Chapter 11

Concluding remarks and future prospects

The principal aims of a technological analysis of ceramics are the exploration of temporal changes in the potters' craft, and the illumination of possible cultural relations through material identifications and the location of their sources. In this work particular attention has been given to clay sources, temper, fabric mineralogy, vessel construction including firing and fabrication, and to non-pottery ceramics related to pottery and metallurgical industries. The long period of occupation and clear stratigraphic contexts of mortuary wares and industrial features at Ban Na Di, coupled with a comprehensive and geographically extensive sample of comparative pottery, have provided an opportunity to investigate these variables.

A model, which combines both technical analysis and aspects of archaeological data related to both physical and sociological factors, has been employed to bring into focus aspects of prehistoric ceramic production in Northeast Thailand. Evidence for broadscale changes in ceramic traditions, possibly originating beyond the southern borders of the Khorat Plateau, in addition to extensive exchange networks, has been presented. Such networks are indicated both within the Sakon Nakhon Basin and between it and Chi Valley sites. All possible clay sources were sought with the help of local informants. Suitable sources are few and locally restricted in extent. The Ban Na Di clay is only suitable for a limited variety of uses. For pottery making, a blended composition of local and quality imported clays was often used. Artefacts less demanding in utility were often rendered in local clays, thus conserving valuable imported raw materials.

Recognition of mineralogically distinctive materials plays a central role in technological analysis. About 70% of the Earth's terrestrial surface is sedimentary in origin (Tucker 1981:1). As most sedimentary deposition occurs in continental areas, local geology, relief and climate determine the kind and quantity of material deposited. When exploited clays were derived from sediments adjacent to distinctive country rock, the potential of petrographic analysis is likely to be increased. Such regions, however, are anticipated to be poorly represented, compared with regions where sedimentary country rock dominates, in view of the overall proportion of sedimentary terrain mentioned above.

The natural distributions of distinctive source rocks, likely to provide clear associations for sourcing purposes, may often be limited to areas outside those of immediate concern. This problem may not be as elusive as it at first appears, however, as methods are available with the potential to solve such problems. Our most pressing problem, however, probably concerns deciding what depth of analytical intensity is appropriate to the problem at hand. This question is likely to be a recurring one, for, apart from the natural distributions of indistinctive materials, pottery production sites have a tendency to concentrate in such regions (Arnold 1985). This bias will act further to exacerbate the disproportionate occurrence of sedimentary deposits.

We may anticipate, with respect to pottery production, that many prehistoric settlements were located in sedimentary regions. This is because the lowlands and waterways suited to irrigation and transport are key agricultural resources. It applies equally to irrigated cereal and inundation rice cultivation (Sherrat 1980). In Eurasian contexts, the rise of large urban populations may be related to plough agriculture (Goody 1976), and the development of intensive exchange of "secondary products" (Sherrat 1981). We noted that an increase in pottery exchange between the Khorat and Sakon Nakhon Basins developed with time, but accelerated markedly with the adoption of bleb-tempering within the latter basin.

Rice remains are always present in some ceramic fabrics at Ban Na Di. Chang and Loresto (1984:384) considered that kernels from level 7 at Ban Na Di could be of the cultivated type. Evidence for possible plough agriculture has been presented by Higham (1975), Kijngam (1979), and Higham and Kijngam (1979). They later modified this stance for two reasons: because socketed bronze ploughshares, common in the Red River Valley during this period, are not present, and evidence suggesting an expansion into land suitable for ploughing in the Middle Chi region is also not available (Higham and Kijngam 1984:721-722). Current data, however, suggests that some form of intensive rice cultivation could have been conducted by at least level 7 at Ban Na Di. At Ban Chiang the large gastropods *Pila polita* and *Pila ampullacea*, which are sensitive indicators of prevailing environmental conditions, significantly become rare after Early Period levels. *P. polita* requires permanent water and no longer survives naturally. *P. ampullacea* survives the dry season by aestivating and exhibits a monsoon-regulated breeding cycle. Paddi field environments would therefore presumably favour *P. ampullacea*. Ploughing, and paddi bank rebuilding, may have so reduced this species that intensive collecting was unprofitable (Higham and Kijngam 1979). Evidence that animals were used for traction is provided by the comparison of prehistoric *Bovidae* phalanges with modern draught animals, this indicates that *Bubalus bubalis* from these levels at both sites were as robust (Higham and Kijngam 1979, 1984:355).

Pottery production methods are more compatible with sedentary than with mobile lifestyles, so we may anticipate that most pottery production was undertaken in regions favouring permanent settlements, as opposed to areas unsuited to year-long habitation. Climatic extremes can affect production schedules (Arnold 1985). Rice cultivation is seasonally regulated (Geertz 1968). As has been noted, the above seasonality may also regulate pottery production. Seasonally wet-dry climates, such as the monsoon conditions presently experienced in Thailand (Koppen Am), restrict production to relatively dry portions of the year (Arnold 1985:78). If wet monsoons reflect present equatorial and tropical conditions (Strahler 1973:177), stable sea levels (Galloway and Loffler 1972:27), and glacial activity both suggest they typify the climate in the region for at least the last 5,000 to 8,000 years (Hope and Hope 1976).

Integration of pottery production with rice cultivation is a "deviation amplifying situation" (Flannery 1968), which may have important implications for the intensification of a stable subsistence strategy, related interactions with technology, and the development of ranked societies. Wet rice agriculture is a particularly stable and durable system with a marked ability "to respond to a rising population through intensification" (Geertz 1968:32). Even with the most intense population, the system does not break down. Once adopted, the paddi system lends itself to numerous improvements; for example transplanting, ploughing, weeding, and improved irrigation or drainage. Adoption of paddi rice agriculture turns on the necessary technology and a commitment to an agricultural lifestyle. The more developed the system becomes, the less likely are the cultivators to abandon it, even though this may lead to extreme human impoverishment (Geertz 1968:32). According to Geertz, unlike swidden agriculture, soil fertility

has no long-term effect on crop yields. Water plays a paramount role by transporting nutrients, nitrogen fixing algae, and promoting chemical and bacterial processes. Water is more important than soil type.

Societies are essentially conservative, and social factors regulate population growth (Renfrew 1972:487). Innovations are only likely to be accepted when traditional technological and subsistence strategies are no longer adequate. Once established, a fully developed paddi wet-rice system can be maintained to give optimal production levels by the input of technological skills. Expertise, not sheer energy, is needed (Hanks 1972:155-161). The nature of paddi-fields: clearly defined boundaries, locations adjacent or in relation to neighbours' fields, locational quality variations (ease of clearing, embankment construction and overall working), drainage and water availability, distance from storage and habitation areas, and the capital investment of labour, all enhance the concept of individual ownership, the accumulation of equity and social differentiation.

Bayard (1984a:161-168), has proposed four general periods (GPs') of regional social and economic change for northeast Thailand as a whole. Period A (3500-2500 B.C.) is characterised by "at least semi-sedentary agricultural communities ... with noticeable but fairly weak social ranking." Period B (2500-1800 B.C.) witnessed the appearance of bronze technology, and increased, but still "simple-ranked", social ranking. Period C saw both iron technology and intensive wet-rice farming introduced during the "mid-first millenium B.C. with a more marked increase in ranking". Period D, followed shortly after the commencement of the present era, with either incipient state formation, or complex chiefdoms and a development of "true states" by the fusion of indigenous entities and Indian "socio-political and religous concepts". This scheme has been accepted by regional specialists (Higham and Kijngam 1984:710; White 1986:278). Welch (1985:229), however, argues for a separate Mun Valley chronology; but Wilen (1987:110), mainly on the basis of ceramic styles, views Nam Phong piedmont "culture history" as corresponding to GP's B and C. Recent debates (Bayard 1987, Higham 1987), have been mainly concerned with chronological detail rather than overall structure.

If the general phase chronology is correct, and if pottery production played a significant role in socio-economic factors, and acted as an index of the importance of exchange networks, changes in ceramic assemblages should be related to more general cultural change. We have noted in chapter two that pottery style analysis has been used extensively to characterise various prehistoric changes and relative chronologies. We can now compare these findings with technological information.

Because to date technological data have, with few exceptions, been generally neglected, a strategy designed to overcome this deficiency has been adopted. Although intensive petrographic techniques are essential for precise technological analysis, methods which need excessive work, without necessarily providing unequivocal results, have been avoided. Heavy mineral analysis, for example, may give misleading results when ceramic fabrics are composed of blended clays from different sources (Williams and Jenkins 1976). In view of the Ban Na Di results, which show blending was employed, this method could only have been applied with considerable caution. In essence, therefore, intensive geological techniques have not been emphasised. This allowed an extensive range of technological questions covering the maximum possible number of sites to be considered. Thin- sections and other standard geological techniques have allowed a geographically extensive range of sites to be compared with the more intensively examined Ban Na Di ceramic traditions and Sakon Nakhon Basin clays.

The strategy of contrasting intensive analysis of local data with extensive comparative

material has allowed an overview of broadscale developments which span the plateau as a whole. These bear directly on major changes which influenced Ban Na Di and the Sakon Nakhon Basin. Petrographic evidence has illuminated two major facets of technological inquiry. Mineralogical data point to likely raw material source areas. Although much of the sample derives from relatively indistinct sedimentary strata, a process of elimination has enabled mineralogically irrelevant regions to be excluded from consideration where these are distinctive. As a corollary to examining pottery within a large-scale sedimentary setting, however, detailed information regarding a temper species specifically related to such terrain has been uncovered. It gives important insight into socio-economic questions and bears directly on processes underlying changes reflected in the General Periods discussed above.

We need now to reflect on several key components related to sedimentary terrain adaptations which bear on the development of complex societies. First we will review ceramic evidence. Hodges (1965) has suggested that grog temper development may represent a response to a lack of locally available alternatives. He notes that in Europe it is associated with sedimentary areas. In Thailand, two different sub-species of grog are evident, both related to such terrain. Rice husk is added to one but not the other. Prior to its first appearance within the Khorat Basin, this bleb grog occurs at Khok Phanom Di. Bleb-temper later becomes prominent in the Chi Valley (*c.* 200-100 B.C.). By *c.* 100 B.C., its production replaces a substantial portion of pre-existing orthodox grog traditions in the Sakon Nakhon Basin. This change occurred following a period of gradually increasing representation in wares imported from Chi Valley sources at Ban Na Di.

Apart from the more immediate cultural implications of such a change, an important technological question arises: why reject a successful and longstanding method for another process almost identical in expenditure of preparation effort, and identical in ceramic effectiveness? From a technological perspective this change seems unwarranted, particularly as tempering materials must fulfill the two critical criteria of functional reliability and consistency of supply. We must look beyond technology for answers to such a radical change.

We have examined a range of ceramic artefacts at Ban Na Di and noted the earliest indigenous pottery tradition was replaced by a different one. The temper species of both were similar, differing only in the addition of rice husk. Rice husk, however, is present throughout the sequence in pottery fabrics. Vessels of potentially ritual significance aside, rice husk is incidental to the earliest Ban Na Di pottery tradition. While available, it was not used for temper. Why? Two possible reasons seem relevant. First, the extant tempering tradition could have been adopted prior to a reliable supply of rice husk becoming available. Second, although rice husk later became available, and other Sakon Nakhon Basin potters used it as a single element, potters familiar with using orthodox grog were not stimulated to change to another method, a response consistent with their inherent conservatism in technological matters.

The concept of using pre-fired clay as temper embraces both grog methods. Bleb-temper being a modified variety. The step from orthodox grog to blebs is a small one, involving only the mixing of rice husk into the balls prior to their initial firing. A reliable supply of rice, however, is essential. The scale of bleb ware production suggests rice surpluses were available. In this respect it is important to contrast the relatively minor amount of purely rice-tempered Sakon Nakhon Basin wares in the Ban Na Di sample prior to the influx of bleb wares. These could easily represent localized exploitation of what White (1984:28) has termed "non-cultivated rice", or alternatively the non-plough method of broadcasting (Hanks 1972). The broadscale incidence of bleb wares, and their prominence alongside orthodox grog in the Sakon Nakhon Basin fabric spectrum, strongly suggests that bleb- tempering potters were implanted

into a pre-existing pottery manufacturing province. This would not rule out the adoption of bleb-tempering by some innovative local potters. Such an event seems unlikely, however, unless *potters practicing bleb-tempering implanted their method among them.*

What kinds of stimulation are likely to induce practicioners in a technologically complex craft to change unnecessarily a key component of their industry? Given the sociological imbeddedness of pottery production in ranked societies (May and Tuckson 1982), it seems reasonable to assume that changes in social organization would be the most likely source of such a stimulus. This kind of change is consistent with emulation of externally derived exotic prestige artefacts, which confer status and promote or enhance social ranking (Renfrew 1975). This is, of course, speculative, but it may fit the evidence. The association of bleb-tempered anvils and pottery at Ban Na Di, the predominance of these wares at Ban Muang Phruk from its inception, and their extensive regional distribution, however, provides direct evidence that another more pervasive process affected much of the Sakon Nakhon Basin. On the basis of these data, the diffusion of people from a region which produced bleb-tempered pottery is clearly indicated. We have seen that this type of pottery is earlier present in the southern alluvial basins and plains. It occurred in quantity at Non Chai, a major site occupying a strategic position (figs. 4.4 and 8.2). A natural corridor runs north directly into the Sakon Nakhon Basin giving easy access to the Kumphawapi and Upper Songkhram areas.

If diffusion was substantially responsible for the changes evident in ceramic production, we can anticipate changes in the sociological framework. Ritual, subsistence and technical aspects of societies are sensitive to such influences. We can expect morphological changes in recipient societies, not obliteration by the donor group. The resultant structure should retain aspects of both groups. The transition should be heralded by an increase in exotic artefacts, and culminate in the substitution of obsolete techniques and the introduction of novel artefacts and ideas. If the process involved neither imposition nor implantation (Renfrew 1975), but assimilation, it suggests that pre-conditions existed which acted to enhance such a transition.

Higham (1984:72-86), has argued for moderate "lineage ranking", and "little if any supra-village authority structure" on the basis of Ban Na Di remains during mortuary phase 1 (MP1). He compared the burial wealth of two postulated different social sub-groups (A and B), mainly in terms of non-ceramic artefacts, and found that area B burials were consistently richer through time. Although in area A later burials were richer than earlier ones. We can test these findings against whole vessel data previously unavailable. A total of 18 exotic vessels are present as funerary furniture, 1 in phase 1a; 6 in 1b; and 11 in 1c, (appendix one).The phase 1a burial is disturbed (Kijngam 1984:397). Proportions of exotic to total vessels are: for phase 1b area A has 5:16 (31.25%), B has 1:20 (5%); for phase 1c area A has 7:28 (25%), and B has 4:12 (33.33%). A 5 year old child in phase 1b area B was interred with 8 vessels, 1 is exotic. Its fabric is consistent with a Sakon Nakhon Basin source. A 2 year old in phase 1c area A had 3 vessels, 1 consistent with a Chi Valley source. They are the only non-adult interments with exotic vessels. Overall, the number of burials with vessels varies little with time: phase 1a has 9:15 (60%), 1b has 15:21 (71.42%), 1c has 14:24 (58.33%). Burials with exotic vessels, however, increased markedly: 1a has 1:9 (11.11%), 1b has 4:15 (26.66%), and 1c has 6:14 (42.85%). This is a very small, but important sample. It corroborates the overall tendency of exotic wares to increase with time, and if we include Higham's evidence, it supports the notion that ranking was present. It also suggests a steady increase in exotic exchange throughout the period.

Exchange networks during MP1 at Ban Na Di, as reflected in the exotic pottery spectrum,

were extensive, but concentrated towards the Eastern Sakon Nakhon and Khorat Basins. Important copper and tin sources lie beyond the former region. Exotic stone and marine shell help underline the extensive nature of exchange network participation (Higham and Kijngam 1984:702). The latter could derive from the Gulf of Siam or, perhaps via Mekong River exchange networks, from further afield. The quantity of Chi Valley pottery imports increased steadily during late MP1. A significant expansion in this exchange coincides with the advent of local bleb production. This is achieved at the expense of Sakon Nakhon Basin imports. Substantial elements of the pre-existing orthodox grog traditions in this latter region survive these developments apparently unaffected. These data, coupled with the level 5/6 ceramic discontinuity at Ban Na Di, argue for an influx of people with strong Chi Valley links who maintained close ties with their region of origin. Their settlement of the Sakon Nakhon Basin appears to have supplemented pre-existing occupation areas. It may also have expanded settlement along new habitats, such as flood-prone lake margins.

Sherrat (1980:313-330) reported that the plough formed an integral component of lowland water-exploiting agriculturalists in the Nile, Indus and Tigris/Euphrates alluvial basins. It may be recalled that Ban Na Di is situated near stream confluences on a low terrace, a location shared with many other early GP A and B sites. White (1982:30) observed that modern wet-rice cultivation is often carried out with a hand tool and without a water- buffalo-drawn plough. Without a plough, however, it is unlikely that the full benefits of water control could be gained. Thus, in order to ensure successful wet-rice cultivation, soils rich in nutrients, which are located close to perennial streams, would present advantages for pre-plough agriculturalists. The early restricted concentration of Sakon Nakhon Basin sites follows patterns noted by Sherrat (1980:316) "of early agrarian systems in the western Old World". In this latter region, and most of Europe, introduction of the plough saw extensive land clearance, increased livestock numbers, and brought a shift in focus to drier areas.

Bronze technology was familiar to the first settlers of Ban Na Di, and the first evidence of iron working occurs in level 5 in the form of slag. Higham and Kijngam (1984) associate the transition from GP B to GP C with the appearance of this slag and many associated changes. These include burial ritual, abandonment of the early cemetery, which became a bronze working area, and the first appearance of clay rollers and rice "steamers". Bronze was first introduced to Ban Chiang and Non Nok Tha after initial occupation, probably *c.* 2,000 to 1500 B.C.. At Ban Chiang, a change in burial ritual, along with associated material culture and technological differences, marks the change from Middle to Late Periods. Thus, according to Higham and Kijngam (1984), this GP B to GP C transition parallels events at Ban Na Di.

Iron and intensive wet-rice farming are key components of GP C. Yet, according to Higham and Kijngam (1984), metal may not necessarily be crucial to population increases attendant upon "expansionary settlement" of the Kumpawaphi and Upper Songkhram regions by Chi Valley immigrants who were accustomed to a more developed ranking. This is because no bronze or iron plough tips are evident in the Khorat archaeological record, but they are common in contemporary Vietnamese contexts, and another wet-rice technique is available. The method is known as ratooning. It uses floating rice and is particularly suited to areas prone to gentle flooding to which some rice varieties are intolerant. Ratooning does not require plough cultivation. More extensive production associated with the introduction of this method could have provided sustenance for a sudden influx of Chi Valley peoples possibly under the threat of warfare. Although fissioning from the periphery of developing Chi Valley chiefdoms "involving steady but peaceful infiltration" could have been absorbed by the local population, the Ban Na Di data [illegible] make this seem unlikely" (Higham and Kijngam

1984:723-724).

Whether the transition from GP B to GP C in the Sakon Nakhon Basin was peaceful or not, in terms of the ceramic spectrum, it was substantial, and at Ban Na Di, complete. If warfare played a vital role, it seems unlikely that total annihilation resulted as pottery fabrics characteristic of GP B continue into GP C. Again, the retention of earlier socio-economic variables, such as bronze metallurgy and important associated exchange networks, tend to support a process of assimilation as the ultimate result of the transition. For example, although the technology asociated with bronze casting at Ban Na Di changes, early exchange relationships appear to have been maintained and probably strengthened. More complex methods, such as high tin alloys and clay moulds, the latter paralleled at Non Chai, were introduced (Higham and Kijngam 1984:688-700). Close ties are maintained with the Eastern Sakon Nakhon Basin region, however, which lies closer to key raw materials. A crucible fabric suggests this region may have provided itinerant metallurgists. Chi Valley relationships, however, strengthen at the expense of those of the Sakon Nakhon Basin. Notably, Chi Valley pottery imports show a steady increase with time. The process is orderly, without any sign of a major temporal discontinuity such as that which marked the transition at Ban Na Di. Transformation of the social form is implied by post-transition changes in exchange networks, this is an evolutionary process which suggests an intensification of social organisation (Renfrew and Cooke 1979). Systemic evolution prior to the transition point may have set the scene for revolutionary processes of the kind envisaged by Higham and Kijngam (1984). The resultant metamorphosis incorporated aspects of both the recipients' and donors' traditions.

External relationships show a clear shift in emphasis from intra-regional to inter-regional after the transition from GP B to GP C at Ban Na Di. In addition to retaining important links with the Eastern Sakon Nakhon Basin bronze industry network, a vigorous new relationship is opened up with a much larger Khorat Basin system. This latter development gave access to exchange networks of an entirely different magnitude. Iron was introduced, and *c.* 200 A.D., the first glass beads appear at Ban Na Di. Glass beads replace shell and stone jewellery common throughout levels 6-7. Their specific gravity suggests an Indian origin (Pilditch 1984:78). In addition, ceramic seals in the form of either incised rollers or stamps first occur (fig. 11.1).

Examples of stamps similar to figure 11.1c were recovered from Chansen by Bronson (1976:29). He considered that they resembled "Funan" finds at U Thong on the Chao Phraya Plain and at Oc Eo in the Mekong River Delta. It is important to note that each seal at Ban Na Di bears a different design. This is repeated at Ban Chiang (Gorman and Charoenwongsa 1976:22; White 1982:46, 75, 88). Such exclusivity implies that the intended function was not related to manufacturing processes such as imparting patterns onto other materials. For if so, we can reasonably expect to find several of the same design. As some were broken, replacements would be needed, and fashionable designs are likely to have had wide currency. Unique designs suggest special purposes. The size and rarity of these artefacts precluded thin-sectioning. A ceramic composition is apparent in hand specimen. Experiments with plastic clay demonstrated that they readily impart an excellent impression when pressed firmly into the surface, and provided the clay is not sticky, a clean separation is easily achieved. Clay tablets with negative impressions are unknown in Southeast Asian achaeological contexts. The durability of unfired clay in these situations is unclear, however, even given that they were relatively intact when discarded. It should be noted that the Lerna sealings were subjected to fire (Caskey 1955, 1958). This probably ensured their survival.

The Ban Na Di seals could be tokens (Folan and Hyde 1980), but this seems unlikely in view of their form. The possibility that they were a means of denoting individual ownership

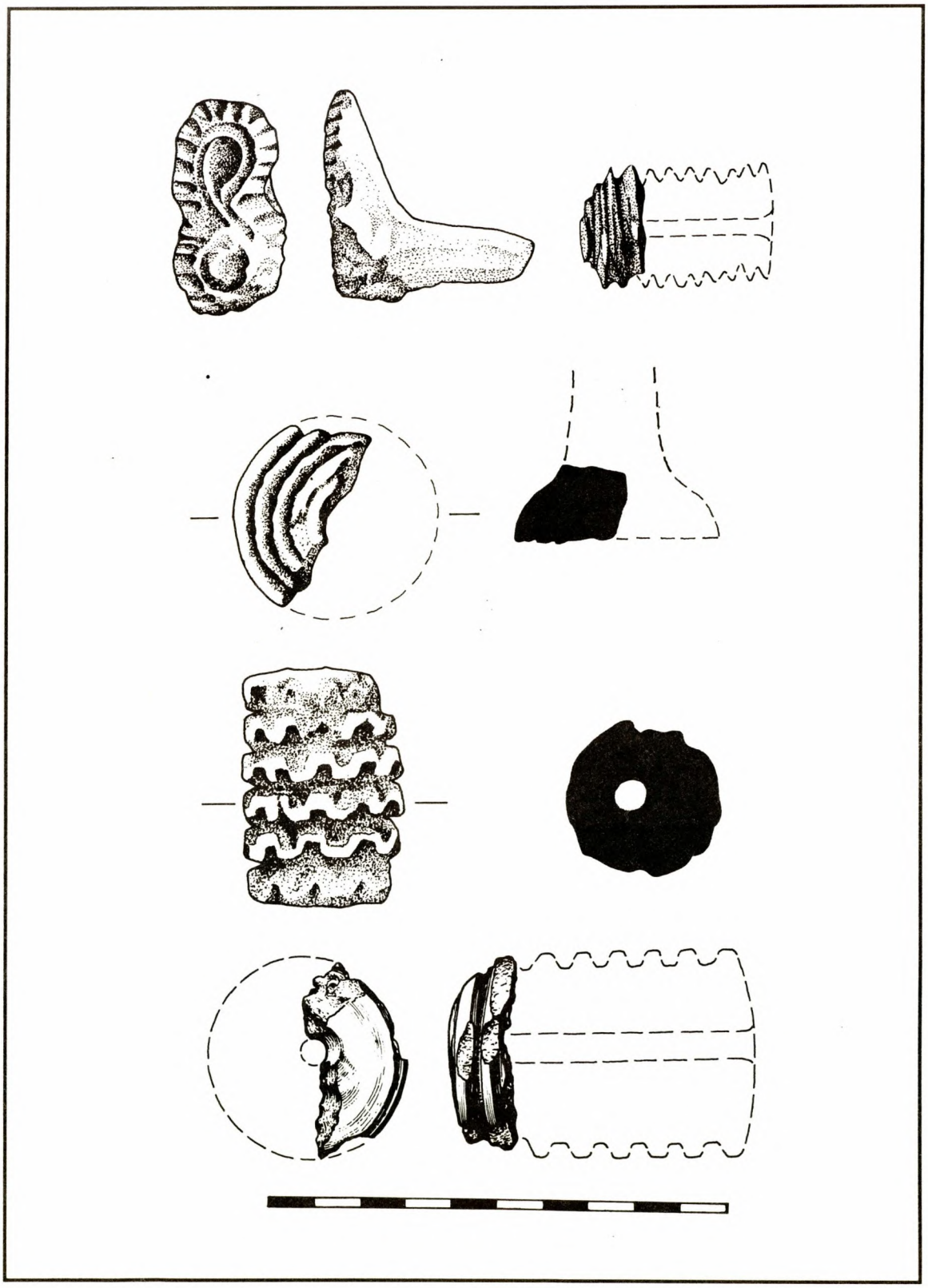

FIGURE 11.1: THE BAN NA DI CERAMIC SEALS (a: top left; b: top right; c: second top row; d: third top row; e: bottom.)

gains strength when the value of prestige goods, such as glass, are considered. As exotic items, such as marine shells and pottery, predate seals, material value alone is unlikely to have been a sufficient cause. Thus, if the seals were used to denote ownership, it seems unlikely that they related to goods freely available on an open market. They could, however, have acted as symbolic information carriers which helped reinforce close social relationships enjoyed by those who were privileged to direct participation in an extensive economic redistributive system.

Lamberg-Karlovsky (1975) reports that such a system existed in early third millenium Mesopotamia. In this latter case trade in luxury carved chlorite bowls is involved. Lamberg-Karlovsky suggests that the successful maintenance of long-distance trade in luxury items points to strong sociopolitical control. He also notes that the distribution of distinctive seal types overlaps that of equally distinctive ceramic types (1975:363). It would be unwise to push comparisons with Mesopotamian city-state trade networks too far. On the other hand, we should not draw .back from attempting to explain the association of two artefact groups unique to GP C in the Sakon Nakhon Basin. To do so would be an omission. In seals and the GP C highly decorative bleb-tempered wares we also have a coincidental association. It extends from Non Chai, where glass beads are abundant during phase 3, to Ban Na Di and Ban Chiang. On the basis of present data, however, it excludes Ban Chiang Hian and Non Nok Tha.

Schauffler (1976:27-37), excavated small test squares at Don Klang, Ban Phak Top and Ban Tong. The former is close to Non Nok Tha, the latter two lie near Ban Chiang. Serious looting had damaged each site and the results can only be treated with caution. Glass beads were recovered from Don Klang and "clay rollers" from Ban Tong. Such tantalizing glimpses fall short of the kinds of evidence needed for valid inferences to be drawn, and until Northeast Thailand is further explored it would be misleading to formulate models based on them. Conclusions should be drawn on the basis of clear evidence, although this need not be comprehensive (Higham and Kijngam 1984:710).

Function aside, the presence of seals and glass beads in association with iron argues for inclusion in a much broader exchange network which included prestige items. They also help link Ban Na Di with LP Ban Chiang. Bronze technology, and a range of associated jewellery is similarly correspondent (Higham and Kijngam 1984). It is clear that we are dealing not only with different technologies and more reliable agricultural methods but also a more complex level of social organization. As Hanks (1972) observed for rice cultivation, the important variable is not so much which particular strategy is preferred, although these are influential, but the level of expertise applied. Social changes, not natural forces, may be crucial socio-economic stimuli.

Restricted access to desired resources promotes competition and when this involves improvements to land individual ownership concepts are commonly invoked. In plough societies "diverging devolution" underscores this concept (Goody 1976). We have noted, however, that while ploughing would extend wet-rice into marginal dry areas, the plough-less ratoon method has also been suggested for the Chi Valley, Kumphawapi and Upper Songkhram. This derives from Wheatley's (1983) interpretation of the 3rd century A.D. Chinese reference "Sow (or plant) in one year (and) reap for three", which is to suggest ratooning was practiced in the flood- prone Transbassac. A practice which is only suited to certain zones, required special skills and could have opened up previously unexploited areas. This hypothesis, if true, involves systemic processes of comparable effect to the introduction of ploughing. Individual ownership of triennial crops and preferential access to prime sowing or planting locations would

provide a comparable stimulus.

These events take on further significance when we consider the relative significance of Ban Na Di. It is unlikely to have occupied a nodal position in the regional exchange network, in terms of both its geographic location and lack of valuable raw material resources. It was certainly not a central place in terms of relative size (Kijngam *et al.* 1980, Higham and Kijngam 1984). Pottery manufacture could have only been carried out under the stress of a local absence of suitable clay. Thus it is unlikely to have been an important production centre, and as such a net exporter of pottery in any economically significant manner. Overall, it is reasonable to portray Ban Na Di as a typical small autonomous village located outside the mainstream of regional socio-economic interaction.

We have noted in chapter seven that MP2 pottery incorporated a much increased range of techniques and construction expertise. An extensive repertoire of vessel shapes is reflected in rimforms, and skilled use of paint in surface decorations is evident. Compared with the comprehensive MP2 assemblage, the founding tradition is clearly inferior in both manufacturing and variety of design. In both fabric and form, these new locally produced wares mirror in many respects Non Chai pottery. Perhaps even more important are the technological implications reflected in such overall quality. It is unlikely such expertise could be developed in areas lacking quality raw materials. This requirement clearly hindered potters of the early local Ban Na Di tradition. Production centres with access to quality clays are in a position to increase output when and if the occasion arises. Thus it seems reasonable to assume that a relationship of this kind would favour the quantitative and qualitative florescence of ceramic production. Positive feedback with other subsystems, such as subsistence, is therefore enhanced by these factors (Arnold 1985). This kind of interaction has been promoted as catalytic to the multiplier effect (Renfrew 1972).

Aspects of Goody's (1976) diverging devolution model coupled with Sherrat's (1980) secondary products revolution proposals are socio-economic factors which may have important consequences when substantial ceramic production is associated with land-owning or controlling agriculturalists. Positive feedback between wet-rice agriculture and export-orientated pottery production typifies the kinds of interactions between subsistence, technology and related increased social complexity, which characterised the development of ranked societies elsewhere (Adams 1960, 1966, 1975, Dalton 1975, Johnson 1975, Renfrew 1975, Renfrew and Cooke 1979, Sabloff and Lamberg-Karlovsky 1975).

Prestige quality wares were imported throughout the Ban Na Di sequence. During MP1, they are mainly represented by the same or similar types of incised and painted wares which characterise the Ban Chiang Middle Periods, although equally masterful examples, such as pots 95 and 96, are also present. Both these wares are consistent with Sakon Nakhon Basin sources. In addition to high quality, rarity may also have signalled prestige. Wares from a distant igneous region, and of unusual form, were copied. This corroborates the importance of exotic pottery as prestige goods.

With the inception of bleb-tempered production the presence of high quality wares at Ban Na Di, and probably throughout the Sakon Nakhon Basin, increased dramatically. During the Late Period at Ban Chiang, exquisitely painted probably bleb-tempered vessels became popular as mortuary furniture. Different fabrics indicate that several manufacturies were simultaneously producing wares decorated in this style. Such popularity reflects the prestige accorded this ware. This is a response noted elsewhere following the introduction of exotic pottery (Shepard 1942). In the present case, the first appearance of the ware is followed by a postulated movement of people into a region which previously did not produce it. The rise

in popularity appears to have accompanied the influx of immigrants. This suggests that the popularity was a result of either novelty and/or it reflects a change in social organization engendered by the dominance of a new social order. Production of quality wares can be expected to give exchange advantages.

White (1986:313-315) has argued that a change in the "socio-cultural" scene may have resulted in rapid movements of people. Another explanation for temporal changes in ceramic technology, according to White, is that manufacturing and distribution structures could have changed. She gives as an example a change from "each village manufacturing most of its own vessels to specialized pottery villages manufacturing for a region", this could explain the "broad dispersal of certain pottery styles and technologies".

We have noted that production is critically dependent on the local availability of raw materials. In view of the highly localised nature of suitable potting clays, it seems unlikely that less favourably situated villages could produce surpluses. In many instances, villages are likely to have been not producers but net consumers. Production centres specializing in pottery manufacture would have provided the major influence on the ceramic spectrum. It is these centres which will provide the key to temporal and areal distributions of prehistoric pottery.

Identification of production centres can be anticipated to provide insight into important cultural variables including the evolution of complex societies though the feedback mechanisms mentioned. Production centres are dependent on the availability of raw materials. Thus they are likely to be favourably situated with respect to quality clay sources, distortions produced by efficient transport systems, such as waterways, aside. Wares emanating from them help contribute to the articulation of exchange networks. They affect relative chronologies and important processual factors such as socio- economic organization. An understanding of pottery exchange intensity is a primary step towards illuminating relative chronologies. A lack of clear understanding of mechanisms which generate pottery distributions seriously risks unwarranted assumptions. Assumptions,for example, which regard the relative proportions of pottery through time as valid inferences in establishing relative chronologies, should be treated as suspect unless a detailed understanding of where such pottery originated from is available.

Intensive analysis of production centres is likely to prove rewarding for the above reasons. We have seen that, although some distinctiveness is evident between different Khorat Plateau clays, they can often be expected to be generally indistinctive due to the nature of local country rock. For this reason it may sometimes be necessary to include intensive techniques. Blending renders heavy mineral analysis unreliable for comparisons of clays with ceramic fabrics. Production centres are more likely to utilize non-blended clay, however, because by definition they should enjoy adequate supplies of quality clays. These will often not require modification beyond the addition of standard temper. Heavy mineral analysis is suited to these circumstances.

Mineral identifications are central to sourcing the origins of wares. Elimination of unrelated mineral zones helps narrow the area of enquiry. This strategy may also be applied to differences in technologies. For example, variations in grog temper. Pottery containing orthodox grog can usually be distinguished from wares with bleb-temper. Provided these tempers are first identified in thin-section, examination with a low-power binocular microscope should suffice in most instances. When compositional parameters are fully understood, this can be undertaken by those unfamiliar with petrographic techniques. These temper distinctions, when dealing with large sedimentary regions, can provide significant *prima facie* evidence.

A principal objective of this report has been to illuminate the prehistory of Northeast Thailand through an examination of a range of ceramic artefacts. Adoption of a standard terminology which is both precise and appropriate is urgent and critical for meaningful future

discourse. Pottery types should include fabric and form considerations. Because they are potentially diagnostic of whole vessels, rimforms are important and should receive close attention. When correlated with fabric, they allow assessments of the relative proportions of types. The identification of exotic wares, which may often comprise a small percentage of a ceramic assemblage, is thus enhanced. At Ban Na Di, exotic vessels were copied by local potters. In view of this propensity to imitate novel designs or styles, it is necessary that both the fabrics as well as forms are subjected to detailed study.

Regions which display a distinctive geology are best suited to petrographic analyses, particularly when fabrics which derive from such areas contain diagnostic rock and mineral inclusions. Under these conditions, suggested sources are less ambiguous than those proffered for more homogeneous regions. Even in difficult areas, however, it is often possible to identify exotic wares. An intensive examination of clays and modern comparative materials helps distinguish between different source zones and manufacturing methods. This is particularly valuable when potting clay sources and fabric compositions can be understood in terms of the local regional geology and manufacturing methods respectively. These are important questions and ones which should be addressed in future studies.

Ceramic analysis has the potential, not only to illuminate temporal production changes and cultural relationships through material identifications, either by locating or excluding likely sources, but also to address such questions as exchange, social organisation and related cultural change. Production centres are vital to many aspects of pottery analysis, even when production is conducted under adverse conditions and is essentially aimed at internal consumption. Related manufacturing techniques may often indicate a regional homogeneity derived from social cohesiveness. This kind of association has often been attributed to stylistic similarities. Exclusive style-orientated assumptions, which are invalidated when styles are imitated, are not comparable with inferences drawn from the essentially intransient influences of technology. We have seen that these may be as equally widespread as pottery styles. The two, however, can not be assumed to be correlated, although they often may be.

Pottery, of course, forms just one component of prehistoric endeavour. Durability may act to impart undue bias and prominence to ceramic artefacts. We must, therefore, not promote pottery beyond its true function and meaning as cultural detritus. Pots never equal people. Clay is the plastic medium par excellence, however, and this allows a measure of human expression not afforded by many other artefacts. Symbolic expression, favoured contemporary styles, social unity and economic development are all reflected in ceramic preferences. Ceramics also embody evidence of considerable importance to the identification of exchange networks and relative levels of technological development. We are fortunate indeed that such artefacts are durable. Their relative abundance in Southeast Asian prehistoric contexts demands careful analysis if misleading avenues of inquiry are to be avoided. Ethnographic data greatly enhanced the identification of the bleb temper. Our attention to ethnographic information is likely to give rewarding results when correlations with archaeological data are evident. Valid conclusions rest on the acquisition of worthwhile information gathered from aspects of ceramic manufacture that give meaningful results. In this respect the mode of production is an important indicator of socio-cultural associations. Designs or art forms commonly fall under a specific stylistic rubric. This is not a limiting factor because individual styles may be rendered in a wide variety of materials and techniques. Cubism, for example, retains its form whether oils, water paint, or charcoal are applied to canvas, wood, or paper by hand or machine. Ceramic modes of production, however, are constrained by the kinds of materials and technology available. Technological strategies, therefore, can be expected to relate directly to

locally available materials and technical expertise. Access to exchange networks and transport facilities will act to enhance technological development through the input of new ideas and materials.

Finally, ceramics should be approached both from intensive analytical directions, and as a means of bringing together broad syntheses of disparate sociological relationships. Together, these relationships articulate processes central to the dynamic forces whose manipulation have characterised temporal changes in human societies. We should not allow ourselves to be bogged down by the gathering of more and more data, so that we feel constrained and reluctant to formulate bold new hypotheses or models based on available evidence. Ceramics represent one of the most important human inventions. We should organise our approach to pottery with the knowledge that although it forms only a small, occasionally unimportant, component of human expression, the information it may contain is worth careful consideration. This is a dedication that is warranted, not for any intrinsic satisfaction, but in view of the valuable conclusions to which it may lead.

Appendix One

The ceramic fabrics of Northeast Thailand

A.1 The petrology of Ban Na Di "whole" vessels

A total of 147 vessels have been examined (chapter seven). Detailed descriptions of the different fabrics identified are set out below.

A.2 Mortuary Phase One fabrics

(a) local wares

Fabric groups 1 to 4 inclusive are categorised primarily in terms of *technological* variations in temper. Fabric group 3 is considered to comprise a blended mixture of a plastic with a short clay. Clay preparation of this kind, in a sense, is a form of tempering. It acts to increase the proportion of nonplastics in the mixture.

Fabric group 1.

The parent matrix is comprised of a clay petrographically consistent with Nong Kham Din (sample 10, chapter five). Its most distinctive features include a moderately micaceous matrix, few nonplastics, and numerous sponge spicules.

Fabric group 1 is tempered with "orthodox" grog (figures 6.1 and A.1) below. It is usually comprised of the same constituents as the parent ceramic body, although it may often be free of large inclusions. The matrix of both often appears argillaceous in thin-section. Orthodox grog is angular to subrounded in shape. It ranges in size from very fine to very coarse sand. Coarser nonplastics often tend to be concentrated within a central core, a narrow portion of which is often reduced, at times heavily. The fabric is usually oxidised to a shallow depth (about 1 mm), in from vessel surfaces. These areas are dominated by finer particles, an artefact of paddle and anvil construction. Any oxidised micaceous particles display a characteristic sheen. These particles, when randomly mixed, give a distinctive "cross-hatched" effect. Voids are rare.

In contrast with the fabric group 12 "bleb" temper discussed below, "orthodox" grog does not incorporate rice husk. In many Khorat Plateau fabrics, including strictly sand-tempered wares, it is common for isolated fragments of rice husk occur. These are considered "incidental", because they were probably not added deliberately. Orthodox grog may, in very rare instances, display husk impressions to exterior surfaces.