Chapter 3

Objectives and methods

3.1 Objectives

The object of this report is to illuminate the prehistory of Northeast Thailand through an analysis of ceramics from Ban Na Di and related sites within the Sakon Nakhon Basin and the upper Chi and Mun Valleys. We have noted in chapter one that these sites were examined so as to fill a lacuna in evidence regarding claims for early metallurgy. Ban Na Di was chosen for excavation because it lay close to Ban Chiang, one of the postulated very early sites containing metal, and because it occupied an environmental location shared with many surveyed sites. Test excavations indicated a material culture which included bronze and iron. Several more distant sites will be considered where they provide background data of relevance to the developments documented for the Sakon Nakhon Basin. Inclusion of these additional sites assists the theoretical model outlined below by broadening the scale of the inquiry. The potential of petrographic analysis of pottery is documented with reference to the work of Shepard (1936, 1942, 1956, 1965) in the Rio Grande.

In essence, Shepard applied established geological and statistical methods to prehistoric ceramic technology as revealed by archaeological surveys and excavations in the Rio Grande region. The result was, according to Kidder, "not only a valuable contribution to Rio Grande prehistory but an exposition, by what might be called the case system, of the role of ceramic technology in archaeological research" (Kidder 1942:ii). This assessment was later denied by Shepard (1965:62-63) when she argued that "Several distinct circumstances favored the technological study of Pecos pottery". The first included the relationship between archaeologist and analyst which meant that the "archaeological background", "stylistic features and relative dating of the types" were known from the outset "and throughout the study there were frequent opportunities for exchange of information and discussion with Dr.Kidder. Second, the history of the ware was exceptional because its unique decorative technique required a lead ore that was restricted in occurrence. Third, the geological diversity of the region from which the potters obtained clays, nonplastics, and pigments greatly facilitated the location of sources or source areas of these ceramic materials. Consequently, this investigation was a specific, not a general, test". Whether or not Shepard's Pecos investigation was a case study with general archaeological application, is central to the objectives and aims of this report. It is a question that will be tested in the following chapters.

Shepard's research was undertaken against a background of a series of meetings, conferences and papers designed to cope with an enormous corpus of ceramic data derived from both surface surveys and excavated material. The collection of this material began in 1910 and built up to what was referred to at the Peabody Museum as a "library of sherds" (Kidder 1936:xxiv). By 1936, the combined assemblage in three Southwestern institutions represented a collection of sherds from about 12,000 sites. Further data were accumulating from other North American sites (Phillips *et al.* 1951). Even before sherd surveying was undertaken on a serious basis the need "for a uniform nomenclature of pottery type "(Kidder, *op. cit.*) was considered essential. The 1927 Pecos Conference resulted in general agreement that participants should consider "a binominal ware- nomenclature; the first name to be indicative of the locality of highest development, the second a technically descriptive term; for example, Sikyatki yellow, Mimbres black-on-white, Upper Rio Grande incised, etc." (Kidder 1936:xxv). Further discussion followed at the 1929 Pecos Conference, and the system was adopted at the 1930 Globe Conference. Attempts to correlate ceramic categories with biological taxonomies were quickly discounted as untenable. It was, however, felt that "sound classifications and valid deductions eventually will emerge" (Kidder 1936:xxvi).

Classification of archaeological materials was considered by Kidder to be the domain of the "general archaeologist" who, however, "is not competent to carry out the detailed and highly specialized studies" essential to understanding fabric composition or firing conditions. "A little learning is, in ceramics, a very dangerous thing" (Kidder 1936:xxviii).

3.2 Discussion

Tension over the proper domain of the "general" archaeologist lies at the heart of many of the debates into archaeological practice and its scientific status. Archaeology is multidisciplinary, involving both the natural and social sciences. The natural sciences sometimes involve data associated with phenomena that behave in a predictable manner (Popper 1963:340), for example the sun's motion. Its *apparent* movement does not provide an unequivocal explanation of its true motion or role in the solar system, however. This requires definition and explanation. Such explanations are often best articulated and simplified with the aid of a model. Scientific explanations as discoveries are "the explanation of the known by the unknown" (Popper 1972:191). Such definitions and explanations are sought by researchers in archaeology.

The rigour attached to "scientific" explanations varies according to the kind of data under consideration. Physical phenomena, the subject matter of the natural sciences, once defined and explained, exhibit properties which are predictable in terms of these definitions and explanations. Such interpretations can be relied upon because they correspond to the rules contained within the framework of the unified theory or "paradigm" (Kuhn 1962) they are embraced by. Only if the unified theory or paradigm is overturned is this predictibility destroyed. For each such destruction a new unified theory or paradigm is created (Kuhn 1961:348-365, 1962:67-105). Hence, given general agreement as to the theoretical framework within which research is undertaken, and the rules which define and order this framework, predictions can be made with confidence.

By contrast, many explanations in the social sciences do not enjoy such predictive confidence. They cannot explain nor predict conclusively either unknown past, or future historical developments. Two important factors contribute to this lack of explanatory power. First, societies are inherently in a state of constant transformation (Renfrew and Cooke 1979). Second, these developments are in the main not repetitive (Popper 1963:340). In contrast, the solar-system-type cyclical events are determined by physical laws. Their explanation may have enhanced the predictive respectability of the natural sciences.

Societies, however, are not governed or constantly constrained by physical laws. Humans may act to modify their physical and/or social environment. Their actions are merely subjectively appropriate however; and historically, even if effective, only more-or-less rational. As a consequence, typical social science models need to incorporate "the rationality principle" (Popper 1967), which weakens their explanatory power. This principle effectively denies the possibility of individuals or agents acting adequately or appropriately in any given situation. To do so would require perfect knowledge of all possible variables involved in all possible instances or events. Thus actors are historically inadequate for any given situation *as they see it* (Popper 1967:9). Therefore, to understand their inadequate actions, we must "reconstruct a wider view of the situation than their own "(Popper 1967:9). The social science approach involves construction of models which include typical situations or conditions. They are over-simplifications that omit much and over-emphasize much (Popper 1967:7). In order to animate such models we must accept the truth of the rationality principle but need not allow its uncertainty to destroy our models because its adoption considerably reduces their arbitrariness. It assumes the adequacy of human actions to problem-situations as we see them. Such problems are not encountered in the natural sciences.

The theoretical/methodological dichotomy between the natural and social sciences places constraints on archaeological problems where both are interrelated. This applies whether we favour a processual or historical approach. Where physical laws are involved, considerable analytical rigour can be expected. Conversely, sociological data require a different approach, and, without the utility of appropriate models, are seriously weakened by that omission. These problems, while general in archaeology, are encapsulated in ceramic studies. As Peacock (1982:173) observed "Ceramic studies are a microcosm of the discipline as a whole: the form and decoration of vessels can be a subject for the art historian, graffiti and stamps for the epigraphist, while the fabric can be analysed by the geologist, chemist or physicist".

We may now return to the enigma thrown up by Shepard's denial of the petrographic method's universality. She argued that special circumstances were enjoyed in the Pecos study, because the investigation involved unequivocal evidence. Significantly, such circumstances are analogous to those embodied by the natural science's "paradigm". As the Rio Grande geology was variable, and clearly divided into mineralogically discrete zones, the sources of raw materials were readily determined. This evidence did not, however, identify the production sites. These owe their origins to a combination of physical and social factors.

To extract meaningful informatiom from raw physical data, background or "contextual" archaeological information is needed. As Shepard (1965:83-84) observed, without this information, "The analytical data would have said nothing more to me than that pottery from Pecos contained a number of kinds of tempering material". Sociological factors helped determine where the pottery was made. Shepard's raw data comprised material amenable to analysis and interpretation within the rubric of established physical laws. Complete confidence in the petrographic and chemical results is thus warranted. Shepard's treatment of these, however, *and the archaeological data combined*, involved the use of a model typically employed in the social sciences. The rationality principle is implicit in this model.

Unfortunately the clear geological variability of the Rio Grande is not ubiquitous. Often the study area will contain geologically more-or-less homogeneous terrain. These are difficult, occasionally impossible, to differentiate with standard methods. Alternatively the data may require excessively laborious and/or expensive analytical techniques. In the former cases the *methodology* is often labelled as inadequate (Matson 1951:273-275, Shepard 1965:62-63, Peacock 1970:382-383). Other workers argue that, because of the latter problems, the petrographic/technological approach generally should be rejected as time consuming, expensive and inadequate (Matson 1951:112).

Ideally we would prefer the method to be universally applicable. A major difficulty may be that in the identification of raw material sources we are dealing with singular events, whereas the overall aim of archaeological analysis is the explanation of certain kinds or types of events. Popper (1967:2) notes that "the difference between these two kinds of problem is that the first can be solved *without constructing a model*, while the second is most easily solved *with the help of constructing a model*" (italics Popper's). Thus the difficulty lies not with the petrographic method but in *the formulation of a model appropriate to the available data* (italics mine).

The success enjoyed by petrographic-based technological investigations stems from the explanatory rigour attached to methods involving physical laws. Shepard's Pecos study epitomises this point. Unequivocal physical evidence articulated Shepard's explanatory model. Yet this clarity is not always so readily attained, even in the physical sciences. In geological stratification studies, for example, the law of superposition cannot automatically be assumed. Thus the stratigraphic younging direction is often unclear and top-to-bottom inferences may be invalid. Many instances of tectonically overturned beds have been documented which require detailed analysis for explanation and stratigraphic correlation (Dunbar and Rodgers 1957:112). Two devices are often used to overcome such problems. The first involves increasing the intensity or detail of the study, and the second is to widen its scope. These strategies will be adopted.

Regions containing clearly differentiated geological areas can be expected to provide powerful *prima facie* petrographic evidence. Less heterogeneous regions may often provide equivocal petrographic information. This may require testing against other evidence or enhancement. Physical evidence, however, is normally essential to adequate interpretations and explanations. Yet petrographic information devoid of archaeological and/or sociological background knowledge is of doubtful use. Similarly, ceramic data lacking petrographic details are often highly suspect, and occasionally erroneous and misleading (Peacock 1970). Ceramic fabrics are potential sources of either physical evidence alone or in combination with sociological data. But ceramic forms encapsulate essentially sociological information only. It is axiomatic, therefore, that the formula "fabric-plus- form-equals-type" be invariably applied if the fullest possible information is to be extracted from ceramic artefacts.

Shepard assumed that the *method* was an essential part of the Pecos investigation because it coincided with the circumstances. Petrographic analysis, however, was only one part (albeit a very important one), in an overall *model* constructed to illuminate the prehistoric ceramic processes involved. It is interesting to note in this regard that while presented as "a test of petrographic analysis" the Pecos study also involved what was described as an "unique decorative technique" Shepard (1965:62-63). Clearly, sociological factors also played an important role.

Ceramics embody both social and physical phenomena. If, by some culturally determined factor, the Pecos tempers had been, for example, regionally undifferentiated organic material rather than rock, Shepard's thesis could still have been validated by the mineralogy and chemistry of the parent body and the glazes. While the inclusions may have been less easily defined and required a more fine-grained treatment, such as heavy mineral (Peacock 1967) or textural analysis (Streeten 1982:123-134), the method would have still provided sufficient useful data to articulate the overall model. In some investigations, however, petrographic analysis *alone*, may fail to provide sufficient data for such a result. Yet this weaker petrographic information may provide sufficient background information for valid conclusions to be drawn when associated with other pertinent information. In the absence of any unequivocal evidence, the integration of two or more pieces of uncorroborated information is often rewarding. Equivocal in isolation, they become mutually supportive and explanatory in association. This interrelatedness is analogous to geological mineral associations as applied to the definition of rocks (Press and Siever 1974:109-111) and/or facies (Mason 1966:262-276).

A deductive explantory model, which contains several discrete but related hypotheses, need not demand that each hypothesis be validated. The exclusion of each hypothesis through a process of elimination is a valid means of deducing which is correct. Provided, of course, that the number of such hypotheses is not infinite. As with all scientific explanations, the model should meet the requirement of "explanatory relevance" (Hempel 1966:48). It should be non-circular, non ad hoc and independently testable (Hempel 1966:28-32). Given this, and that the model has a valid logical structure, reliable conclusions will result.

Ceramics sometimes play a pivotal role between ecological and sociological relationships. Models designed to illuminate these relationships, therefore, may need to include a comprehensive number of factors. Each case will involve a variety of socio- physical variables. Their importance will depend upon the special, and sometimes unique, circumstances of each inquiry. Thus, the weight accorded each variable may be crucial. When unequivocal physical data of the Pecos kind is encountered, however, it will suffice.

3.3 Methods

Eliminative deduction lends itself to archaeological ceramic studies because, while it is often difficult, and occasionally impossible to identify the origin of ceramic materials, it is usually possible to *exclude* potential areas. This principle is, in a sense, articulated by negative evidence. Typical "initial conditions" in ceramic studies involve the kind of local and regional geologic terrain, the scale of the investigation, the weight given to the various elements of the data available, background or "contextural" information of the kind discussed above, and the analytical methods employed.

In ceramic studies, an understanding of the origins of archaeologically-derived material can be crucial. A ceramic artefact's provenance may be deduced by first assuming that it was made from locally available raw material "X". Thus, if any given ceramic artefact is local, then it would be made of "X". Hence if it is not made of "X" it is therefore not local. When several possible sources exist these can be eliminated one by one, using the same procedure, until the correct raw material source is identified.

This kind of procedure was set out by Bacon (1620) in his *Novum Organum*. It became known as *eliminative induction* (Musgrave pers.comm.). Essentially Bacon argued that by eliminating possible causes one by one, we shall finally end up with only one possibility which is thereby established *by the whole process* as the true cause of *X*. Of course the procedure assumes that the number of possible causes of anything (or of possible hypotheses) is finite and known. For our purposes, in instances where it may be impossible to suggest a likely source, it may be useful to at least determine that the material an artefact was made from could not be locally derived. In such cases it is not necessary to gain insight into all possible derivations, but merely to establish that the material was not local. We would, however, prefer additional information, even of a general nature, regarding likely sources.

Unfortunately, in ceramic provenance studies, additional problems face us to that suggested by Bacon's method. Elimination of, for example, igneous and metamorphic terrain as possible source regions may be a Pyrrhic victory. We may be left with a sedimentary region which presents problems of just as great a magnitude as that with which we commenced. In addition, several manufacturies could have availed themselves of different portions of what essentially, in standard mineralogical terms, is the same clay deposit. Furthermore, such production could be stylistically undifferentiated. In many studies the response to these sorts of problems has been to intensify the methodological detail or to invoke fine-grained analyses such as heavy mineral or size/texture studies (Streeten 1982). We have noted, however, that these approaches have been criticised as too time consuming or expensive. Quite so. For large geologically undifferentiated areas, economic factors may rule out such methods. In these cases the question that now presents itself is: can we satisfy both the logical and the pragmatic problems that face us? I think we can by the use of an appropriate model. This model is outlined below.

3.4 The eliminative deduction or "sieve" model

In terms of Baconian eliminative induction, if the rejection of our first hypotheses leaves us with a problem of much the same magnitude as that we started with, one option is to enumerate a further set of hypotheses. This procedure could be repeated until we discover the right one. For fabric-inclusive ceramic studies, this means the available data must be *enhanced* in order to make it amenable to testing in terms of the new hypotheses. Each failure means we must proceed to a higher order of investigation. Each succeeding order requires additional inputs of information and/or more complex methods of inquiry. The process thus becomes increasingly more difficult to formulate with each additional step. Eventually, some problems may prove insoluble. The key question is where to draw the line between ideal solutions and pragmatic resolutions. While we seek a perfect view it may be "better to view the scene through blurred vision than to have not looked at all" (Hanks 1972). Pyrrhic victories are victories nonetheless.

Our eliminative deductive model involves testing a series of related hypotheses. Hypotheses unable to provide conclusive explanations are passed over until all the hypotheses have been considered in turn. If none of the hypotheses is correct, the data are then enhanced. This allows the hypotheses to be reformulated. In some instances a hypothesis initially not verified will benefit from this treatment and become verifiable. Such sorting is analogous to passing the data through a sieve. The treatments are discussed below.

It should be apparent from the above discussion that the model proceeds through a series of steps. Each step involves the use of several hypotheses, some or all of which are liable to be eliminated. Thus, in effect, each step is also liable to elimination. The consequence of a step elimination is the need to assess whether "data enhancement" is practicable. Each succeeding step elimination involves further enhancement. Data verifiable using commonplace analytical methods are termed *standard.*

Critics of this approach may argue that enhancement procedures should continue indefinitely until all possible hypotheses are verified, rather than rely on an apparently arbitrary cessation and retreat to the "negative evidence" position outlined above. While at first glance this proposition seems to have considerable appeal, it would be prudent to note that this strategy brings with it no *guarantee* that any hypotheses so treated will eventually *ipso facto* become verifiable.

3.5 Data treatment and "enhancement" procedures

Ceramic artefacts are here approached within the rubric that "fabric-plus-form-equals-type". Inclusion of this rule is axiomatic. The weight accorded each element is equal, yet each may be analytically independent. Only when both are understood can the equation be resolved (cf.Shepard 1971:316). The degree to which these elements can be defined and explained varies in accordance with the available data, and conclusions stemming from analysis of them are in accordance with the physical/sociological explanatory parameters discussed above. Adequate background knowledge is essential to the overall articulation of the model.

A different but related view of “type” is detailed by Gardin (1980:62-134). Gardin suggests that physical, geometrical and semiotic properties are intrinsic, while temporal, locational and functional properties are extrinsic attributes (1980:72). Gardin commences with a provisional definition of typology as “any classification of material remains used as the basis of inferences relating to facts that are not included in the initial representation of those materials” (Gardin 1980:63). Through a process of “a systematic matching of intrinsic properties with extrinsic attributes,”(*op.cit.*:76), typological classifications are achieved. According to Gardin, such typologies often incorporate both compilations, where the primary objective is to present previously unpublished materials, as well as explanations of these same materials. The boundaries between these two classes of archaeological constructions, however, are not always clear.

Here we are interested in presenting both compilations and explanations of the data. In terms of the intrinsic properties recognized by Gardin, the type concept employed here can be viewed as incorporating both geometrical and semiotic properties under the form element in the equation discussed above. The equation is in Gardin’s terms “intrinsic”, while explanations in terms of the typological results may include, either implicitly or explicitly, both “intrinsic” and “extrinsic” parameters.

Many variables are incorporated within the framework of each of the fabric/form elements. For each element, these can be divided into physical and non-physical. They are approached in terms of the theoretical/methodological dichotomy evident between the physical and social sciences. The assymetry in explanatory force between these two sciences means that variables subject to physical laws are accorded primacy. This is not to suggest that physical variables will necessarily prove more useful than non- physical, but that in the absence of any single conclusive item of evidence this assymetry is likely to prevail.

A broad range of ceramic variables, many unique to this study, are discussed below. These are not promoted as formal or standardised classification units, nor are they required to be in terms of the model discussed above, although many have been previously employed by others in this way.

Data enhancement is achieved in three separate ways. Firstly, the scale of the inquiry may be increased. By widening the geographic area under consideration, greater geological variability is favoured. This strategy, in a sense, creates geological variability. The number of archaeological sites can also be increased, with or without increasing the study area geographically. Such sites include either occupational and/or raw material sources. Similarly, the chronological scale or range of artefact types can be increased.

Second, the detail and scope of the inquiry can be increased. For example, in fabric studies, this could involve intensive and fine-grained analyses such as electron microprobe, scanning electron microscopy or nonplastic size/texture distribution assessments. These techniques are, of course, standard geological approaches. The first enhancement step, however, acts to increase the quantity of data requiring analysis. Because of this, methods often applied to smaller scale investigations become increasingly time-consuming with scale. Some will eventually prove excessive. Thus extended databases act to limit analytical intensity for practical reasons.

Thirdly, the number of variables may be increased. This is related to the weighting procedures discussed above.

3.6 Enhancement examples

Some problems may require enhanced analysis of all the variables. Given that the choice of variables is adequate, however, this is unlikely. A typical example of the need for enhancement would arise when a particular fabric was clearly different from the material representative of a local ceramic tradition, but similar and consistent mineralogically with the regional geological terrain within which the site is located. A distinctive form may often assist to clarify such problems. The artefact's form, however, also proved to be equivocal.

One strategy could be to widen the scale of the inquiry and thus increase both the geological territory and the amount of comparative ceramic materials. If the fabric was mineralogically consistent with the expanded terrain, but still incompatible with the increased range of fabrics examined, two likely reasons appear possible:

(i) insufficient comparative material from within the geological study region had been examined.

(ii) the fabric was exotic.

As possible sources within the study zone are increasingly eliminated, the exotic status of the fabric is statistically enhanced. It would not be possible directly to identify the fabric as exotic to the immediate geological region. It would seem reasonable, however, *in the absence of evidence to the contrary*, to assume that it was not local.This position is admittedly tenuous because, statistics aside, there is no evidential reason to favour one source against another. If, however, similar enhancement treatments of the artefact's form characteristics also indicated a non-local origin, then this additional evidence would further advance the probability that the artefact was exotic. It is argued that in such instances, sufficient *prima facie deductive evidence exists to allow a valid conclusion in the absence of any negating data.* Such explanations are valid because they have been subjected to "rigorous tests", are non-circular, non-ad-hoc and independently testable. The subsequent discovery of any local source would falsify this conclusion.

In order to enhance the petrographic data derived from within the Sakon Nakhon Basin, the scale of the present study area has been broadened to include geologically differentiated regions. Some of these are a considerable distance from the primary site. Similarly, a comprehensive assemblage of Sakon Nakhon Basin material surface collected from 29 sites by Kijngam *et. al.* (1980) has been examined in order to broaden the scale of comparative data.

Use of the eliminative deduction model is a response to a study area that, unlike the Rio Grande mentioned above, is generally petrographically homogeneous. It is not promoted as infallible. The model would benefit from being subjected to "severe tests" (Popper 1972:287). The principal objectives in constructing this model are to minimise the arbitrariness of classifications or "identifications" (Peacock 1981:187), a problem that concerned Shepard (1971:312), and to organise the data in an archaeologically meaningful manner.

3.7 Production and consumption

Central to prehistoric ceramic investigations involving technological analysis is the exploration of temporal changes in the potters' craft, the illumination of possible cultural relationships through material identifications, and the location of their sources, and the characterisation of ceramic cultures. Ceramic cultures, however, may be either consumers or producers. Production is restricted by access to raw materials and climatic factors (Arnold 1985). Producers may consume their own or other production, but consumers do not produce. Because several different modes of production (Van der Leeuw 1981, Peacock 1982), and consumption (Arnold 1985), are possible, many alternatives exist. The organisation of these processes, therefore, is central to the manner groups of ceramic communities are related. An understanding of the nature of such linkages is an important objective.

Ceramic cultures fall along a production/consumption continuum. Those cultures critically dependent on production lie at one, and those dependent on consumption the other, extreme. We may anticipate that most will lie somewhere in the middle, with ceramics forming a more-or-less important cultural component. In order to make sensible the distribution of prehistoric pottery, ceramic cultures first need to be characterised in these terms. The mere presence of pottery in archaeological contexts, however, does not, in itself, allow this. Characterisation of cultures as producers and/or consumers depends critically on the proportion of local versus exotic wares present archaeologically. This may be impossible to establish precisely. It is essential, however, that production sites are accurately identified as without this information many conclusions regarding the origins of prehistoric ceramics are without foundation. An important objective here is to provide an outline of the distribution of ceramic artefacts in order to demonstrate relationships between groups of communities.

Arnold (1985:9), considers Steward's (1955), "cultural ecological" perspective as inadequate because, apart from resources, it seems to perceive the environment as unimportant in ceramic variability. Ceramic cultures are here, however, defined in two ways. Producers involve both environmentally affected "culture core" processes and "secondary" aspects. The latter need only apply in the case of consumers. Producers are involved ecologically on two discrete but interrelated levels. Firstly, production and distribution are affected by the environment. Secondly, cultural *style*, a secondary factor, is influenced by both material-related production methods and consumer demands. The function and/or fashion-related preferences of consumers will intimately reflect their various cultural styles. A vital first step in characterising the nature of any ceramic culture is to establish where the pottery was produced, how it changed hands and where it was used.

As Peacock (1982:165) observed, production sites are central to several important questions. They assist "chronological evaluation," because an understanding of "origins can be vital, particularly if the same form is made in a number of places at different times". In contrast, "production sites can produce evidence for the contemporaneity or sequence of different forms of common origin". Most importantly, according to Peacock, they direct our understanding of the "mode of production".

Peacock outlines a hierarchical framework of production modes increasing in complexity from simple sporadically-produced and self-consumed household production, to more complex income- orientated entities such as "workshops",and "manufactories". The major difference between these entities, technological questions aside, is effectively economic.

An understanding of the Ban Na Di ceramics, therefore, is a first step towards our assessment of its position, within a web of contemporary sites, as a ceramic culture. Evidence for production is set out in the following chapters. It is variously treated with the intention of bringing into focus the different methods and modes of production evident in the prehistoric sequence at Ban Na Di and related sites.

3.8 Discussion

Many petrographic analyses of prehistoric pottery have been undertaken prior to this study. Yet few American studies have been comparable to Shepard's pioneer Pecos investigation (Fry 1981:147). In Western Europe, however, "the field is developing into a specialised and sophisticated branch of archaeology" with a "growing interest .... in the analysis of fabrics," (Peacock 1981:187). Shepard's Pecos study provides not only methodological but also historical interest. This is because, in a sense, two major corollaries of this important work have strongly influenced the present research.

In the first instance, the Rio Grande investigation provides an ideal set of methodological and theoretical variables for comparison with and testing against, and this has been discussed in part above. Secondly, the influence exerted and the fate suffered by Shepard's seminal work is germane to both the history of ceramic research and the current state of the sub-discipline in Southeast Asia. A brief assessment of these earlier research developments will help bring into focus the theoretical background behind an apparent rejection of what seemed a research strategy of great promise.

Ceramic technological studies, after Shepard, were initially held to be "essential" yet "because of the wider horizons opened by" (them) "one can hardly draw conclusions at all" (Kidder 1936:xxiii-xxiv). Shepard's results turned the regional Rio Grande chronology on its head. In retrospect, given the impact these findings had on contemporary archaeologists, a classical Kuhnian paradigm change would seem called for. Yet it did not occur. Perhaps the reasons for this lie at the heart of the subsequent turning away from such detailed technological research in North and MesoAmerica, and ultimately, Southeast Asia. In order to illuminate this problem, it is necessary to review post-Pecos developments in North American ceramic studies and their influence on the present study area.

Following the Pecos and Globe conferences mentioned above, a series of further meetings was held. Of particular concern was the need to establish a standardised set of taxonomic definitions and terms. Classification was seen as the first step in coping with a corpus of data that was accumulating at an alarming rate. Considerable effort was accorded the definition of the most comprehensive and detailed lists of pottery "attributes". Little attention seems to have been paid to weighting attributes, although a comparative system which featured a formula comprising "principal diagnostic traits" capable of wide comparative applicability was proposed by Gillen (1938). Pottery forms were conceived as the result of the interplay between the human "mind", hands and principles of physics. "Qualifying attributes follow (the) traits they refer to" (Gillen 1938:27).

Such approaches have been labelled as belonging to a "mentalism" paradigm (Arnold 1985:5-19). According to Arnold, this Boasian view of ceramics was still evident in American anthropology during the 1970's. Boas initially argued that data collection should precede generalizations, but later abandoned this approach. "His concern for mentalism and the native's point of view led to a relativistic approach in which the units of analysis were defined differently in each culture with no cross- cultural standards of comparison" (Arnold 1985:8). Linguistics provided a basic descriptive and analytical unit, phonemes, which influenced ceramic studies in four ways. Like phonemes, ceramic types became basic descriptive units, they had a "psychological reality" for both their creators and archaeologists, and since phonemes were composed of features, so did the ceramic type.

Both the "potter's mental template" and the "archaeologist's ceramic type" definitions originated in the 1920's and 1930's, "and these concepts are still important in American archaeology" (Arnold 1985:7). "Even more important ....was the impact that mentalism had on the lack of generalization in archaeological research " Arnold (1985:8).

In outlining the midwestern taxonomic method McKern (1939) echoes Boas's data collection, classification and generalization concepts. Classification is a means of "discovering order", and "essential trait elements" are used to demarcate discrete cultural entities. Linked traits are shared by two cultures while unshared are diagnostic as cultural determinants (McKern 1939:305).

Others followed McKern's method, but found difficulty in determining and expressing the relationships between sites in the framework of "an arbitrary taxonomic system" (Griffin 1943:335). This problem is rationalized away in later studies, which, while still following the mentalist approach, view scientific method as "a set of probabilities which lead to conclusions that are our best guesses" (Phillips *et al.* 1951:219). A response perhaps to the "terrifying heap" of sherds available for analysis (Phillips *et al.* 1951:66). Ceramic types are conceived as stylistic entities whose surface finish and decoration are constants. They are also time space fossils of cultural relationships (Phillips *et al.* 1951:61).

In a key review of technological studies, Matson (1951:102- 116) considers shape, decoration and "recently Anna Shepard's design analysis" as characterising the "traditional" as opposed to the technological approach. Matson argues that itinerent potters, a major problem, and/or the importation of raw clays for mixing with local clays, seriously complicates physical analysis. Consequently, subtle differences in shape and decoration may constitute the primary means of import recognition. Chemical analysis, while acceptable for glazes and glasses, is a "complete waste of time" for pottery due to its heterogeneity (Matson 1951:110). Petrographic microscopy, valuable for the recognition of temper, natural inclusions and paste texture, was considered by Matson to have only limited value in differentiating between local and imported pottery. Such studies as Shepard's (1942) "classical work" are described as time-consuming, expensive, and reflecting inadequate sherd sampling. In any case, few microscopists are available and other techniques can produce results "archaeologically satisfying" (Matson 1951:111). Matson recommends examination of clean breaks by binocular microscope at 6x to 20x magnifications. This requires no special training and is indispensable for evaluating fabric texture, temper types and for firing assessments. Ethnographic evidence assists in solving firing and chemically related post-depositional problems, according to Matson, who considers the role of the potter in the community and the function of ceramics as the most important aspect of ceramic analysis.

Shepard's (1953:273-275) response is to view these criticisms of the technological method as stemming from differences between Matson's Near Eastern material and that studied by American researchers. Had Matson mainly considered American material, Shepard responded, he would not have accorded the differentiation of local and imported pottery a secondary place. Furthermore, Shepard argues, the complexities inherent in ceramics require the use of precise methods, particularly for temper identifications and firing assessments, and these should commence with petrographic data. It is important to note that, in essence, Shepard defends the *method* by implying that *the Pecos material demanded such an approach.* Thus the method had specific not general application.

An enthusiastic promotion of Matsonian "archaeologically satisfying" non-specialist techniques is implicit in many subsequent American ceramic studies. A "type-variety" concept (Wheat *et.al.* 1958; Phillips 1958; Smith *et.al.* 1960; Phillips 1970; Toth 1974), first applied to Mayan ceramics de-emphasized fabric analysis in favour of stylistic features. Clusters of similar types were held to reflect ceramic systems which in turn reflected cultural images.

Type clusters were related in design style or surface treatment, vessel form and "general technology", conceived as "a class of pottery" (Wheat *et.al.* 1958:40). Ceramic specialists are apparently now considered unnecessary because a "Fundamental requirement of taxonomic procedure is to make the analyst's own observations useful and available to others..." (Wheat *et.al.* 1958:42). Smith *et.al.* (1960:332) see the type-variety system as a "first step" towards an essential standardisation of pottery analysis.

In these studies, Shepard's Pecos research is either ignored or dismissed in passing with a wave of the hand. Spaulding (1960:60-81) outlined a statistical framework for type definition and characterisation but noted a major problem was the "proper weighting of attribute combinations" (*op.cit.*:81). Extensive site survey programmes produced huge pottery collections which took several years to sort and collate. Hence publications were often considerably delayed. The entire process was both labour intensive and expensive. Collation often revealed the existence of previously unsuspected new "types". In some cases, had all the classes identified in the sample been known at the outset, a different strategy would have been applied (Phillips *et. al* 1951:66). In short, much of the cataloguing proceded inductively and often simply involved the recording of data in an entirely accumulative manner. This "library of sherds" syndrome appears to have been aimed at the collection and collation of as many pottery "types" as possible in an archaeological *terra incognita.* Hill and Evans (1972) give a summary of typological approaches.

Definition of a key entity capable of providing data amenable to statistical analysis and the characterisation of the broadest possible range of culturally definable entities was energetically sought. Several researchers attempted to promote the concept of an artefact *type* as providing the answer to an unified theory of cultural characterisation and structure.

3.9 Summary

The theoretical approach to be employed involves the use of an eliminative deduction model. This is partly a response to the analysis of sites located in a relatively homogeneous geological region. Standard analytical techniques will be used where possible. When these methods prove inadequate, the data will be enhanced in various ways. Negative evidence is considered useful in suggesting likely source areas in the absence of contrary information. This is because it helps narrow the area of inquiry by sieving out irrelevant sources. Its importance increases with each application of the model.

Modes of production, distribution and consumption are key elements in determining the character of ceramic cultures. Evidence for ceramic production at Ban Na Di and related sites is set out below. A definition of the pottery "type", which gives equal emphasis to the fabric and form is employed. This differs from definitions previously used in the area by form or style analysts. Where relevant, physical evidence is given primacy over non-physical. Production site identification is considered a key determinant in the characterisation of ceramic cultures.

Chapter 4

The study area and potting clays

4.1 Introduction

Ceramic industries employing simple manufacturing techniques of the kinds extant in Northeast Thailand today, and postulated as extending back into the prehistoric periods under question here, are closely affected by their environment. Raw materials are distributed according to geological processes (Shepard 1956), and their acquisition involves a detailed knowledge of the areal terrain. Potting clay distributions and climatic conditions can constrain clay extraction and pottery manufacture (Arnold 1985). The availability of quality materials can determine the location of production centres (Shepard 1956, Arnold 1985), and weather conditions may restrict potting to favourable climatic zones and seasons (Arnold 1985). In this chapter we will briefly examine the geography, geomorphology and climate of Northeast Thailand. The geology of the Khorat Plateau, and its implications for pottery production, will also be touched on. Finally, the clay mineralogy of 14 Sakon Nakhon Basin potting clays will be considered in detail.

4.2 Geography, geomorphology and climate

The following geomorphological outline is derived mainly from Cruijs (1964, 1978), Moorman *et. al.* (1964), and Thiramongkol and Pisutha-Arnond (1983).

Ban Na Di is situated in the Sakon Nakhon Basin, the smaller of two located within Thailand's northeastern Khorat Plateau (fig. 4.1). The Khorat Plateau comprises an area of about 170,000 km^2, and is bounded to the north and much of the east by the Mekong River. Its western, southern and southeastern natural boundaries are formed by steep escarpments of uplifted Mesozoic strata. These vary in elevation from about 250 m to 900 m above sea level (m.a.s.l.). Bordering the western plateau perimeter are combinations of sedimentary, igneous and metamorphic formations which together comprise the Central Highlands. In places these combinations are complex. This includes the 1,300 m high Phu Kradung "mesa-like outlier" (Cruijs 1978).

The plateau's two basins have surface elevations ranging from about 100 to 300 m.a.s.l. Their principal landscape features are the river terraces located in plane to gently undulating surfaces, while mounds and hills are common microreliefs (Cruijs 1978, Moorman *et al.* 1964). The plateau is located between 14° to 19° north, and 101° to 106° east. It gently slopes down towards the east and southeast. Stream patterns are directed principally to the east, and the major Khorat Basin is entirely drained eastwards into the Mekong River by the Mun and