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Pots As Tools: The Marianas Case

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Abstract—Archaeologists have traditionally approached ceramic analysis with culture-historical objectives such as the delineation of certain horizon markers or the separation of various temporal units or ceramic producing groups. An important point, often neglected by archaeologists, is that pots are tools—complex pieces of technology that are designed to perform specific tasks. As such, significant technological changes in a ceramic tradition may have major implications for changes in vessel function. Ceramic data from the Marianas are reviewed in this light with particular attention on the major changes that characterize Latte Period ceramics. Certain of these changes are argued to have functional significance with wider implications for late prehistoric subsistence.

Introduction

Pottery is a class of material remains that has always been of special interest to the archaeologist. Pottery is relatively durable and often survives to be studied, and the various changes in ceramic form and decoration have provided a means to gage time and cultural change. In most parts of the world, ceramics are one of the primary means of defining culture-historical units. Archaeological analyses have traditionally emphasized the stylistic (decorative) aspects of ceramics; such an approach is in keeping with the acknowledged goal of developing temporal frameworks but it ignores the obvious point that changes in ceramics involve both stylistic and functional variables. In fact, one must explicitly recognize that pots are tools—complex pieces of technology that are designed to achieve specific functions. Although this realization has been around a long time, it has only occasionally figured in our analyses of regional ceramic sequences. Fortunately, in recent years researchers have devoted more interest to the technological properties of ceramics and some of their potential implications for vessel performance (e.g., Rye 1976, 1981, Braun 1982, 1983, 1987, Intoh 1982, Woods 1986, and others). The goal of this paper is to review recent data on the prehistoric ceramics of the Mariana Islands in view of certain functional considerations which have implications for prehistoric subsistence patterns.

Human occupation of the Mariana Islands dates to at least 3,000 years ago, and possibly earlier (Bonhomme & Craib 1987). Like the other high islands of western Micronesia, the Marianas were settled by a people or peoples who had pottery technology, and archaeological deposits indicate a continuous record of ceramic manufacture until Spanish colonial domination destroyed most of Chamorro traditional culture in the early 1700s. Like most places in Micronesia, archaeological work in the Marianas has been plagued by poor preservation and difficulties in obtaining reliable stratigraphic sequences. The situation in the Marianas is somewhat more favorable in that numerous sites are located in calcareous beach deposits which have been subject to storm-generated building episodes (Kurashina & Clayshulte 1983) which have, in turn, created deep stratigraphic sequences of a sort.

Alexander Spoehr (1957; Pellet & Spoehr 1961) developed the first systematic framework of Marianas prehistory, building on the earlier work of some Japanese scholars (most notably Yawata), the Hornbostels, and Laura Thompson (1932). The key to that cultural and chronological framework was Spoehr's ceramic typology. Researchers familiar with Marianas archaeology will generally agree that Spoehr made some unfortunate decisions in establishing his typological system, but he did note and, indeed, his classifications emphasize the marked differences between the late prehistoric Latte Phase or Period and much of the earlier material. The ceramics of the former are grouped under the general rubric of Marianas Plain ware whereas the ceramics of the latter are mostly included under the term Marianas Red ware.

Subsequent workers (Reinman 1977, D. Thompson 1979) have pointed out some of the problems with Spoehr's original classification scheme, especially in regard to Marianas Red ware. Reinman focused on the temporal trends in temper and used temper as the most important element in his typological system. D. Thompson's work clarified some aspects of vessel form but, more importantly, showed that an attribute-based approach held far more promise in dealing with Marianas ceramics than the traditional typological approaches. In general, however, the work of both Reinman and D. Thompson confirmed the basic distinctions between the late prehistoric Latte ceramics and earlier ceramics.

All of these studies suffered from poor stratigraphic and chronological control, and it was not until Moore's (1983) analysis of the ceramics from the deep deposits at Tarague Beach that we have a detailed ceramic analysis with improved stratigraphic control. Moore's was an attribute-based study which identified a number of technological trends in the ceramic sequence. The 1984 excavations on the north coast of Rota (Butler 1988) provided another opportunity to examine a stratified beach sequence, although not as long a one as at Tarague. A large sample of ceramics from the Rota project was subjected to an attribute-based study similar to that of Moore, and a major result of this study (Sant & Lebetski 1988) is that it confirms most aspects of the technological trends identified by Moore and possibly provides more detail in some portions of the sequence. An important point here is that despite the fact that the Tarague and Rota sequences are derived from storm-generated beach deposits (see Kurashina & Clayshulte 1983), the evidence suggests that relatively good stratigraphic order has been maintained in the deposits near the crest of the beach berm. Although storm events may have caused extensive surface disturbance and lateral displacement, they seem to have rarely mixed large vertical segments of the deposits, at least on that portion of the landform.

The focus of this paper is not the specifics of ceramic typology as they have been developed in the Marianas, but rather certain aspects of ceramic change that can now be clearly demonstrated. The previous concern with defining typological entities has caused us to overlook some rather obvious things regarding the prehistoric ceramics. It is argued that some of these changes have important *functional* significance for the use of ceramics which, in turn, have major implications for subsistence patterns.

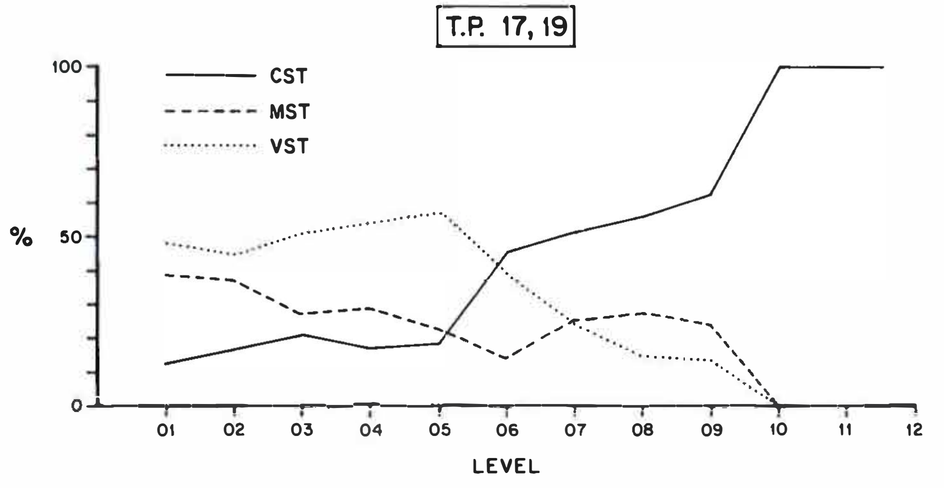
Changes In the Pottery

The temporal frame for the following comments is the period from around A.D. 1 (ca. 2000 BP) to the end of traditional Chamorro settlements late in the 17th century. This span, which corresponds to Moore's (1983) Transitional and Latte Periods, represents the period for which we have the most detailed information and the best chronological control in the Marianas sequence. Ceramics were being made in the Marianas at least a thousand years earlier, but our control over these data is presently very poor. The changes in ceramics which are of most concern here are those that occurred around A.D. 800 to 1000 and gave rise to the distinctive ceramic expression of the Latte Phase or Period. The major changes in ceramics during this span are summarized below using data from the Rota project.

The ceramic complex from around A.D. 1 is characterized by a variety of shallow bowls and pans, some of the latter being of very large size and great thickness. Most of the vessels are less than 15 cm high and many are less than 10 cm. There are some taller vessels but these are rare. Decoration is almost non-existent, although there are some mat-impressed bases from large pans or griddles. The scarcity of decoration in the Rota samples at this time may be a local peculiarity and may not characterize the other islands. Vessels are predominantly tempered with calcareous sand. As time passed, volcanic sand temper increased steadily in frequency. There was also considerable use of mixtures of calcareous and volcanic sands as temper. The temper percentages, however, exhibit a marked bimodality. After its appearance, volcanic sand temper increased sharply to a point but then leveled off or even declined for a period, increasing sharply again around A.D. 1000 to dominate the late period assemblages (Fig. 1).

Concurrent with change in temper frequency, mean vessel wall thickness was also changing (Fig. 2 and 3). Vessels from around A.D. 1 are quite thick with mean values of 10 to 12 mm and a standard deviation of 3 to 4 mm. Vessel thickness then exhibits a steady decline until mean values of 7 to 8 mm with a standard deviation of 1.5 to 2.0 mm are attained. This point in time cannot be precisely dated but appears to be around A.D. 500. The character of thickness changes from this point depends on which test pits one examines. In general, vessel thickness increases again reaching a mean value of 9 to 11 mm with a standard deviation of 2.5 to 3.0 mm in the late period. In some units, the trend appears more complex with an increase and then another decrease before the final increase to late period values. It is not clear if the latter is an anomalous situation or a more refined reading of the changes.

Between A.D. 700 and 800, the first slightly thickened (incipient Type B) rims appeared, and around A.D. 1000, Rota ceramics changed rapidly into the well-known Latte Period ceramic complex. The primary vessel form changed to a relatively deep (ca 30 cm or more) globular or subconoidal pot with a reinforced (thickened) rim. Rims are predominantly incurvate. There are also some shouldered or angle-necked jars with strongly constricted orifices. Bowls or pans were still made but represent only a minor portion of the assemblage. Almost all vessels are tempered with volcanic sand, and average vessel wall thickness increases as previously noted. Also beginning around A.D. 1000 is a noticeable increase in the frequency of surface-roughened vessels, and such vessels increase



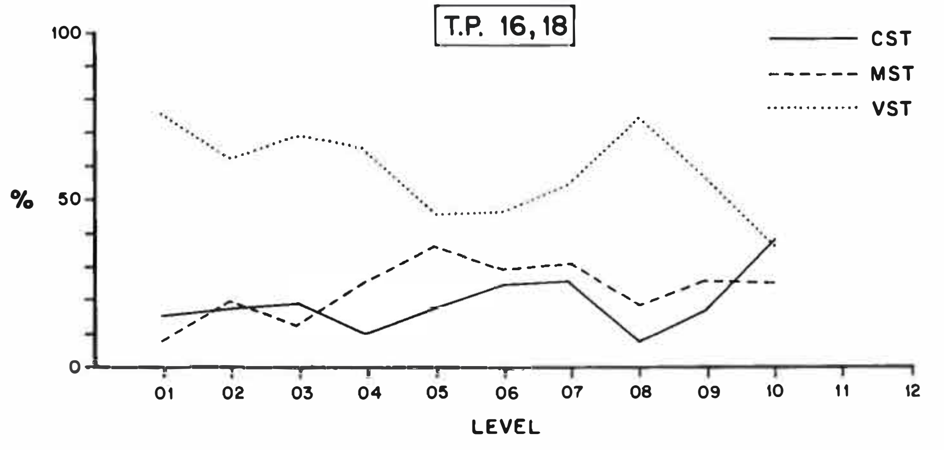


Figure 1. Percentage distribution of temper types by level for Test Pits 17 and 19 and 16 and 18 at Borja Area 1, Rota. Test Pits 17 and 19 better illustrate the early portion of the sequence, whereas Test Pits 16 and 18 better illustrate the latter portion. Note that Test Pits 17 and 19 contain few late ceramics in their upper levels. The upper levels of Test Pits 16 and 18 contain some earlier ceramics, and the VST percentage is artificially low. CST = calcareous sand tempered; MST = mixed sand tempered; VST = volcanic sand and rock tempered.

in frequency toward the end of the Latte Period. Latte Period assemblages from the Rota project average 10 to 15% brushed-scraped surfaces and 15 to 20% plain-rough surfaces; thus, surface roughening is present on 25 to 35% of the sherds. Since surface roughening is normally restricted to the upper portions of vessels, a larger percentage of the vessels, perhaps as many as half, may exhibit some kind of roughened surface. Some decoration is present in the form of incising and punctation but is still quite rare.

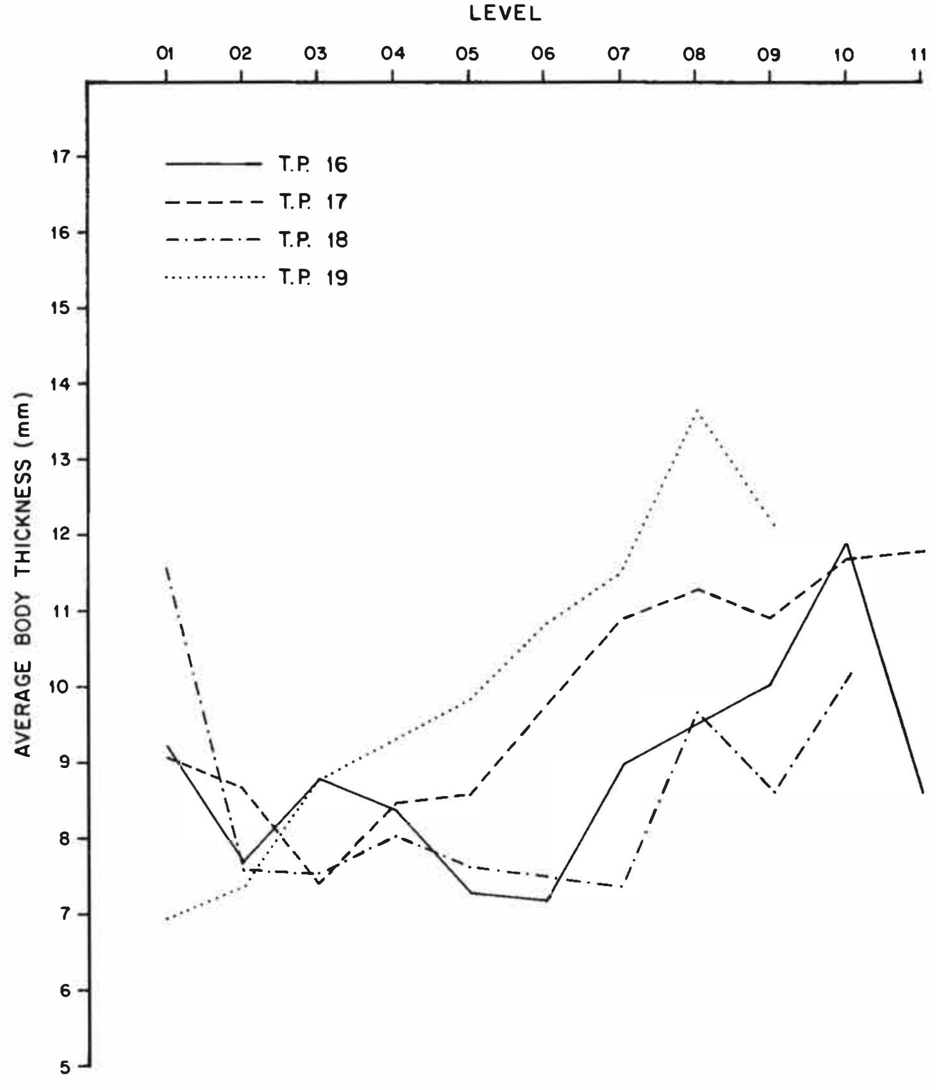


Figure 2. Mean body sherd thickness by level in test pits from Borja Area 1, Rota. Note that the chronological and stratigraphic dimensions of the individual units do not equate precisely; thus, trends should be viewed in relative terms rather than compared level by level.

The above comments are an extremely brief summary of a complex data set. It does appear, however, that the span of ca. A.D. 500–1000 is a period of "experimentation" in which potters were exploring various form and temper combinations relative to functional and performance characteristics. In general, it appears that the changes in vessel wall thickness are more consistent and predictable than the temper changes, which exhibit more localized variation.

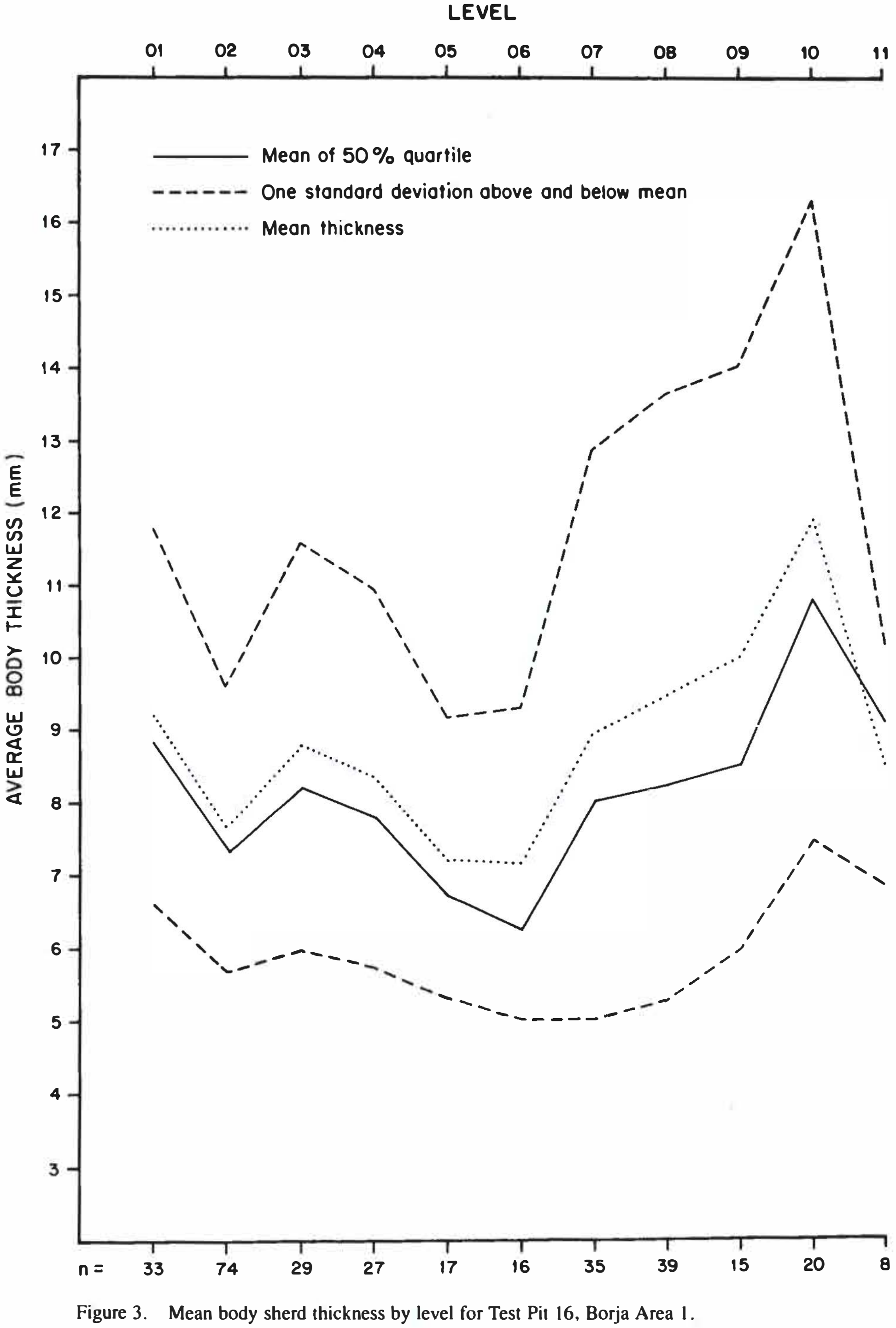


Figure 3. Mean body sherd thickness by level for Test Pit 16, Borja Area 1.

The changes that characterize the distinctive Latte Period ceramic assemblages have major implications for vessel performance and function. The most significant changes are in the vessel form. Over a span of 200–300 years, the ceramic assemblage changed from one dominated by shallow bowls and pans, vessels with large diameter to depth ratios, to one dominated by taller, thick-walled pots or jars with a restricted orifice. These vessels are generally globular or subconoidal and must be propped up or set in a hole to keep them upright.

Shallow bowls and pans are suitable for a number of tasks, which include food processing, baking or roasting, frying, and serving; they could also be used for boiling provided that the rapid loss of the liquid contents (due to the large surface area relative to the volume) was not a concern. Comparing a small sample of measurable vessel fragments from Tarague, Moore (1983: 165) notes that these simple rimmed vessels exhibit little variation in height and concludes that height was not a significant feature in regard to their function. Such vessels could scarcely be used for storage or for prolonged boiling or simmering. These functions, however, are more appropriately accomplished with vessels of the type that dominate the assemblage after A.D. 1000. The basic form of the Latte Period vessel is very similar to those of the Eastern Woodlands of North America (and many other parts of the world) which were used as cooking pots, most often for boiling (Braun 1983, 1987, Arnold 1985, Henrickson & McDonald 1983). The inference drawn here is that this major form change reflects the emergence of a vessel form intended primarily for prolonged boiling and stewing and capable of sustaining the increased thermal stresses of such use. The earlier vessels appear to be primarily designed for baking or roasting and various non-cooking tasks. This shift represents a major change in the functional character of the ceramic assemblage. Based on the data from Tarague, Moore (1983) reached similar conclusions, suggesting that the standard Latte Period vessel represents a more efficient container for cooking or storage and that the appearance of this distinctive form probably indicated a change in food–processing activities.

Other technological data support the inference of functional changes in the ceramics. The durability of cooking vessels is the result of complex relationships among a number of variables. A major factor in having an effective cooking vessel, that is, a vessel that can sustain prolonged and repeated heating, is resistance to thermal shock (Rye 1976, Braun 1983, Steponaitis 1983). Vessel form is an important consideration here. Round–based, globular forms are generally superior because they have fewer stress points (Rye 1976). The sharp base-to-wall angles of flat–based vessels are major stress points and the frequent locus of vessel failure. The relationships of (non-plastic) temper particles to vessel strength and durability are more complex. Within certain limits, increased density of temper particles increases resistance to thermal shock (Steponaitis 1983.) Too much non-plastic temper, however, causes the vessel to be brittle and fail quickly — an obvious problem with some of the earlier Marianas ceramics which are tempered with large amounts of calcareous sand. Smaller temper size increases the initial strength of vessels but such vessels lose their strength more rapidly under repeated use.

Porosity is also a key factor in thermal shock resistance. A porous ceramic fabric better absorbs the expansion and contraction caused by heating cycles (Woods 1986) and helps limit the spread of cracks that can lead to vessel failure. More coarsely tempered vessels are generally more porous and, while initially not as strong, prove to be more durable (Steponaitis 1983). Analysts have always commented on the markedly coarser nature of Latte Period ceramics compared to the earlier materials. The paste is less compact and the temper particles (usually volcanic sand) are more numerous and larger than in earlier ceramics. Such statements have generally been made on the basis of impressionistic (qualitative) observations, but recent technological studies of samples of Rota ceramics by David Snyder (unpub.) have confirmed this trend with quantitative methods. Thus, the Latte Period jars, which are more coarsely made and seem to be a cruder product, are actually better (more durable) cooking vessels than the more finely made earlier vessels, which are predominantly shallow bowls. I would suggest that these characteristics do not represent a deterioration of the ceramic art in the Marianas, but rather, highly functional modifications in local ceramic technology.

A previously noted aspect of late prehistoric ceramics in the Marianas is a marked shift to volcanic sand temper at the expense of calcareous sand and mixtures of volcanic and calcareous sands. This change has been noted by virtually all researchers in the islands and it seems to characterize *most* places in the Marianas. The unmixed late assemblages on Rota, for example, consist of 90% or more volcanic sand–tempered sherds. This situation obviously reflects a conscious selection, as volcanic sand is, in many places in the Marianas, the least available of potential temper agents. The widespread nature of this shift implies that a basic functional reason underlies it. The expansion characteristics of various temper agents are a factor in resistance to thermal stress, and Rye (1976), for example, has pointed out that calcareous temper has some distinct advantages if certain factors, most notably lime spalling, can be controlled. The first half of the Marianas ceramic sequence is, indeed, dominated by calcareous temper, but the latter portion reflects the gradual abandonment of it in favor of volcanic sand and mixtures of the two. In fact, the technical advantages of calcareous temper are probably over-emphasized (see Woods 1986). She notes that the use of non-calcareous sands in low-fired ceramics increases porosity and actually improves thermal shock resistance.

Another point concerns vessel wall thickness, which decreased steadily from around A.D. 1 until around A.D. 500 and then increased again in the Latte Period. Increased thickness actually reduces the thermal efficiency of a ceramic vessel (Rye 1976), and one might ask whether this point undermines the functional arguments made previously, since an attempt to improve the thermal efficiency of cooking vessels would lead to a decrease in wall thickness. The increased wall thickness, however, may have been required to increase the flexural or tensile strength of these taller vessels and the loss of some thermal efficiency may have been scarcely noticed. In other words, strength and durability may have been far more important to the potter than thermal efficiency. Ceramic design is, after all, a process of compromise among a host of competing design and performance characteristics.

A cautionary note is in order. Studies of prehistoric pottery using modern principles of ceramic engineering tend to assume a conscious selection by potters for optimal performance characteristics. While a low-level optimization model seems to work well for the Marianas, one should not assume that such models are applicable everywhere (Woods 1986; see also Rands 1988). In many cases potters may have merely desired to make pots that were "good enough" rather than the most durable and efficient vessels possible. Woods (1986), for example, argues that thermal shock resistance, while important, is overrated as a design criterion for prehistoric pottery, and she points out the frequency and persistence of cooking pots made with shapes and tempers that, in ceramic engineering terms, are less than optimal for thermal shock resistance. Thus, while functional requirements may push ceramic technology in certain directions, one should not expect rigorous adherence to scientific principles of ceramic design and performance, especially in cases where the performance demands made of ceramics were rather low (see Braun 1983).

A final aspect of the changes is the appearance in the Latte Period of significant numbers of vessels with textured or roughened surfaces. Generally the technique is one of brushing or scraping the green vessel surface with a bunch of twigs, a shell, or other objects. Cord marking has been reported in a few instances. Sometimes the roughened surface is partially smoothed afterwards leaving a slightly rough, uneven surface that analysts have referred to as "plain-rough." Previously, vessel exteriors were almost always well-finished and quite smooth. The appearance of textured surfaces appears to be functionally related to the production of taller vessels with poor stability characteristics (rounded or pointed bases) that would often be used with liquids. Simply put, the textured surfaces make for surer handling of vessels that would often be wet and hot.

The late vessel forms would also be well-suited for storage functions. There may be some functional differentiation within the general late prehistoric jar form, with the most common form (D. Thompson's Type 3a) with the thickened, incurvate rim being the main cooking pot while the relatively rare examples of shouldered jars with more restricted openings and everted (excurvate or flared) rims (D. Thompson's Types 3b and 3c) being used for storage. In fact, the predominance of the former is an argument for its primary use as a cooking vessel since cooking vessels normally have much higher loss rates (shorter use lives) than storage vessels (Arnold 1985). In Thompson's data from Tanapag (D. Thompson 1979: Table 4), vessel Type 3a outnumbers Types 3b and 3c by a ratio of about 9 to 1. In the Rota project samples, the latter vessel forms are even rarer, with thickened, incurvate rims outnumbering the everted rims by ratios of 15 to 1 or higher.

To summarize, I have pointed out certain changes in late prehistoric (Latte Period) ceramics in the Marianas and suggested that these reflect a shift to ceramic vessels more suited for the tasks of prolonged heating of liquids (boiling or stewing) as well as storage. The vessel forms are most telling in this regard, but certain characteristics of paste, temper, and surface treatment also appear to be related to improved vessel durability under thermal stress as well as ease of handling. These vessels suggest that storage needs and the use of prolonged boiling in food preparation increased substantially around the beginning of the Latte Period.

Cultural Changes

Early historic sources for the Marianas (L. Thompson 1945) indicate that boiling food in ceramic vessels was a major cooking technique, and indeed the linguistic evidence indicates a strong association of starchy food (taro, bananas, and breadfruit) with the technique. The Chamorro language has a specific noun and verb for such food cooked by boiling (see Topping *et al.* 1975). The archaeological evidence of the ceramics suggests that the extensive use of boiling was a late development associated with the Latte Period. Earlier vessel forms, as cooking vessels, appear to be intended primarily for baking, roasting, with some perhaps serving as griddles. At a minimum, the ceramic changes suggest major changes in food processing and cooking practices, but it seems more likely that the changes reflect more than that, namely an expansion or intensification in the use of one or more food resources.

The ceramic changes under discussion did not take place in isolation, but rather are a part of the broad array of changes that mark the Latte Period. These include the appearance of the distinctive stone pillar structures, the possible reorganization of village areas, and the appearance or great increase in frequency of certain artifact forms such as pounders, pestles, mortars, slingstones, and some abrader forms. Of particular importance is the fact that there is good evidence for a substantial increase in population in late prehistoric times. Late sites are far more numerous and larger than earlier sites and they occur in a greater variety of settings, most important in the interiors of the islands where earlier occupations are absent. In reviewing the settlement data from Guam, Kurashina (unpub.) concludes that there is evidence for the expansion of settlement through time with the increases in the number and density being especially dramatic in the Latte Period. Under such conditions, increased pressures would be placed on the resource base and the subsistence technology. As coastal areas filled up and settlement expanded into the interior, there would have been little choice but to expand and intensify agricultural production. The Sancho account contained within the Juan Pobre narrative (A.D. 1602) contains the following description of the trade relationships between coastal and interior inhabitants on Rota and Guam. "The people living along the shore have an abundance of fish; those who live inland have an abundance of agricultural produce. Consequently, they arrange exchanges, trading fish for rice, for tubers, and for other varieties of fruit that the land produces." (Driver 1983: 213) The passage points out the obvious imbalance in the kinds of foods available to coastal and interior settlements. Interior villages of necessity must have expanded agricultural production because of their limited access to marine resources.

Indeed, agriculture is the one segment of the economy that could be significantly expanded. Unlike most Micronesian islands, the Marianas have a comparatively large landmass accompanied by very small areas of lagoon. The islands primarily have narrow fringing reefs, and the only large expanses of lagoon are on the west coast of Saipan and the southwest corner of Guam. Compared to their inhabited landsurface, these islands have relatively small areas of reef and lagoon habitat. This condition has affected subsistence practices, and it is no coincidence that the prehistoric inhabitants placed considerable emphasis on the risky and unpredictable technique of open water trolling for large pelagic species such as marlin/swordfish and dolphin (Leach & Davidson 1988, Driver 1983). It is also noteworthy that the shellfish data from the Rota work (Carucci 1988) can be interpreted as reflecting the depletion of some shellfish resources in late prehistoric times.

The Marianas also suffer from periodic droughts and the porous geology of the large southern islands makes potable water a problem, especially during the dry season. Historic accounts (Arago 1823: 276)) describe the use of leaf devices to funnel rainwater from tree trunks into storage vessels. Increasing population size would provide strong incentives for improving storage technology—whether for water or foodstuffs, and most likely both.

With this background, I would like to offer the following scenario. At a minimum the changes in vessel form and technology that characterize the Latte Period appear to mark the emergence of boiling as a major food preparation technique and also the increased use of ceramic vessels as storage containers. More importantly, I suggest that these changes are a reflection of increased population levels and the demands they made on subsistence and technology. The changing emphasis in food preparation techniques reflects the increasing importance of certain starchy foods in the diet. At this point it is not clear which of the starchy foods might have been the object of expanded production. Breadfruit, taro, and yams were all important subsistence items at historic contact. Given environmental conditions on the interior of these islands, tubers probably had a greater potential for expanded production than breadfruit.

The passage from the Juan Pobre narrative cited above also mentions rice. There has been a continuing debate concerning the existence and/or status of rice in late prehistoric times in the Marianas (see Craib and Farrell 1981; Pollock 1983). The question is still not resolved, and while rice *may* have been cultivated prehistorically in the Marianas, there is as yet no compelling evidence that it was produced in large quantity and was a staple. The most likely preparation technique for rice would be boiling, and one could use the changes in vessel form as an argument for the introduction of rice. I would not do so, however, and prefer to view the increased use of boiling as a correlate of the increasing importance of starchy foods.

Conclusions

In summary, I have argued that certain changes in the late prehistoric ceramics in the Marianas are functionally derived, reflecting the increased use of boiling as a food preparation technique and possibly also the increased need for ceramic storage containers. Further, I suggest that these changes reflect important shifts in subsistence practices, namely the increased production of starchy foods, most likely tubers. These developments are seen, at least in part, as a result of increasing population size which increased the demands on food production and processing/storage technologies. Archaeologists are often justly criticized for making simple population pressure arguments. The relationships involved here are complex, but there is justification for seeing population pressure as one of the ingredients. The changes in the ceramics are obvious and well documented, but there is much in this scenario that is, at this point, still speculative and requires support. These interpretations are offered tentatively as a group of hypotheses for further testing. Regardless of whether these hypotheses prove to be correct, this paper is a reminder of the potential danger in becoming too absorbed in narrow typological problems in ceramic analysis. Pots are indeed tools and unless we view them as functional pieces of technology designed to fulfill specific purposes, we run the risk of missing important clues about the past.

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