A TYPOLOGICAL INVESTIGATION OF WESTERN MICRONESIAN ADZES

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By John Ligertwood Craib

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ABSTRACT

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This thesis is concerned with the discovery of patterns of variation extant among adzes blades occurring in the archaeological collections from western Micronesia (Palau, Yap, and Mariana groups) in order to establish a classificatory system based upon morphological variables. These types were subsequently employed in the testing of hypotheses concerning culture-historical relationships and the relationship of source material utilization to tool morphology.

Nine morphological types were established, based upon a systematic, though largely intuitive, classification. The spatial distribution of these types demonstrated a stylistic discontinuity among the three island groups. These differences were suggested to be the result of independent development rather than causation by differential availability of source materials. Further analysis shows that material variability may cross cut morphological types with only minor influences on the types themselves. Suggestions for future research and analysis are offered.

TABLE OF CONTNETS

LIST OF FIGURES

LIST OF TABLES

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CHAPTER I

INTRODUCTION

The ordering of artifactual data is a basic process in archaeological analysis. In order to isolate and recognize variability within the archaeological record, the investigator must create a classificatory system into which the corpus of data can be placed. As Watson, Redman, and LeBlanc (1971:84) suggest, artifacts must be categorized and analyzed in a manner that enables their variability to be compared along many different dimensions. In this way, types should be created in order to solve stated problems rather than merely to serve as descriptive devices.

Any set of data can be classified in a variety of ways, resulting in the formation of descrete groups or types. One of the many aspects of typological analyses is the development of spatial/temporal relationships, based upon stylistic similarities in contiguous areas, as a method of testing hypotheses relative to culture-historical models.

This method has been, and continues to be, employed in Oceania as a method of testing cultural relationships within the three major insular culture areas (Polynesian, Melanesia, Micronesia). While cultural assemblages, linguistic affinities, and physical types must be considered as independent variables, we may assume that similar artifact types in contiguous areas represent some form of direct or indirect contact. Therefore, in this study, the artifact sample shall be analyzed in its stylistic mode as defined by Sackett (1973:320):

> It is based upon the notion that there are usually alternate means of achieving the same end, that the specific expression any given artifact assumes results in a sense from a choice made among several equally valid and feasible options and that the choice made in any given cultural situation is determined by its historico-gentic setting.

There exist in Oceania useful artifactual data for determining such historical relationships. Throughout most of Oceania the ground stone adze is the primary artifact type used in hypothesis testing. Groube and Chappell (1973:177) maintain that since excavation in various parts of Polynesia has reconfirmed many of the hypotheses developed from these (i.e., adze) classifications, it could be fairly claimed that not only was it the most frequently surviving artifact in this area of the world, but more was known about its development and dispersal than any other single artifact type.

Adze Development

Generally, adzes--an artifact class of cutting implements--are associated with woodworking activities and have been traditionally identified with the Asian and Oceanic areas. In fact, Duff (1959:121) claimed that adzes are "scarcely known beyond the Pacific basin, notably Indonesia-Southeast Asia and Polynesia with a tenuous extension reaching along the Asiatic littoral to the Bering Strait and Northwest America."

Braidwood (1967) argues that the adze is a product of the chopper-chopping tool tradition of southern and eastern Asia. Ghosh (1973) suggested that the hafted ground adzes developed from an earlier hand adze tradition found in the early "Paleolithic" of India and Malaya. The distribution of hand adzes is quite restricted in both time and space in that they are found in south and southeast Asia. Specifically, they are found only in Burma, Malaya, and the northeast and western parts of peninsular India (Ghosh 1973:164).

Van Heekeren (1957) suggested that the adze first came into use in Indonesia between the first and second millenium B.C. and continued in use into historic times. However, Gorman reported ground stone adzes recovered from culture layer II in Spirit Cave in Thailand in association with the radiocarbon date of 8806$\pm$200B.P. He also indicated, from the associated radiocarbon determinations, that the adzes appear to be the earliest dated examples of edge grinding in mainland southeast Asia and that the dates further suggest a very surprising antiquity for the simple quadrangular adzes (1972:96).

Recent discoveries of edge ground implements in Oceania also display an amazing antiquity. In New Guinea White (1972) describes edge ground implements (axe/adze) in association with a radiocarbon date of 26,000 B.P. Edge grinding has also been recorded from Arhem Land in northern Australia and dated 22,900 B.P. (Shutler and Shutler 1975: 38).

Given this antiquity and distribution of these edge ground tools, it would seem unwise to argue any particular area as the original homeland of the adze. Traditional hypotheses regarding adze development and distribution will have to be modified in light of these recent discoveries. In fact, I would suggest that the adze will most probably be found within assemblages of any group which regularly exploits wood and/or other fibrous materials. Having examined monographs dealing with archaeological data from various parts of the world, I have noticed that many of the tools illustrated appear to have the general characteristics of the adze. As a result, adze-like implements can be found, archaeologically, from Africa (Allchin 1966), Mesoamerica (Delgado 1965:69, Figure 66 e,f; Lee 1969:135, Figure 94 a-g), and Eastern and Southeastern America.

Therefore, Duff's contention regarding the limited distribution of adzing implements must be abandoned and his alternative hypothesis be endorsed, that is, that adze shape and hafting may be unimportant peculiarities and have arisen independently in various areas of the world.

Archaeological Research in Oceania

The history of systematic archaeological research in Oceania is indeed short for it was not until after WWII that archaeological activity began in earnest. Prior to that, most archaeological research consisted of surface collection with attendant artifact description and classification. As previously mentioned, the adze was generally the most prevalent artifact.

During this initial period, the main focus of research was directed upon population movements throughout the Pacific, especially those who eventually inhabited the Polynesian area. Hypotheses were largely concerned with culture-historical problems and based primarily upon linguistic and anthropometric data (c.f. Buck 1938) with artifact collections utilized as corroborative evidence. However, with the increased archaeological fieldwork in the last two decades, many of these early hypotheses have been modified, especially in terms of the temporal framework which has been pushed further into the past.

Polynesia has received the majority of archaeological research within Oceania with all major island groups having had varying degrees of archaeological investigation. However, recently, the Melanesian area has come under closer investigation, in large part as a result of archaeological discoveries in western Polynesia.

Sites in western Samoa (Golson 1959; Green and Davidson 1969) and Tonga (Poulsen 1968; Groube 1971) have yielded evidence of a ceramic tradition stylistically similar to the Lapits ware from eastern Melanesia. Bellwood (1975:13) suggests that Lapita pottery is likely attributable to a mobile group of Austronesians, expanding in central and eastern Melanesia after 1300B.C. Further field reconnaissance in Melanesia has resulted in an increasing number of Lapita sites. Significantly, as Groube points out:

> The distribution pattern of known sites with Lapita ware, extending into the central Melanesian region, was close to the ideal pattern anticipated to document the movements of Polynesians through Melanesia; small impermanent settlements in an already populated region (1971:280).

As a result, much of the archaeological energy in the Pacific is still involved with the Lapita/Polynesian problem.

Additional research efforts, directed largely towards determining regional sequences and chronologies, in Melanesia include the archaeological program on Bouganville sponsored by the Chicago Field Museum and the Australian National University's programs in New Guinea (cf. J. P. White 1972, Golson 1968; Allen 1970).

However, amidst the increasing activity in Oceania, the insular area of Micronesia stands as an almost entirely neglected region. This may be partly due to the fact that the majority of islands within the Micronesian area are coral atolls and, until Davidson's work on Nukuoro atoll in 1970 demonstrated stratigraphic deposits, it was generally held that "there is normally no aggragation on a coral atoll other than that which takes place irregularly along a narrow strip of coast as the result of occasional storms" (Kennedy 1931:288). This explanation seems plausible in light of the fact that the totality of Micronesian archaeological excavations (excluding only Nukuoro) has been conducted in the islands of western Micronesia (Palau, Yap, Marianas). However, in addition to the high islands within the Palauan archipelago, Osborne has also investigated islands of both the raised limestone reefs (e.g., Pelilieu, Angaur) and coral atoll (e.g., Kayangel) types. Sites, some containing midden deposits, on Kayangel Atoll, were noted by Osborne (1966:300-310) and more recently he has conducted excavations of sites on Pelilieu and Angaur. Nevertheless, the fact still remains that Micronesia is the least known, archaeologically, of the Oceanic areas and as a result, many basic problems of Micronesian prehistory have yet to be pursued.

The Adze in the Pacific

Perhaps the most described and analyzed artifact in the Pacific has been the adze. This class of cutting implement is known archaeologically and ethnographically from all areas of the Pacific. Because of its widespread distribution within this vast insular area, and its many varieties of form, the adze has been found useful as an indicator of local development, population movements and/or contact throughout the Pacific.

Consequently, many adze typologies have been formulated (though almost all have been concerned with the Polynesian area) which have served to suggest spatial/temporal relationships. Investigators such as Duff (1956) and Figueroa and Sanchez (1965) have contributed specific essays dealing with internal island adze development for New Zealand and Easter Island, respectively. Taking a more general approach, Emory (1968) postulated cultural relationships among Eastern Polynesian island groups and Suggs (1960) utilized adze forms as a primary indicator of movement within the Polynesian triangle.

Concentrating on an area peripheral, though unquestionably crucial to Oceania, Duff (1970) presented a general typology of sourheast Asian adzes. From his typology and the geographic distribution of adze forms, Duff postulated three major foci for the development of adze types and their eventual dispersion into the Pacific; (1) South China, Formosa, Philippines; (2) Viet Nam, Laos, Cambodia, North Thailand, Burma; (3) South Thailand, Malay, Indonesia. However, this scheme was created for the primary purpose of determining origins of Polynesian adze forms and as a result only passing attention was given to the adzes of Micronesia and Melanesia.

The Adze in Micronesia

Salesius, a member of a German scientific team which visited the Micronesian area around the turn of the century, offered his personal observations on the relationship of the Yapese men to their adzes:

> It [the adze] is so indispensable because it is almost the only tool of the Yapese, replacing for him every possible kind of cutting implement, the saw, the chisel, the knife, the plane and must, therefore, be at hand every moment . . . In short, for him the axe [sic, adze] is a universal instrument which he knows how to manipulate with extraordinary skill as a result of his varied and constant use of it (1907:48).

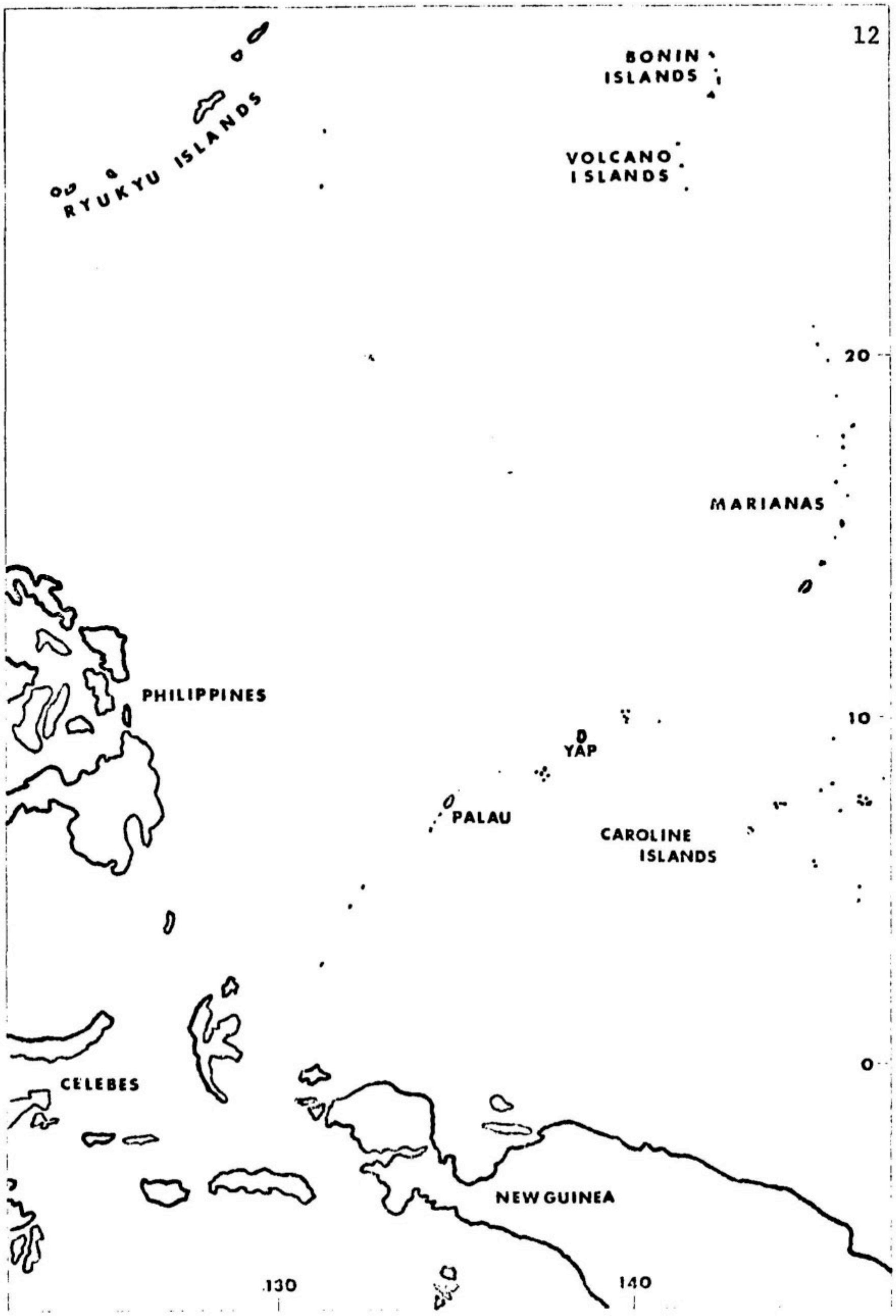
While this account may not accurately reflect the tool inventory which the Yapese utilized, it does reflect the central position this single class of implements held, generally, in Oceania. Other reports of early visitors to Micronesia indicate that it was not an uncommon situation to observe a man with his hafted adze worn over his shoulder (Keate 1788:2; Christian 1899:133).

Generally, little archaeological fieldwork has been undertaken and the work that has been done is primarily confined to the western region of Micronesia which shall be defined as those islands comprising the Palau, Marianas, and Yap groups (Figure 1). As a result of the paucity of archaeological fieldwork from the remaining areas of Micronesia (i.e., central and eastern Carolines, Gilberts, Marshalls) with the notable exception of Nukuoro, is negligible. Consequently, there are too few archaeologically derived adzes from all areas of Micronesia to formulate any comprehensive typology for the area as a whole. A relatively large sample of adzes exists from the western region. Recent (post WWII) fieldwork by Spoehr (Saipan, Tinian, Rota), Osborne (Palau), Gifford and Gifford (Yap), and Reinman (Guam) have yielded the sample analyzed in this study.

The above cited fieldwork has yielded a sample universe of 320 specimens. Of this number a large percentage (31%) were broken or unfinished. As a result, the total sample chosen for this study was considerably less (N=220). All whole specimens were included as were partially broken blades which still contained most of the cutting edge. Some unfinished forms were selected while poll fragments were generally disregarded.

Unlike the Polynesian area which is basically aceramic, the most abundant artifact in western Micronesia

Fig. 1. Western Micronesia and Environs.


BONIN
ISLANDS
VOLCANO
ISLANDS
RYUKYU ISLANDS
20
MARIANAS
PHILIPPINES
10
YAP
PALAU
CAROLINE
ISLANDS
0
CELEBES
NEW GUINEA
130
140

is ceramic sherds. Understandably, most analytical attention has been directed toward the ceramic data with the result that ceramics currently serve as the best, albeit far from conclusive, indicative artifact.

The bipartate division of Marianas prehistory established by Spoehr (1957) is reflected strongly in the seriational analysis of ceramic data. The ceramics were divided into two classes: Marianas Red and Marianas Plain, each having related subgroups. The redware is found in larger percentages in the earlier levels (the earliest dated to 1527±125 B.C.) with a gradual decrease in time until the plain ware becomes dominant and eventually the exclusive type in the latter phases of Marianas prehistory. The emergence of Marianas Plain as the dominant type is also closely correlated with the appearance of the latte structures which served as supports for chiefly structures and possibly, canoe sheds (cf. Thompson 1945; Spoehr 1957). This period is roughly dated 845 A.D. (Spoehr 1957:170).

Reinman (1970:63) has classified his ceramics from Guam primarily according to tempering materials (volcanic sand tempering -VST and calcareous sand tempering-CST) suggesting that Spoehr's classification does not work well for his Guamanian collection. Despite the different approach to classification, Reinman's ceramic data also demonstrates a change over time (VST-CST) and is closely associated with the latte structures. In fact the VST wares correlate with Spoehr's Marianas Plain and are generally late while the CST wares are consistently found in the earlier levels and closely correlate with Spoehr's Marianas Redware.

Gifford and Gifford (1959) also offers a two type approach to his Yapese ceramics, suggesting an unlaminate ware occurring more commonly in the early levels with a later, laminated ware becoming dominant in the later levels. Both Gifford and Spoehr have claimed a similarity between the unlaminated ware of Yap and the Plain ware from the Marianas (Gifford and Gifford 1959:200). Unlike the Marianas no structural associations have been demonstrated in the Yap group. The latte do not exist on Yap.

Osborne's ceramics from the Palaus does not resemble significantly the sample from either Yap or the Marianas. In his collection the temporal variability appears to be much more subtle than suggested from the other island groups and any temporal association is correspondingly much more tenuous.

Therefore, while pottery is found in abundance within these island groups (the only groups in the entire Micronesian area on which ceramics are found), the information relative to culture-historical relationships that they have yielded is not always temporally clear cut.

MICRONESIAN ADZE ANALYSIS

Currently each archaeological monograph from Micronesia has dealt specifically with one island and/or group with little or no attention turned toward establishing typological relationships between island groups. Of course, only now are suitable amounts of data extant from which to postulate such relationships.

While Hornbostel did not publish his data, Thompson (1932) presented a short descriptive report based upon Hornbostel's collection from the Marianas. In her examination of the 4300 plus adzes in this collection, she suggested six types, three entirely of stone and three comprised solely of shell. She implicitly employed source material as the main determinant, presupposing the mutually exclusive groupings. Later Spoehr (1957) used the same types to classify his adzes from the Marianas, although his sample consisted of only ten whole stone adzes and 48 whole shell adzes specimens. Nevertheless, with the extraordinary large number of adzes, of both shell and stone, the few types recognized by Thompson suggest four possibilities. First, it could represent a "lumping" tendency resulting from a lack of close analysis. Secondly, shell may indeed inhibit variability, thus limit form. However, this would not explain the apparent lack of variation among the stone specimens which have less limiting factors than shell. Thirdly, the typology constructed by Thompson adequately classifies the available collection, or, finally, the existing typology is inadequate and needs to be reanalyzed and further refined.

Yawata (1942), after undertaking fieldwork on Palau, consisting largely of surface collecting, suggested that given the utilization of stone for adze manufacturing in southeast Asia and the reliance of shell in the Palaus and Micronesia that the Palaus may have marked the point of transition of stone to shell usage (1968:255). If his hypothesis is accurate we should then expect to find more or less equal amounts of shell and stone usage or a quantifiable change in source material in the vertical distribution of adzes.

Shell Utilization

Within Micronesia, shell was the primary material for adze manufacturing even in the high islands of Yap and Palau where stone (of admittedly poor quality) is extant. While different genera of shell were utilized, it appears that the giant clam shell, Tridacna spp., was the principal material.

As I scanned the literature on artifacts and their manufacture, I found a lack of attention paid to shell as source material. With rather obvious Eurocentric provincialism, many authors have failed to explore shell utilization in Oceania and consequently, have dismissed the potential for this type of analyses. Hodges (1964:172) for example, states that shell utilization is "seldom of great interest" due to his unfounded assumption that shell has "normally fragile" characteristics. No statement by Hodges alludes to shell exploitation for cutting implements.

The most credible statement as to shell utilization comes from S.A. Semenov in his classic study, Prehistoric Technology. He not only neglects any analysis of shell utilization, he dismisses totally its technological importance:

> . . . without stone tools there was no possibility of [cultural] development . . . Only on special geographical circumstances where technically suitable stone was absent, but, where instead there was such inadequate substitutes as shells, tortoise [sic turtle] shells or fish jawbones [?], did man contrive to manage with very few stone tools, although needless to say at a lower technical and cultural level (1972:33; emphasis mine).

Quite obviously this statement contains many overt value judgments and, unfortunately, it is offered as given with no substantiation. The above cited authors quite clearly do not demonstrate any observable knowledge of shell use within Oceania or elsewhere resulting in a greatly skewed concept of this material's usefulness.

This skewness exists even among Oceanic researchers. Bellwood has demonstrated this attitude with his statement that "adzes are generally absent on atolls (except in shell)" (1975:12). This statement is confusing at best and seems to convey the implicit assumption that unless adzes are manufactured from stone, only parenthetical attention need be offered.

In a related situation, archaeological reports within the Oceanic area and specifically Micronesia generally divide artifact descriptions according to source material. Stone artifacts have traditionally been discussed first followed by a separate discussion of shell implements. Whether intentional or otherwise, there appears to be at least an implicit division of artifacts based upon the material exploited rather than concentrating upon tool types, irrespective of source material. Thus, the hypothesis arises that if source materials determine artifact types, we should not find any types which cross cut material types. Conversely, if this traditional division is merely one of convention then there is a possibility that adze types will cross cut these material types.

The exploitation of shell may offer problems as to the applicability of stone adze terminologies and typologies to specimens manufactured from shell: will a new terminology be needed; will types (shell/stone) overlap; does shell restrict the variability of adze forms?

Poulsen (1972) has suggested that shell puts limitations upon the range of variations an adze may have, thereby restricting its value as an indicative artifact.

The preponderance of shell adzes from Palau and Yap also suggests interesting problems. In almost all areas of Micronesia, shell is the only source material employed in artifact manufacture. While an occasional stone adze has been reported from Yap and Palau, an abundance of stone adzes have been collected from the Marianas. This raises the question of why such a large quantity of stone tools exist in one group while the neighboring groups exhibit a significant paucity of adzes made from stone. Was this a result of cultural preference, limited lithic resources, or possibly indicative of a lack of trading networks among the separate groups?

Poulsen (1972:46) suggests that shell is an overlooked but potentially important industry which may prove useful in culture-historical synthesis and he offers examples of distribution of certain types (e.g., conus bracelets) of artifacts. However, while stating the possibilities and offering suggestions for implementation of analysis due to the paucity of extant archaeological data specifically on shell, Poulsen could offer no concrete examples.

Referring specifically to shell adzes, Poulsen (1972:36), states that _Tridacna_ is the most commonly utilized mollusc and that most adzes are manufactured from the outer portion of the shell while the thicker hinge section was only occasionally utilized. Working on this assumption Poulsen maintains further that shell adzes would then be limited in form thereby reducing their value as an indicative artifact. Therefore, two related hypotheses may be stated: (1) if adzes are manufactured from the outer section of the _Tridacna_ and it does actually limit variability, then we should find a limited range of types; (2) if the hinge section is utilized then the variability within adze forms and thus adze types would increase. Related to hypothesis (2) is the additional hypothesis that given the potential size of the hinge section it is possible that we may find stone types duplicated from this portion of the _Tridacna_.

Shell offers many interesting questions and is an important, though generally overlooked, component of artifact assemblages within Oceania. This study will attempt to fill some of these gaps and offer new directions for this research to proceed.

Summary

This study concentrates upon formulating a formal typology of adzes occurring archaeologically in the western region of Micronesia, based upon morphological attributes, in order to explore hypotheses concerning general tool morphology and problems of culture-historical significance.

Western Micronesia stands at the crossroads leading from Asia into the Pacific basin and as such occupies an important corner of the vast Oceanic area. It also marks the beginning of an area where shell becomes the primary source materials for artifacts. These two factors serve to make this area potentially significant to the understanding of the prehistory of Micronesia and to the prehistory of Oceania.

CHAPTER II

THEORETICAL CONSIDERATIONS

Given the myriad of artifactual and ecofactual data an archaeologist may obtain during his fieldwork, some system of classification must be applied in order to arrive at some coherent order of data. This assumption is basic to archaeology yet its principles and methodologies are among the most discussed and debated topics in the discipline. When one has any compilation of data, regardless of its nature, a multiplicity of classificatory schemes are available. The following discussion will confine itself to application within archaeological analysis.

Within the multitude of published discussions regarding archaeological typology some basic concepts can be extrapolated which form a coherent approach to classification. A basic premise is that typologies must not be considered as merely descriptive devices. Rather they should be established in order to test hypotheses explicitly formulated by the investigator. Thus, if two investigators working on different problems were given the same set of data they will most likely develop differing methods or choose different attributes for analysis and arrive at different classifications. Therefore, neither typology is more "correct" than the other, rather each system should be analyzed according to its usefulness in solving its stated problems and to its validity within the methodological framework. Utility is a major criterion for evaluating typologies. As Hill and Evans (1972) suggest, archaeological data have no inherent meaning nor empirical validity grounded in cognition but rather are assigned meaning by the investigator. Recent research in ethno-archaeology (i.e., White 1968; White and Thomas 1972; Heider 1967) has suggested that traditional typological classifications are often at variance with native categories and that even native categories do not always neatly correspond with empirical data. Therefore, a more appropriate approach may be that of Watson, Redman, and LeBlanc, when they state that statistically verified types reflect patterned behavior, which may or may not correspond to mental template (1970:27-28).

Important to the above position is the further assumption that due to the fact that any artifact may have multiple (infinite?) attributes, it would be impossible or impractical to attempt to record and define each one. Choices, as Hill and Evans point out (1972:251), must be made with regard to which attributes are to be emphasized. It follows that the variables or attributes selected are influenced directly by the hypotheses to be tested and that any group of artifacts can be typed in innumerable patterns depending upon the attributes selected for analysis. The attributes one chooses to work with should reflect ones problem. However, the objects and their types, while observable and repeatable do not contain meaning in themselves and it is the interpretation of these classifications that becomes the archaeologist's task.

To give a rather simple example, a group of books may be selected from a library. The possibilities for classification of these books would be numerous. Types could be formulated according to singular variables such as color, thickness, subject matter, or even types of cover illustrations. However, if the investigator was interested in book morphology relative to cover material (e.g., cloth vs. paper) he would select only those variables dealing with morphology (height, width, weight, thickness, etc.) and would eliminate such superfluous variables as subject matter, cover illustrations, etc. The point remains that the selection of the variables is determined by the problem at hand and should not be construed as the only manner by which the data can be classified. An artifact type in this study shall be defined as a basic analytical unit founded upon the recognition of non-random correlations of attributes, recognized by proceeding through a flow-chart series of decisions.

The problems with which this typology will be concerned were discussed in the previous chapter, however, to reiterate briefly the concern of this study will be in the construction of types based upon morphological variables in an attempt to explore culture-historical hypotheses for western Micronesian and the relationship of tool types to source materials, specifically shell and stone.

The initial phase of any typology study is the description of attributes to be included for analysis. Basic assumptions and the explanation for the choice of variables should be formulated at this time. Secondly, the attributes should be defined as succinctly as possible with the aid of illustrative keys when possible. This is one area of typological method that still creates problems. The attributes are the basis of any classification and despite the recent increase in statistical analytical procedures, an attribute still must be presented in a logical, repeatable manner. The results of any computer program is only as good as the attributes entered.

Prior to the description of the selected variables, an explanation of the basic assumptions involved in the choice of morphological variables is in order. If we assume that cultural systems are patterned, then the behavior involved in the manufacture of artifacts will reflect this pattern, which will ultimately be observable in the archaeological record. As Wilmsen (1970:3) suggests, since individual participation is within a cultural reference system held in common with other members of a society, behavior sequences will tend to vary within the limits of that system. This patterning and attendant variability will vary among and between social/cultural groups and over time. Nevertheless, in areas where there is evidence of historical relationships, (i.e., adzes in Oceania), similarities in artifact morphologies are more likely to be an expression of stylistic continuity rather than to have been invented independently. This proposition should hold if we assume that available artifact source material set minimal, if any, restrictions upon the morphology of the final form. However, in those areas where source material may inflict significant limitations upon the variation of forms, similarities may reflect simply the natural limitations rather than cultural drift. In this way, we may assume that any similarities in adze styles in the Oceanic area are largely the result of historical relationships within this area.

DEFINITIONS OF CUTTING IMPLEMENTS

In a perusal of literature concerning cutting implements within Oceania, one finds an apparent confusion and/or inconsistency regarding the application of the terms axe, adze, and gouge. Specifically, Yawata (1942), and van Heekeren (1957) refer to adze blades as axes while

Thompson (1932) typologically separates adzes from a rather nebulously defined group of gouges. These can be a potential source of typological and comparative problems and at the same time pose some interesting technomorphological questions. Are these terms interchangeable; can an axe serve as an adze or vice versa? Or are these terms mutually exclusive and have thus been misapplied?

Buck, Emory, Skinner, and Stokes (1935) have offered definitions of cutting implements which are widely cited and generally accepted among Pacific researchers. In their article an axe is defined as a hafted cutting implement with the edge running parallel or nearly parallel to the long axis of the haft. An adze, on the other hand, is a cutting implement with the edge running transversely to the long axis of the haft. In these definitions it is the manner of hafting which is considered the most important variable. However, these definitions overlook one important attribute which appears to be functionally significant: the profile (saggital section) of these tools.

An axe has a relatively symmetrical profile resulting from two, more or less, equally angled bevels meeting at the cutting edge. In this fashion, the axe is used so that the cutting edge approaches the plane of the working surface at a right angle.

The adze profile is relatively asymmetrical, resulting from a single, usually high angled bevel. The asymmetry and its high angle single bevel allows the cutting edge to cut in a plane parallel to the surface being worked without biting into the surface as would a symmetrical axe. In other words, an axe is a cutting (chopping) implement while an adze is generally employed for hewing.

In all definitions of an adze, the most important variable seems to be the manner of hafting. Thus, the hypothesis could be stated that if an axe was hafted with its edge running transversely to the haft then it could effectively be used as an adze. Practical experiments have shown that this is not generally the case.

I would like to expand upon the previous definition so that an adze may be defined as a cutting tool which exhibits an asymmetrical profile and when hafted has its cutting edge at right angles to the long axis of the haft. This definition may be of more use to the archaeologist who would be extremely fortunate to find an axe or an adze still on its haft.

Returning to the definition of cutting implements, a gouge is less distinguishable from the adze. Defined as a special form of chisel in which the edge is curved to such a degree that the bevel is hollowed or grooved, Buck, Emory, Skinner, and Stokes then suggest that some chisels are difficult to distinguish from adzes (1935:179). Generally, gouges have a single, angled bevel with a curved cutting edge. If we accept this definition we would have to confront the cumbersome, somewhat subjective, typological problem as to what degree an edge must be curved before it leaves the adze group and becomes a gouge. I would suggest that what we are actually dealing with are adzes with curved blades. Ethnographic descriptions (Kramer and Damm 1938:169; Garanger 1972:Figure 4,5) have illustrated curved edge blades hafted as adzes. With the long axis of the implement perpendicular to the handle it would function in a hewing motion. As will be seen, the curved edge blades are common in this sample under analysis and may form an important functional group.

Obviously, these groups of cutting implements are less clearly distinguishable when found in archaeological contexts, without hafts, and therefore wear pattern analysis will prove beneficial in determining how a tool was hafted. Perhaps in the future, methods can be developed which will aid in delineating wear patterns upon shell artifacts.

Adze Terminology

Since its publication in 1935 the terminology presented by Buck, Emory, Skinner, and Stokes, has been generally followed among Pacific researchers in discussion of adze collections. This study will also follow their terminology with only minor modifications.

One of the many questions to be explored in this study was whether stone implement terminology would prove appropriate to the discussion of adzes made from shell. It was soon apparent from a perusal of the sample that little modifications would be necessary.

During the initial phases of observing the adze forms it appeared that some of the blades contained the bevel upon the front, that is, of the surface distal from the haft. If this was found to be correct it would be in direct contradiction to the definition by Buck et al., which stated that the bevel was always of the back. Several attempts to identify and analyze wear patterns on shell specimens failed to yield any positive results. Recently, Reinman (personal communication) has hafted some of these questionable specimens obtained from archaeological contexts and found that they are more functional hafted with the bevel carried on the back (i.e., proximal to the haft) and the cutting edge angled upwards, away from the haft. Therefore, with minimal evidence to suggest otherwise, the definition of front and back will remain the same for all adzes within this study.

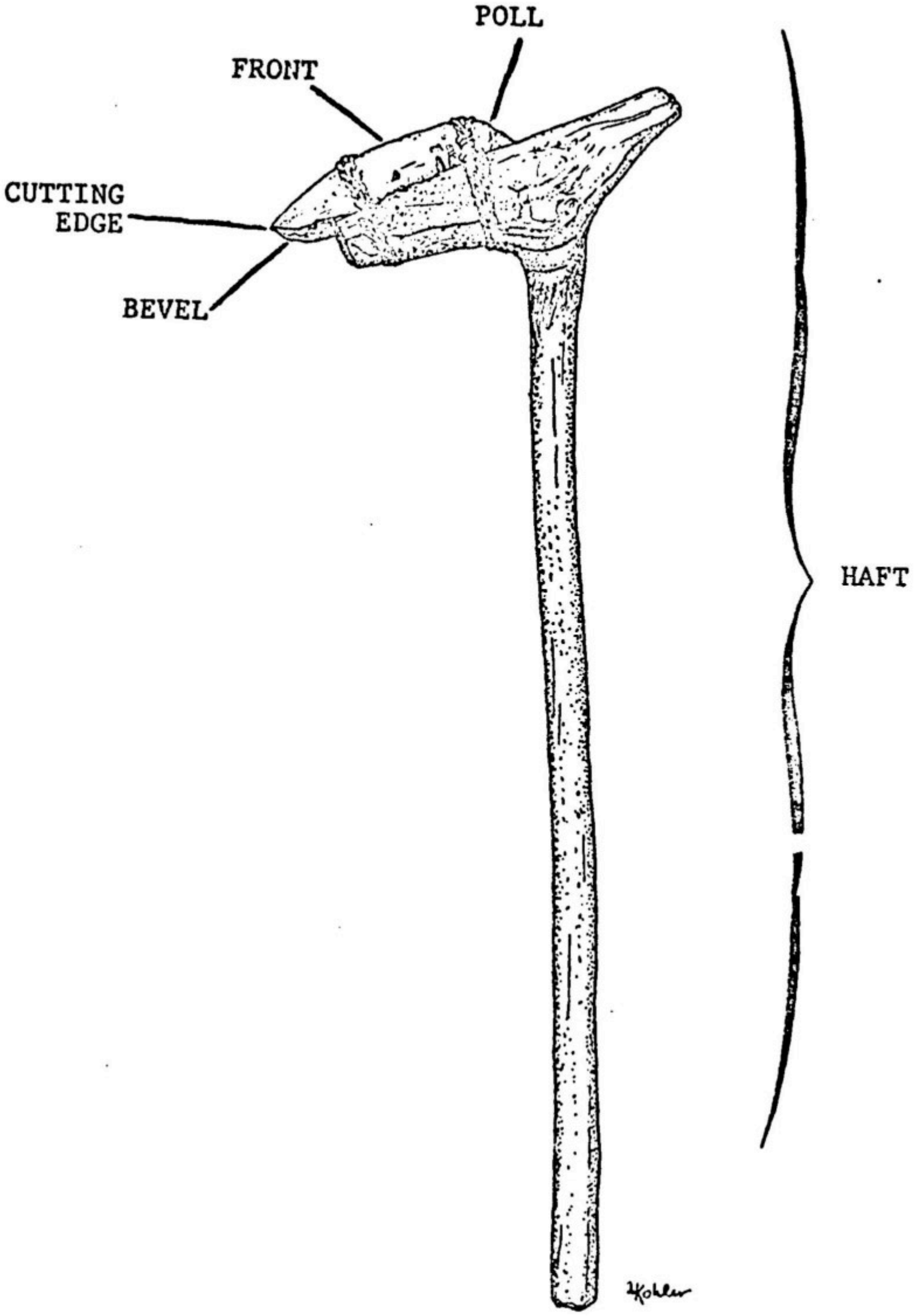


Fig. 2. Hafted Adze.

Definitions (Figure 3)

Front: that portion of the adze which is proximal to the worker and distal to the haft.

Back: that portion of the adze which is proximal to the haft and distal to the worker.

Side: the area of the tool separating the front from the back.

Cross-Section: a saggital profile of an adze at a random midpoint.

Poll: the protion of the tool which has been shaped for cutting purposes.

Bevel: the part of the adze which has been angled from the body on which the cutting edge is contained.

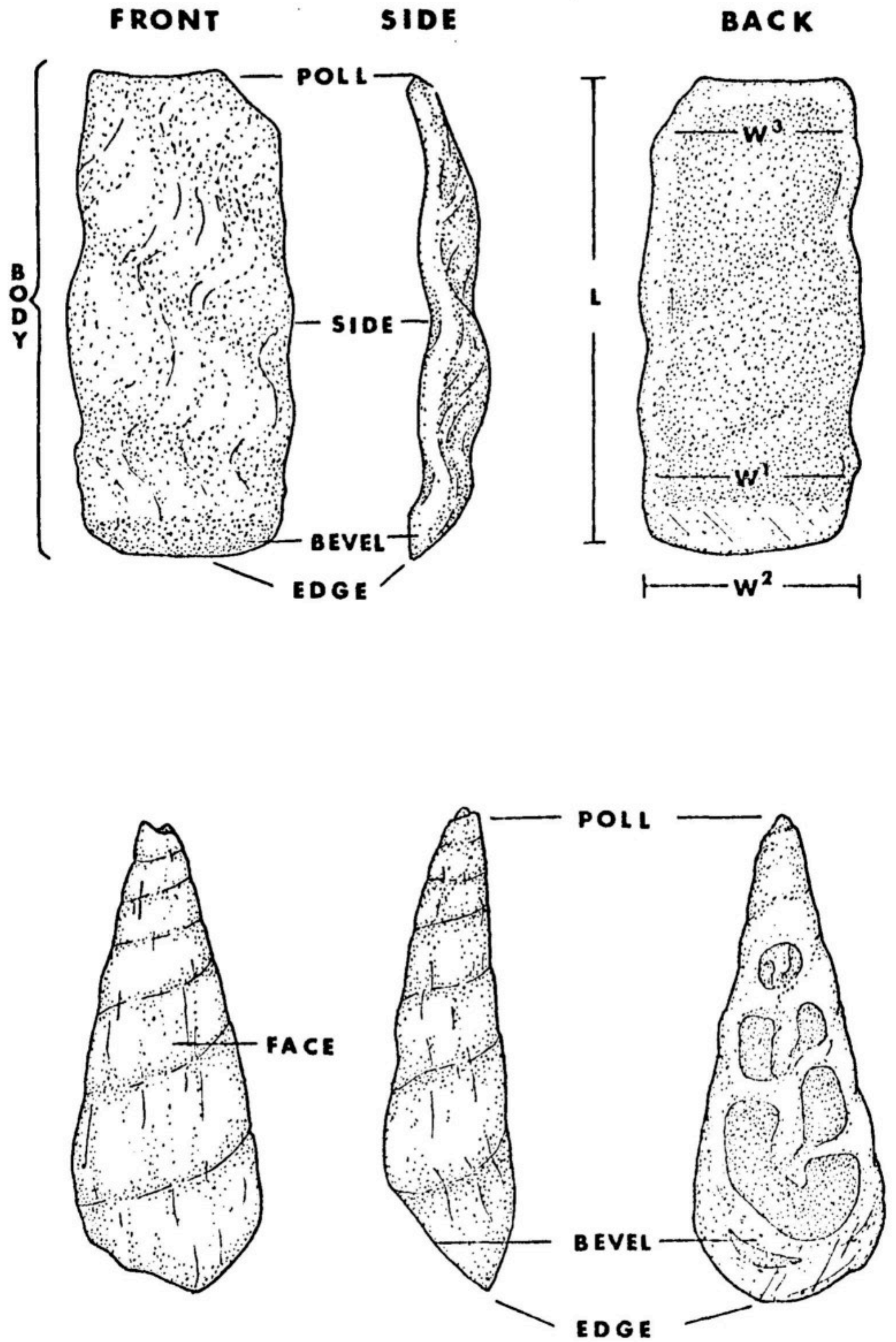


Fig. 3. Adze Terminology.

ATTRIBUTES

Sixteen attributes were selected for analysis in this study. Eight of these area/metric attributes requiring specific measurements and the remaining eight are descriptive attributes having an all or nothing property (see Appendix).

One of the problems to be discussed in this study is the application of attributes assigned to stone adzes and those specimens manufactured from shell. Generally, the same attributes can be found on specimens of both material largely as a result of the technomorphology of the adze which supersedes the limitations of source material. In order for a tool to be classified as an adze it must have the minimum attributes in the definition given earlier.

All linear measurements in this study were taken with metric calipers and were recorded in millimeters to the nearest .05 mm. Bevel angles were recorded to the nearest $.5^{o}$ utilizing a protractor (exact method will be described fully in the Appendix). All attribute determinations for each artifact were recorded on a separate edge-punch card which was subsequently coded along the edge.

SAMPLE COLLECTION

The collections employed in this study are the

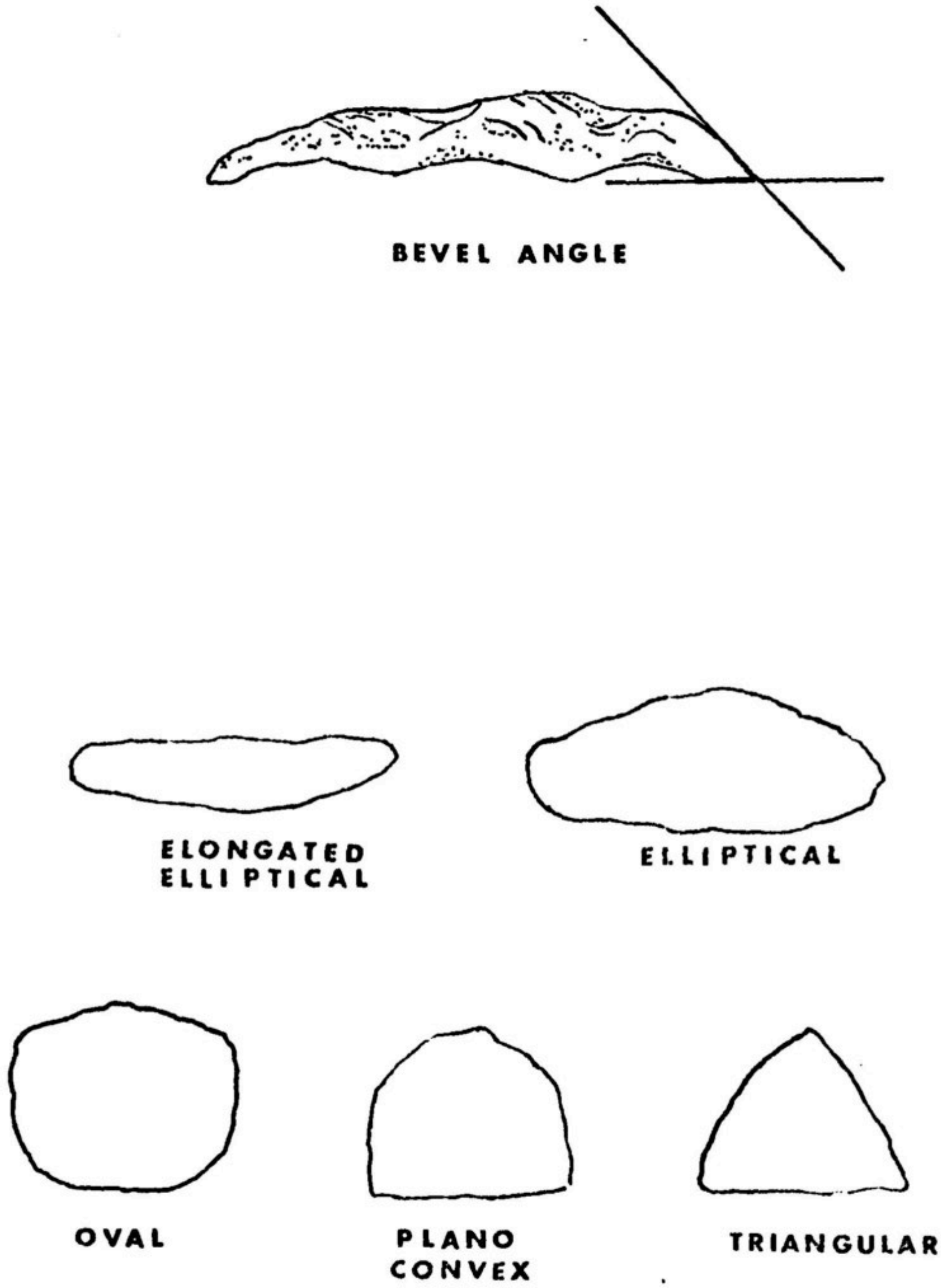
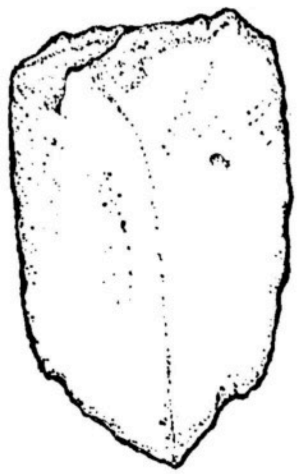
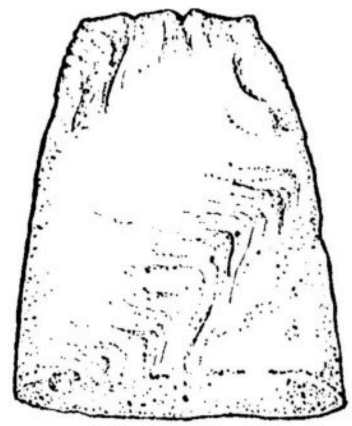


Fig. 4. Adze Attributes: Cross Sections; Bevel Angle.

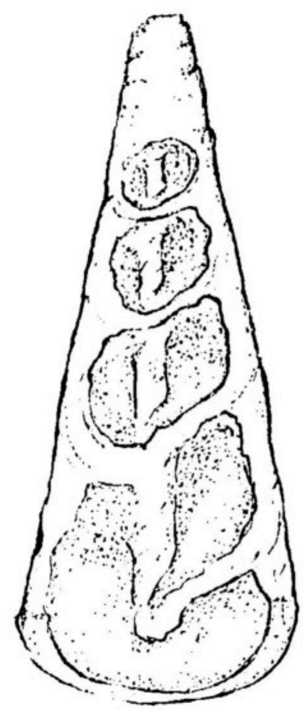


a. Pointed (beaked)



b. Straight

c. Wide Curve



d. U-Curve

Fig. 5. Variation of Shape Among Cutting Edges.

results of archaeological fieldwork by Alexander Spoehr (Saipan, Tinian, Rota--Mrianas Islands), Fred Reinman (Guam--Marianas Islands), E.W. Gifford (Yap Islands), and Douglas Osborne (Palau Islands). This author had the opportunity to observe all of these collections firsthand despite the considerable distances between collections. The Marianas collections of Spoehr and Reinman are housed at the Field Museum of Natural History in Chicago, Illinois, the Yap collection is in the Lowie Museum at the University of California, Berkeley, California, and the Palauan collection from Osborne's 1968-69 work is contained at the Department of Anthropology at California State University, Long Beach. In addition to these collections I was also able to briefly inspect the Hornbostel collection of Marianas adzes and the general Micronesian adze sample housed at the Bishop Museum in Honolulu, Hawaii.

Dividing the sample by island group shows a definite skewness in favor of the Palau group (N=121), with the Marianas having the next largest (N=75) and the Yap group yielding the smallest suitable sample (N=24). These samples will vary for statistical analysis in that some specimens were in various stages of manufacture or breakage. These incomplete adzes were added to the sample for analysis if they contained evidence of a cutting edge or if a major portion of the body was intact.

The Palauan sample is primarily from three sites, each located on a separate island. Ngerkekelau (Ngerkekelau 1) is a small island in the northern portion of the archipelago on which Osborne conducted a surface survey and collection with no excavation. The other two islands, Angaur (Angaur 19) and Pelilieu (Pelilieu 1), are raised limestone formations located in the extreme southern portion of the group on which excavations were undertaken. However, most adzes were surface finds.

The bulk of the Yapese sample comes from a single site, Pemrang, located at the southern tip of the island of Yap. The majority of this sample collected by Gifford were in various stages of breakage so that the final sample utilized in this study is quite small.

Surprisingly, the sample from the Marianas is comparatively meager, despite the fact that it was collected from sites on four separate islands (Guam, Tinian, Saipan, Rota). Statistical manipulation of variables is predicated upon the assumption that the sample under analysis has been randomly selected from the local population and that a significant number of items have been chosen. Unfortunately, the sample extant from western Micronesia fits poorly into either category. As a result, statistical usage will be minimal with any and all results tempered by the above considerations.

METHODS

In preparation for the typological process, an edge punch data card was prepared for each artifact. These cards contained both the descriptive and metric data described above. The discrete attributes were coded in such a manner that each artifact could be selected from the sample on a presence/absence basis, whereas, the metric attributes were coded on an interval scale. This coding was accomplished by preparing the edge of each card according to the presence or absence of an attribute at the numerical designation of that particular attribute.

The process of classifying any sample, inherently, is predicated upon a number of assumptions regarding divisive criteria. Traditionally, these assumptions have been implicitly suggested, often leading to confusion and/or misunderstanding as to how an investigator arrived at a specific grouping. In this study, the basic methodological approach is reflective of the assumption that artifactual classification essentially proceeds through a series of distinct and definable decision points, whether intuitive or computer derived. Each of these points mark a qualitative division within the sample. Furthermore this process can be mapped so that each decision point may be visually depicted (Figure 6).

Currently, many varying approaches to classification exist within archaeology. Factor analysis, multiple regression, chi-square manipulations represent a portion of the statistical methods which are gaining in popularity among archaeologists. However, the statistical manipulation of attributes were severely restricted (and in most cases avoided) by the small sample available for this study. The initial phase of the typological process began with a physical selection of attributes. This was possible and practical given the small sample size and the relatively small number of attriburcs under consideration.

I found that in this process different numbers of attributes were needed to define types. In-group homogeneity was attained in some types with the selection of a single attribute while other types required the selection of multiple, related attributes. For example, Type 8 was primarily determined on the basis of a single attribute, a circular cross section. Variation within this group "appeared" to be small enough not to warrant any subsequent divisions. Statistical tests for metric variation supported this decision although this was not always possible for each type.

Formal types were established based upon morphological similarities after which a flow chart of this process was established. In this sense the process employed in this typological sequence is a posteriori as defined by Thomas (1972), that is, proceeds from established types and attempts to systematize the formulation process. The actual attribute selection will be discussed in the next chapter.

CHAPTER III

TYPE DESCRIPTIONS

The following types are the result of analyzing whole and fragmentary shell and stone adzes from western Micronesian archaeological collections. In this section I will discuss the process in which these types were formulated and then proceed to provide descriptive accounts of each type.

Figure 6 offers a visual depiction of the process of typological formulation. This is somewhat similar to the flow chart approach employed by Thomas (1972) in his analysis of Great Basin projectile point types. I feel these types will be defensible and this typology's usefulness may be reflected in the fact that many of the original types created by the researchers in western Micronesia are found, relatively intact, in this study.

The initial step involves the selection of that attribute which best divides the collection into two separate classes. Having analyzed all the discrete attributes in this study, it was established that the elliptical cross section best divided the sample. This initial divisive variable was established (as were the others to follow) primarily through a process of elimination. In

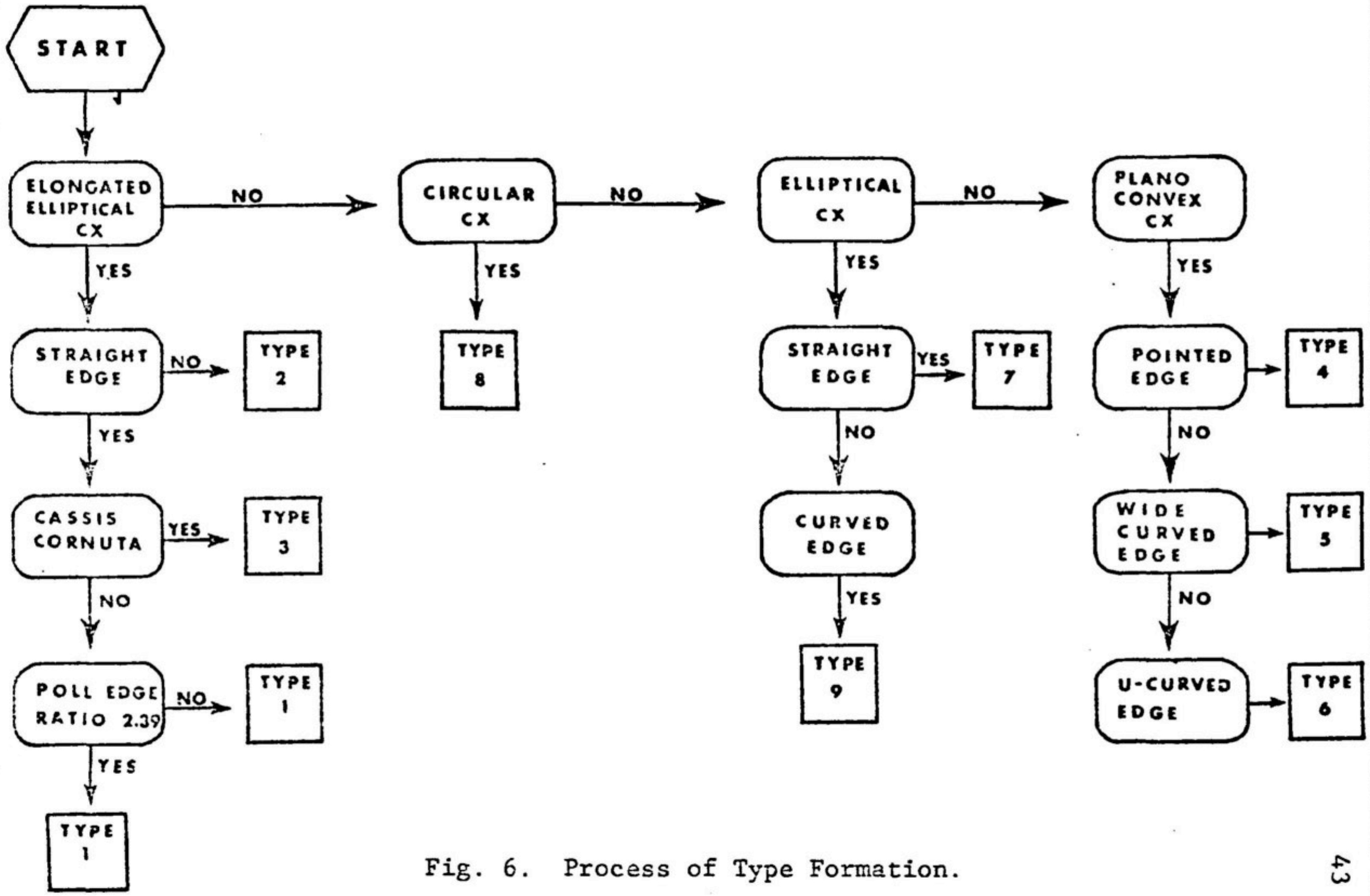


Fig. 6. Process of Type Formation.

other words, all discrete attributes were considered equally. Many of the attributes (e.g., edge shape, material, outline) were found to cross cut morphological groups, negating their usefulness. Other attributes (e.g., other cross sections) accounted for a minimal amount of variation in that only a small, irreducible group was separated. As a result, the elliptical cross section was chosen because it best divided the total collection into two, mutually exclusive groups.

Interestingly, this division effectively reflects the inner/outer shell division employed by Davidson (1971) and Rosendahl (1970). However, that specific a division would not be useful in this analysis in that it would eliminate the consideration of stone specimens. The usage of the elliptical cross section would appear to imply thickness as an important attribute, however, this is correct in only a general sense. While the elliptical cross section sample is relatively thinner than the majority of other specimens there are variations of thickness that overlap with the elliptical. Nor should weight be implied as an important morphological factor. As with thickness, weight overlaps morphological variation and often varies significantly among groups demonstrating morphological similarities.

The second division in line A is determined by the shape of the cutting edge. This is one of the few divisions in which statistical verification is involved. A chi-square test of association was undertaken which shows a definite positive association between blades having an elliptical cross section and a straight cutting edge. This association was at the [illegible] level of significance, although, within the elliptical smaple there are blades which deviate from this straight edge group. These adzes exhibit a definite wide u-curve edge and were separated from the sample to become Type 2. We are then left with a numerically large sample of adzes with an elliptical cross section and a straight cutting edge.

The third phase of type differentiation on the A line involves a division based upon source material. This is the only division in the entire typological process which is based upon this attribute. It was decided to divide the sample so that the blades manufactured from <u>Cassis cornuta</u> became a separate group. This decision was based upon the observation that the <u>Cassis</u> adzes were restricted, morphologically, by the natural configuration of this type of shell. The remaining sample consists of specimens manufactured from stone and the outer portion of the <u>Tridacna spp</u>.

In order to account for the variation in this remaining sample the outline of the blades as a whole was determined, visually, to be the major source of variation. This variation tends to form a continuum from the fully triangular adzes to those which form a definite rectangular outline. To differentiate between groups within this continuum I selected the poll/edge ratio as established by Sorenson (1967) in his typology of Indonesian adzes. Albeit, an arbitrary division, it will be shown that variation of outlines proved to be an important spatial distinction. In any event this division resulted in a separation of varieties within a single type. Thus we have Type 1 with varieties A (triangular) and B (rectangular).

In order to describe the processes involved with line B we must now return to the initial step.

As mentioned above, this line B division roughly corresponds to the inner (i.e., relatively thicker) division established by Rosendahl (1970). Due to the fact that in this division we are dealing with a thicker group of adzes, the configuration of the cross section becomes a more useful and significant variable in that it can take many more shapes than the relatively thinner sample in line A.

The first division includes those adzes exhibiting a circular cross section. The variation within this group is small enough to warrant an inclusive group based upon the shape of the cross section. Thus we have selected

Type 8.

Secondly, the remaining sample was divided into two groups, one containing the sample displaying an oval cross section and the other having those blades containing a plano-convex cross section. The first sample exhibits little within group variation and has been combined to form Type 9. The second group, however, still exhibits much variation.

The sample consisting of the plano-convex cross section can be further divided according to the shape of the cutting edge. This group was divided into those adzes having a pointed ("beaked") edge, those having a wide curve and those containing a u-curve. These have been designated Types 4, 5, and 6, respectively.

The above discussion has been directed toward an explicit explanation of the type formation in this analysis. The main purpose of this process has been to isolate those factors which are important in reducing variability within groups and maximizing variability among groups. As can be seen these factors vary from type to type, that is not all factors have the same significance within the sample as a whole. For the elliptical (line A) group most of the variation was in terms of edge shape, source material, and blade outline, in descending order of importance whereas the line B adzes varied according to cross section and bit shape. Again, while these factors are not verified statistically their utility may be substantiated by this typology's effectiveness including specimens from other collections. As for any typology, statistically derived or otherwise, its value is dependent upon its ability to incorporate new data. If additional data cannot effectively be included employing the above divisions then a new method and/or process must be devised. For the sample under study here, all variation has been accounted for within the above morphological factors.

Type 1

This group of adzes contains the largest number of specimens within the western Micronesian collections and also appears to be the most common type among those manufactured from the outer portion of the Tridacna, within the general Oceanic area. This type also exemplifies a group which cross cuts source material in that there is a basic morphological continuity between specimens manufactured from shell and stone. This continuity was noticed by Spoehr (1957:32), however, for reasons unstated, he did not include shell and stone within the same type. The Type 1 here corresponds to Type 2 (Stone) and Type 1 (Shell) as described by Spoehr; Type 4 in Osborne's typology; and Type 1 in Gifford's work.

This group has been further divided into two varieties due to a continuity in form which does not involve any significant transitional point for separation. While morphological attributes, other than outline, remain the same, some dimensional attributes do vary according to material and location. First, however, permit me to discuss the general characteristics of both varieties.

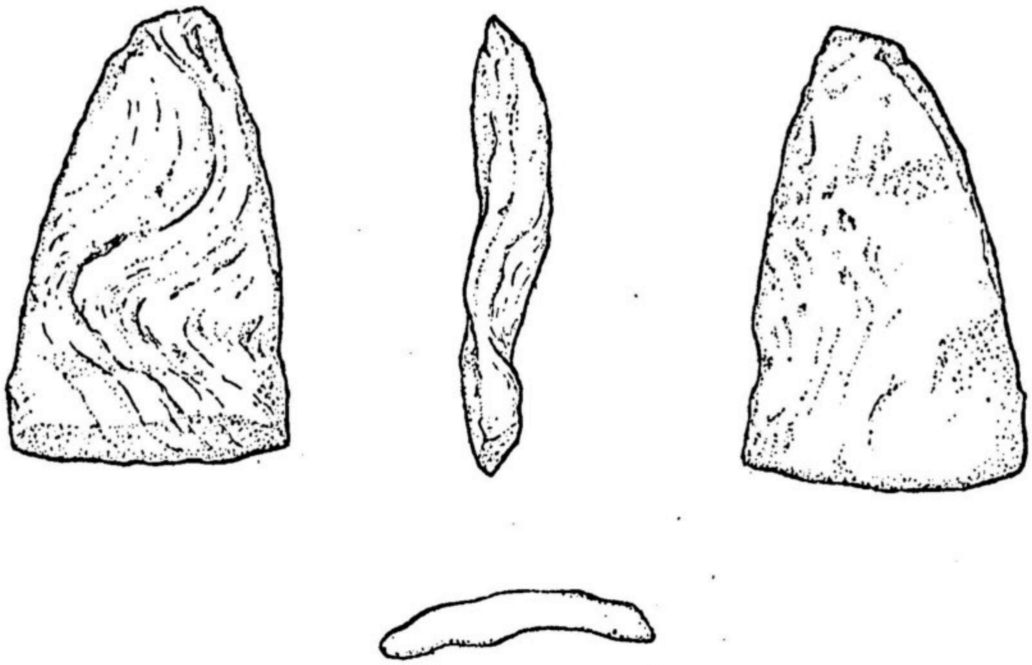
All shell specimens in this type are manufactured from the outer portion of the *Tridacna spp*. while the stone specimens are formed from basalt and andesite. Little, if any, shaping is undertaken on the *Tridacna* forms after the blank has been removed from the shell. Nevertheless, most visible evidence of working is on the bevel and occasionally on the front in order to obtain a surface. Additionally, grinding is often evident of the back side of the bevel. This may be the result of attempts at resharpening these blades or, perhaps, added initially as a double bevelled edge.

The stone adzes are generally flaked into a preform, then pecked and ground into final form. Most specimens had been ground over the entire surface although there is no evidence of polishing.

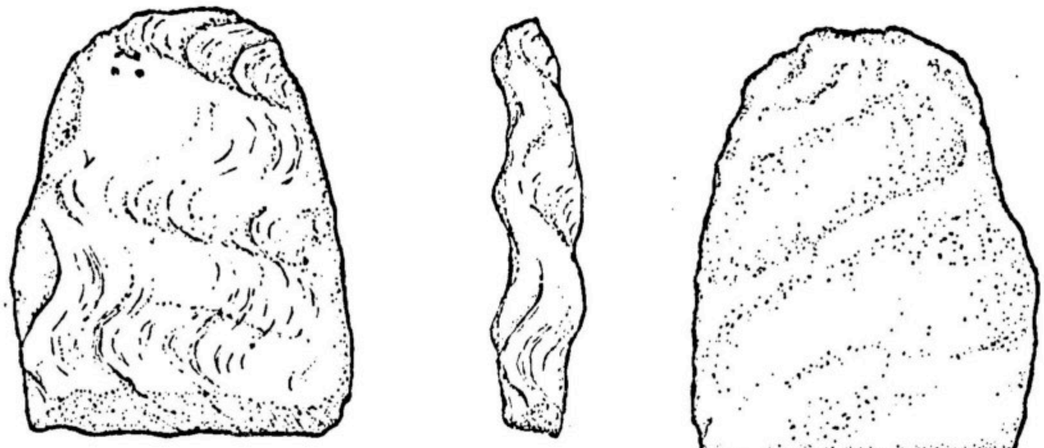
Variety A (Figure 7)

These adzes have a triangular to trapezoidal outline with a trapezoidal mean poll/edge ratio of 2.22. The polls are generally rounded with the sides flaring out

Fig. 7. Type 1, variety A. (a) 20/Negerkeklau 1, *Tridacna spp.* (b) 22/Negerkeklau 1, *Tridacna spp.* Osborne 1968-69 collection.



a.



b.

toward the cutting edge. Of the blades manufactured from Tridacna, the front corresponds to the outer portion of the shell and, as such, these adzes still have evidence of the natural striations. Additionally, there is a definite pattern to these striations in relation to the cutting edge. The adzes are consistently constructed in such a manner that the striation always lie perpendicular to the cutting edge. In fact, as the illustrations will demonstrate, this pattern is found on all adzes manufactured from the outer portion of Tridacna and, perhaps, related to maximum stress resistance. The back is then formed by the interior of the shell and exhibits little evidence of grinding except for smoothing prior to hafting. The stone specimens of this type exhibit the same morphological attributes, excluding of course the striations on the front.

The cross section is an elongated elliptical in both the stone and shell specimens with the shell blades' section being determined entirely by the natural morphol ogy of the shell.

The cutting edge is generally straight with some blades exhibiting a very subtle curve which may be more the result of wear than any purposeful patterning. The bevels, contained on the front (at least for the shell adzes) have a mean angle of 50.05°($50.6 \pm 8.9^{\circ}$-shell; $51.5 \pm 6^{\circ}$-stone).

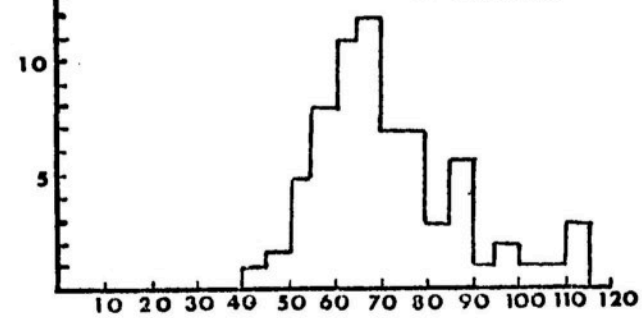
Variation within this type is dimensional.

and is, surprisingly, not based upon source material but rather geographic distribution. For example, the mean length of Type 1 adzes from Palau and Yap is 66.±11.8mm., while the Type 1 blades from the Marianas exhibit a mean length of 83.2±9.7mm. Of course, as shall be discussed below, the totality of stone adzes, save one, within this type are from the Marianas and thus it might be expected that this variation is due to the variation in source material. However, when the means of the shell and stone Type 1 adzes from the Marianas are compared, little variation is found. The stone specimens have a mean length of 85.45mm, while the shell blades form a mean of 80.94mm., significantly larger than the mean length of Palauan and Yapese adzes (all shell) of this type.

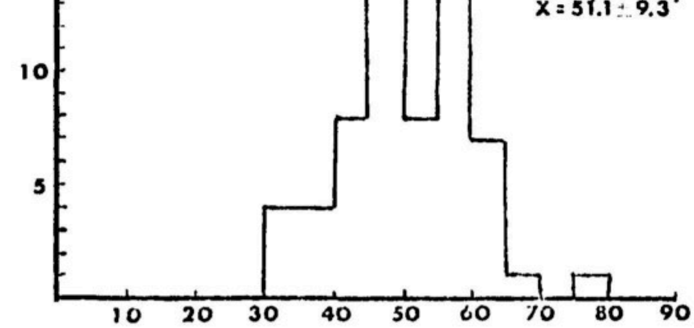
The dimensional variation was primarily in length and width, although there was no direct correlation found between these two variables. Bevel angle was found to remain constant regardless of the dimensions of the adze. Interestingly though, when the length of these adzes were plotted on a histogram (Figure 8) the Marianas specimens form a linear alignment rather than clustering around a mean at the Palauan and Yap specimens do.

These adzes are found within most sites on all three island groups with the exception of the stone specimens. All stone adzes of Type 1A with the exception of a single specimen from Yap, are from the Marianas.

Fig. 8. Morphological Variability in Type 1 Adzes, varieties A and B. (a) Adze Length (mm.). (b) Bevel Angle.


X = 72.0 ± 17.4
15
10
5
10 20 30 40 50 60 70 80 90 100 110 120

a.


X = 51.1 ± 9.3
15
10
5
10 20 30 40 50 60 70 80 90

b.

Variety B (Figures 9 and 10)

With the fully triangular adze (variety A) representing one extreme, this variety B represents the other end of the apparent continuum. As in variety A this group also contains specimens of both shell and stone. This variety corresponds to Spoehr's Type 1; Reinman's Type 1; and Gifford's Types 1 and 4. No specimens of this variety were found in Osborne's Palauan collection.

The materials utilized in manufacturing this type were the outer portion of the Tridacna spp., basalt and andesite. Similar to variety A, these specimens of shell exhibited little working except for the bevel while the stone blades were usually completely ground. Important differences between this group and variety A are: a) the sides which meet the edge are set at right angles and proceed in a parallel fashion toward the poll; b) and the more squared poll, giving this variety a decidedly rectangular outline (poll/edge ratio $\bar{X}$=1.28).

Within variety B there exist definite differences among the shape of the cutting edges. Some specimens have the straight edge, prominent in variety A, while others have a slightly curved edge.

The Marianas specimens again tend to be somewhat larger though not to the significant degree they are in variety A. The mean length for this group is 78.05$\pm$12.8mm.

Fig. 9. Type 1, variety B, *Tridacna* *spp*. (After Spoehr 1957).

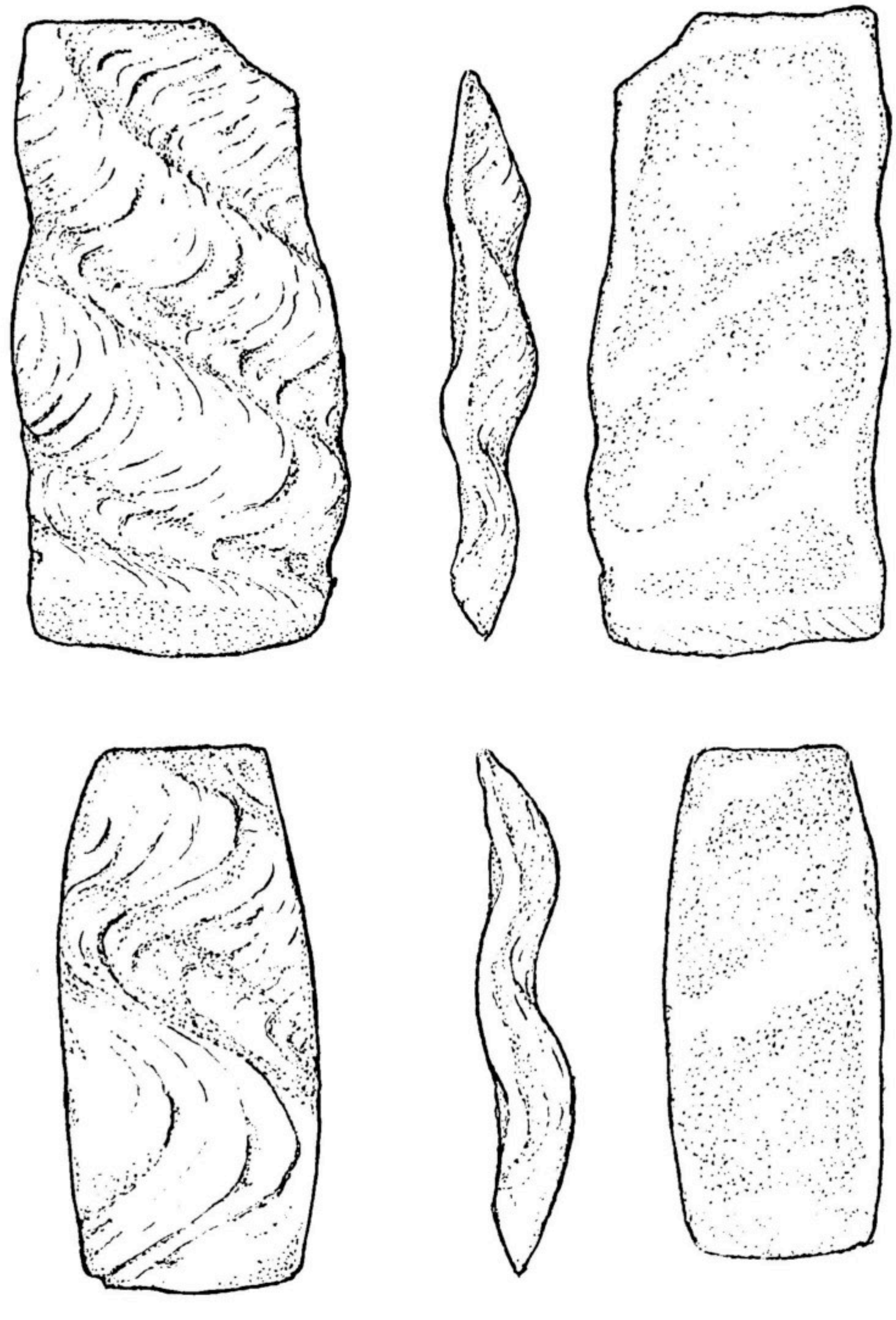
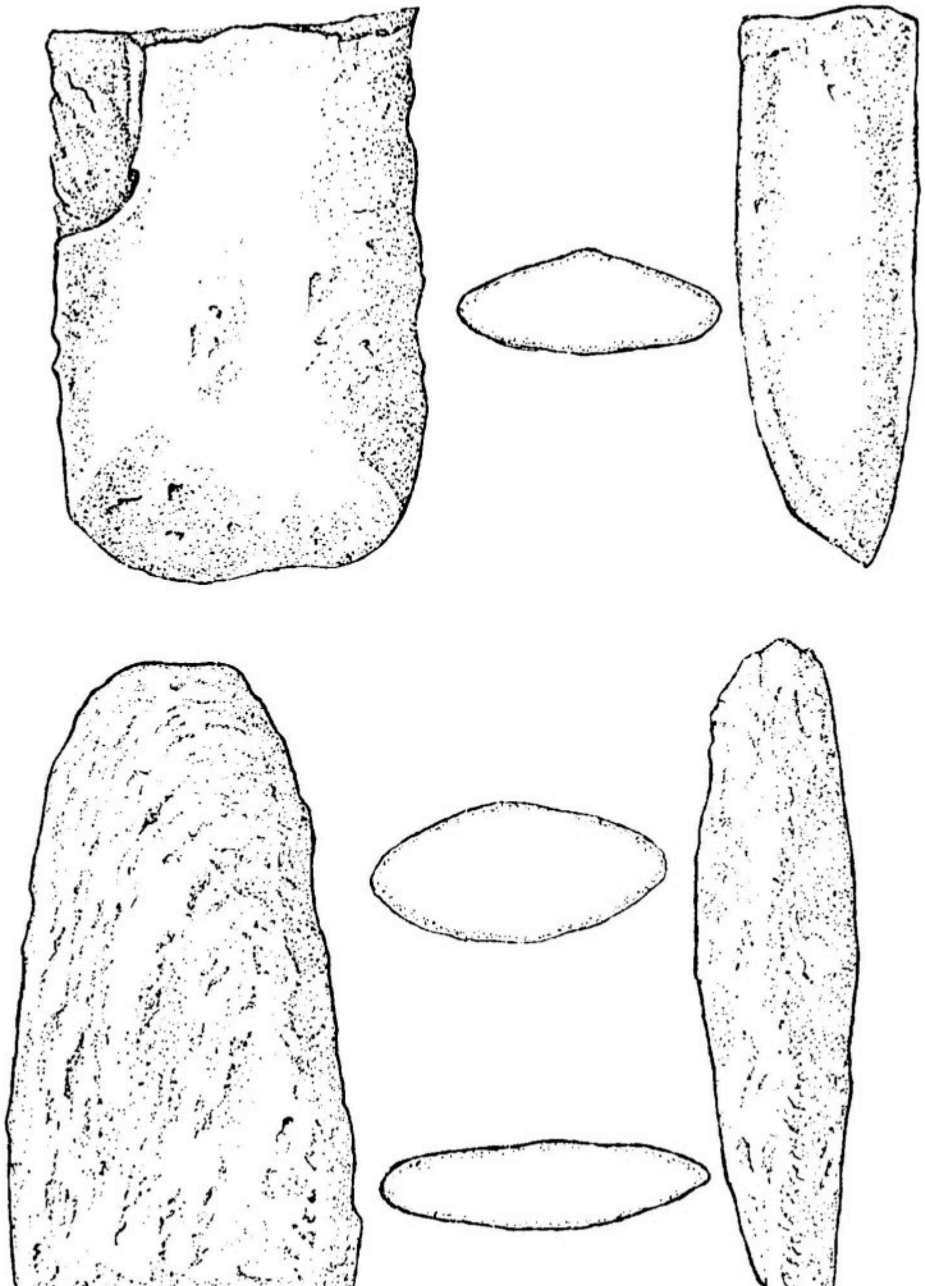


Fig. 10. Type 1, variety b, Stone (Reinman 1970).



with a mean thickness of 13.6 ± 3.5mm. The bevel angle falls within the range for the entire collection with a mean of 49.9 ± 9.0^{o}.

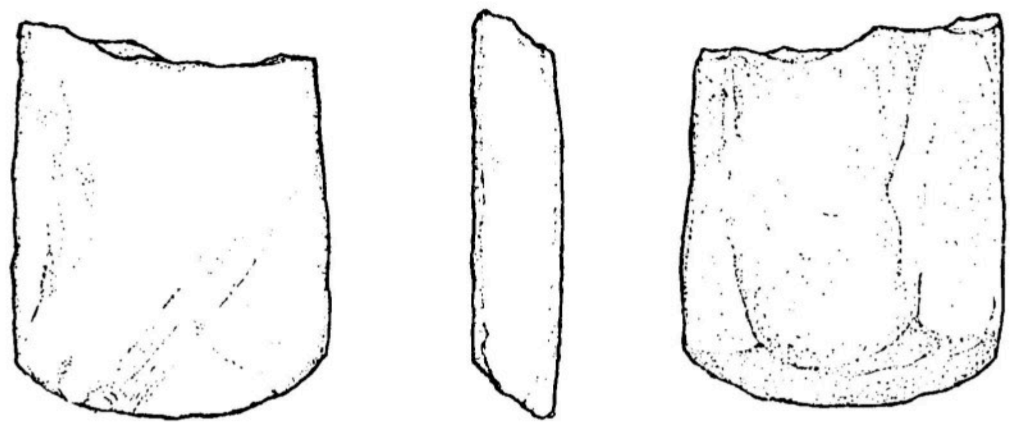
The type 1 adzes have been collected from all three island groups although the distinctly rectangular variety are primarily from the Marianas, as are the stone specimens in this type. Yap has yielded a single stone specimen (32379) of variety a.

Type 2

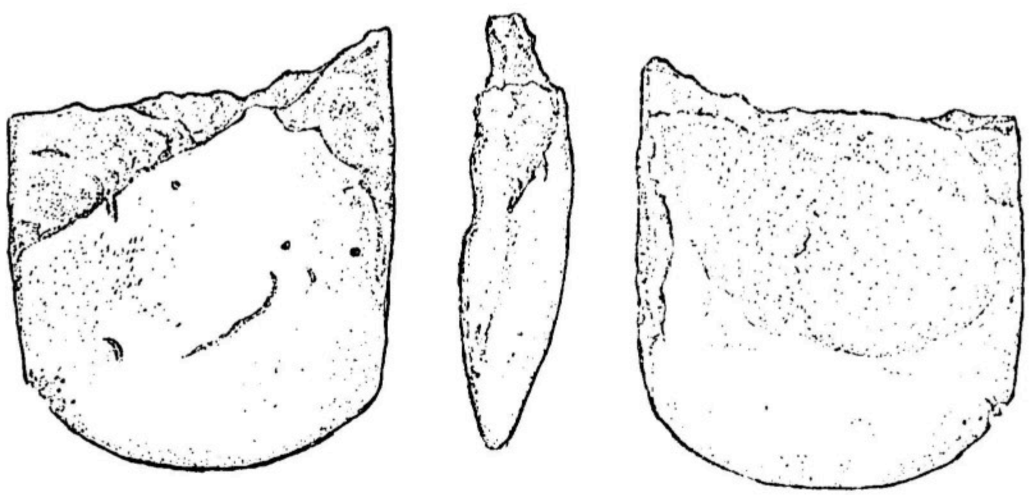
This type (Figure 11) differs from the preceeding type in two important respects. First, this group of adzes has a major portion of the front and back ground to a smooth surface and furthermore, this is the only group in which more than a single genus of shell has been used. The adzes of this type were manufactured from the Tridacna and Cassis. The Tridacna specimen still retains faint evidence of the surface striations, while the Cassis blade is completely ground.

Curiously, the poll end of the adzes are missing and may be the result of an inherent weakness in the structure of the shell in that the breaks do not exhibit any evidence of purposeful patterning. The sides are parallel as they run from the edge toward the broken poll. The front is curved so that, sagittally, the front and back meet at a common point. The back is ground flat for

Fig. 11. Type 2. (a) 48/Ngerkekelau 1, *Cassis cornuta*. (b) 40/Angaur 19, *Tridacna spp*. Osborne 1968-69 collection.



a.



b.

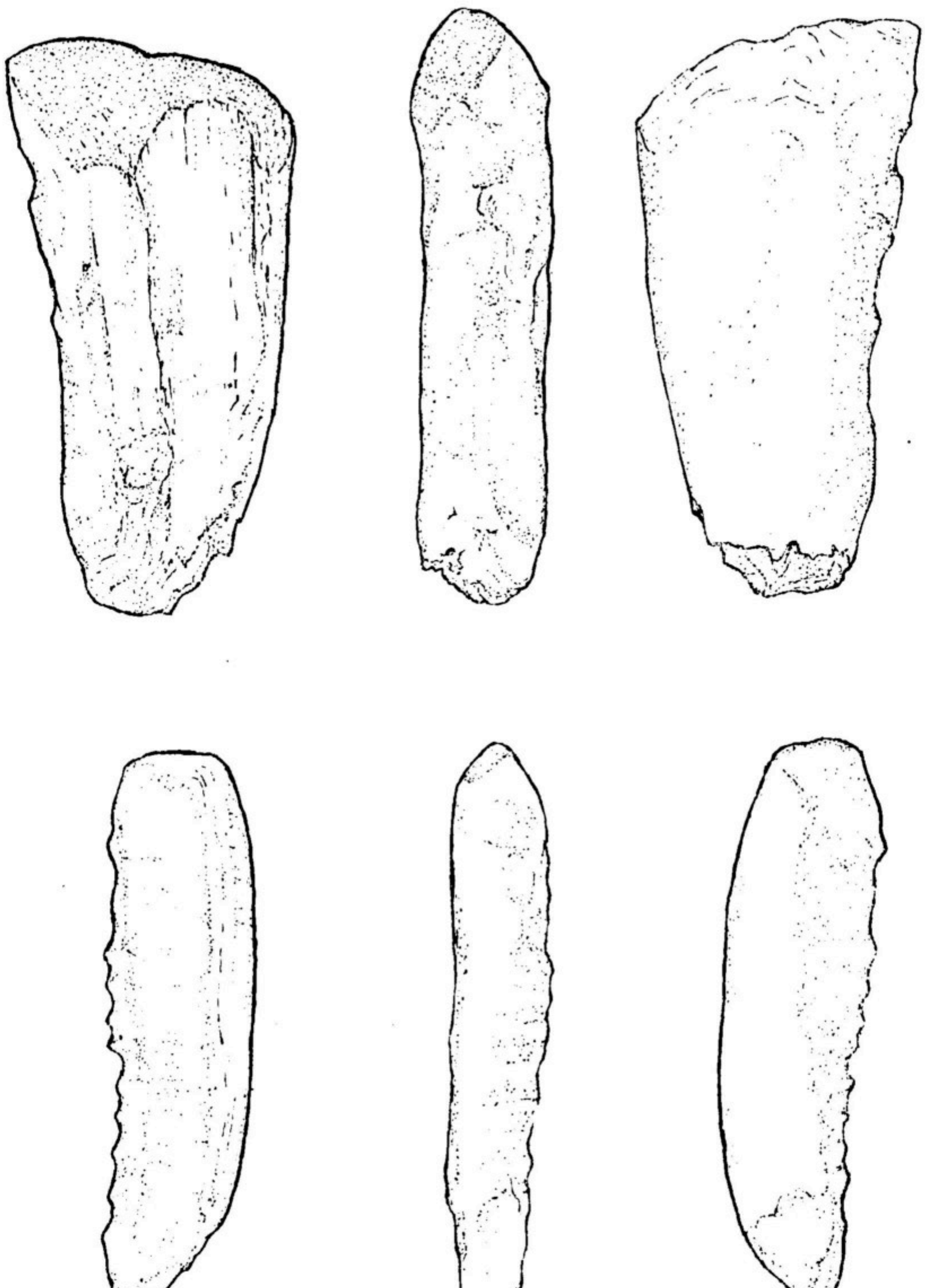
hafting, giving these adzes a planoconvex section. The cutting edge forms a u-curve with 48 Ngerk 1 (Cassis) having the bevel on the back and 40 Ang.19 exhibiting a double bevel. Whether these adzes were utilized in the form they now exhibit or represent broken specimens is uncertain. However, like other adzes made from the outer section of Tridacna they are relatively thin ($X=10.7 \pm 1$mm.). The mean bevel angle is lower than most types measuring 34.5 ± 8.5^{o}.

Type 3

These adzes (Figure 12) are formed from the outermost lip of the Cassis cornuta. Due to the natural morphology of the lip section, the possible variations within this type are severely restricted. The small sample observed during this study exhibited little variation except for overall size.

The shape of these blades is triangular to trapezoid in outline ($\bar{X}$E:P=1.84-3.50) dependent upon whether the poll is altered or left natural. Generally, the only blade portion which appears to have been modified is the bevel. This group exhibits a single bevel ($\bar{X}=43^{o}$) with a slightly curved edge. The cross section is a skewed oval resulting entirely from the natural configuration of the lip area.

Fig. 12. Type 3. (a) *Cassis cornuta*. (b) *Cassis cornuta*. Osborne 1968-69 collection.



It appears that the lip area of the Cassis was detached by percussion from the main body. With minimal grinding on the face and back, the bevel was formed. The bevel is contained on the back with the front retaining its natural convexity.

Adzes manufactured from the Cassis cornuta form only a minimal portion of the adze inventory now extant and this material is utilized in only one other type (2). These blades are not included in the reports of Reinman, Spoehr, Gifford, or Egami. However, adzes of this type do exist in the Marianas (Reinman, personal communication). Rosendahl (1970) has described this type from other areas within Micronesia and they have also been described in other areas of the Pacific (Poulsen 1970). In this sample one specimen was from Yap while the Palauan sample (N=3) were all recovered from the same site, Pelilieu 1.

Type 4

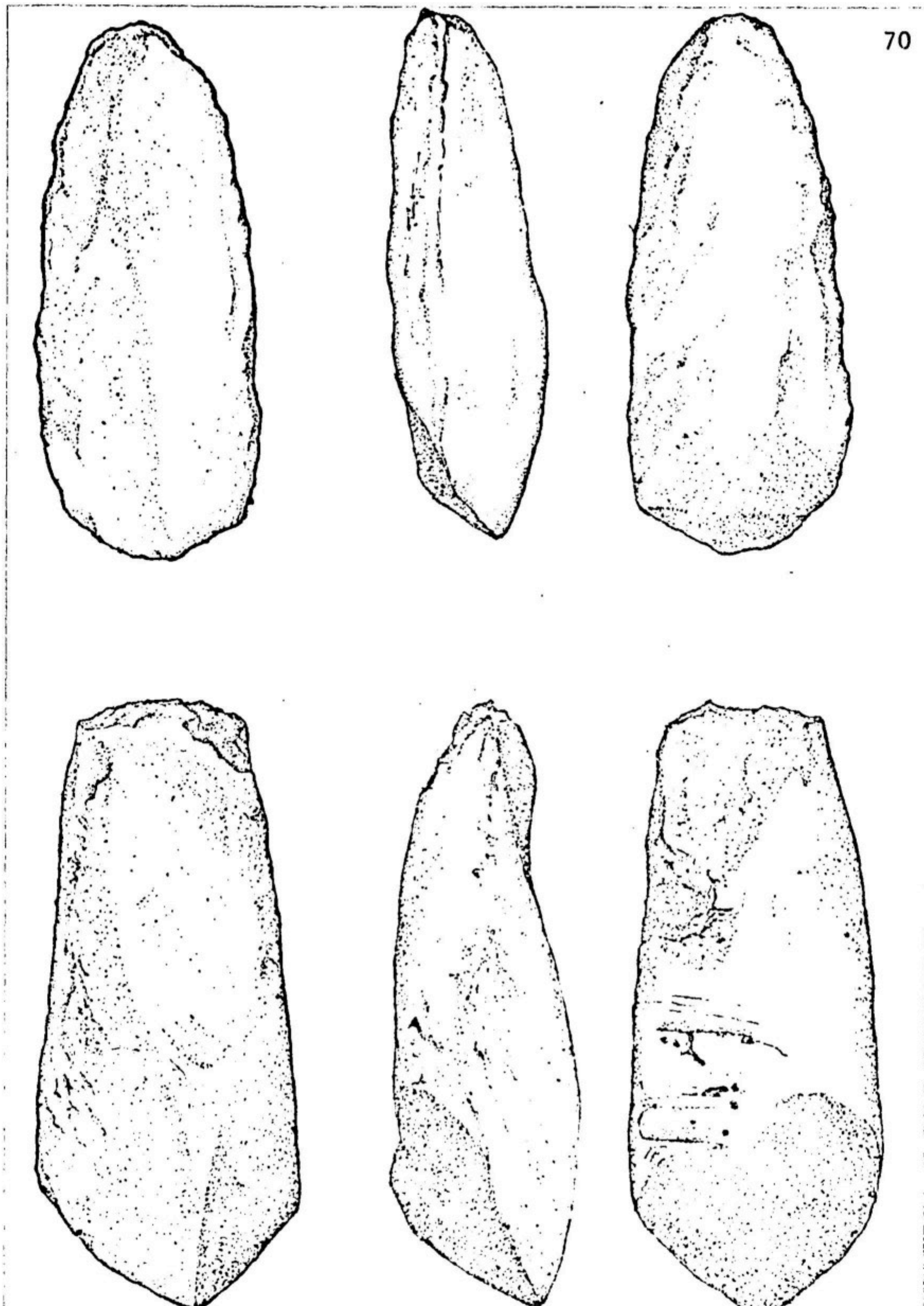
This type has the most distinctive cutting edge among the Micronesian adzes. These are the "beaked" adzes as described within Micronesia by Osborne (Type 2; 1966), Davidson (1971), and Rosendahl (1970).

Every beaked adze that currently exists in the collection from western Micronesia has been manufactured from the thick hinge portion of the giant clam shell, Tridacna. The exact manufacturing technique is not known and given the hardness of some shell fragments, grinding must have been only a final portion of the process rather than the main procedure.

The cross sections range from triangular to plano-convex with the back generally ground flat although in some specimens it is slightly convex. The poll is square to round with the round examples following the contour of the original shell. The most distinguishing variable on this adze is the shape of the bevel. The bevel is pyramoidal with the edges divided into two sides joining together at the apex of the bevel. The bevel is contained on the back of this type with a mean angle of $43.4 \pm 11.1^{\circ}$. The cut produced by this adze is generally narrow and more groove-like than other adzes. Given the almost 90° pyramoidal bevel, Osborne (1966:456) has called it a corner-cutting adze which seems plausible. Unfortunately, no ethnographic data are extant regarding the function of this particular type of adze. In any event, we may suggest that, given the unique shape of its cutting edge, the beaked adze was manufactured and employed for specific purposes which called for grooving cuts to be produced in the material worked.

There is little variation among the mean measurements within this type. However, when the means of the bevel angles between two sites, Angaur 19 and Ngerkeklau 1

Fig. 13. Type 4. (a) 26/Angaur 19, *Tridacna spp*. (b) 39/Pelilieu 1, *Tridacna spp*. Osborne 1968-69 collection.



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were compared statistically, the results demonstrated a probability of .999 of significant difference. Granted, the sample size is small, however, the total adze collection from Angaur 19 generally exhibits a lower bevel angle. This point will be further discussed later.

While all the beaked types found in Micronesia exhibit striking similarities, there seems to be a distinct distributional pattern, at least within western Micronesia. Palau, the southwesternmost island group in Micronesian, and thus the closest to Indonesia, has revealed the greatest amount of the beaked adzes. Osborne in his fieldwork has recovered twenty-four (24) of these adzes which is roughly 16% of his total collection of adzes. Yawata (1968) has described twelve "pointed axes" which are currently in the Tokyo University collections. Although these specimens of Yawata's are not illustrated, the variables fit well into this beaked type.

The northwest corner of Micronesia seems to be devoid of the beaked type. The Marianas display a total absence of these adzes. Thompson (1932) and Spoehr (1957), and Reinman (1970) do not describe nor illustrate any beaked types, and in my examination of the Hornbostel collection (comprising more than 4300 specimens), I found only one specimen (B.8478) which could be placed within this type. However, it is suspect in that Carolinian adzes are contained within the collection and this single specimen may not actually be Marianas in origin. However, like the other beaked adzes, this example was shaped from the Tridacna and exhibited a triangular, angled bevel with a pointed edge. The beaked adze is also absent from Gifford's sample from Yap nor does it appear in any of the literature from that area. The significance of this distribution will be discussed in Chapter IV.

Type 5

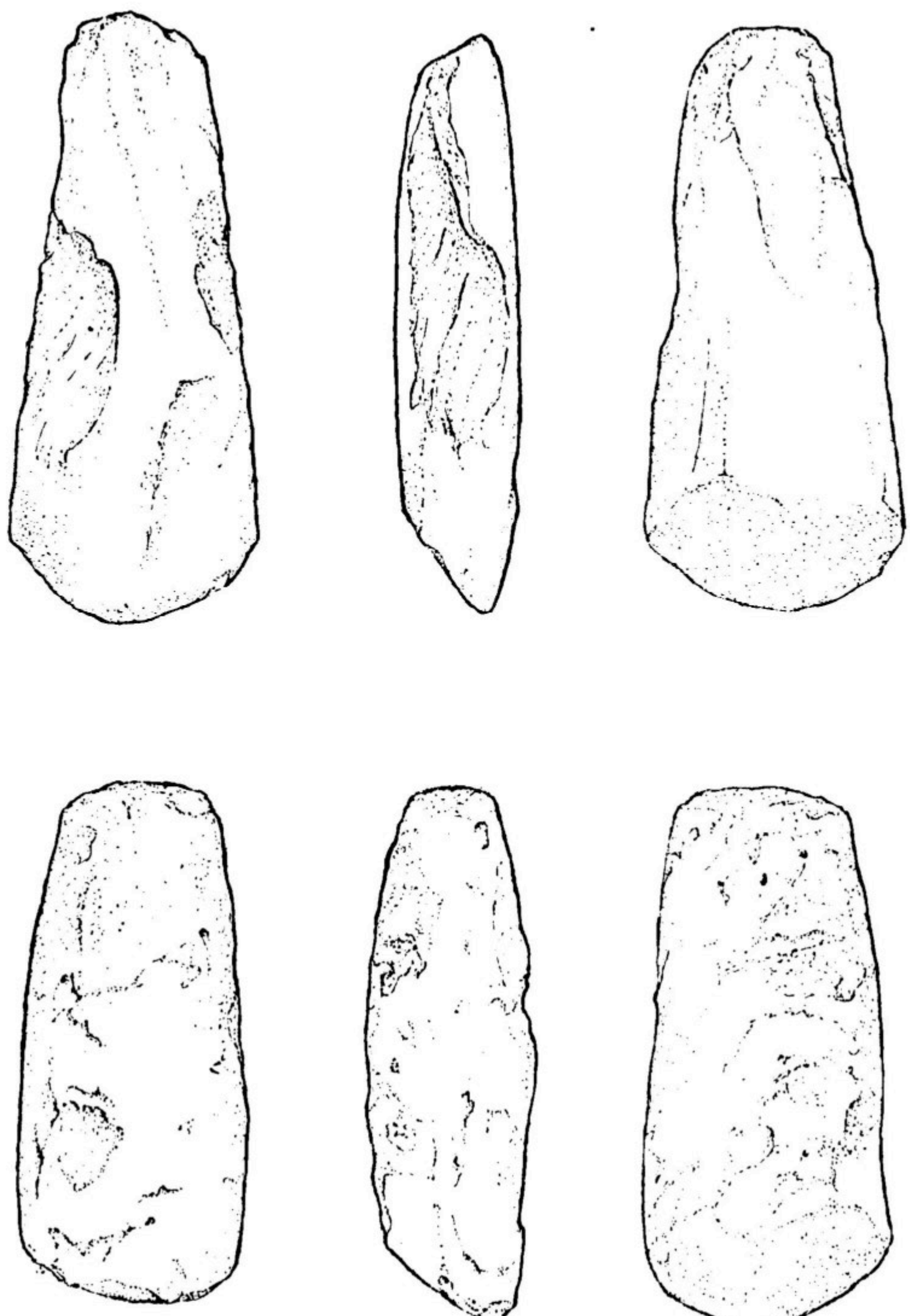
This type represents a distinct intermediate form on a continuum between the beaked adze, Type 4, and the Terebra adze, Type 6. These three types may have been functionally similar though the cutting edges of types 5 and 6 are much closer morphologically.

All adzes of this type are manufactured from Tridacna spp. Being relatively small (L $\bar{X}$=71.49), these adzes could have been manufactured from the hinge section of an adult crocea, or young to adult forms of T, maxima and gigas. Like Type 4 specimens, the hinge section was removed by percussion with the final shape being ground on all sides.

All specimens of this type have a plano-convex cross section with the back ground to a flat or slightly convex surface. The front is curved so that there is little differentiation between the front and sides. The

Fig. 14. Type 5. (a) 65/Angaur 19, *Tridacna spp*. (b) 45/Aulong 1, *Tridacna spp*. Osborne 1968-69 collection.

74



polls are generally square. The bevels are on the back with the edge forming a u-shaped curve.

These adzes are significantly shorter (P >.01) than the Type 4 population though tend to be about the same in width and thickness.

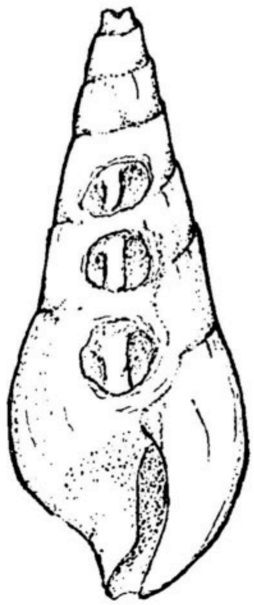
The Type 5 blades are smaller versions of the curved edge adzes found further to the east in the central Carolines. These eastern specimens have been observed as having much greater proportions, sometimes reaching 20-25mm. in length.

In this study, this type of adzes are found in both Yape and Palau and are absent from the Marianas.

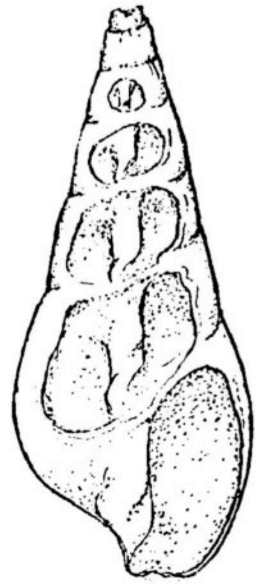
Type 6

This type is most easily recognizable because it is the only type manufactured from the Terebra and Mitra shells. Some authors (Gifford and Gifford 1959; Spoehr 1957) have classified these implements as gouges, given the curved cutting edges, however recently these tools have been included in adze typologies from Micronesia (Osborne Type 1; Davidson Type 1; Rosendahl Type 1). Illustrations (J. Garanger 1972) show these implements in an adze haft. Traditionally the Terebra adzes have been classified as a separate type; however, this type may be found eventually to merge with the preceding Type 5 in that the main criteria for separate classification lie primarily in the

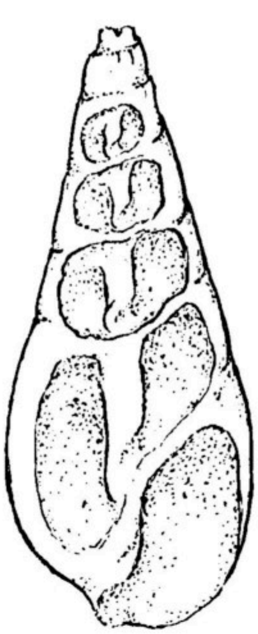
Fig. 15. Process of Type 6 Adze Manufacture, *Terebra maculata*. (a) 14/Angaur 19. (b) 13/Angaur 19. (c) 15/Angaur 19. (d) 62/Angaur 19. Osborne 1968-69 collection.



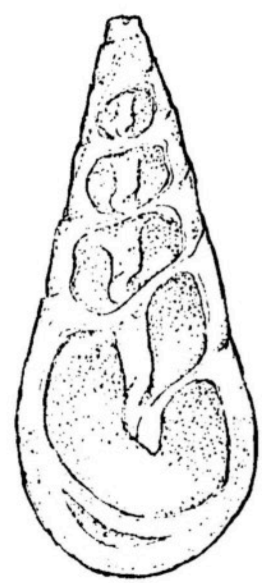
a.



b.



c.



d.

difference in manufacturing material and edge shape (Type 6 having a more u-curve bit).

The adzes of this type were manufactured primarily from Terebra maculata, although some Mitra mitra shells (Osborne 1966:451) have also been utilized. These genera are common on the reefs of the Pacific (the family Terebridae to which both genera belong comprise more than three hundred species) and are easily identified by their tapered, conical form. These shells are also heavier and more solid than other turret shells, thus making them more suitable as woodworking tools. Terebra maculata is the largest species within the family, with a normal range of 152-203mm. in length, with some specimens occasionally reaching 254-305mm. (Kira 1962:157). The largest complete Terebra adze from western Micronesia measures 133.35mm. although the mean length of these adzes is only 78.83mm. However, many of the broken specimens are estimated to have been in excess of 133.35mm. in their original length.

1. The exterior of one side of the shell was broken by pecking, producing an ever widening aperture (Figure 15a). The two specimens which demonstrate this stage both show the pecking process to be on the side opposite the last full spire, or terminal, end of the shell;

2. After the exterior had been pecked away, leaving the central spire of the shell exposed (Figure 15b), the process of grinding began. This was most likely done with a piece of coral or rough sandstone. This process served to smooth down the rough edges caused by the pecking and, more importantly, made it easier to haft;

3. It is assumed that the last step was the grinding of the bevel (Figure 15d), because it appears that the bevel angle was an important functional variable in adze construction. If this is true, then it would seem reasonable that the back would be finished prior to the shaping of the bevel so that a proper angle could be selected.

The general, descriptive attributes of the Type IB2 adze demonstrates exceedingly little variation, due entirely to the limitations imposed by the general morphology of the shell. However, the overall shape of this adze is triangular with the poll always being formed by the natural pointed end of the shell, though many of these adzes have the poll end missing, especially the larger, heavier specimens. This type also exhibits the widest range of bevel angles, though still having a mean close to the other type.

Davidson (1971:53) observed that some Nukuoro Terebra adzes had the poll and bevelled, possibly for

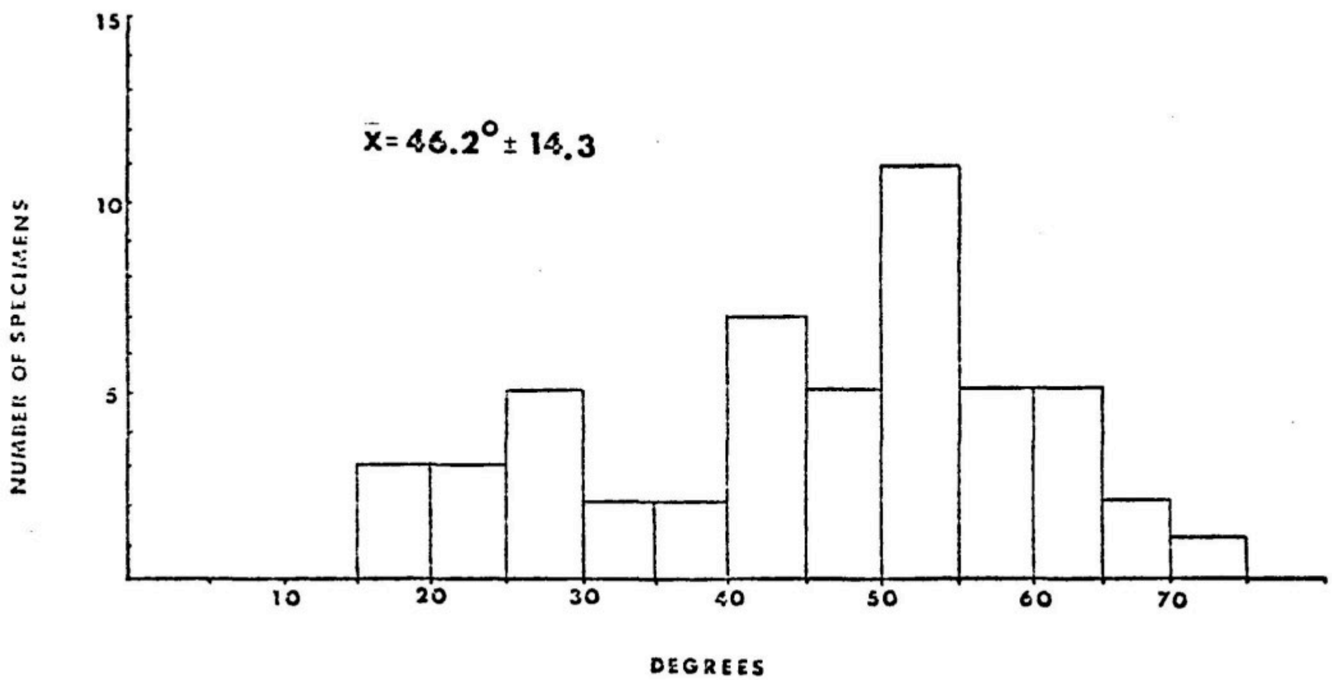


Fig. 16. Type 6: Bevel Angle.

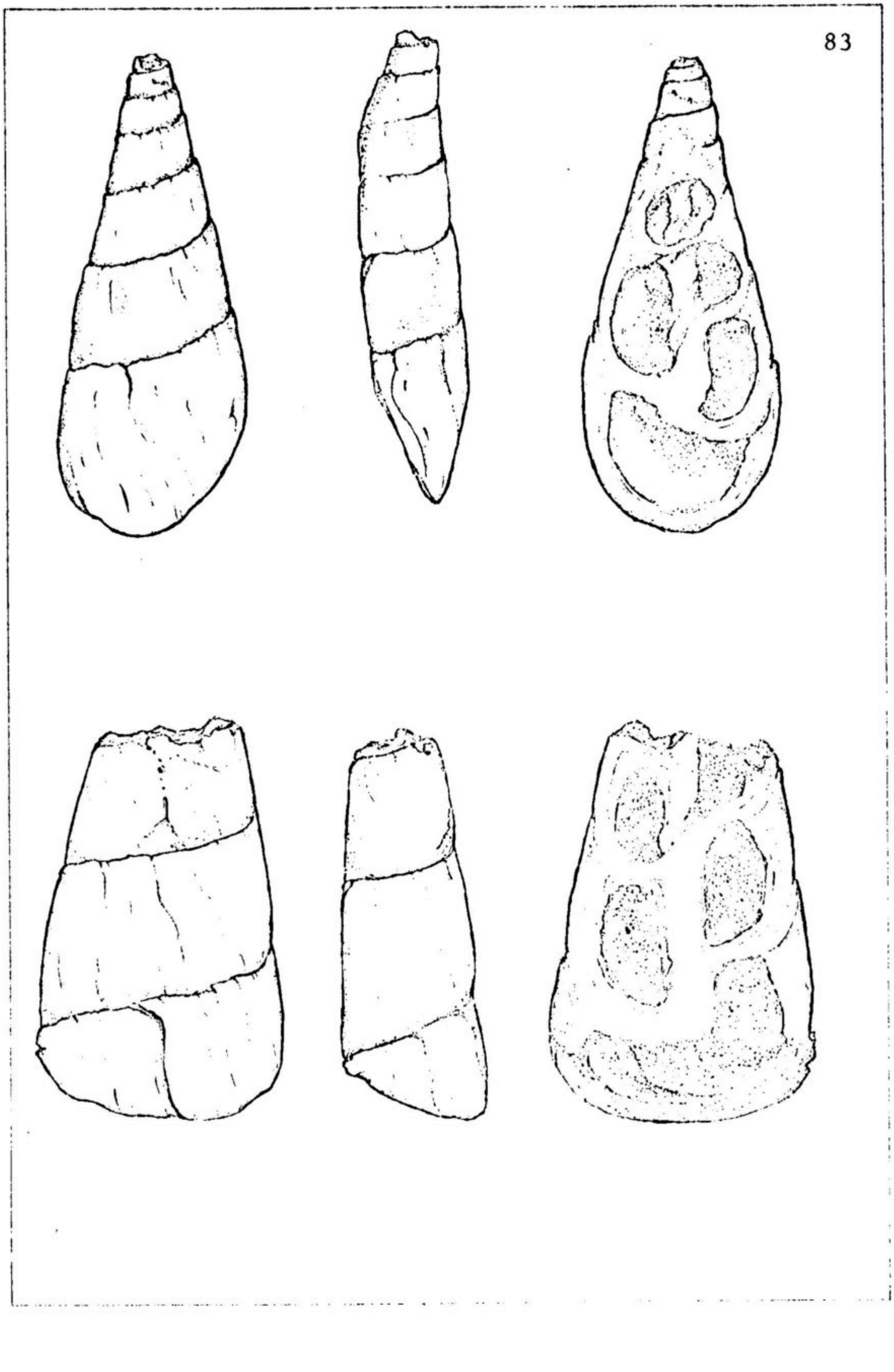
gouging purposes. None of the adzes of this type from Yap or Palau exhibited any bevelling of the poll. However, in the Marianas where few Terebra specimens have been collected or described, the Terebra forms often have only the poll end bevelled with the natural aperture left unmodified (Reinman 1970:Figure 38).

The section of this type is, invariably, plano-convex because of the natural curve of the exterior of the shell which forms the front. The sides are rather indistinguishable from the front as it slopes toward the flattened back.

All specimens examined contained a single bevel and revealed a u-shaped cutting edge. However, there is a difference in edges which, though similar in outline are set at different angles from the back. With the bevel set at a relatively low angle, the adze would cut a shallow, relatively thin groove. As the bevel angle steepens toward ninety degrees, the groove would both deepen and widen. As we shall see the angle of bevels are not random but rather demonstrate definite clusterings.

Within the sample area, Palau has the greatest amount of these Terebra adzes, comprising 43% of the Palauan sample and 24% of the total sample. Relative to this significant amount, the island groups of Yap and Marianas are almost devoid of this type of adze blade.

Fig. 17. Type 6. (a) 16/Angaur 19, _Terebra_ Maculata. (b) 4/Pelilieu 1, _Terebra_ _Maculata_. Osborne 1968-69 collection.


83

The three sites in Palau yielding these adzes, the ratio of these adzes to the total sample from each remains relatively the same. In the Marianas we get a different manufacture of Terebra.

Given this large sample of adzes made from Terebra there appears to be no significant statistical variation among or between sites of island groups. I would suggest that this is a function of the natural shell morphology.

Within the larger Oceanic area, these adze forms have been reported from all of the major insular areas (e.g., Polynesia, Melanesia, Micronesia). Recent survey and excavations in some of the northern Melanesian islands (New Ireland, Clay 1974; Solomons, Kirch and Rosendahl 1973) yielded no evidence of the Terebra adzes, however, they appear to be quite plentiful in Garanger's excavations in the New Hebrides (1972). Within the Polynesian area the Terebra blades have been reported from Tonga (Poulsen 1970), the Marquesas (Poulsen 1970) and most recently from Huahine in the Society Islands of central Polynesia (Sinoto and McCoy 1975).

Type 7

This is a rather general category which includes all the relatively heavy adzes manufactured from the hinge section of the Tridacna spp. and those which do not fall within the range of the other types. Some of these specimens are blanks and preforms in that no bevel had yet been ground. However, other specimens are in completed form and still retain their relatively massive characteristics. Perhaps, with future fieldwork, a larger sample can be obtained so that a more specific classification of these forms may be established.

These adzes are generally rectangular in outline with the single exception of 46/Ngerkeklau 1 (Figure 18) which has a pointed poll. They exhibit a straight cutting edge with the bevel possibly on the front, though underdetermined at this time. The cross section is roughly elliptical although the unfinished examples have an almost quadrangular section. Therefore, it is possible to suggest that in the process of grinding the body (all the finished adzes in this type are ground over the entire surface) the sides were rounded in order to achieve this elliptical section.

These adzes are found only within the Yap and Palau groups with the bulkier specimens entirely from Palau, though not concentrated within any specific site. These forms must have been used for the heavier cutting functions such as Buck describes in the Kapingamarangi sample. There Buck (1950:165-171) describes the thinner shell adzes (Type 1) as hewing while the heavier shell blades, similar in form to Type 7, as the implements used

Fig. 18. Type 7, 46/Ngerkeklau 1, *Tridacna spp*. Osborne 1968-69 collection.

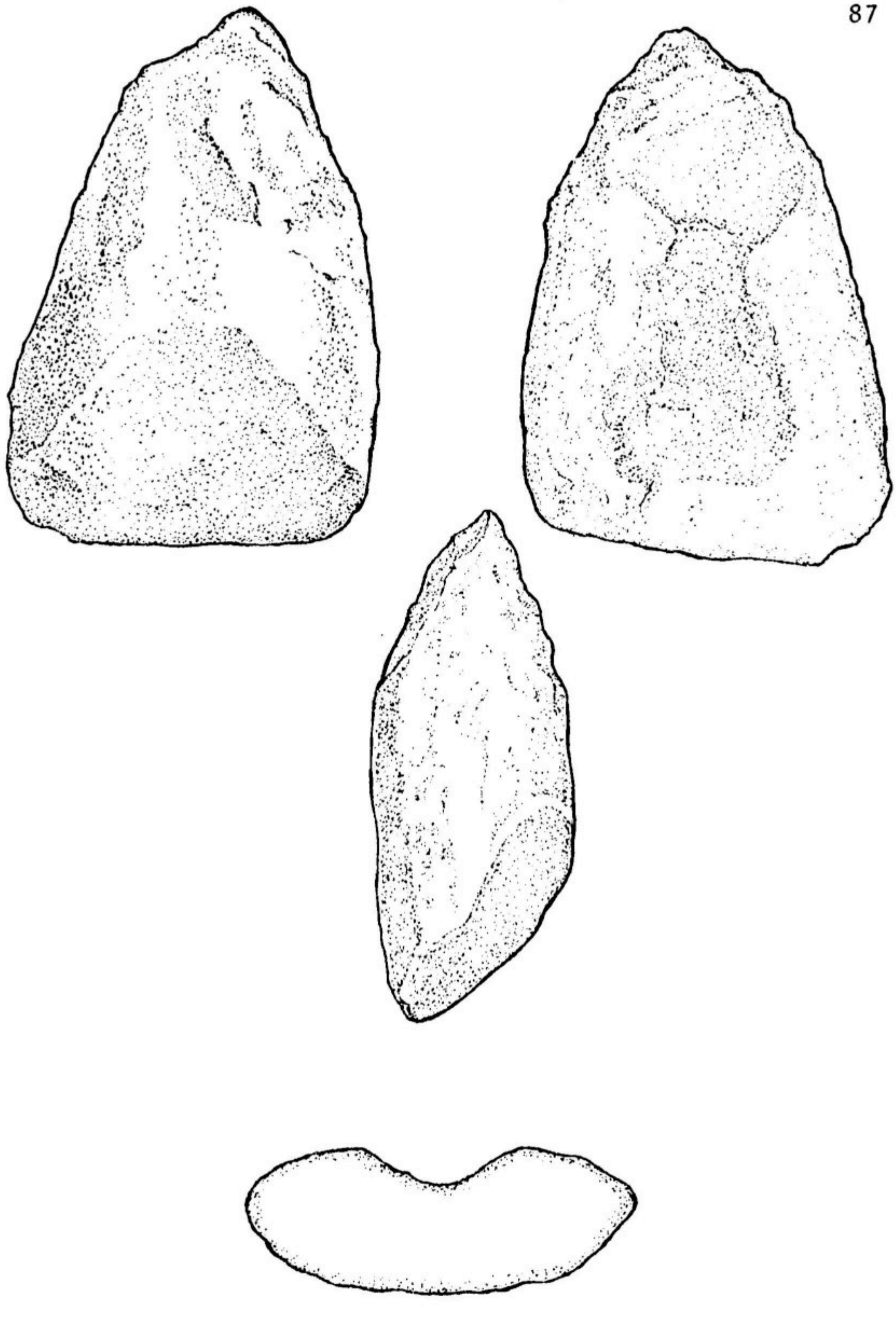


Fig. 19. Type 7, 100/Pelilieu 1, <u>Tridacna</u> <u>spp</u>. Osborne 1968-69 collection.

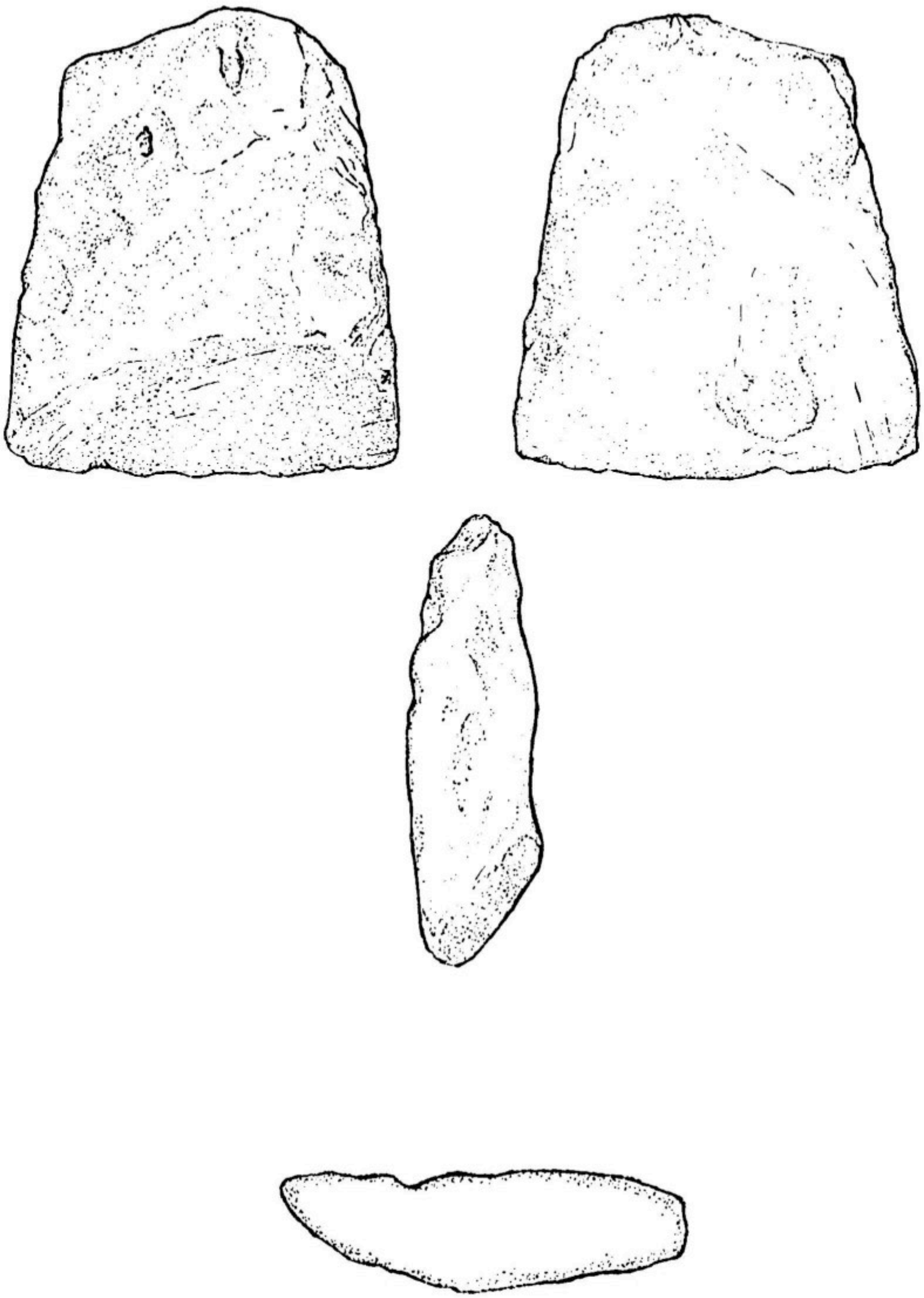
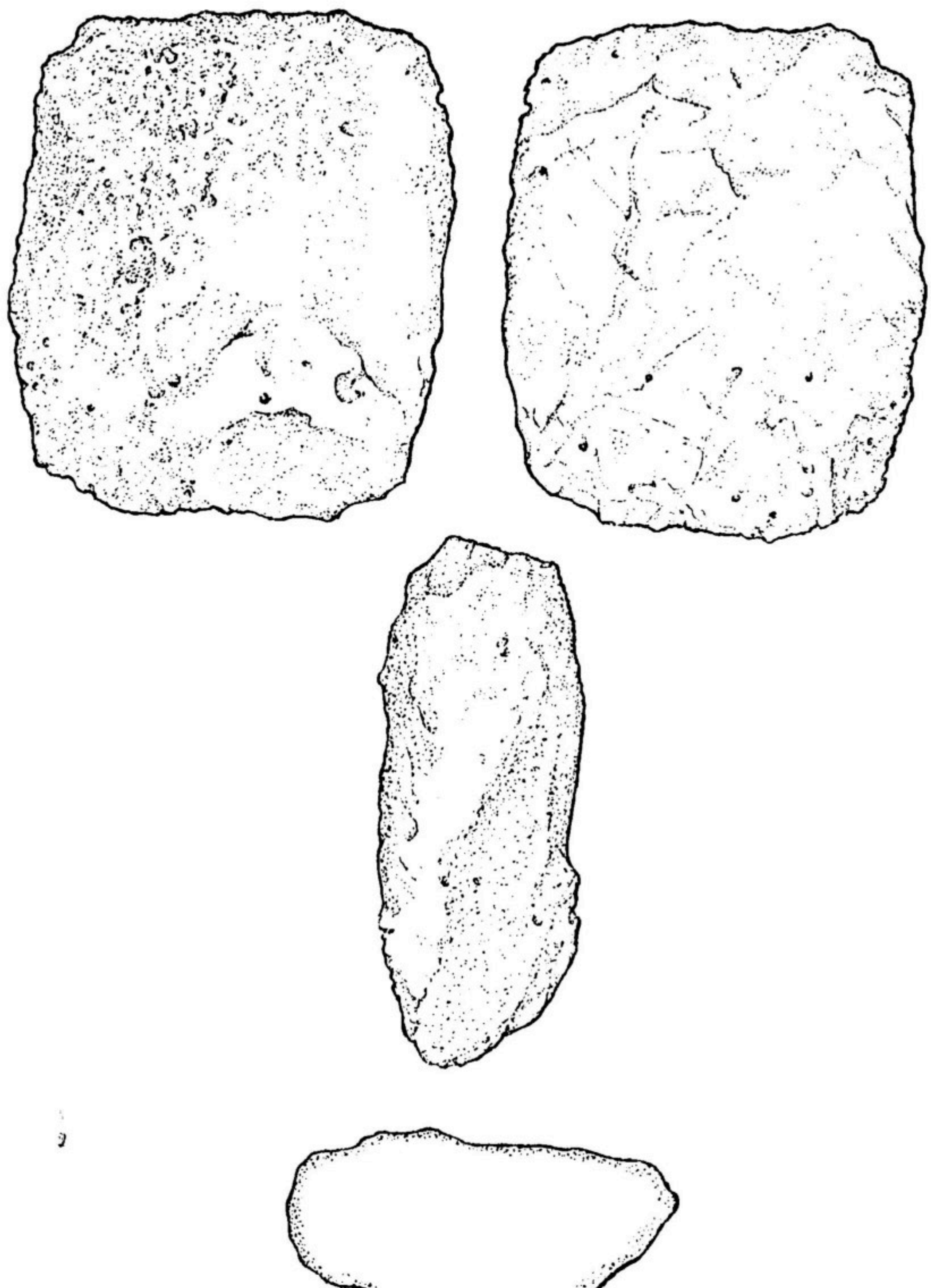


Fig. 20. Type 7, 61/Ngerkeklau 1, Tridacna spp. Osborne 1968-69 collection.



to cut out sections of logs for canoe building.

The possible implication for the restricted distribution of these forms will be discussed further in the next chapter.

Type 8

This group of adzes is unique to the island group of the Marianas and represents one of the two types which is exclusively manufactured from stone. This type corresponds to Type 1 as described by Thompson, Spoehr and Reinman.

All adzes of this type were manufactured from stone, specifically, basalt and andesite. Evidence of initial percussion flaking is found upon the few preforms in the collections, with complete grinding found on the finished forms. Some specimens approach a polished surface although, generally, only the bevel area exhibits a polished surface.

These adzes can be subdivided into two varieties dependent upon their overall size while maintaining the identical morphology. The first group (A) consists of the large, heavy specimens ($\bar{X}L=87.2\pm10.3$; $\bar{X}=33.1\pm10.4$). The cross section of these adzes are circular to slightly oval. On some specimens, the poll section is more circular with the edge section tending toward oval. This is due to the fact that some adzes are reduced in thickness toward the

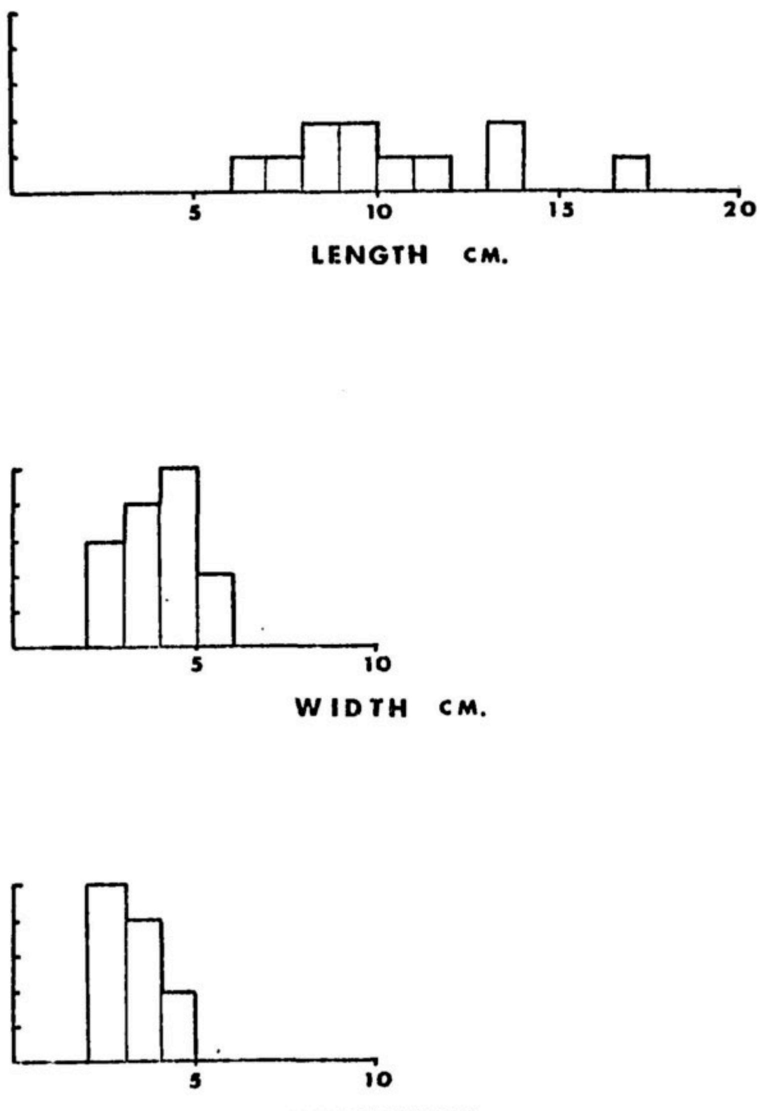


Fig. 21. Type 8: Morphological Variability.

Fig. 22. Type 8, 1522/Guam, Basalt. Osborne collection.

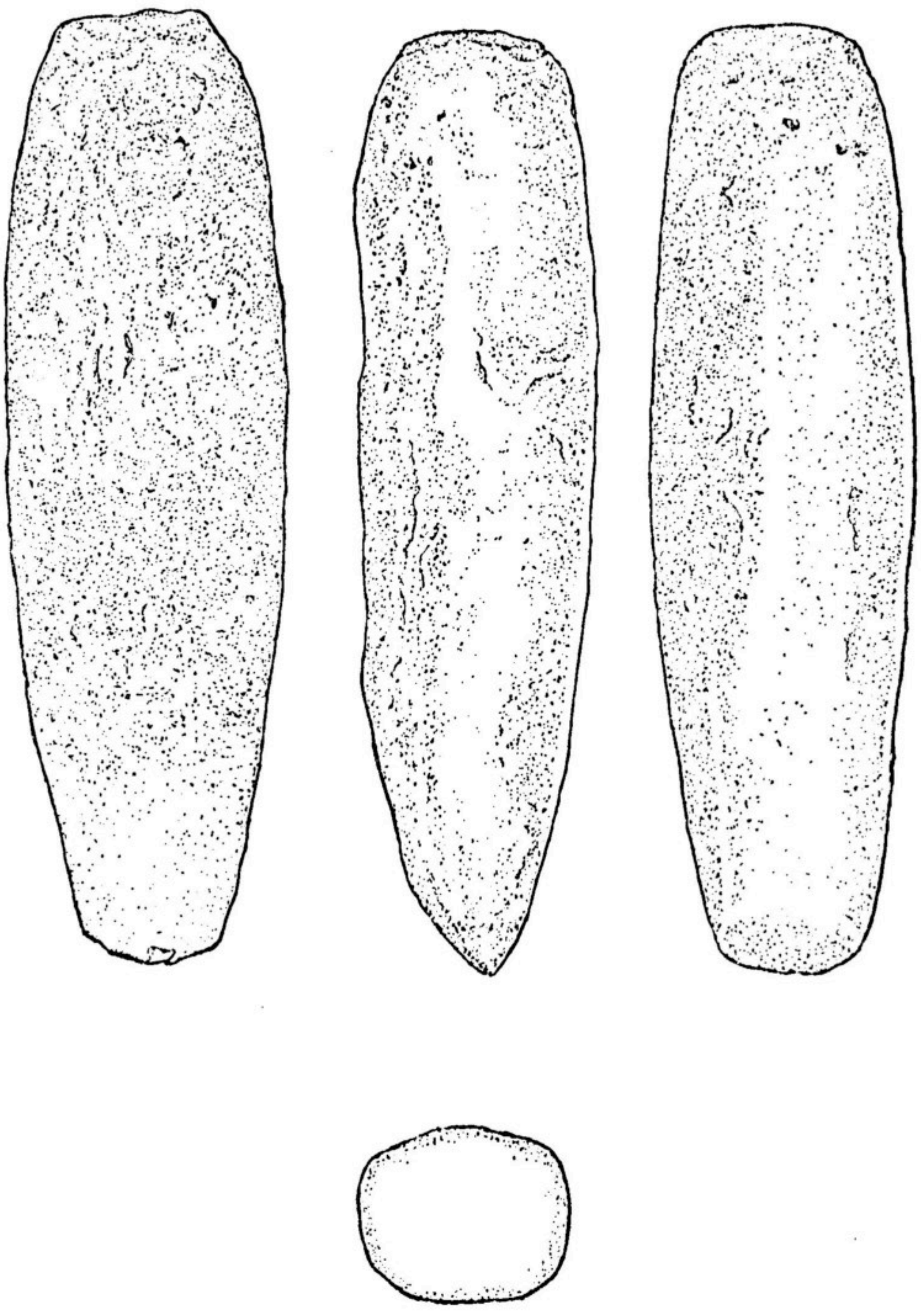
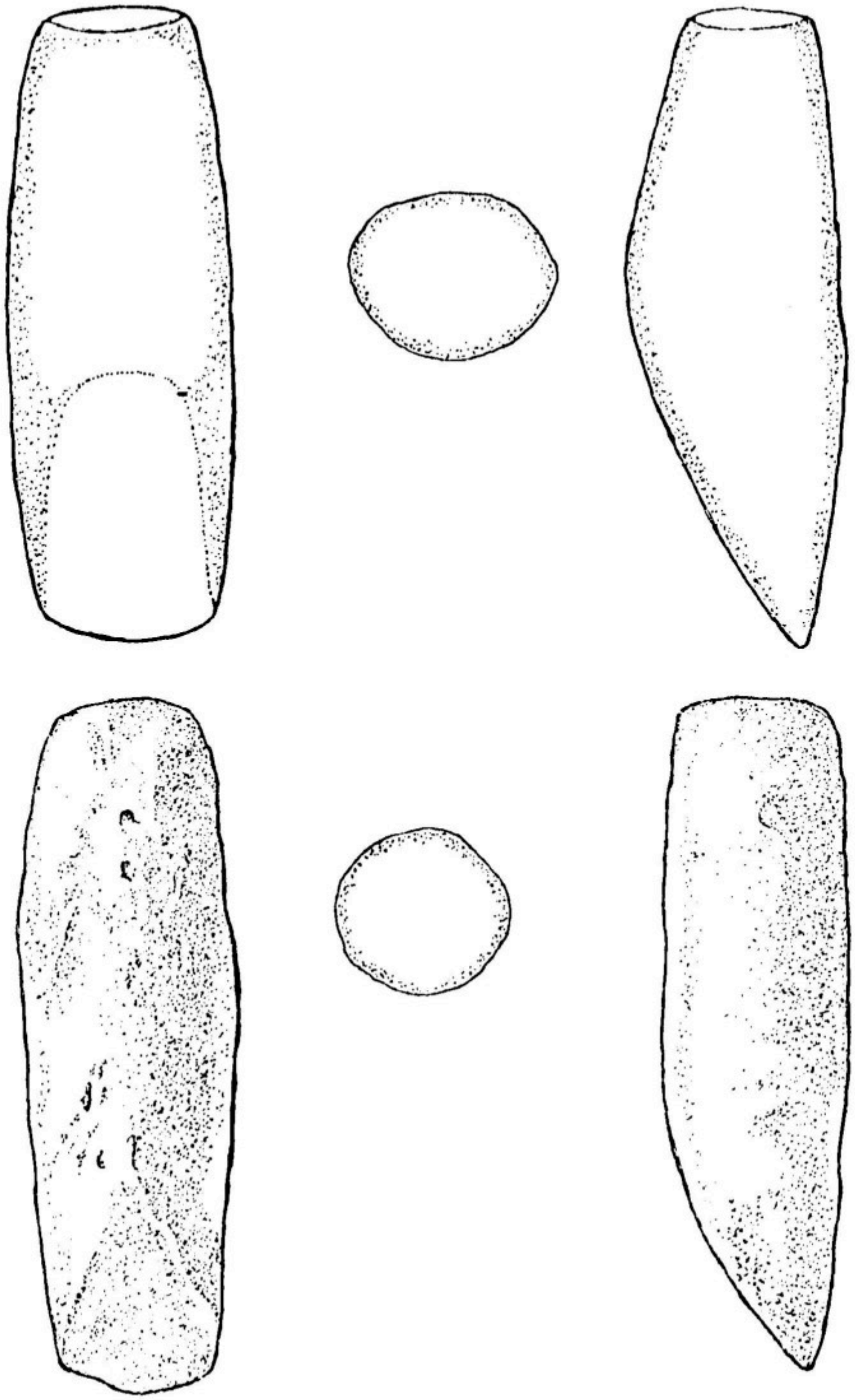


Fig. 23. Type 8. (a) Marpo Valley, Tinian (after Spoehr 1957; Fig. 63). (b) MaGI-2, Guam (after Reinman 1970; Fig. 23a).

97



edge, almost in a reversed tang manner. The poll is square and often flat. The bevels are generally steep with a mean angle of $55.0 \pm 6.9^{\circ}$, and the cutting edges range from rather straight toward u-curved. However, these large varieties tend to have a straight edge more often than the smaller varieties of this type.

Variety B consist of significantly smaller group of these adzes which have been classified as gouges by both Thompson and Spoehr. In form, they represent smaller specimens of Variety A ($\bar{X}L=43 \pm 7.4$). These smaller adzes generally have a more u-curved cutting edge with a bevel angle of $52.3 \pm 7.8^{\circ}$.

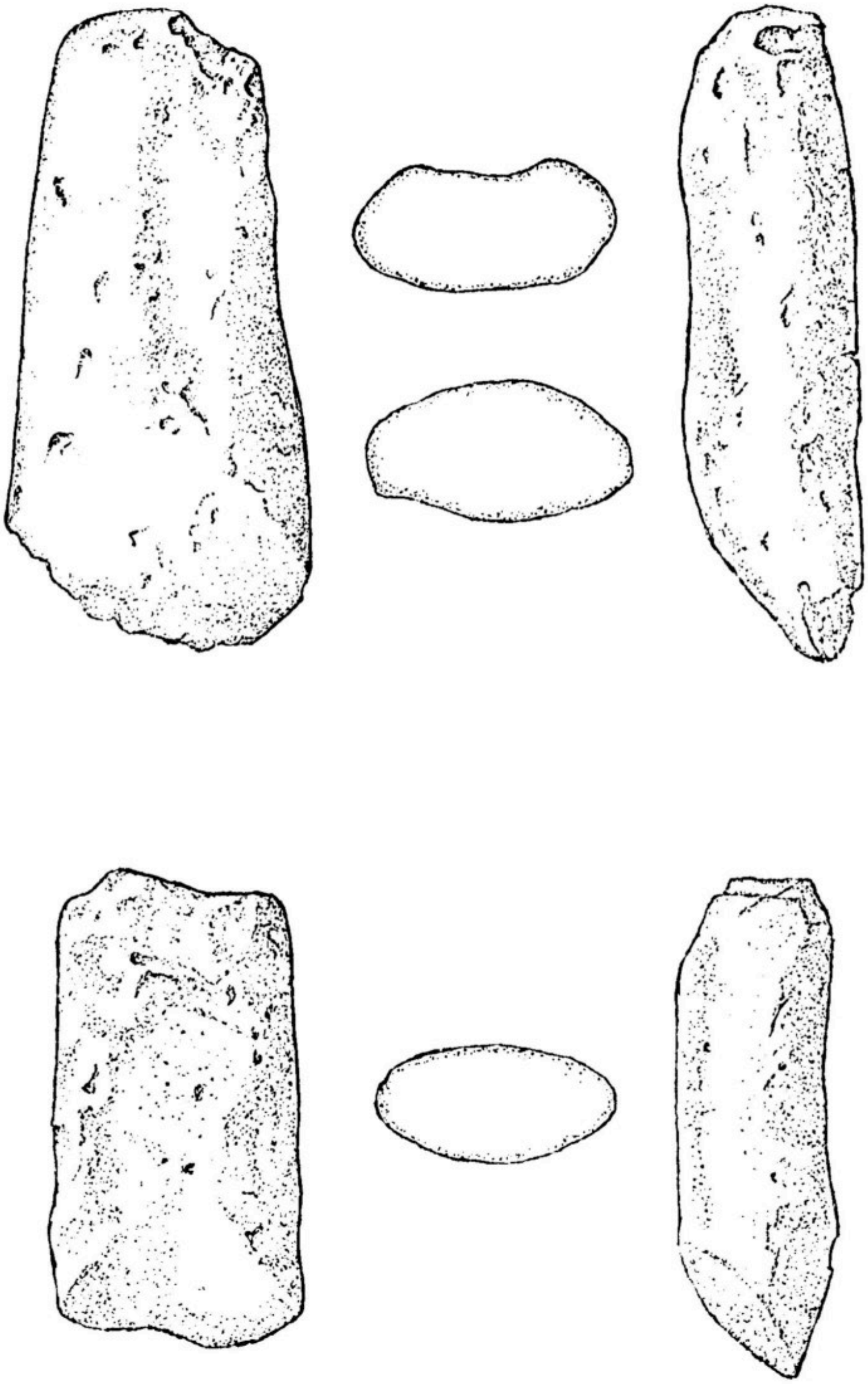
As mentioned above, these adzes are found only within the Marianas and are only made from stone. Interestingly, the size and morphology of most of these adzes would fall within the capabilities of the hinge section of the Tridacna.

When plotted on an histogram (Figure 21) the lengths of these adzes form a somewhat linear pattern. Even so, the other dimensional attributes remain constant. I would suggest that this variability in length may be a function of wear, resharpening and reuse of these implements.

Type 9

This final type represents a small aberrant group

Fig. 24. Type 9 (after Reinman 1970).



into this Type 1 (Stone) and Type 2 (Stone). However, there do appear to be valid distinctions between the above types and these particular specimens and as such a new, separate type was created.

This type also represents the only other group in this typology which is manufactured exclusively from stone. All specimens were ground from basalt with no evidence of polishing.

While the Type 1 adzes have an elongated elliptical cross section, these Type 9 blades are thicker and therefore have a more fully elliptical cross section. In outline, the specimens exhibit a fully rectangular shape. The cutting edges vary from straight to a wide curve with the straight edge specimens contained on a double bevel.

All were whole and were relatively short vis a vis Type 8. As in the Type 8 group, length may be a function of use and resharpening which would account for the variability of this attribute relative to the other metric attributes contained in this sample.

No specimens of this type have been found in the Spoehr collection nor observed in the illustrations of Egami and Takayama. To date, Reinman's work in Guam has yielded the only samples and in his most recent work, Reinman has recovered another specimen (personal communication). While having an unquestionably elliptical cross section, this type of adze comes the closest to resembling the traditional Oceanic quadrangular adze within the Micronesian area.

CHAPTER IV

SUMMARY AND CONCLUSIONS

In this study, adzes manufactured from shell and stone were measured, recorded, and analyzed. These implements were archaeologically obtained from the major island groups of western Micronesia. From the total sample, nine types, based upon morphological attributes were extablished (Figure 6).

By far, the source material most commonly exploited was Tridacna spp. (table 1). Basalt was the most commonly used stone material. As indicated in Table 1, Tridacna spp. accounted for five of the nine types. Excluding the two types (8 and 9) made entirely from stone, Tridacna specimens exclusively comprise five of the seven types containing shell blades.

The use of the outer shell of the giant clam is reflected in Types 1 and 2. The thick hinge portion of the Tridacna was employed in the manufacture of Types 4, 5, and 7. Because of the mass extant in the hinge section much more internal variation is apparent in the above three types than is found in the two types manufactured from the outer portion of the shell. In none of the types

TABLE 1

SHELL GENERA USED IN ADZE TYPES

GENUS	TYPES									TOTAL
	1	2	3	4	5	6	7	8	9	
TRIDACNA	X	X	-	X	X	-	X	-	-	5
TEREBRA	-	-	-	-	-	X	-	-	-	1
CASSIS	-	X	X	-	-	-	-	-	-	2

where *Tridacna* specimens are present is there a combination of hinge and outer shell specimens.

The other two genera of shell represented in this typology, *Cassis* and *Terebra*, each comprise a separate type resulting from the natural limitations of blade morphology inherent in the shells themselves. While dimensional variation (length, width, etc.) exists within these exclusive types, this is entirely due to the natural morphology of the shell selected for manufacture and they do not appear to have been selected to conform to any recognizable pattern.

Despite the heavy reliance upon shell as artifactual material, excavations from western Micronesia yield only a small percentage of these genera except in the form of artifacts. The *Cassis* and *Terebra* shells do not appear to have been exploited as food materials and due to the grinding and pecking in the construction of the shell adzes little residual material would remain. However, the situation is different with *Tridacna*.

Ethnographic descriptions (cf. Kramer 1926; Emory 1965) have indicated that the meat of the *Tridacna* clam was exploited as a food source, yet residual shell is rare in middens. This suggests that while *Tridacna* was important as both a food and an artifactual material source, these usages involved separate, independent gathering activities. Emory (1965) describes a chant from Kapingamarangi which relates the harvesting of the meat of the Tridacna. The chant tells of the removal of the clam muscle but there is no mention of the removal of the shell. Since this harvesting often takes place at a significant depth underwater and given the potential weight of these shells, the negative evidence here strongly suggests that the shell is left in place. This would help explain the significant absence of this genus in middens despite its multiple uses as artifactual material.

MORPHOLOGICAL CONSIDERATIONS

An important aspect of this study has been the analysis of the relation of adze morphology to source material. As stated in chapter 1, this relationship previously was generally assumed to be an unimportant consideration. However, this typology offers new data against which these hypotheses may be evaluated.

First, there do appear to be significant differences among types dependent upon the source material utilized. That is, types are generally composed of spceimens made entirely of stone or entirely of shell. Nevertheless, the range of variation among shell types can be significant when the hinge section of the Tridacna is utilized. The range of variation of adzes from this section of the giant clam shell was seen to wide enough to warrant four separate types. Therefore, Poulsen's hypothesis regarding shell adze variability is essentially correct, as far as he goes. That is, if the shell adzes are manufactured from the thin outer section of the *Tridacna* or other small, thin shells, then the variability will be expected to be minimal (i.e., Types 1-3). However, variability among types can be expected to be much greater if the implements are manufactured from the hinge section of the *Tridacna*. Consequently, with the potential for increased variability among shell adzes the potential for becoming significant indicative artifacts correspondingly increases.

The morphological capabilities of the hinges section are quite large although there do appear to be limitations as a result of the mineralogical structure of the shell itself. For example, no specimens made from the hinge were observed to have a quadrangular section, rather in general, the cross sections had a plano-convex to oval/round configuration. This appears to be the result of the layered shell structure of the *Tridacna*. These layers lie in a slightly curved (i.e., convex) configuration and as such would make it difficult to shape an adze with four flat surfaces. This, however, does not negate the possibility of stone types being reproduced from the hinge section. A notable example, Type 5, the beaked adze, is manufactured entirely from stone in the Indonesian area (Duff 1970) and entirely from shell in the Micronesian region. Having the same morphological characteristics as the Indonesian stone specimens, the Micronesian beaked adzes are manufactured from the hinge section of the Tridacna.

Traditionally, in Pacific archaeology, the cross section has been emphasized, perhaps overly so, as an important diagnostic variable within adze collections. In the initial phase of this study it appeared that the cross section would not play an important role in the classification of these adzes. However, when the attributes were analyzed, relative to the flowchart decision points, cross section was found to generally account for the largest amount of variation between types.

Specific cross sections were generally found not to be determined by source material although potential variability increases with the use of stone and the hinge section of Tridacna spp. even though some types exhibiting specific cross sections were made entirely of stone or of shell.

It was discovered that the elongated elliptical cross section proved most useful to separate the numerically dominant group of relatively thinner adzes but accounts for little of the variation within that general group. On the other hand, cross sections account for much of the variation within the other (line B) group, with many types primarily determined by the shape of the cross section.

One last aspect of shell/stone utilization concerns is that at least in western Micronesia shell utilization, or the extent of same, is closely dependent upon the availability of other suitable material (i.e., stone). In other words, in the Marianas shell types are limited to a single type, Type 1. All of the heavier, thicker Marianas types are manufactured from stone. No specimens manufactured from the hinge section of the Tridacna have yet to be recovered from the Marianas and I would suggest that none would be expected. In Yap and Palau, where little usable stone exists for adze manufacturing, there is a greater increase in shell usage, primarily the hinge section as would be expected. As a result I would like to offer the following hypothesis: in areas where suitable types and amounts of stone are available, shell adze types will exhibit less variation, largely as the result of minimal use of the hinge section because the stone types will be designed to undertake the heavier types of cutting tasks.

CULTURE HISTORICAL IMPLICATIONS

Temporal Considerations

Of all the problems explored by this typology, the temporal aspect was the least rewarding. However, this was not totally unexpected given the relatively small total sample and that little stratigraphic data exist, relative to adze types. In conjunction, all surface sites from each island group could be classified as late prehistoric protohistoric.

The majority of the Palaun sample was surface collected from the sites of Pelilieu 1, Angaur 19, and Ngerkeklau 1. No radiocarbon dates are available from these sites and associated artifactual material (i.e., ceramics) tend to indicate a late occupation of these areas. In fact, Osborne has placed them into his late period (1400-)(Osborne 1966:460). The fact that few subsurface adze blades have been recovered from the Palaus is due in part to the fact that the vast majority of adzes are shell and that, generally, the volcanic soils in the large islands of this archipelago are extremely lateritic, thus destroying organic material through natural decay. In fact, the three sites from which this Palauan sample was collected all have a calcareous soil composition thus allowing better preservation of organic material such as shell.

Given the lack of a well defined sequence of adze types in the Palaus, Yawata's hypothesis regarding a change over time from stone to shell has not definitively been solved. However, I feel that the extant evidence demonstrates the need to reject his hypothesis. In the sample of Palauan adzes, only three stone specimens were recovered, all from the surface. One would expect that if the earlier periods of Palauan prehistory witnessed the usage of stone implements that these tools would have been recovered even in those areas where soil condition negated the possibility of shell retrieval. This negative evidence becomes more apparent with each excavation undertaken in the Palauas. Yawata also disregards the environmental data (limited availability of suitable lithic resources in Palau) and its limitations upon his hypotheses.

Secondly, since Yawata's article was published in the 1940's, research has shown the utilization of shell in areas further to the west of the Palaus implying that shell utilization was not a unique phenomenon of peopling entering Oceania but rather a well established tradition by the time such movements began. Fox (1970:62) describes large <u>Tridacna</u> adzes associated with a burial in the Duyong Tabon Cave on the island of Palawan in the Philippines. Radio-carbon determinations for this burial yield a date of 4630$\pm$250 B.P. (2680 B.C.). In another cave approximately 250 kilometers north of Duyong Cave another burial was uncovered which contained Tridacna adzes although this was not dated (Fox 1970:64). Casino (1965) has also reported tools and fragments of Tridacna on the islands of the Sulu archipelago. These sites have yielded the same type of assemblage as found by Fox in Duyong (Fox 1970:64). Given this distribution it is not inconceivable that additional areas, at least within the Philippines will be found to have implements manufactured from shell (Tridacna). Warren Peterson has also recovered Tridacna adzes (similar to Type 1) from his excavations along the east coast of northern Luzon (personal communication). Pearson (1969:84-85, 122), also describes the discovery of shell adzes (again Tridacna) in his excavations in the Ryukyu chain.

The majority (85%) of the total Yapese sample was recovered from the Pemrang site in the southern top of the island group. Adzes were found throughout all levels of the site, the earliest of which has been radiocarbon dated to A.D. 176 (Gifford and Gifford 1959:195).

To date, the Marianas offers the most stratigraphic data from western Micronesia, even so we are limited to a single site. This site, located on Talofofo Bay in Gaum (GI-23), yielded a sample of 36 adzes of which only 5 (.14N) were collected from the surface. All of the surface finds were stone specimens of types 1B,8,9. Shell specimens appear to be numerically dominant in all of the lower levels, becoming 100% of the adze sample from the lowest two levels. This stratigraphic disparity of stone to shell adzes evident in this site as well as the relative densities of thick/thin blades extant in Palauan sites may be explained by employing the curated/expedient dichotomy devised by Binford (1973).

While observing the hunting activities of the Nunamuit Eskimo, Binford found that in the movement of these peoples some tools were used and left while others were carried with them from site to site. He also observed that there was a significant correlation between the amount of energy expended in the manufacture of a tool and its "curation." A tool which required a large output of energy (e.g., a ground stone adze) once produced or purchased is carefully curated and transported from place to place (Binford 1973:242). Conversely, expedient tools were generally manufactured, used, and left at the same site, involving less investment upon the individual manufacturer.

Relating this to the Micronesian situation we may suggest that the tools made from stone and the thick portion of the <u>Tridacna</u> would have involved more energy output than the outer <u>Tridacna</u> shell blades. As a result we should expect a larger number of these thin blades. Therefore, the paucity of stone adzes in the lower levels from Guam may be more a result of sampling error due to the expected lower numbers of stone adzes in these levels. It would also be expected that the curated tools would have a longer "life" in that they would be used until they were lost, broken, or became useless. In the Palauan sites, there is a greater number of thin blades than thick specimens and this too would seem to substantiate Binford's classification.

Spatial Aspects

While the temporal aspects have yielded little definitive data, the spatial distribution of types in the western region offers some interesting problems. As seen in table 2, there are definite differences between island groups relative to the distribution of certain adze forms.

The Palauan sample, the largest and typologically the most diverse, varies little among the three sites sampled. All of the types made from shell are in evidence in Palau with only Types 8 and 9, exclusively stone types, being absent. Numberically, the most dominant type in the Palaus is the Terebra (Type 6) adze, followed closely by Type 1, both rather expediently manufactured. Given that these Palauan sites are all contained within the later periods of Palauan prehistory and that they represent opposite geographic ends of the Palauan archipelago, it seems likely that the basic adze kit of this island group

TABLE 2

SPATIAL DISTRIBUTION OF ADZE TYPES

ISLAND GROUP	TYPES									TOTAL
	1	2	3	4	5	6	7	8	9	
PALAU	X	X	X	X	X	X	X	-	-	7
YAP	X	-	X	-	X	X	X	-	-	5
MARIANAS	X	-	X	-	-	X	-	X	X	5

X--present in collection

consists of Types 1, 4, 5, 6, 7 with minor local variations. Additionally, the recent Osborne collection employed in this study appears to vary minimally from his first collection obtained from other areas within the archipelago.

Palau differs slightly from Yap in terms of the type groups present; however, this should not necessarily be construed as an inter-island influence of adze styles. Examining table 2, we find that three of the five types which Yap and Palau have in common are also found in the Marianas (Types 1, 3, 6). All three types represent forms which are found throughout the Pacific and also represent three different genera of shell; Tridacna, Cassis, and Terebra, respectively. The remaining two types (5, 7) found only on Yap and Palau in western Micronesia would be expected in those areas where shell is the primary source material. In other words, these two types represent the heavier, thicker blades which are generally manufactured from stone when lithic resources are available. Therefore, stylistic similarities may be more a result of functional considerations than cultural contacts.

Within the entire typology the most significant type may be the Beaked adze, Type 4. Its unique form has definite parallels in the southern Indonesian area and it also appears to represent a stone shape having the same basic metric attributes which is exclusively manufactured from shell outside of the Indonesian area.

In other parts of Micronesia, Davidson (1971) reported two specimens of the beaked type from among the total sample of 156 adzes she collected from her survey and excavations in Nukuoro atoll in the southeast Carolines. In addition, Vern Carroll has collected two other specimens of the beaked type from this atoll (Davidson personal communication). Three more specimens from the Carolines, though not identified with any particular island group, are located in the general Micronesian adze collection at the Bishop Museum and have been described by Rosendahl (1970).

Davidson also suggests that beaked adzes are "quite numerous" among the islands in the northern Solomons and in other areas of northeastern Melanesia. However, reports of recent archaeological fieldwork in Anunta in the Solomons (Kirch and Rosendahl 1973) and in New Ireland (Clay 1974) do not list nor illustrate the beaked type in their classification of excavated material.

The beaked adze also appears in some early descriptions of Micronesian material culture, most notably, the Ergebnisse Der Sudsee Expedition series. Although some of the illustrations are ambiguous at best, beaked adzes were described from the Carolines (Tobi, Mogemog, Woleai) and also in some islands of northern Melanesia (Luanguia, Nukumanu, Sikiyana). Yawata (1942:254) reported beaked specimens from Jaluit in the Marshall Islands. In this typology of southeast Asian adzes, Duff (1970) states that the "Beaked-Pick" adze complex, his Type 7, represents an important focus of typological development in the southwestern extremity of southeast Asia. He further suggested that the Beaked-Pick adze complex was a late development in southeast Asia primarily because of their limited distribution, though no specific dates have been associated with these artifacts. I would not disagree that this adze form may have occurred relatively late but would not want to suggest any particular time period given the paucity of associated data.

Unfortunately, the Micronesian adzes have little available data for chronological considerations. Osborne (1966) has assigned the sites from which these adzes were recovered to his Late period (A.D. 1400-).

If there is any significant pattern to the distribution of beaked adzes within Micronesia it lies in the fact that they are relatively more common on the southwestern corner (i.e., Palau) and appear to become increasingly rare eastward. At the same time, they extend in a similar eastward direction along the northern Melanesian islands bordering Micronesia. The beaked adze is completely unknown in Polynesia.

However, this pattern of distribution may reflect a functional consideration rather than any temporal significance. The beaked adze, with its rather unconventional cutting edge, represents an unique form and as such most likely was utilized for a specific set of activities. All other adzes contain either a straight or curved cutting edge and thus it would appear that the shape of the bit would not be the main determinant for their use in a given situation. Therefore, I would suggest this is not the case with the beaked adze.

It seems reasonable that the beaked adze entered the western Pacific from southern Indonesia (Celebes) and moved eastward through Micronesia and northern Melanesia, though never reaching, or possibly never adopted by, the Polynesians.

Therefore, what Duff described for the southeast Asian area were the progenitors of the Oceanic beaked adze and that, at least the Indonesian variety has a far greater distribution than originally hypothesized.

One hypothesis can be offered for the adoption of this blade for the Palaus. Osborne has described the change over time of club house types similar to that found on Yap to the carpentered house types, similar to those of Indonesia, which are still characteristic of the

Palaus (personal communication). If this influence is indeed from Indonesia then the introduction of this specialized type of cutting implement may have also been adopted for specific carpenter activities associated with the new forms of house types. Of course this is not testable yet, given the current data but may be tested for association of this type of blade with the later, (i.e., Indonesia) house styles.

The Marianas sample differs from the Palauan sample in that there are fewer types extant inthis group and all the adzes examined fall readily into three types (1, var A&B, 8, 9). Two other types are also found in the Marianas, Types 3 and 6 (Cassis and Terebra) although in small numbers. The sites which produced a sufficient sample of adzes demonstrate a consistent patterning. The shell specimens are the most numerous while Types 8 and 9 exist in smaller numbers. The similarity of forms within the Spoehr and Reinman collections are also repeated in the collections of Egami and Takayama, and Hornbostel.

The circular (Type 8) adzes of the Marianas are unique to this island group within Micronesia. Interestingly, this adze form is within the capabilities of the hinge section of the Tridacna as evident in the length and thickness of other hinge shell types. Duff (1970) has identified circular section adzes within his Focus 1 and

Focus 2; mainland S.E. Asia and Philippines, South China, respectively. This adze form according to Beyer dates from the early Neolithic of the Philippines ca. 4000-2250 B.C.

As often mentioned in this study, stone specimens are almost entirely limited in their distribution to the Mariana Islands. Only two specimens were recovered by Gifford on Yap, both falling into the Type la group. Three stone specimens were in Osborne's 1968-69 collection none of which can be reasonably included into any of the established types. In fact, these specimens are also significantly different from each other. One of the specimens, 40/Angaur 1 is a broken specimen which exhibits attributes common to the general quadrangular adze found within Asia and the Pacific. The other stone adzes from Palau are small. Osborne believes that these few stone specimens may not be native to the Palaus though as yet has no firm evidence to support or deny this assumption.

Among the adzes from estern Micronesia there is a complete absence of tanged specimens despite the presence of tanging in portion of the areas immediately to the west, notably the Philippines. Duff (1970) cites Beyer as suggesting the presence of "stepped" adzes in the late Neolithic of the Philippines circa 1750-200 B.C. The southern portions of Indonesia appears not to have developed the tanging process possibly accounting for the lack of tanging in the Palauan sample.

Despite the apparent stylistic discontinuity among the island groups of western Micronesia there may be distinct functional groups extant in this area. In other words, while the body morphologies of adzes vary from group to group all three island groups contain adze groups with distinctively straight cutting edges and others with distinct curved, gouging cutting edges. If we can assume that the shape of the cutting edge of an adze is a primary functional variable, then body morphology may have more of a stylistic consideration than a functional usage.

To summarize briefly the spatial distributions, it appears that there is a sharp break between the Marianas and the other groups of western Micronesia and that this is due to stylistic differences and not due to the more extensive use of stone in the Marianas. Palau and Yap have the same general types with the notable exception of the Type 4 Beaked group which is only found in the Palaus in western Micronesia and has definite stylistic origins in the southern Indonesian area.

Shell Adze in Oceania

In the remaining portions of Micronesia shell is almost entirely the exclusive source material for adze manufacture. Rare specimens of stone adzes have been reported from Kusaie in the central Carolines (Davidson, personal communication). As in Palau and Yap the thick hinge portion is extensively used for the heavier implements. The dimensions of these adzes are larger than those from the western region with some specimens approaching twenty centimeters in length and weighing upwards of three pounds.

Davidson's work on Nukuoro produced a sample entirely of shell which basically resembled the Palauan sample. This collection also produced two beaked (Type 4) specimens. Despite some confusion in the radiocarbon dating it appears that these adzes come from a rather late (i.e., A.D. 1300) occupation.

Monographs dealing with the material culture of groups within Micronesia (e.g., LeBar 1964-Truk; Buck 1950-Kapingamarangi, Ponape ESSE, Damm 1910) all contain reference to shell adzes and the absence of the same implements made from stone. In a visual comparison of some of the illustrations (which are often ambiguous at best) there is revealed a general similarity of from throughout the Micronesian area. The beaked type appears in many of these monographs but is lacking in Yap and the Marianas. It seems to have spread into the rest of Micronesia as well as some of the islands in northwest

Melanesia.

The use of shell for adze manufacture is also found in the Melanesian area though to a much lesser extent. Again, in the areas where shell is the predominant material, stone is of limited availability. Recent archaeological fieldwork in New Ireland revealed adzes of the Type 1 group (Clay 1974:11). Elsewhere in Melanesia they have been reported from Watom (Specht 1968:126), Buka (Specht 1969), New Hebrides (Garanger 1966:80), and coastal areas of Bounganville. A sample of 211 shell adzes exists from the Polynesian outlier of Anuta in the Solomon Islands. Of this sample, 206 (97.7%) were recovered from surface collections and excavations while 5 (2.3%) were ethnographic collections (Krich and Rosendahl 1973:66). No stone specimens were located during this fieldwork. Their adze collection includes those made from both the outer section of the *Tridacna* as well as the hinge. Adze made from the *Cassis* shell also were present in the local tool kit.

Jose Garanger's work in the New Hebrides (1972) yielded an adze sample comprised predominantly of shell blades though in association with stone specimens. The shell tools were manufactured from *Terebra* (1972:Figures 48,83) and from the outer and hinge portions of the *Tridacna spp*. The New Hebredian blades made from the outer section of Tridacna spp. (1972:Figure 80) exhibited the same morphological variations as the Micronesian Type 1. Garanger's sample of the hinge section blades does not contain any specimens of the Beaked (Type 4) variety. With minimal variation all the hinge section adzes resemble the Micronesia Type 5. Also, the few stone adzes that have been recovered by Garanger fall into the Type 5 category. Interestingly, the Micronesia sample of Type 5 is comprised entirely of shell and within the Marianas area which does have exploitable stone, Type 5 is totally lacking.

In the Polynesian area the use of shell for adzes is relatively rare, expecially forms made from the Tridacna. These have been reported from Tonga (Poulsen 1968:90) and Terebra forms have been described from the Marquesas (Suggs 1961).

Recently, Sinoto and McCoy (1975) described shell adzes from an early site on Huanhune in the Society Islands. These blades were manufactured from Cassis (similar to the Micronesian Type 3) and from Tridacna, resembling the Micronesian Type 1a.

As predicted earlier, the specimens from the above examples, made from the outer section of the Tridacna retain the characteristics of Type 1 with minimal variation. The adzes from the hinge section demonstrate more variability which resemble the types in Palau and Yap, with the exception of Type 4, the beaked adze.

The distribution of shell adzes appears to stretch from at least insular southeast Asia into Micronesia and Melanesia and extends slightly into the early levels of Polynesia. While the knowledge of shell manufacture must have travelled with the movements of populations throughout the Pacific, the morphological types are so general that reconstructing culture-historical models based on the available evidence would be tenuous at best. In many cases, shell utilization was an environmental necessity which may have been lost and rediscovered many times throughout the prehistory of Oceania.

In summary, among the adze sample sufficient variation was established to create nine morphological types. These types do not radically differ from those already established by other archaeologists; however, this study is the first to combine all three island groups into a single sample from which to derive types. Although little data relative to the temporal aspects of these types could be generated, they do provide us with clues to the spatial distribution within western Micronesia. I feel that the distribution data offers two important considerations. First, the apparent stylistic discontinuity between the three groups (or at least between Palau and the Marianas) argues for a relative isolation from each other in cultural development. This is also apparent in other aspects of material culture as well as linguistically and physically. The second important consideration is that the stylistic differences also point toward different geographical influences. Marianas styles tend to point toward a more northerly direction (i.e., Northern Philippines, Taiwan, possibly southern Japan) while Palau has definite affinites to southern Indonesia, most probably southern Philippines, Celebes, etc. Also from the evidence presented we can emphatically suggest that the original settlers of the western Micronesian island areas brought with them a knowledge of shell manufacturing.

In terms of adze morphology, shell has been shown to have a greater variability than originally suggested and as such shows promise as a useful indicative artifact.

I feel that there are areas of the Pacific which beg for research but which have yet to see any valid archaeological fieldwork. Work in eastern Micronesia must be undertaken in order to supply data for a large segment of Oceania both in terms of its relationship with the western region and how it may relate to the Melamesian area to which it is related linguistically. Work in this area will also provide a larger adze sample with which to test the validity of the typology established here. Hopefully further research along the eastern coastal region of the Philippines and other areas of Indonesia will begin directed toward establishing early relationship with the Micronesian areas.

This study was designed to bring together useful data relative to adzes in western Micronesia and shell utilization in the manufacturing of these implements. As stated many times, the data extant today are minimal but hopefully this typology will prove useful to future researchers in both the area of Micronesia prehistory and shell utilization in Oceania.

APPENDIX

APPENDIX

ATTRIBUTE LIST

1. Location--Each artifact is identified spatially according to island group and specific island. In the case of the Palauan sample only a single site from each island yielded adzes.

1.1 Marianas

1.11 Guam

1.12 Saipan

1.13 Rota

1.14 Tinian

1.2 Palau

1.21 Angaur

1.22 Ngerkeklau

1.23 Pelilieu

1.3 Yap

1.31 Pemrang

2. Source Material

2.1 Stone

2.11 Basalt

2.12 Andesite

2.2 Shell

2.21 *Tridacna*

2.22 *Terebra*

2.23 Cassis

3. Metrical Attributes

3.1 Length (L)--This measurement is taken perpendicular to the cutting edge of the blade (Fig. 3).

3.2 Thickness (T)--Taken at point of maximum thickness.

3.3 Widths (Fig. 3)

3.31 Point of maximum width (W^1)

3.32 Width of cutting edge (W^2)

3.33 Width of Poll (W^3)

3.4 Outline--geometrical shape as determined by shape index.

3.41 Shape Index--$\frac{W^3}{W^2}$

3.411 Rectangular >2.39

3.412 Trapezoid 1.7-2.39

3.413 Triangular < 1.7

3.5 Bevel angle--The degree to which the bevel is angled from the body. This angle is measured from the axis of the plane of the bevel with the plane of the back. This angle was measured with a protractor to the nearest $.5^o$. For the sake of consistency and statistical manipulations the angles were recorded from 0^o-90^o, Osborne (1966) differentiated between back bevel angle and front bevel angle with the latter having angles of 90^o-180^o. While this is an important distinction it would make statistical analysis cumbersome so these high angles were transposed into the lower case (Fig. 6).

4. Discrete Attributes

4.1 Cutting edge

4.11 Straight

4.12 Wide curve

4.13 U-curve

4.14 Pointed

4.2 Cross section

4.21 Oval

4.22 Circular

4.23 Quadrangular

4.24 Triangular

4.25 Plano-Convex

4.26 Elliptical

4.3 Body--This attribute is dependent upon the amount and placement of grinding present.

4.31 All surfaces ground

4.32 Back only

4.33 Front only

4.34 Unaltered--only ground surface present is the level.

4.4 Poll--Geometric attributes.

4.41 Round

4.42 Square

4.43 Pointed

4.44 Broken

4.5 Sides--Geometric attributes.

4.51 Square

4.52 Round

4.53 Square/Round

4.54 Unaltered

4.6 Bevel--This attribute is determined by the number of ground, angled surfaces on both sides of the cutting edge.

4.61 Single

4.62 Double

4.621 High

4.622 Low

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