	2	1	1	5	3	1	1	—	—	—	—	1	—
Canis familiaris	—	—	—	—	—	—	—	—	—	2	1	1	—	—	1	—	—	—	1	—	—	1	—	—	1	2	2	—	—	—	—	—	—	—
Cervus eldi	—	—	—	—	—	—	—	—	—	1	2	1	1	—	1	1	1	2	1	1	1	1	1	1	1	3	2	1	1	—	—	—	1	—
Cervus unicolor	—	—	—	—	—	2	—	—	—	1	2	1	2	—	2	1	—	1	2	1	—	1	1	1	1	2	1	1	—	1	—	—	—	—
Herpestes javanicus	—	—	—	—	—	—	—	1	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—
Lepus pequensis	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—	—	—	—
Naemorhaedus goral	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—
Rattus sp.	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	1	—	2	—	1	—	—	—	—	—	—
Rhinoceros sondaicus	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—
Sus scrota	—	—	—	—	—	—	1	—	2	1	2	2	2	3	3	2	2	2	2	2	3	2	2	1	3	8	4	2	1	1	3	—	—	—
BIRDS																																		
Callus	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	1	—	—	—	2	—	—	—	—	—	—	—
indet.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	1	—	—	—	—	—	1	—	—	—
REPTILES																																		
Crocodylus siamensis	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Malayemys subtrijuga	—	—	—	—	—	—	—	—	—	—	+	—	+	+	+	+	+	—	+	+	+	+	+	+	+	+	+	+	—	+	—	—	—	—
Testudo elongata	—	—	—	—	—	—	+	—	—	—	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	—	—	—	—	—
Trionyx-Chitra	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	1	1	—	—	—	1	1	—	—	—	—	—	—	—	—
FISH																																		
Channa-catfish	—	—	—	—	—	—	1	—	2	—	2	2	3	1	3	4	4	2	3	4	2	2	2	1	2	5	2	1	—	—	—	—	—	—
ARTHROPOD																																		
crab	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—
MOLLUSCS																																		
Chamberlainia sp.	—	—	—	—	—	—	—	—	+	—	—	—	+	—	+	+	—	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Filupaludina sp.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	+	—	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Pila ampullacea	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	+	—	—	+	+	+	+	+	+	+	+	+	+	+	+	+	—	+	+
Pila polita	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	+	—	—	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+

NOTE: + indicates presence of species; no minimum numbers available.

Most of the dog bones recovered were in small pieces, with traces of butchering indicating that dogs were used for food as at Ban Chiang, although pigs were obviously of greater importance. The water buffalo appears to have been present from at least phase II times, and possibly earlier; given its apparent domestication in the first half of the first millennium B.C. (post-800 B.C. at Ban Chiang Hian; Chantaratiyakarn 1984:2–19), this is not surprising.

The presence of large numbers of shellfish and fish remains and significant quantities of turtle *(Trionyx/Chitra* and *Malaymus)* obviously echoes the importance of aquatic resources evidenced at other sites in the region. Had finer screens been used for sieving, the numbers of fishbones would doubtless have been significantly larger, as at Ban Chiang Hian (Chantaratiyakarn 1983:2–18). As Higham and Kijngam have pointed out (1982*b*:20), the presence of the two *Pila* gastropod species indicates both permanent still water *P. polita* and swamp margins or intermittent bodies of water; both would have been found to the south and east of the site. Sporadic finds of rhinoceros and crocodile (both of course now extinct in the area) also suggest proximity to a swampy plain. On the other hand, the presence of the hare *(Lepus),* mongoose *(Herpestes),* pangolin *(Manis),* civet *(Viverricula),* and porcupine *(Hystrix),* as well as the deer species, suggests utilization of the dry deciduous forests covering the Middle and High Terrace soils to the north and west of the site (Fig. 2).

A rather puzzling feature of the site is the marked dropoff in shellfish remains above layer 4. The presence of turtle and fish remains in layer 3 demonstrates a continuing reliance on aquatic resources (not surprising given their still-heavy exploitation in the region today), and it seems likely that the midden area was simply relocated elsewhere. The thick shell lenses in layer 4 may have resulted from a glut of snails reaped as a byproduct of draining and diking swampland to increase the area under cultivation, but this cannot be demonstrated. Similarly, the absolute reduction in all faunal remains in layer 2 presumably indicates a change in function—perhaps from occupational/industrial to more or less strictly industrial use; but again there is no clear evidence of what this industry (or industries) was.

The overall picture of the economy is clear: some form of relatively intensive rice cultivation, presumably utilizing the tractive power of the buffalo (although positive evidence of plowing still remains to be discovered), supplemented by domestic cattle, pig, dog, and chicken. Following a pattern begun in the third millennium at the latest and continuing to the present day, the inhabitants of Non Chai also relied on broad-spectrum fishing, hunting, and doubtless gathering of plant and insect resources. In short, if one can talk of a typical economy in a region that has still seen relatively little archaeological investigation, Non Chai seems typical of Khorat and upper Songkhram basin economies of the later first millennium B.C.

CHRONOLOGY

Two charcoal samples were dated by the Thai National Energy Department and an additional nine by the Institute of Nuclear Sciences of the New Zealand Department of Scientific and Industrial Research: the results are as follows, with years before present based on the standard 5568 half-life. Two-sigma corrected ranges and midpoints are those of Klein et al. (1982).

Layer 6: NZ–4814, 3490±160 B.P., corrected 2185–1555 B.C., midpoint 1870 B.C. Square D1, surface of level 42, concentration of charcoal collected during surface clearing.

Layer 5: NZ–4819, 2270±70 B.P., corrected 525-175 B.C., midpoint 350 B.C. Square D1, Feature 6 at surface of level 39, charcoal from hearth.

NED #2, 1520±235 B.P., corrected A.D. 70-865, midpoint A.D. 468, same provenance as NZ–4819.

NZ–4817, 2200±70 B.P., corrected 405-45 B.C., midpoint 225 B.C. Square D1, Feature 7 at surface of level 36, area of black soil with charcoal concentration.

Layer 4: NZ–4818, 2150±90 B.P., corrected 405 B.C.–A.D. 25, midpoint 190 B.C. Square D3, level 30, charcoal in shell midden.

Layer 3: NZ–4816, 2140±70 B.P., corrected 390-5 B.C., midpoint 198 B.C. Square D4, Feature 1 at surface of level 20, area of grey ashy soil composed of animal remains, sherds, and charcoal.

NZ–4812, 2040±70 B.P., corrected 185 B.C.–A.D. 185, midpoint A.D. 0. Square D2, level 18, concentration of charcoal collected during clearing of the layer.

Layer 2/3: NZ–4815, 2080±200 B.P., corrected 550 B.C.–A.D. 240, midpoint 155 B.C. Square D1, Feature 1 at surface of level 12, firepit composed of gravel, lateritic pebbles, burnt clay, and abundant charcoal (N.B.: level 12 rather than 13/14 formed the layer 2/3 interface in this portion of Square D1).

Layer 2: NZ–4811, 2040±70 B.P., corrected 185 B.C.–A.D. 185, midpoint A.D. 0. Square D2, Feature 1 at surface of level 5, hearth area with patch of burnt clay and concentration of charcoal.

NZ–4813, 1850±65 B.P., corrected A.D. 5-245, midpoint A.D. 125. Square D3, level 14, concentration of charcoal in level.

NED #1, 1760±241 B.P., corrected 160 B.C.–A.D. 600, midpoint A.D. 468. Square D3, level 13, concentration of charcoal in level.

The very late date from the layer 5 hearth (NED #2) and the very early date from layer 6 (NZ–4814), which may date the postulated but fugitive earlier occupation responsible for the human bone concentrations and shell disc beads, are clearly aberrant. However, the remaining nine dates form a fairly coherent sequence clearly placing the main occupation of the site in the later first millennium B.C. and the early centuries of the present era. The samples in most cases are of good provenance, and agree well with chronologies established by subsequent excavations at Ban Chiang Hian and Ban Na Di (Chantaratiyakarn 1983, Wichakana 1984). The dates suggested for the various phases of the main occupation are thus:

• The beginning of phase I c. 400 B.C. or possibly slightly earlier; Higham and Kijngam (1984) prefer a date of 300 B.C., but this seems to allow too little time for the buildup of layers 4 and 5, with an average thickness of 1.85 m; compare a 600-year span postulated for the 2 m of deposits of roughly equivalent age at Ban Chiang Hian (layers 6–8; Chantaratiyakarn 1983:2–4,2–8), and a 700-year span postulated for the approximately meter-thick layers 5 and 6 at Ban Na Di (Wicha-

kana 1984:9, 16). Moreover, the handful of Non Chai-type rims discovered at Ban Kho Noi, 15 km west of Ban Chiang Hian, were recovered in spits 16–35 of layer 3 (Chantaratiyakarn 1983:3–39); two secure dates of 620 B.C. (corr.) were obtained from spits 39–42 of the same layer (Chantaratiyakarn 1984:68). A date as early as 500 B.C. may thus be possible for the beginning of phase I at Non Chai.

- The phase II and III deposits are ill-dated, but were probably laid down in the period 300–200 B.C.
- Phase IV seems fairly securely dated to the first and second centuries B.C.
- Phase V may have begun in the first century B.C. and continued to the second century A.D. or somewhat later.

We think that the chronology proposed here will find general acceptance, given a margin of error of perhaps a century. In some earlier publications Higham and his co-workers postulated a date of C. A.D. 100–400 for the equivalent layer 5 at Ban Na Di and the Ban Chiang Late Period, and a corresponding mid-first millennium A.D. date for increasing site size and social stratification (Kijngam, Higham and Wiriyaromp 1980:79–80, Higham and Kijngam 1982*c*:2, Higham, Kijngam and Manley 1982:22–23). However, they have recently revised these estimates backward (Higham and Kijngam 1984), and are now in close agreement with the general chronological schema used here (cf. Bayard 1984*b*), and the earlier statement by two of us that "the 1st millennium B.C. must increasingly be viewed as a crucial one for the rise of civilisation in the lower Mekong Valley" (Charoenwongsa and Bayard 1983:522).

CONCLUSIONS: ECONOMY, TRADE, AND INTERACTION

Turning to the Khorat Plateau as a whole, it seems clear that the inhabitants of Non Chai participated in a general economic (and presumably social) oikoumene characteristic of much of the region during the latter half of the first millennium B.C. The growth of large sites like Non Chai and Ban Chiang Hian was clearly reliant on some form of relatively intensive wet rice cultivation, although the nature of this remains to be determined archaeologically. It is also necessary to note that while such sites can be viewed as central places, and may well have functioned as such prehistorically, many of them are in fact well within the size range (c. 10–70 ha, with a mean of about 20–25 ha; Bayard 1985) of the modern nucleated villages which form the bottom level of the settlement hierarchy of contemporary Thailand. We feel that arguments other than the presence of a simple site size hierarchy are perhaps more convincing. These include the expenditure of labor in construction of moats and other earthworks, and the documentation of trade and exchange networks beyond the local level, suggesting the growth of regional entities and the spread of political authority beyond the village level.

As mentioned above, Non Chai produced no clear evidence of earthworks; however, it is possible to document contact with other contemporaneous sites at a regional level. While completing the analysis of Non Nok Tha ceramics in 1980, Bayard noted the presence of several small red-on-buff painted sherds from Middle Period levels 7 and 8 (roughly dated to between 800 B.C. and 0–A.D. 200). The sherds are grog-tempered, and similar to common types not only at Non Chai but in contemporary and earlier levels at the subsequent test excavations of Ban Chiang

Hian and Ban Kho Noi (Chantaratiyakarn 1983). It is thus not possible to state conclusively that the intrusive sherds at Non Nok Tha came from Non Chai itself, but it does seem clear that contact of some sort existed between the Phu Wiang region and the central Khon Kaen-Maha Sarakham area some 100–150 km downstream via the Phong and Chi Rivers.

Clearer general parallels in ceramic and nonceramic material are present between Non Chai and two sites excavated by Higham and his colleagues in 1980–1981. Chantaratiyakarn's 1983 analysis of the ceramics from the 9 m^2 Ban Chiang Hian excavation, located some 65 km ESE of Non Chai, makes the general resemblance of its layers 6–8 to Non Chai apparent. Although only some 14 rims out of the sample of 1126 were classed as Non Chai types by Chantaratiyakarn, a generic affinity would seem to be present; however, Vincent's preliminary analysis suggests no close, specific relationships (1984*b*:688). Unfortunately it is impossible to establish quantitative indices of affinity between Non Chai and Ban Chiang Hian layers because of the very fine-grained typology established by Chantaratiyakarn for both rim and body finish types (61 rim types for 1126 sherds, of which only three types have over 100 members; and 60 body finish categories for almost 65,000 body sherds, with 13 categories having more than 100 members). Such a multiplicity of types is of great utility in establishing chronological distinctions within a site, but makes comparison with other sites difficult. However, a clear parallel can be seen between Ban Chiang Hian layer 6 (which, with 34% of all body sherds recovered, reflects intensive use) and Non Chai layer 3 (phase IV). Both layers show a sharp rise in cord-marked ware and corresponding decline in red-slipped wares (cord-marked ware rises from 3% in layer 4 to 24% at Non Chai, and from 24% in layer 7 to 54% at Ban Chiang Hian). Clay molds for casting bells and bracelets were recovered from layers 6 and 7, again reminiscent of the upper layers at Non Chai.

The more distant site of Ban Na Di, almost 100 km NNE of Non Chai, also shows clear affinities in the analysis of rim sherds carried out by Wichakana (1984). Here again, only nine sherds of a total of almost 2900 were identified by type as Non Chai. Seven of these sherds come from Ban Na Di layers 5 and 6, and are of types characterizing the earlier part (phases I–IVB) of the Non Chai sequence (viz., types AA, 5, and 22). Again, the fine-grained typology of rim sherds used (177 types, or about 16 sherds per type) precludes detailed comparison with Non Chai, as does the lack of body sherd data. However, the figures given for the latter in a preliminary report (Higham and Kijngam 1982*c*) show a range for red-slipped and red-on-buff ware at Ban Na Di spanning layers 4–6. It seems likely to us that the onset of the ceramics and other artifacts characteristic of Late Period Ban Chiang (White 1982) and Non Chai can be placed in Ban Na Di layer 6, possibly correlated with the abandonment of the Phase 1 cemetery there. We would interpret the anomalous position of layer 6 in Wichakana's cluster analysis of rim temper (1984:90–91) to this transition rather than to the high fraction of distinctive temper in Om Kaeo-style rims which he argues for, as the bulk (about 75% by weight) of Om Kaeo *body* sherds seem to derive from layer 7 at the site (Higham and Kijngam 1982*c*:1). The presence of two red-painted vessels generally similar to Non Chai or Ban Chiang Hian ware in mortuary phase 1B and 1C burials (Nos. 12 and 35) also suggests initial contact with areas to the south at about the beginning of deposition of layer 6 at the site, although Vincent's analysis of these two

TABLE 5. SUGGESTED CORRELATION OF SITES IN THE CHI-UPPER SONGKHRAM AREA (LAYERS)

	NON CHAI	BAN CHIANG HIAN	BAN NA DI	BAN CHIANG
200 A.D.				
	2	5	4	LATE
0				
	3	6	5	PERIOD
200 B.C.				
	4		6	—
400 B.C.	5	7		
				MIDDLE
600 B.C.		8	7	PERIOD

vessels produced no speculations as to origin apart from their clearly exotic nature (1984*b*:664). The exact date of the transition thus remains open for discussion, but the presence of rollers in Non Chai phase IVC and abundant glass beads from phase III upward, coupled with at least one clay roller in Ban Na Di layer 6, suggests ties of these levels to the Late Period at Ban Chiang, and that White's (1982) estimate of 300 B.C. for the onset of this period is not far off the mark.

However, there is little doubt that the clay molds and iron slag from Ban Na Di layer 5 (Higham and Kijngam 1984) indicate a general affinity between that layer and Non Chai layer 3 (phase IV). This is strongly reinforced by Vincent's research, which shows that a marked ceramic change took place in Ban Na Di layer 5. This is characterized by the appearance in quantity of Non Chai-style bleb-tempered ware (1984*b*:685–686). Our overall chronological correlation is presented in Table 5; while there are some slight differences between our correlations and those arrived at by Higham and Kijngam, the agreement is close, with discrepancies of not more than a century or two. All would agree that significant moves toward some form of centralization were occurring in the latter half of the first millennium B.C.

It is also becoming increasingly obvious that such a trend toward centralization was not confined to the Upper/Middle Chi and Upper Songkhram areas; as two of us noted in our initial report on Non Chai, regional trade networks were very likely developing over much of the Khorat Plateau at this time (Charoenwongsa and Bayard 1983:522). Welch (1984) has postulated the growth of such an entity to the southwest, in the Phimai region; research by Higham and Parker (1970) and more recently by Vallibhotama and Suchitta (Vallibhotama 1984) has indicated the likelihood of a third in the Lower Chi/Mun region. These entities correspond generally to what one of us has recently labelled the Non Chai, Phimai, and Non Dua phases (Bayard 1984*b*:165). The sociopolitical nature and even the geographic extent of each of these entities is still ill-defined; the abandonment of the Non Nok Tha cemetery (Bayard 1984*a*, Higham and Kijngam 1984) may correspond to the northwest expansion of Non Chai influence. Certainly the pottery of the upper layers of the nearby site of Don Klang (Schauffler 1976), subsequent to the end of the Non Nok Tha phase in the Phu Wiang region, shows clear affiliations to Non Chai ware, as well as to that found by Penny in burials of the same date (c. 400 B.C.–0) further west (1982). Higham and Kijngam (1984) note as well the close correspondence between upper Don Klang, Non Chai, and layers 6–8 at Ban Chiang Hian.

We think that all authorities would agree that trade was crucial in the rise of these regional entities. However, trade networks were, of course, not an innova-

tion of the first millennium B.C., but rather an elaboration and intensification of previous networks based on fine-grained stone, marine shell, and bronze which go back to at least the end of the third millennium in the region. First millennium additions appear to have been salt, iron implements, "mass-produced" bronze ornaments, and possibly fermented fish and silk (Charoenwongsa and Bayard 1983, Higham and Kijngam 1984). Kennedy's statement on the importance of such trade in the maintenance of diversity and stimulation of innovation throughout the pre- and protohistoric period is worth quoting in full:

> Systems of exchange, in maintaining links between old and new forms, not only foster innovation by decreasing the risks of specialization or nonconformity; they also, by their areal extension and persistence, are the bridge that leads to growth rather than to simple substitution of the new for the old. The increase in diversity and differentiation of productive modes is conducive not only to further economic specialization, but also to the development of intra- and inter-group controls and to the rise of central-place exchange. In such developments, perhaps, lies the origin of the ethnic mosaic of modern Southeast Asia. (1977:36)

The question obviously remains as to why the latter first millennium B.C. saw the intensification and expansion of regional entities, of which Non Chai is only one example. A consideration of the rise of complex societies in Northeast Thailand as a whole is beyond the scope of this report, but we can at least state that the simple explanations offered for such developments (diffusion or migration from more "advanced" areas) must now be replaced by more complex multicausal explanations. The first of these has now appeared in the form of Higham and Kijngam's massive and groundbreaking summary of their researches in the region. Bayard (1985) has written a critical evaluation of the various factors and models they put forth for increasing sociopolitical complexity. Readers may wish to consult both studies.

However, we might ask in closing, what can sites such as Non Chai (or even those with sequences extending into the historic period such as Chan Sen) tell us about the actual mechanisms of Indianization? Historians and geographers like Wolters (1982) and Wheatley seem to agree that religious ideology was somehow crucial. In an earlier article Wheatley (1975) argued for a transition from "shaman to Brahman." In his recent massive and scholarly investigation into urban genesis in Southeast Asia he argues for a concentration of spiritual power in local chieftains until a state of theocratic kingship is attained, based on the replacement of an earlier ancestral or territorial spirit cult with Śaivite devotion (1983, Chapter 7); that is, the guiding political and moral sanctions for the early historic polities were religious. Bronson, on the other hand, comments in a review of Wheatley's monograph that "I personally find it hard to believe that the average early Southeast Asian kingdom was so otherworldly it cannot be analysed in the same terms as any other statelike polity: in terms of grasping noblemen, reluctant peasants, profit-oriented traders, and vainglorious kings with a tendency to believe their own often ineffective propaganda" (1985:4).

We have neither the space nor the expertise to discuss such theories in detail; nor is Non Chai particularly relevant to them. What we can say is that the transition that took place in Northeast Thailand during the later first millennium B.C. was a complex one, the detailed documentation of which will entail much attention to local and regional studies rather than application of overarching theories. Wolters has argued well for the essential cultural diversity of Southeast Asia as perhaps its

most salient feature (1982:52); in the conclusion of his monograph he pleads for the identification and understanding of historical processes. His conclusions are as applicable to archaeologists as to historians: "we and our students have to keep as close as possible to the subregional [or regional in our sense] sources, treated as cultural texts, and forgo efforts for the time being to delineate a shape to regional [pan-Southeast Asian] history" (1982:100). Non Chai's major value, then, is in providing one small and incompletely documented text to add to our growing corpus. With the continued growth of data, in time we should be able not only to document the rise of regional entities in Northeast Thailand, but begin to move from explanations largely based on speculation to the application of models using variables with a high factual content.

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