ARCHAEOLOGY ON NUKUORO ATOLL

A POLYNESIAN OUTLIER IN THE EASTERN CAROLINE ISLANDS

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I. INTRODUCTION

Nukuoro is a small coral atoll in the Eastern Caroline Islands 245 miles (394 km) south of Ponape. Its nearest neighbours are also atolls, Ngatik 170 miles (274 km) northeast, Satawan in the Mortlock group 110 miles (177 km) northwest and Kapingamarangi 140 miles (225 km) south. The centre of the atoll is estimated to lie at 3° 51′ north latitude and 154° 8′ east longitude.

The atoll consists of an almost circular lagoon with 46 islets dotted around three quarters of the perimeter and an expanse of open reef on the west (Fig. 1). The lagoon has an area of 10.52 square miles (27.25 km²), while the total area of the 46 islets is 0.644 square miles (1.67 km²). There is a single entrance through the reef which separates the five southernmost islets from the remainder. At low tide, when the reef is exposed, it is possible to walk from islet to islet and the total distance from the pass to the northernmost islet can be traversed on foot without difficulty.

The climate is pleasant, with adequate rainfall and no extremes of temperature. Hurricanes are unknown. The resources of Nukuoro are considerable. The lagoon, which is one of the deepest in the Pacific, abounds with fish and shellfish, and vegetation is plentiful on the islets.

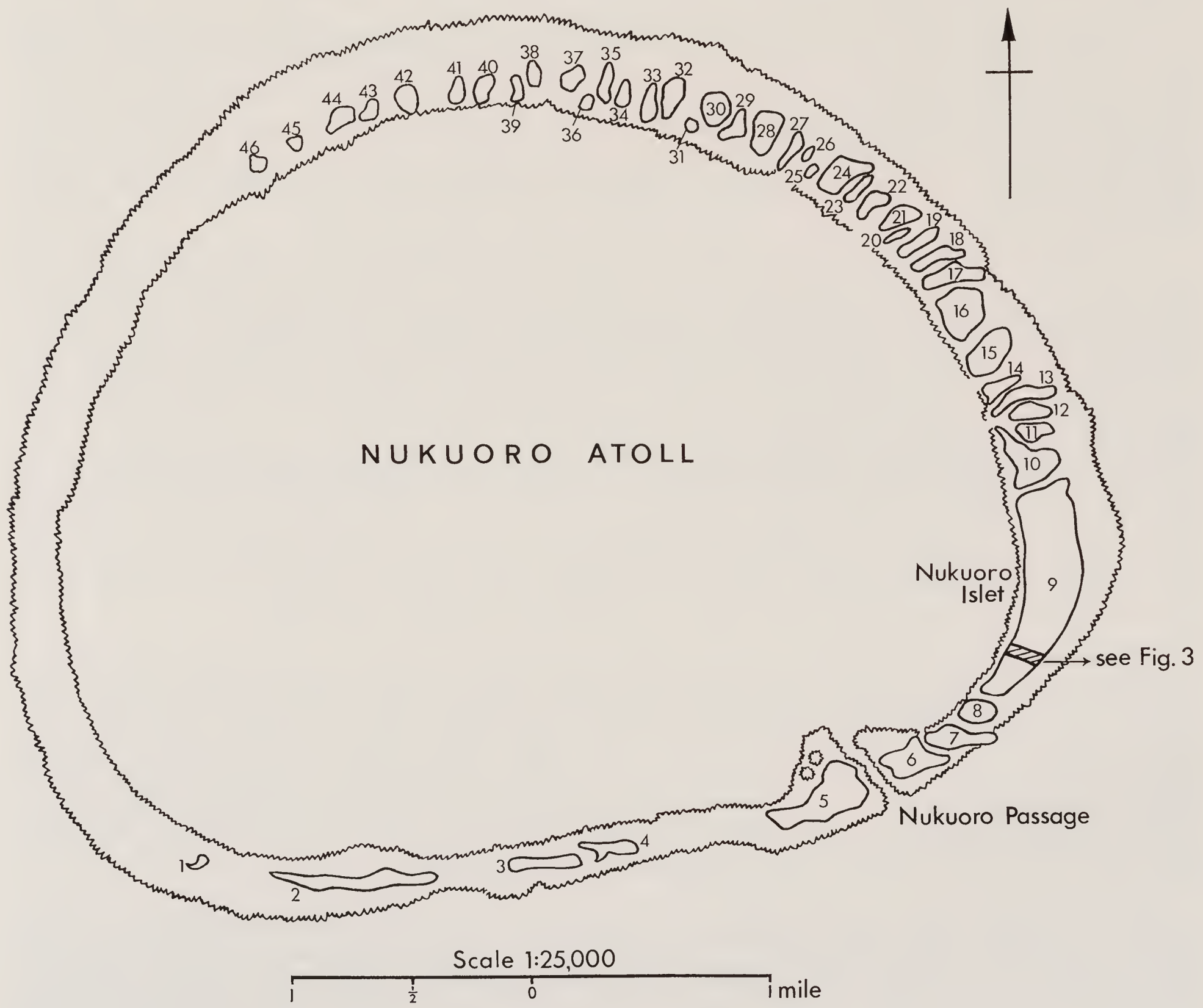

Fig. 1. Plan of Nukuoro Atoll (adapted from H.O.6042).

While the number of species of birds, animals and plants is naturally limited in comparison with those on larger and more diversified land masses, the atoll nevertheless conveys an impression of fertility and greenness.

Today the majority of the 280 inhabitants live on the largest islet, from which the atoll takes its name. Two other islets are inhabited permanently by one or two families, and there are small houses on several others for temporary visitors engaged in fishing or gardening activities. Three islets beside Nukuoro have excavated taro gardens.

Nukuoro was apparently discovered in 1806 and visited sporadically during the 19th century (Eilers 1934, pp. 163-170); by 1874 a trader was in residence. Two ethnological studies were made, by Kubary who visited the atoll in 1873 and 1877 (Kubary 1900), and by a German expedition of 1910 (Eilers 1934). Eilers' report also incorporated notes on the atoll by Captain Jeschke who called there on various occasions between 1910 and 1913 (Volprecht 1968). After 1913 no scientific attention was paid to Nukuoro until Dr Vern Carroll, a social anthropologist, began fieldwork there in 1963. The atoll passed successively from German to Japanese and then to American rule, but was never occupied by any of its rulers, nor affected by the Pacific war.

Although Nukuoro lies within the geographical area of Micronesia it has long been recognised as a "Polynesian outlier" because of the language, which belongs to the Polynesian language family (Pawley 1966), and culture. Traditionally the Nukuoro claim to have come from Samoa or the Ellice Islands, but most of the traditions were collected after the Nukuoro had been informed by European visitors of their resemblance to the inhabitants of those islands; Micronesian traditions and creation myths are also present (Carroll, unpublished field notes).

During his residence on Nukuoro in 1963-1964, Carroll observed evidence suggesting that deep stratified sites productive of artifacts were present. During mid 1964 ne began negotiations for an archaeologist to carry out work on the atoll when he and his family returned in 1964-1965. Through his enthusiasm and assistance it was possible to carry out the investigations described in the report. Financial support was obtained in the form of a grant from the Wenner-Gren Foundation to the Bishop Museum, Honolulu, and the project was planned for the period March-May 1965.

A number of different factors made the prospect of archaeological research on Nukuoro an appealing one. At the time the project was conceived, little archaeological research had taken place on atolls in the Pacific and there was some doubt whether they offered any worthwhile prospects for excavation. Carroll's favourable report on the potential of Nukuoro suggested that this atoll, at least, warranted investigation. More important, however, was Nukuoro's position as the northern most of the Polynesian outliners, for the steady accumulation of archaeological data from both East and West Polynesia was prompting the formulation of new questions about Polynesian prehistory, and arousing interest in the hitherto neglected outliers. In particular, the presence on Nukuoro of one-piece fishhooks in pearl shell raised some interesting questions about the distribution of this type of artifact in Polynesia. More general questions were also posed about the length of recognisable Polynesian occupation on the atoll, the possible presence of an earlier Micronesian culture, and the possibility that Nukuoro might have retained some early Polynesian characteristics now lost in the area of triangle Polynesia.

Because of the uncertainty of communications within the district it was impossible to make a definite research programme and keep to it. Work began on the assumption that at least four weeks would be spent on the island, and with the knowledge that the period could be up to three months. For this reason excavations were begun immediately, with the aim of sampling several different areas in the estimated minimum time, and extending the excavations and exploring the atoll more fully as time permitted. Work was concentrated on Nukuoro itself because of the known potential of excavation sites there. Other islets were explored only in weekends and at the end of the season when excavations were completed.

Of 93 half days spent on the atoll, 42 were spent in excavation with the assistance of local labour. A further three were devoted to mapping sites and drawing sections without the assistance of the crew, although most sections were drawn when the crew was working elsewhere. Twelve half days were spent in exploring other islets and 18 in washing and cataloguing artifacts and doing as much preliminary analysis of midden samples as was possible in the field. Six half days were occupied in packing artifacts and samples. The remaining time consisted of the days

of arrival and departure and afternoons on which the community was engaged in various social functions. Excavation was conducted during the week, processing in weekends and towards the end of the season. While the time spent in excavation may seem slight, the quantity of material recovered and the difficulty of transporting it from the island meant that a considerable amount of time had to be spent in analysing, cataloguing, and packing.

I carried out the reconnaissance survey and the processing, photography and packing by myself. Excavations, however, required the use of local labour. The labour force varied in size, depending on what other projects people were engaged in, but there was an average of eight to nine people each half day. There were usually more in the afternoon when 7th grade school pupils assisted. Only a few people actually excavated and these were carefully selected and supervised. The majority carried buckets, manned screens and sorted material. The labour force included women and older children. The Nukuoro displayed the same aptitude for archaeological work that has been encountered among other Polynesians.

ACKNOWLEDGEMENTS

The project described in this paper was carried out under the auspices of the Bernice P. Bishop Museum, Honolulu, and financed by a grant from the Wenner-Gren Foundation.

I wish to thank the High Commissioner of the Trust Territory for permission to work in Nukuoro, and the staff of the District Administration in Ponape for their cooperation. Numerous individuals in Ponape and Kwajalein offered hospitality and assistance, and I would particularly like to thank Frs. Costigan and Cavanagh S. J. of the Catholic Mission in Ponape, and Mr and Mrs R. McKay, then of Kwajalein.

Many people have helped me while I have been preparing this paper. I am grateful to Mr W. O. Cernohorsky and Dr A. W. B. Powell for shell identifications, Mr R. J. Scarlett, Miss J. Allo and Dr A. N. Baker for help with bone identifications, Miss J. Goulding for advice on botanical specimens and Dr P. Black for identification of rocks. Dr R. C. Green, Dr Vern Carroll and Dr R. C. Cooper have read and criticised drafts of the manuscript. Mr K. Peters and Miss J. Bertram drew the illustrations. Many other people in Auckland and Honolulu took an interest in the project and helped in various ways.

The project was initially inspired by Dr Carroll and without the hospitality and assistance in every aspect furnished by him and his wife it could not have taken place. Their continuing interest and advice has been invaluable, and my debt to them is very great.

Finally I must thank the group of men, women and children on Nukuoro who became known as the people who dug the holes. Without them no holes would have been dug.

II. SITE SURVEY

NUKUORO ISLET

By far the largest amount of archaeological evidence occurs on the principal inhabited islet, Nukuoro. Even there, however, structural remains are rare and the bulk of archaeological evidence consists of the build-up of stratified midden deposits in areas where occupation has occurred over a long period of time.

Houses on Nukuoro generally consist of a roof supported on posts which rise from a floor of coral gravel and beach sand. Most sleeping and storage houses are of this kind, although there are also some European style frame houses. In some instances the house floor is actually a low raised platform faced with vertical slabs of thin coral. While there is some reason to believe that this type of platform is of some antiquity, the few abandoned examples seen appeared to be very recent and could hardly be said to comprise a category of archaeological structure.

The principal structure known to have existed was the *malae* recorded by Kubary (1900, p. 114) as a rectangular enclosure of coral slabs within which three deities were represented by stones and one by an upright spear of coconut wood. No surface evidence of this structure remains, although Carroll, when digging a garbage pit, encountered coral slabs beneath the ground surface in approximately the position of the *malae* wall.

Boundaries are generally indicated by single stones and are known only to landowners concerned. The only existing walls are retaining walls of coral blocks on the shore, which occur both on Nukuoro and on other islets and are further discussed below, and walls building up paths in a few places where they pass through swampy ground. Existing examples are probably modern. The only other structural features are the alignments of low coral slabs or kerbs demarcating the edges of most paths; these are probably also modern.

The most important surface evidence is the variation of the ground itself. On Nukuoro there is considerable fluctuation of the ground surface which invariably reflects human activity. Eilers (1934, pp. 184-5) stated that while most of the islets were only 1 m high, in a few places alluvial deposits built up by hurricanes and rough seas reached a height of 3 m or 4 m above sea level. Excavation, however, showed that, in the village area at least, these "alluvial deposits" were stratified midden deposits built up as a result of human rather than marine agencies. The configurations of the ground surface, therefore, are of considerable importance in understanding the nature of settlement in the past. Whereas areas of high ground represent places that have been consistently occupied over long periods of time, depressions and low ground are also important as indications of former wells or small taro patches.

The central and northern parts of Nukuoro islet are occupied by an extensive taro excavation, surrounded by an embankment of spoil removed from it. To the north and west, in the uninhabited parts of the islet, the ground surface is relatively low and comparable to that of other islets, although there are some low mounds along the reef side. Between the taro garden and the lagoon, however, and particularly south of the taro garden along the lagoon shore, is an extensive area where the ground surface is consistently 3 m or more above sea level. In the south, where the shore is at present prograding, there is a gentle slope from the beach to the higher ground behind, but in the north the foreshore is eroding, exposing stratified midden deposits. In this area artifacts can be found on the beach at low tide.

Along the main path through the present village the ground surface is fairly level and slopes down towards the lagoon. On the landward side, however, a complex series of mounds and depressions occurs which could only be described adequately by a detailed contour map. The highest points are landward of the road, and represent the tops of mounds; behind them the surface slopes down again to the centre of the islet. There is no regular line marking the edge of the built up land, but a series of depressions, apparently the remains of old well shafts and small taro excavations, breaks up the area. The central portion of the islet appears low in contrast to the village area, but even there, except in the bottom of swampy depressions, there is up to 1 m of artificially accumulated deposit. On the reef side there is a series of artificial mounds, although these are not continuous and do not rise as high as the village area.

In the vicinity of the present village, then, but covering a larger area, there is a very extensive and complex series of midden deposits. These cannot be separated into discrete sites, since they are for the most part continuous and there are no structural remains on the surface which can be designated as individual sites. Traditionally some areas are believed to have been set aside for particular purposes, but only their approximate boundaries and positions are known.

OTHER ISLETS

Although attention was concentrated on Nukuoro, which appeared to offer the best prospects for excavation, all islets, or *modu*, were visited and investigated for archaeological remains. Some were explored fairly thoroughly, others only briefly, so that the coverage is not consistent. There is considerable variation in vegetation, depending on the diligence of the land owners, and islets clothed in thick tangled vegetation could not be adequately explored. It is possible, therefore, that some features were missed. However, enough *modu* of various sizes were explored in detail to indicate that the general picture of archaeological remains on *modu* is substantially that described here.

Many *modu* have some traces of artificial deposits, particularly along the lagoon shore and near the intervening channels. Only a few appear to have deposits of sufficient depth to warrant excavation. In most cases the edge of the islet on the outer reef side is very rough with a storm bank of quite large pieces of coral, while the surface on the lagoon side is naturally sandy. A clear, debris-free reef side and a surface of coral gravel on the lagoon shore both appear to indicate human activity.

Surface features on *modu* include old well shafts, deliberately placed stones said to be boundary stones, coral gravel pavements, low walls and cairns of coral rubble, several low amorphous mounds or platforms of coral rubble and a walled enclosure. The last, a prominent feature of *modu* no. 8, is said to have been originally a defensive installation built in the 19th century.

Fig. 2. Modern retaining wall of coral boulders at the southwest tip of *modu* no. 7, Masabu.

Almost all islets have retaining walls. Some of these are modern and similar walls are still being built. A retaining wall consists of coral boulders piled up vertically behind which is a sand fill. A good modern example exists at the southern end of *modu* no. 7 (Fig. 2). In addition to obviously recent walls there are some much older ones in various stages of decay. On the reef side of many *modu* decayed walls are found lying up to several metres beyond the present limit of the *modu*. In many cases the boulders have become encrusted and fused to one another and to the reef beneath. An interesting example of this is to be seen at *modu* no. 3, where the old wall extends considerably beyond the limits of the present islet on both sides, but particularly on the east.

The artificial nature of many of the islets has been discussed by Carroll (1964), largely on the basis of traditional and linguistic evidence. The presence of these old retaining walls shows that people have been actively concerned to preserve the land, if not actually to create it. Sand does tend to accumulate behind the walls, so it is reasonable to assume that some of them may be evidence of reclamation in the past.

Today, shore areas on some *modu* seem to be prograding while others are eroding. The larger *modu* near the pass are substantial and show little sign of eroding, but many of the smaller ones, especially on the northeast part of the reef, are maintaining a rather precarious position and some are said to come and go with storms. It is therefore unlikely that any very old deposits would remain on them. On the one hand they are so small that they were probably never favoured for permanent occupation so that only limited deposits would build up. On the other hand they were thus always smaller and lower than the islets near the pass, and therefore such midden deposits as did accumulate from fishing and gardening trips would more easily be swept away. Thus there are many small *modu* today which have almost no indication of archaeological remains. These are omitted from the following account, and only *modu* with distinctive features are described. It is probably true to say that the most evidence of former occupation is on Nukuoro itself, and that with two exceptions, the evidence on other *modu* is directly related to size of *modu* and proximity to the pass.

No. 1 Moduilalo: a very small *modu* traditionally used for a fishing camp. There is at least two feet of cultural deposit above the natural ground surface. Surface features include one boundary stone, remains of an ordinary retaining wall on the reef side, and at the west end a retaining wall of thin vertical coral slabs, the only example of this type of facing seen.

No. 2 Olomanga: traditionally the sacred islet of the atoll, visited only at certain times by the high priest (Kubary 1900, pp. 95-96). There is no trace of cultural material and no sign of the three sacred stones which formerly stood on the reef side. The *modu* is remarkable for its bird population.

No. 3 Deahua: notable for the remains of an old retaining wall on the reef extending a considerable distance beyond the present limit of the *modu*.

No. 4 Moduilodo: has a modern retaining wall in good condition at the northwest tip, but no other obvious features of interest.

No. 5 Gausema: the second largest *modu* and one of three permanently inhabited in 1965. It occupies a valuable position by the pass. In the centre is a former taro garden, now abandoned. To the north of the taro garden there is an area of midden accumulation similar to that on Nukuoro, although very much smaller and lower. Much of the rest of the *modu* is very rough, with a surface of heavy coral rubble, but even here there is evidence of human activity in the form of low rubble walls and alignments.

No. 6 Senugudai: largely occupied by a sizeable and well tended taro garden with high embankments, particularly on the reef side. The western point on the edge of the pass, would probably have been a favoured camping spot for fishermen in the past, like the corresponding point on *modu* no. 5 opposite. A more recent occupation by U.S. military surveying parties, however, may have affected archaeological evidence here. This *modu* and nos. 7 and 8 have definite, but shallow, midden deposits along their lagoon shores.

No. 8 Masagumani-ingage: remarkable for the presence of the only substantial structure found on the atoll. A free-standing wall of coral boulders forms an enclosure, roughly rectangular in shape, which includes most of the *modu*. The wall varies in height up to about 1.25m. An elderly informant who was normally very reliable told Carroll that the enclosure had formerly been used as a fortification by the people of Nukuoro, who retreated to it in times of invasion by large parties from other islands. There are also several modern retaining walls on the lagoon side of this *modu*, some old enough to have large trees growing through them.

No. 10 Dagamanga: has a large taro garden, much of it not under cultivation at present, and a number of well shafts on the lagoon side. Midden deposits are present, particularly at the southwest corner where there is now a modern burial ground. Here midden deposits containing oven debris are exposed in an eroding section.

No. 15 Sungaulohu: little evidence of occupation or use apart from a taro garden, not particularly well tended.

No. 16 Tuila: explored in greater detail than most *modu*. There are areas of artificially deposited coral gravel on the surface, on one of which an adze was found, but no deep deposits.

No. 20 Baonga: has remains of a retaining wall on the reef side.

No. 23: Ahuedolu: has more noticeable midden accumulation on the lagoon shore than some of the smaller *modu*.

No. 24 Moduovae: several old well shafts were seen on this islet and several heaps of coral boulders. Much of the surface is clear of vegetation and covered with fine coral gravel.

No. 25 Deahu: well tended today with a kerb-edged path, a small house and a well shaft, and a fairly modern looking retaining wall. Some cultural deposits are present.

No. 26 Deahu: the only feature seen was a low but recent looking rubble wall running lengthwise across the islet.

No. 28 Sabinamadogo: possible remains of a retaining wall on the reef side, fine coral gravel surface on the lagoon side.

No. 29 Modubodai: fine coral gravel surface disturbed by burrowing crabs, one coral rubble cairn on the reef side.

No. 30 Moduidua: traces of a retaining wall on the reef side, one coral rubble cairn.

No. 31 Ahuilodo: this *modu* has a uniformly smooth surface with little rubble even on the reef side. One well shaft was seen and a cairn of coral rubble on the reef side.

No. 32 Dahangahaino: traces of a retaining wall on the reef side, some coral gravel surface in the centre.

No. 34 Ahulegalega: this *modu* has a smooth surface, all larger pieces of coral have been piled in a mound in the centre of the *modu* leaving the remaining surfaces smooth and flat. It was not apparent whether the mound was a structure or a gardening expedient.

No. 35 Masagumani-ilalo: an uneven surface in the centre and large areas of fine gravel suggest scattered occupation in the past. Near the reef side an alignment and low circular enclosure of coral boulders were noted.

No. 36 Niulegida: the smallest *modu* of all. This *modu* appeared to be largely artificial, with a retaining wall all round, and an accumulation of cultural deposits.

No. 37 Ahulaanui: at the southern end remains of a rectangular platform of coral boulders were observed. Dense vegetation prevented further exploration.

No. 38 Dolungahale: gravel surfaces and low heaps of coral rubble.

No. 41 Modunui: rough surface with a few cairns or low mounds of rubble.

No. 42 Namoilodoa: two cairns on the reef side.

No. 43 Hauosiga: possible remains of an old wall on the north and west sides.

Nos. 45 (Dalainamu) and 46 (Deungagelegele): both prograding at the present time so that they are surrounded on all sides by sandy beach. Both are thus natural and recent in appearance, but each has remains of a mound or platform of coral rubble in the centre.

III. EXCAVATIONS

Excavations were carried out in or near the village at eight locations which were numbered consecutively Nu-1 to Nu-8. The extent of these "sites" could not be defined; indeed Nu-1, Nu-4 and Nu-5 are all in one fairly small area. The numbers refer only to the actual excavations. Sites were selected according to two main criteria. Four were chosen because they were said to have been used for some particular purpose in the past. The principal aim of such excavations was to test the archaeological content of these traditionally remembered sites. Two of the four were apparently unique sites, while the remaining two were merely the most convenient of several similar sites.

The remaining four locations were chosen because of their geographical position in order to test different parts of the total archaeological sample. Five locations provide a cross-section across the main islet from lagoon to outer reef (Fig. 3).

In all locations a single 2 m square was excavated, and in two instances a second square was excavated adjacent to the first. Area excavations were out of the question because of the depth and complexity of the deposits and also because most locations were in current use. The excavations were column samples of the archaeological content of the village rather than detailed explorations of individual areas.

The individual locations are discussed separately below, but their general nature is outlined here to explain the techniques employed in their excavation. The deposits consisted of natural layers and lenses of coral gravel and sand with varying amounts of charcoal and organic material. Although it was often possible to distinguish floors and layers in section, the looseness of the coral gravel and the lack of clear discontinuities made it impossible to excavate according to natural stratigraphy alone. Accordingly a system of 15 cm arbitrary levels was adopted. Whenever a well defined natural layer could be distinguished it was excavated as a unit within the framework of levels which was reverted to when natural stratigraphy could no longer be followed.

Postholes and stakeholes were present in the deposits, but were not easy to locate and define. At the conclusion of each level or layer the newly exposed surface was searched for features, and whenever they were found they were excavated and refilled with sterile sand before excavation of the next level began.

In drawing sections only major groupings of layers, and extensive or well defined floors which served to divide layers, could be included. The drawings were supplemented, however, by photographs in which all the minor lenses, which could not be distinguished in excavation or drawing, appear.

There are several possible sources of error and disturbance resulting partly from the excavation techniques used and partly from the nature of the deposits themselves. Firstly, the system of excavation by arbitrary levels undoubtedly means that materials from more than one floor have been grouped together. This was a constant source of worry during the excavations, but the nature of the deposits and the lack of time did not permit slow and painstaking attempts to distinguish all the minor lenses. However, major breaks or discontinuities and principal floors were distinguished during excavation, and arbitrary levels were used for mixed deposits such as the upper parts of Nu-4 and bands of continuously accumulating floors such as much of Nu-5 and Nu-8, so there is little danger that material of widely differing ages has been mixed.

Secondly, there is the possibility that artifacts from the fills of postholes or other features have been mixed with artifacts from the lower layers into which the features were dug. This is always a problem in deposits of this kind. However, very few postholes were discovered in section which had not been noticed during excavation, suggesting that error from this source is probably not great. Where postholes do occur in these deposits, it should be remembered that they could have caused disturbance at the time they were dug, and that artifacts found in layers from which postholes were dug may have been brought up from earlier layers penetrated by the postholes.

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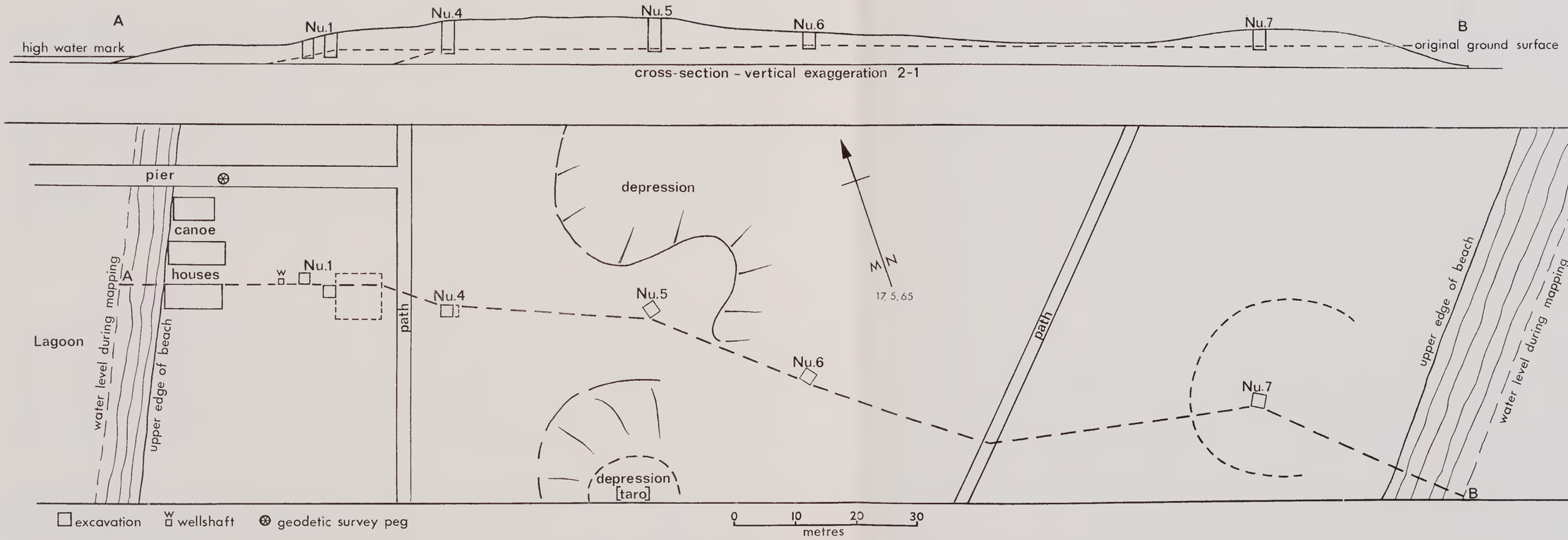

Fig. 3. Plan and cross-section of part of Nukuoro islet, showing the positions of Nu-1, Nu-4, Nu-5, Nu-6 and Nu-7, and the extent and depth of cultural deposits.

assess the extent of disturbance resulting from their activities. The larger crabs are now very rare on Nukuoro islet itself, although they are numerous on uninhabited *modu* and would constitute a very real problem in excavations there. Assuming that Nukuoro has always been inhabited while the deposits accumulated the larger crabs may never have been active in the actual village area. Small hermit crabs, however, are very numerous and dozens would be found in the excavations each morning. It was seldom possible to trace holes from which they could have come and it is more likely they fell from the surface. Only one major disturbance attributable to crabs was recognised, in Nu-5. The appearance of the sections, the facts that no European items were found much below the surface and that, where change through time could be demonstrated, no discrepancies needed be explained by mixing, all suggest that the Nukuoro deposits are largely undisturbed.

Excavations proceeded by trowelling carefully through the deposit. Spoil was removed in buckets and screened through sieves with $\frac{1}{4}$ in. (6.35 mm) mesh. The residue in the sieves was then sorted into its constituents. Artifacts, bone and foreign or unidentified material were kept from all excavations. A more detailed analysis was carried out at Nu-1 where everything retained in the sieves was kept except unused coral which was weighed and discarded. The results of this experience suggested that collections of unworked shell and charcoal were unnecessary at other sites. As charcoal often disintegrated and passed through the sieves the amount collected did not seem to be a valid indication of the total charcoal content of layers. Accordingly charcoal at other sites was collected only when concentrated localised deposits suitable for carbon dating were encountered during trowelling. The shell from Nu-1 proved to be largely water worn and fragmentary, and apparently belonged to the discarded coral gravel constituent rather than with the artifacts or food remains. Only shells thought to have been useful for food or as tools or utensils were retained from other sites.

NU-1

Traditionally there were four *hada* or men's houses in Nukuoro, a larger and a smaller in each half of the village. *Hada* functioned as sleeping houses for unmarried men and also as meeting houses where men made and repaired their tools, talked and prepared for fishing expeditions. A well shaft and house foundations dug by a villager in the area said to be the former site of the *Hadasabugu,* the principal southern *hada,* shortly before my arrival, produced quantities of artifactual material. The identification of the area as a *hada,* which agreed with the position of *Hadasabugu* on Kubary's plan of the village (Kubary 1900, p.113) and the apparent abundance of artifacts recommended this as a good site for excavation.

The site lies just south of the modern landing jetty on the sloping ground between the beach and the main path through the village (Fig. 3). At the present time the beach is prograding owing to the jetty and is said to have advanced about 6 m in living memory. The site of the *hada* was believed to lie inland of this most recent land accretion and to extend up to the village path, although the exact limits were not defined. A large frame house was being erected immediately to the west of the road and holes dug for its foundations had produced numerous artifacts. The well shaft was on the low lying part of the site close to the assumed edge of the beach at the time the *hada* ceased to be used.

Two 2 m squares were excavated between the house and the well shaft. Square G-9 was 26-28 m from high water mark, while square E-5, 2 m north and 4 m west of G-9, was 22-24 m from the sea. A single datum point, corresponding to the ground surface on the inland side of the road and therefore higher than any part of the site, was established and used for both squares.

Nine significant natural layers, falling into three major groups, were distinguished in square G-9. From the top downwards they were as follows (Figs. 4-6).

BAND III *Layer 9* (75-110 cm below datum): fine coral gravel with considerable European material; blackened by root intrusions.

Layer 8 (110-140 cm): white coral gravel lacking root intrusions, with thin lenses of selected beach shells.

BAND II *Layer 7* (140-155 cm): grey puggy sand and shell fragments.

Layer 6 (155-170 cm): blacker sand and coral gravel with considerable charcoal.

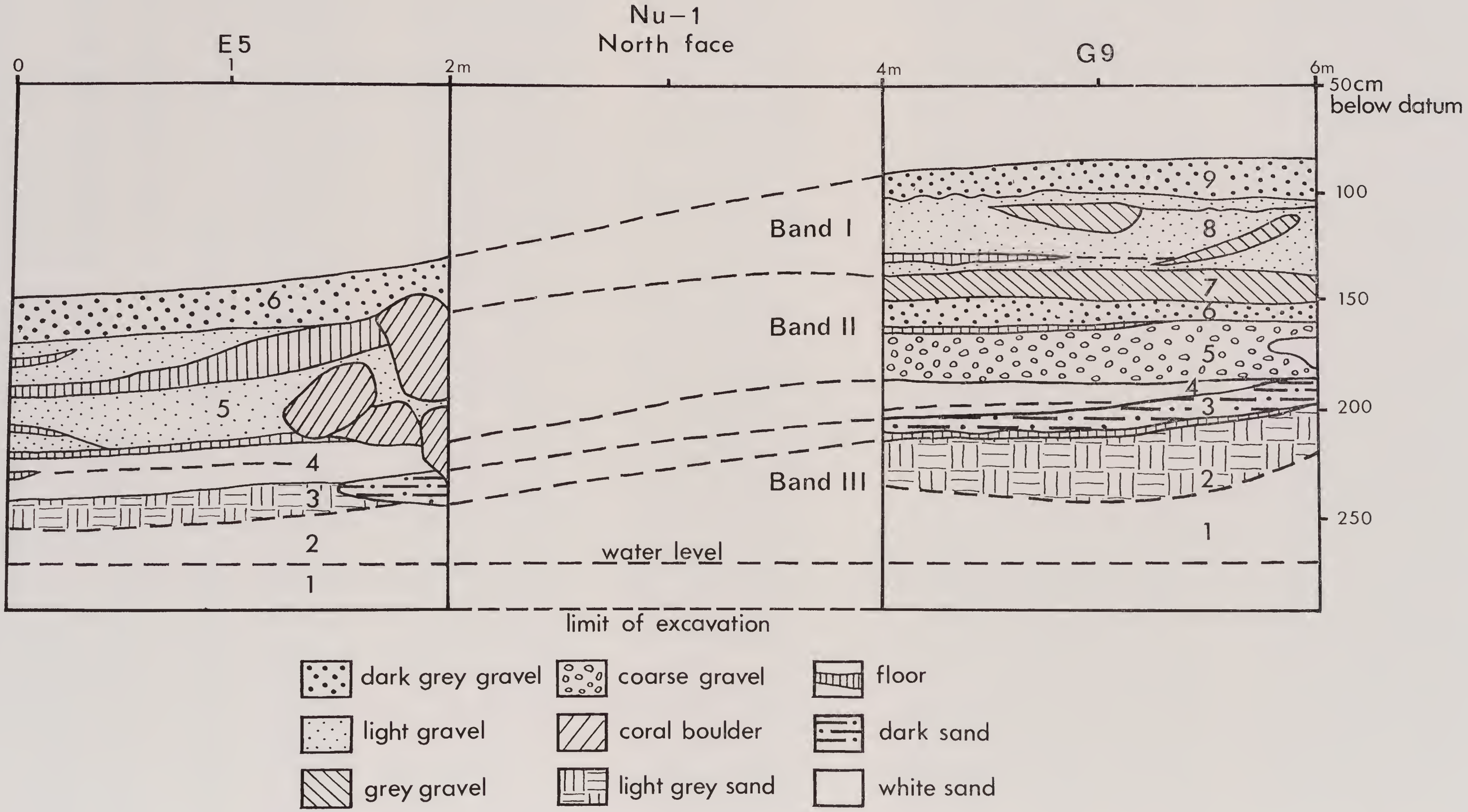

Fig. 4. Cross-section, north faces of squares E-5 and G-9, Nu-1.

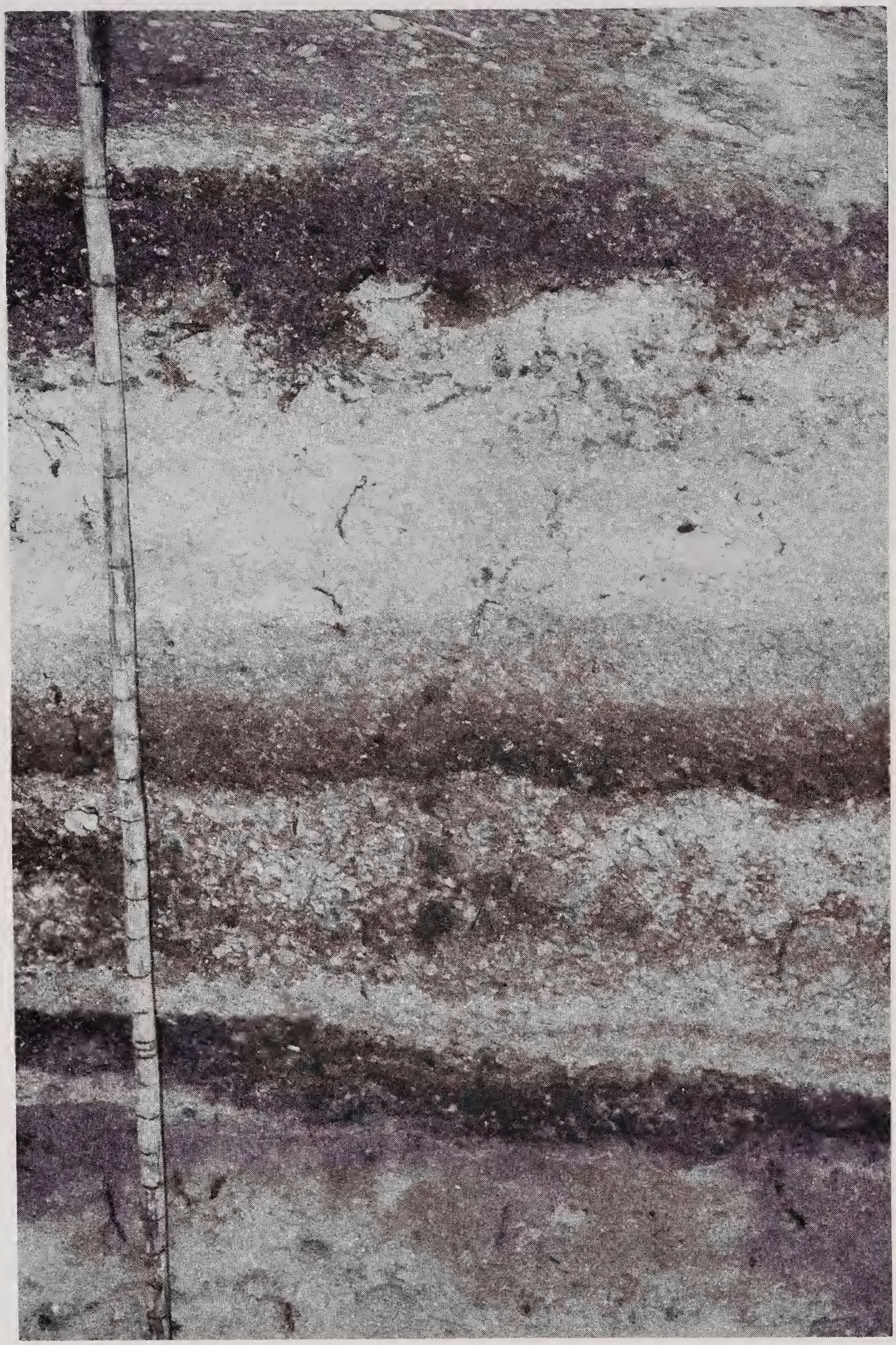

Fig. 5. South face, square G-9, Nu-1.

Fig. 6. North face, square E-5, Nu-1, during excavation, showing layers 4 to 6 and part of retaining wall.

Layer 5 (170-185 cm): very loose much coarser coral gravels; mixed in colour with black and white patches and lenses.

BAND I *Layer 4* (185-200 cm in west of square): clean white sand with flecks of charcoal.

Layer 3 (185-200 cm in east, upper part of 200-220 cm in west): dark black greasy sand with some coral gravel.

Layer 2 (200-235 cm): discoloured patchy grey sand merging gradually into:

Layer 1 (235-290 cm): sand and shell fragments, very similar to the modern beach deposits.

The distinction between layers 8 and 9 was largely one of colour, and seemed to depend on the amount of organic material present. The three layers of band II were distinct only in parts of the square; elsewhere they merged to form a single confused layer, which was, however, distinct from the layers of bands I and III. Layer 4, on the other hand, was a very distinct layer and one of the few that could be excavated with confidence as a separate unit. It was assigned to band I rather than to band II on the basis of evidence from square E-5. Layer 3 appeared to be the principal occupation layer of band I, while layers 1 and 2 contained material either mixed into the underlying sand during layer 3 occupation or deposited at a time when the area was a frequented sandy open space rather than an inhabited site.

Remains of a wall of coral boulders were found in the east side of square E-5 (Figs. 4, 6). This wall was resting on a white sandy layer very similar to layer 4 in square G-9, with layers corresponding to layers 1 to 3 beneath it. Layer 5 in square E-5, however, was a thick, relatively undifferentiated deposit, which terminated against the wall and did not correspond to layers 5 to 7 in G-9. Layer 6, the uppermost layer in square E-5, extended over the top of the wall and appears to correlate with layer 9 in square G-9. The most likely interpretation is that layer 5 in square E-5 corresponds to layer 8 in square G-9 and that band II, which accumulated behind the wall, is absent from square E-5.

At various points in both squares thin but concentrated layers of coral gravel and shell fragments, which were thought to be floors or occupation surfaces, were encountered. The most pronounced of these appear in the sections (Fig. 4). Others which were less well defined may

also have been living surfaces. Only isolated postholes were found, which is not surprising in view of the small area excavated. Although charcoal was abundant in some layers, no actual earth ovens were discovered. It was assumed that much of the charcoal present in the site, particularly in white sand layers, was derived from hearths, ovens or localised fires in the immediate vicinity.

Two charcoal samples from square G-9 were submitted for radiocarbon dating. The earlier sample came from the bottom of layer 3, from a small localised concentration thought to derive from a single fire. Determinations on this sample by two laboratories gave dates of 1574± 127 A.D. (P-1125) and 1495± 80 A.D. (Gak-737), with a range for the two samples at one standard deviation of 1415 to 1701 A.D. and a range where the two results overlap at one standard deviation of 1447 to 1575 A.D. A single determination of 1735± 37 A.D. (P-1126) was obtained for the second sample, which came from the base of layer 5, at the bottom of the band II deposits.

The dates suggest that the principal artifact bearing deposits at this site built up fairly rapidly during the 18th and 19th centuries, which is consistent with the lack of change in artifact types above layer 3 in square G-9. The dates for the earlier sample suggest that layer 4 may represent a time gap between the occupation of layer 3 and the rapid accumulation of layer 5 and upwards, but the range of time covered by the earlier determinations is too great for any certainty in this respect. There is, in any case, relatively little change in artifacts between layer 3 and layer 5.

The recent advance of the shoreline in this location has already been mentioned. Items typical of the basal deposits of excavations inland of Nu-1 were lacking from Nu-1 itself, suggesting that the original shoreline may have been further back. The remains of the retaining wall in E-5 can probably also be regarded as evidence of a fluctuating shoreline in the past. The building up and diminishing of the smaller unstable *modu,* and the filling in and scouring out of the intervening channels, have from time to time affected the flow of currents past the village.

The excavation was carried down to the water level in both squares, and artifacts were found down to the water level and below, although they came from beach like deposits of sand and small shell fragments rather than occupation layers. Alteration of the shoreline has probably affected the shape of the underlying water lens and consequently the water table has varied since the site was first occupied.

Of the many artifacts found in this site, only the fishhooks are sufficiently numerous and diagnostic to demonstrate any significant change through time. The fishhook chronology, discussed in detail elsewhere (Davidson 1967) and summarised below is most clearly demonstrated in square G-9. Even there, however, the early types of hook are present only in the basal deposits (layers 1 and 2) suggesting that they were discarded near the shore, perhaps in the vicinity of a canoe shed, before occupation of the site began. The first actual occupation layer is layer 3, which represents a later stage in the sequence. By layer 4 the earlier types of hooks had disappeared, whilst the most recent type of fishhook appeared in layer 6.

By contrast, the later types of fishhooks are present almost throughout square E-5 with only a single example of the earlier type right at the base of the excavation. This tends to support the view that G-9 consists partly of earlier deposits behind the retaining wall, and that E-5 was a low sandy area while the middle deposits of G-9 accumulated.

The large quantities of artifacts recovered from Nu-1 in comparison with other excavated locations confirms the traditional belief that this was the site of a *hada,* at least during the later stages of its occupation. The most productive layers in G-9 were layers 6 to 8, but layers 3 to 5 also contained a sufficiently large and varied collection to suggest that the *hada* may already have come into existence with the deposition of layer 3. The assemblage from lower layers includes artifacts in various stages of manufacture, as well as complete and broken hooks such as might be discarded on the shore after fishing expeditions. Material suggestive of a *hada* was present throughout the deposits of E-5, with the greatest concentration in the central part of layer 5, corresponding to layer 8 in square G-9.

The area excavated was too small to permit inferences about the buildings which may have stood there. Postholes were found both at the base of layer 3 and in its surface, indicating the presence of structures from an early stage in the site's history. Kubary provided a brief description of Nukuoro house types, including the *hada* with their specialised raised floors, but insufficient information was recovered to confirm or contradict his account (Kubary 1900, p. 116).

The material recovered from the excavations, however, provides a good indication of the kinds of activity carried out at this *hada*. Much of the material from G-9 related to the manufacture of pearl shell items, particularly fishhooks, but also coconut grater heads as well as a variety of knives, scrapers and perhaps ornaments that were not so easily identifiable. Occasional adzes and pieces of pumice suggest that wood working may also have been practiced but there was little evidence of adze manufacture. In E-5, however, in addition to fishhooks and other worked pearl shell some *Tridacna maxima* shells and *Tridacna* shell adze blanks were found. The collection from the well shaft yielded even more adze making material including *Tridacna* shells in all stages of working.

There was less midden material than at most other sites, and very little in the way of oven debris suggesting that cooking and eating were not among the principal activities taking place on the site.

NU-2

This location and Nu-3 lie at the south end of Nukuoro islet. There is some surface evidence to suggest that the southernmost extremity may once have been a separate small *modu* divided from Nukuoro by a channel, which has since silted up, in the vicinity of the most southern cross-island path. The modern village has only very recently spread down into this area, although several artificially built up areas indicate occupation in the past.

Traditionally, the land in the area of Nu-2 was thought to have been the site of a whale cult, about which no details were remembered. A complete shell necklace had recently been dug up in this area during the erection of a new house, and it was thought that other valuable items might have been buried there. The actual necklace in question had been restrung and given away and closer questioning of the finder revealed that it had probably been deliberately buried in recent times. A number of items associated with the old religion were buried in various places around the village when the religious system began to decline in the early European period.

A single 2 m square was opened in Nu-2 on the landward side of the house whose construction had revealed the necklace. Beneath a thin surface layer of sterile coral gravel a homogeneous black layer of charcoal and "oven stones" (small burnt pieces of coral limestone) appeared. Three 15 cm levels excavated through this layer produced two shell beads from the first, a coconut grater, a coral file and some tiny fragments of pearl shell from the second and nothing from the third. At this point, in view of the lack of time available, the excavation was limited to half the original square. When a further level yielded no artifacts, sieving was abandoned and the remainder of the layer was trowelled and then shovelled straight out. The deposit was found to be consistent to a depth of about 80 cm. It was homogeneous except for patches of compacted ash and lime-like material near the base. Underlying this layer was a further 10 to 15 cm deposit of grey sand with dark patches and flecks of charcoal as the cultural layer changed gradually and unevenly to beach deposits beneath. Two large holes, each between 40 and 50 cm in diameter, filled with the black layer, penetrated the sterile beach deposits to a depth of about 160 cm below the ground surface.

This locality, although materially unprofitable, was of interest in that it provided results quite contrary to expectation. The site is on the extreme fringe of the present village where there is relatively little cultural build-up compared with more central locations. The present ground surface of fine white gravel implied that Nu-2 was probably a residential area resorted to in times of high population. Excavation, however, revealed that the deposit consisted of the debris resulting from intensive cooking activities, and the owner of the house nearby confirmed that the deposit is wide-spread in the area. The only use of the land until recently seems to have been as a cooking area, or less probably as a dumping place for cooking debris.

If activities associated with the vaguely remembered whale cult took place here, the devotions must have consisted mainly of feasting, suggesting that the cult was more concerned with the disposal of whales than with rites to attract them to the atoll. However, the whale cult

tradition may be an unreliable one put forward to interpret the find of the necklace, which may have been associated with a whale cult carried out elsewhere. Just south of Nu-2 was a traditional canoe-making site, so the further possibility exists that cooking was carried out at Nu-2 to provide food for the canoe makers. Whatever the interpretation, however, the intensive cooking activity revealed at Nu-2 is surprising in view of its rather isolated situation away from the main village area.

NU-3

South of Nu-2 there is a low lying area with a very slight mound in the centre. This area was said to have been used for canoe making in the past and a number of adzes were found on the surface. The area was chosen for investigation because of the canoe making associations.

Square 1 was situated just south of the centre of the mound which was the only part of the site that appeared to have any noticeable build-up of cultural material. The deposit here consisted of two natural layers excavated in six arbitrary levels. The upper layer, excavated in five levels, was a black dirty layer with burnt coral "oven stones". It was less concentrated than the deposit at Nu-2, which it otherwise resembled, and contained considerably more gravel. The majority of the few artifacts in the site came from this layer. Beneath it was a thin layer of fine white coral gravel. From the interface of the two layers came an adze and a piece of coral used as a grindstone. The surface of the lower layer sloped down towards the north, in the opposite direction from the present ground surface, suggesting that the original deposits may have been intended to fill a small hollow.

A second square in the low lying area on the southern edge of the mound revealed a single thin layer of coral gravel with domestic artifacts, overlying a greyish sandy layer which changed unevenly to sterile beach sand (Fig. 7).

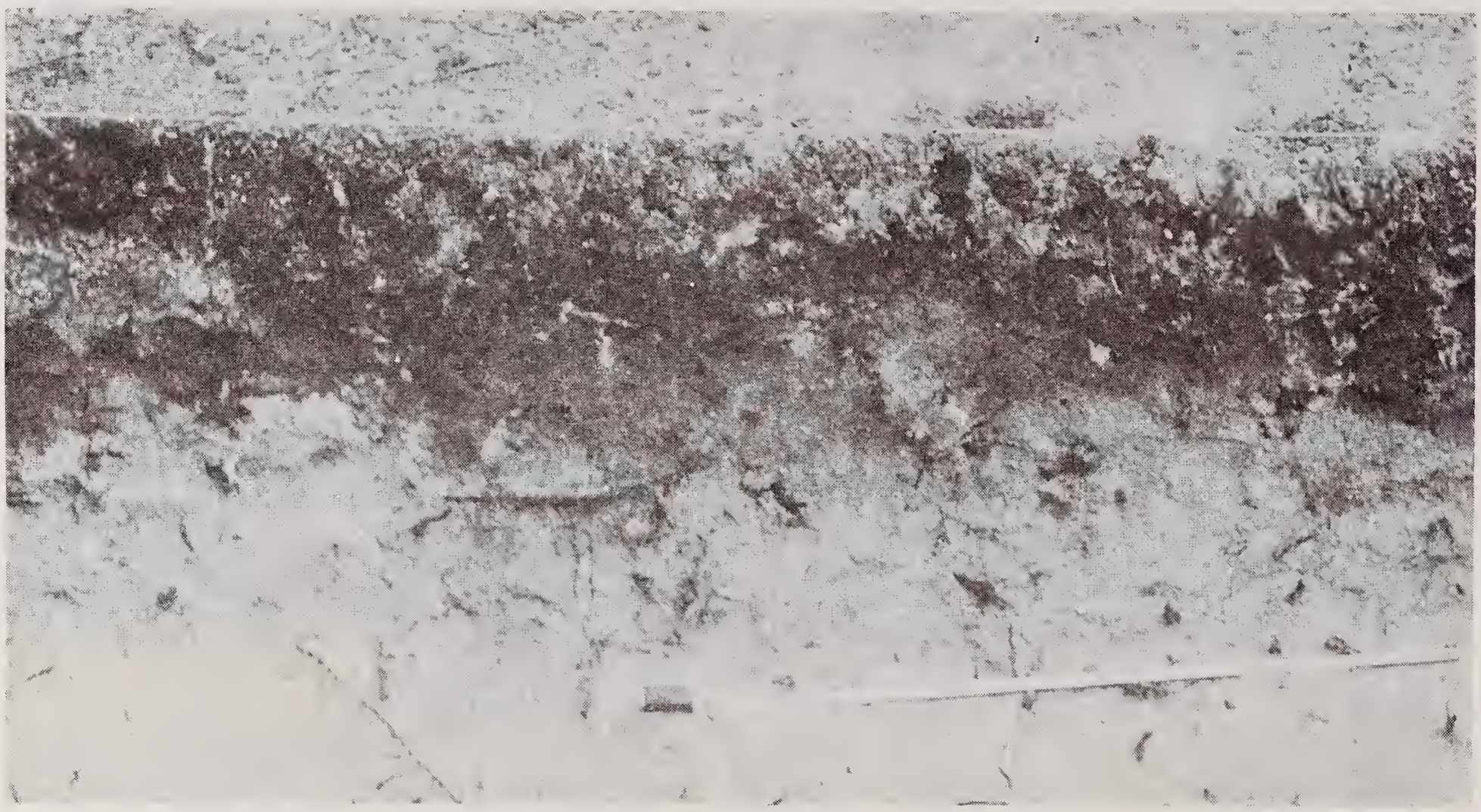

Fig. 7. North face, square 2, Nu-3, showing shallow cultural deposit.
Scale = 50 cm.

Surface finds in the vicinity of this site included a number of adzes, a partially made adze and a quantity of whole and broken *Tridacna maxima* shells, indicating the manufacture and use of adzes in the area. The artifacts from the excavations, however, seemed to reflect domestic pursuits rather than canoe making, and included worked pearl shell, hook fragments, coconut graters, shell scrapers, adzes, a whetstone, pumice, and a whalebone staff.

The site appears to have been occupied for a period of rather short duration, if the shallowness of the deposits is any indication, and used as a living and cooking area. The only evidence of the traditional canoe-making activities is the number of adzes found on the surface.

NU-4

A short distance inland from Nu-1, on the other side of the main path through the village, was the area designated as Nu-4 (Figs. 3, 8). It was originally considered part of Nu-1 and occupied the position J-28 in the grid of that site. As there was no indication that it had ever been occupied by a *hada,* however, it was subsequently regarded as a separate site. The highest point of the ground surface was 20 cm above the datum point for Nu-1, almost 1 m above the highest point of square G-9. Originally an area 3 m x 2 m was set out for excavation, but this proved too large to control and was reduced at a depth of 30 cm to the usual 2 m square. The deposits were excavated using a combination of natural layers and arbitrary levels. Apart from the thin surface layer, the upper part of the deposits contained no easily distinguishable natural layers and was excavated in five arbitrary levels. A thick layer beneath this was divided into two arbitrary levels. Beneath this were several easily distinguished natural layers, while the basal deposits were again excavated in arbitrary levels. The total depth of the excavation was 270 cm and a test pit revealed that excavation had ceased a mere 10 cm above the water level.

Fig. 8. General view of Nu-4 before excavation, looking east.

The sequence of layers and levels was as follows (Fig. 9).

Layer 10: (levels 1 and 2a) very compacted fine clean coral gravel.

Layer 9: (levels 2b-5) mixed deposits of coarse and fine coral gravel with sandy patches, and considerable colour variation.

Layer 8: (levels 6 and 7) more homogeneous deposits of dark coral and sand with lots of charcoal and burned coral.

Layer 7: (level 8) fine rather whitish coral gravel with no oven debris.

Layer 6: (level 9) similar gravel to layer 7 but darker with considerable charcoal, particularly at the base.

Layer 5: (level 10) clean white sand and fine coral fragments with no charcoal stain or discolouration.

Layer 4: (level 11a) a thin layer of black charcoal-stained sand deepening in two areas to fill small fire hearths.

Layer 3: (level 11b) greyish white sandy deposit capped by layer 4.

Layer 2: (levels 12-14) grey charcoal-stained sand, darkening gradually from the colour of layer 3 to an almost black sand and fading unevenly to:

Layer 1: (levels 15-16) sterile white beach sand.

A number of features were found on the surface of layer 7, including three well defined postholes and two less clear ones. In the east side of the square a raised ridge of white sand 10 to 15 cm above the general surface of the layer was encountered. When excavated, this was found to have been deliberately thrown down to cover a concentrated patch of greasy charcoal and bone. Such a concentration of features in a small area at one level was unusual. The only other recognisable features in this excavation were several small hearths, and isolated postholes.

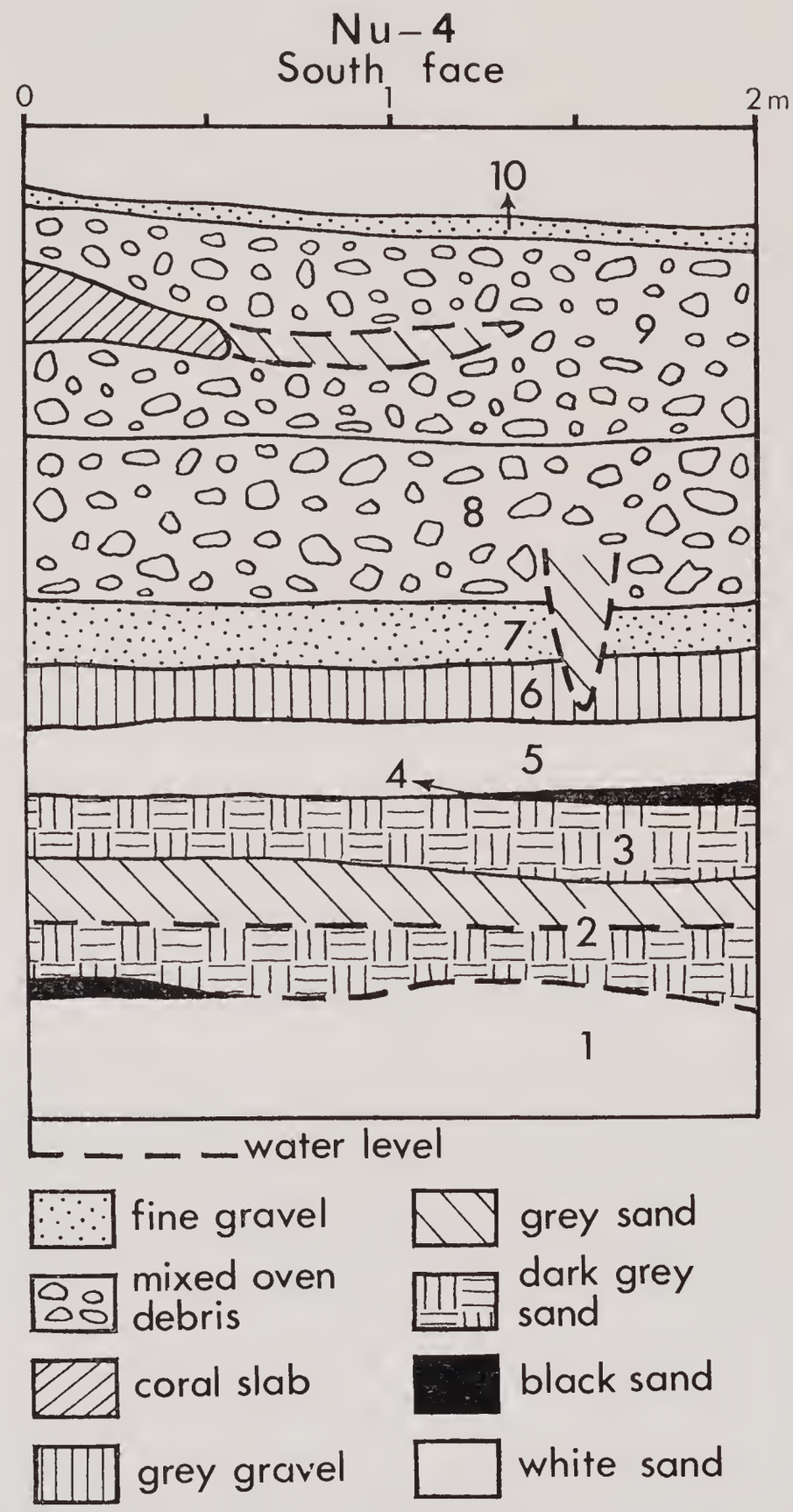

Fig. 9. Cross-section, south face, Nu-4.

A single charcoal sample from this site has been radiocarbon dated. It came from the larger of two hearths associated with layer 4 (level 11a). The initial determination was 20 B.C. ± 90 (Gak-739). As some contamination from impurities was suspected by the laboratory the sample was retested giving a determination of less than 180 years before 1950. The lowest layers of Nu-4, including layer 4, are believed to be among the earliest deposits encountered on Nukuoro, on grounds other than carbon dating, so that the second determination does not appear to be acceptable. The earlier date, however, while possible, is so much older than all other available dates that it must also be viewed with reservations.

Nu-4 was the first of the excavated sites to yield identifiable dog bones. Their significance is discussed below; here it is sufficient to say that dog bones appear to be present only in early occupation layers. In Nu-4 they were found from layer 7 downwards, while fishhooks of Type II, also indicative of relatively early occupation, were also present in layer 7. Both these items, but particularly the dog bones, are good indicators of the relative antiquity of the lower layers in Nu-4.

The history of occupation at this locality appears to have passed through several different phases. The discoloured sand of layers 1 to 3 may reflect human activity, but is hardly a true occupation. The first actual occupation layer, layer 4, probably reflects a transitory type of occupation rather than actual residence and the largely sterile layer above it may indicate a period of abandonment before more intensive use of the site began.

Layers 6 and 7 are similar to occupation deposits in other locations, but are shown to be earlier than most by the presence of dog bones and Type II fishhooks. Layers 1 to 7 probably all antedate the first occupation of Nu-1, implying that the shoreline in the early settlement period may have been as far back as Nu-4. Layers 8 to 10 lack dog bones and contain domestic artifacts typical of the later part of the Nukuoro sequence. Layer 9, particularly, seemed very disturbed, as if it had been recently dug over or hastily deposited as fill.

Artifacts were recovered in small numbers from throughout the deposits. From the upper layers (8 to 10) came fragments of hooks and coconut graters, worked pearl shell and bone, adzes, a shell pendant, a hammer stone and a grindstone. The lower layers contained hook fragments, bone fragments, including pieces of two lure points, beads, an adze and some worked pearl shell.

NU-5

Nu-5 was situated at the inland edge of the main built up area of cultural deposits, directly inland from Nu-4 (Fig. 3). At this point there is a small promontory of higher ground extending into the lower, and in places swampy, land inland of the village. Traditionally this particular promontory or mound was the site of one of many godhouses in the village. It was chosen for excavation partly for this reason and partly because it was a logical choice in the series of excavations designed to provide a cross-section across the main islet.

Natural stratigraphy was present in the form of innumerable thin and often discontinuous layers (Fig. 10). The deposits varied from lenses of clean gravel and sand to thin layers heavily stained with charcoal, and were excavated in 18 arbitrary levels of approximately 15 cm each. It was considered more important to vary the levels somewhat to accommodate any recognisable floors, than to adhere strictly to geometrically satisfying but culturally meaningless spits. The natural stratigraphy can be described in terms of several major bands or groupings of layers (Fig. 11).

Levels 1 to 6 consisted mainly of black charcoal-stained deposits. These were interrupted by a thick floor of white coral gravel containing artifacts, which was excavated as an enlarged level 2, and by a lens of browner gravel in level 4. Levels 7 to 9 comprised a thick band of clean fine gravel layers, penetrated in the northeast corner by an oven dug from a higher level. Levels 10 to 15 again consisted of a series of thin greasy charcoal-stained deposits, interrupted by an irregular and discontinuous lens of sand in level 12. A large oven was dug from these deposits into the underlying sand in the northwest corner of the excavation. Levels 16 and 17 consisted of compacted puggy brown sand, flecked with charcoal, which gave way in level 18 to sterile white sand. Excavation ceased at 290 cm below the surface and a test pit revealed the top of the water table at 350 cm.

Two postholes were identified in this excavation, one in the surface of level 7, and one dug from level 8 or 9 which was identified only on the surface of level 10. There were also the two large ovens mentioned above, and some smaller ones within the layers of cooking debris.

Fig. 10. Part of south face, Nu-5.

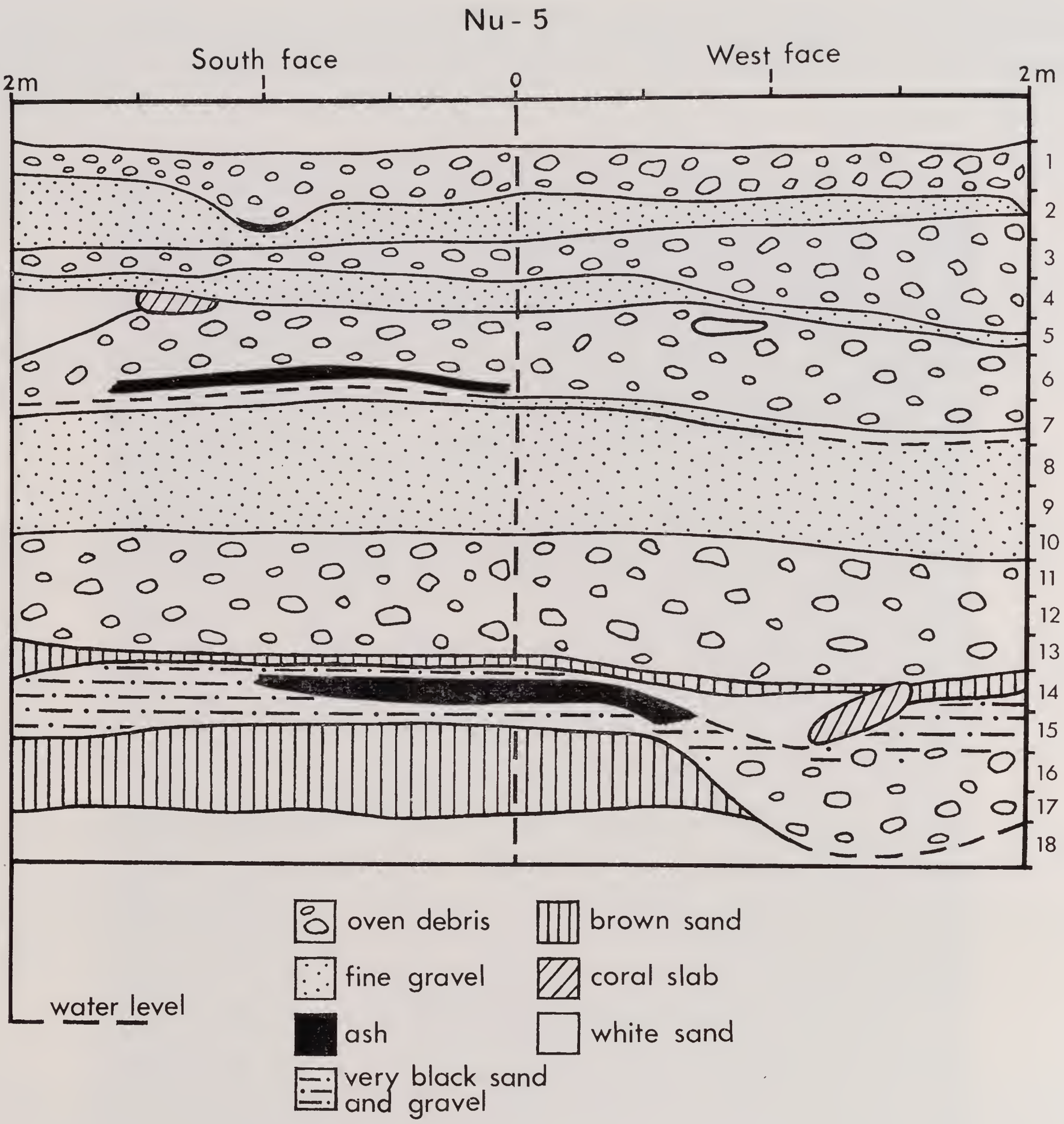

Fig. 11. Cross-sections, south and west faces, Nu-5.

Very few artifacts were recovered in relation to the volume of the excavation. The main concentration was in level 2 associated with the white gravel floor.

Four charcoal samples from this site were dated in an attempt to assess the rate of accumulation of this, the deepest excavated deposit. The determinations were as follows.

Small hearth or oven, level 5, 75-80 cm below surface:

P-1128	1738 ± 43 A.D.

Fill of posthole beginning at 100 cm below surface:

P-1129	1677 ± 45
Gak-738	1475 ± 80

Concentrated charcoal, level 13 (195 cm below surface):

P-1130	1608 ± 45
Gak-940	1430 ± 80

Concentrated charcoal, level 15 (220 cm below surface):

P-1131	1609 ± 111
Gak-740	modern (less than 200)
rerun:	1540 ± 100

It was obvious that these results could not be used as precise indicators of the calendrical years when the deposits from which the samples were obtained were laid down. They do serve however, as a broad framework within which the rate of accumulation can be assessed. The results from the two different laboratories, while differing from each other, are internally consistent, and both indicate a rapid accumulation of the central part of the deposit, so rapid indeed, that it might be attributed to a single deliberate infilling if the stratigraphy did not show so clearly a series of thin horizontal lenses inconsistent with deliberate infilling.

The results from levels 13 and 15 are not as early as had been anticipated in view of the depth below the surface. However, as the dog bones typical of early levels were found only in levels 16 and 17 at this site, and early forms of fishhooks were lacking, there is independent confirmation of the evidence of the carbon dates that the central part of the deposit at this site accumulated very rapidly.

This excavation demonstrated the difficulty of verifying or disproving the traditional use of the site as a godhouse. Much of the occupation sequence seems to consist of cooking deposits, representing cooking houses or rubbish dumps on the inland edge of the village occasionally interspersed with house floors of a different kind such as sleeping or storage houses. A point at which a specifically religious use of the site, as a godhouse or priest's house began cannot be identified, but neither is it possible to say categorically that no such use occurred.

NU-6

It seemed desirable to have one excavation in the low lying central part of the islet to test the nature of any deposit there. Nu-6 was therefore set out a short distance inland of Nu-5 in the lower ground behind the village. This land is at present not inhabited, and is planted in coconut palms.

The location was excavated in nine 15 cm levels (Fig. 12). The first five levels comprised mainly black charcoal-stained sand and coral, with a thick lens of fine dark sand in the north-west corner of the square. The bottom of level 5 and level 6 contained similar coarse gravel and cooking debris but were brown in colour. Levels 7 and 8 also had the pronounced brown colour, but were of finer sand and lacked the coarse gravels of upper levels. There was a gradual

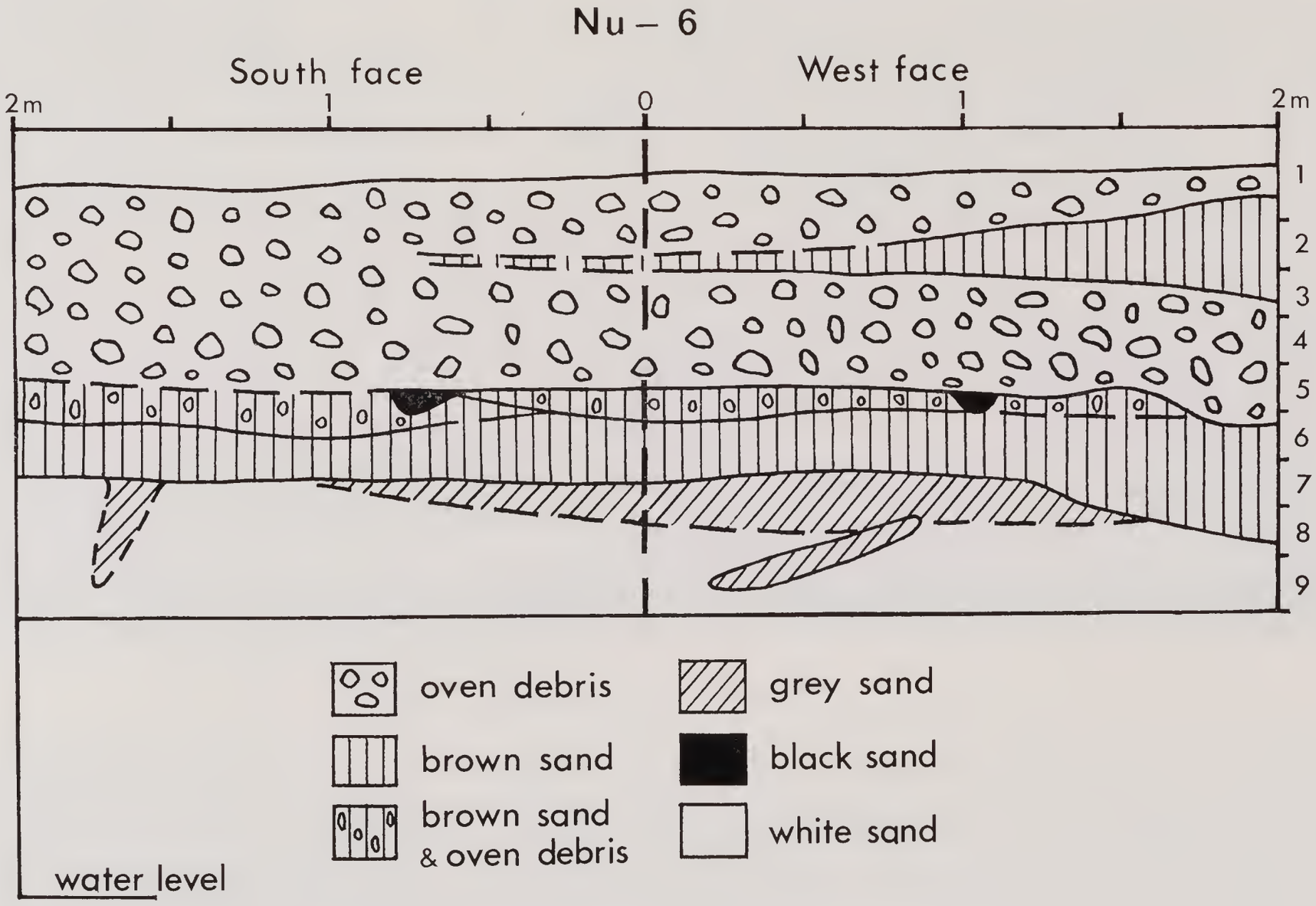

Fig. 12. Cross-sections, south and west faces, Nu-6.

change in colour in level 8 to grey and then white sand. Level 9 consisted of clean white sand penetrated by several post and stakeholes from the darker layers above. A test pit revealed the water table 90 cm below the bottom of the excavation.

No radiocarbon dates are available for this excavation. Dog bones were present in levels 6 to 8, and also in level 4. Both the brown sandy layer and the lower part of the more concentrated occupation layer seem to belong to the early part of Nukuoro prehistory, while the location was abandoned in the later phases when the really deep deposits were accumulating nearer the lagoon shore.

Disappointingly, but not surprisingly, very few artifacts were found in this site. The small assemblage included adzes, a hook fragment, ornament fragments, a coral disk and the usual worked shell and bone fragments.

NU-7

The final excavation to complete the sampling of a representative cross-section of the islet was situated on one of several small raised areas on the reef side of the islet (Fig. 3). The surface in this area was noticeably higher than at Nu-6 and in fact appeared to form a low mound. A single 2 m square was excavated near the estimated centre of the mound, slightly to the landward side to avoid concentrations of coconut rootlets (Fig. 13). The deposits varied from black oven debris to fine white gravel, changing gradually at the base through finer grey and brown sand to clean beach deposits. As in other sites, drawing of sections tended to exaggerate distinctions that were by no means easy to make during excavation (Fig. 14). There were, however,

Fig. 13. General view of Nu-7 during excavation.

several distinct features in this deposit, including a posthole dug from near the surface, 55 cm deep, and a curious small rounded pit, 30 cm deep and 50 cm wide filled with very clean white gravel. These features were excavated separately. The rest of the deposit was excavated in ten 15 cm levels. The first seven levels consisted of coral gravel with varying amounts of cooking refuse, while the last three were merely discoloured sand changing gradually to the beach sand underneath. The water table was discovered 115 cm below the limit of the excavation.

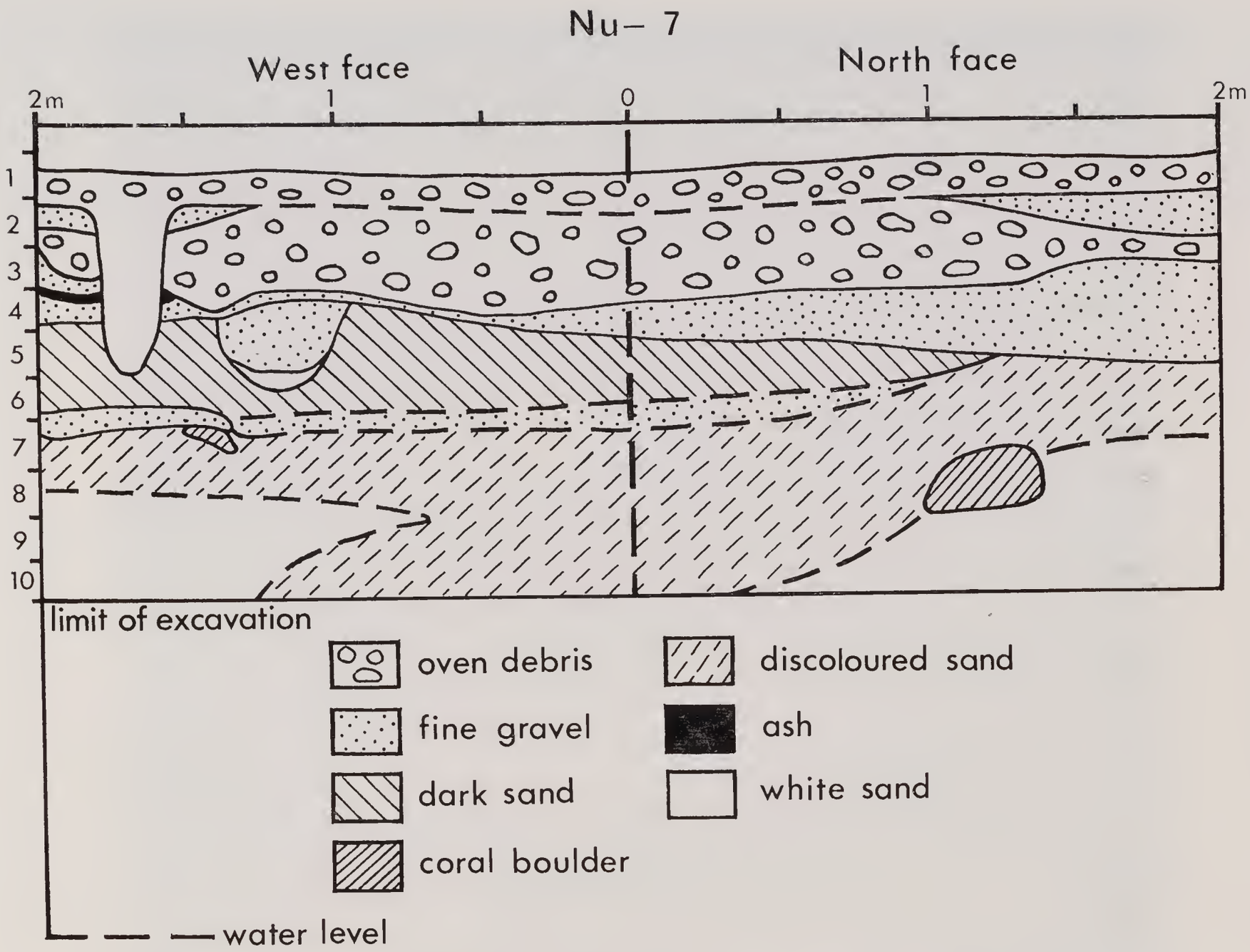

Fig. 14. Cross-sections, west and north faces, Nu-7.

No radiocarbon dates are available for this location, but the complete absence of dog bones suggests that it may be relatively late. The small assemblage of artifacts included adzes, hook fragments, coconut graters, a coral file and worked pearl shell.

The nature of the deposits and their content suggests that this was a living area inhabited during relatively recent times when the population was large enough for the village to expand to the reef side. Kubary's plan of the village in the 1870s shows a number of houses on the reef side which were no longer there in Jeschke's time (*c.*1913) when the village more closely resembled its present form (Eilers 1934, p.199). Nu-7 occupies the position of the reef side house immediately to the north of *Te hai awa tue te holau* (*De-haiava-tua-de-holau* in modern orthography) in Kubary's time, suggesting that it may have been occupied into the early European period although no European artifacts were found there.

NU-8

This location, the last to be excavated, most closely resembled Nu-4 and Nu-5 in its geographical position and in its content. It was the only site excavated in the northern half of the village and was situated north of the *malae,* a short distance inland of the main path through the village. Close by is the land where the colonising ancestor's house traditionally stood and in this area, which is still regarded as a very desirable residential area, land holdings are very fragmented, suggesting long occupation. It was expected that this location might prove comparable to Nu-4 in length of occupation.

Like Nu-5 the deposits at Nu-8 consisted of innumerable fine lenses of coral gravel with relatively few clear distinctions or discontinuities (Fig. 15). Accordingly the excavation was carried out in 17 arbitrary levels of approximately 15 cm each, varying slightly to accommodate any clearly defined natural layers. The first 130 cm consisted of thin gravel lenses, varying in colour from white to dark grey. Noticeably darker lenses with more charcoal were encountered in level 3 and level 6, and there were particularly white gravels in level 8 and coarser gravels in levels 6 and 7.

Fig. 15. North face, Nu-8.

Below level 9 the excavation was reduced in size because of the instability of the west wall after heavy rain. The stratigraphy of the deeper deposits was more complex. A clearly defined dark charcoal-stained layer provided a recognisable marker dividing the grey gravels of levels 9 and 10 from underlying coarser gravels with more charcoal which in parts of the excava-

tion continued to the bottom of level 14. In the south side of the excavation, however, a thick white gravel deposit occurred in levels 13 and 14 and was excavated separately. Fine grey gravel was widespread throughout the square at the base of level 14. Beneath this was a deposit of puggy brown sand, quite different from the overlying layers and resembling the basal deposit at Nu-5. This gave way to clean sand in the south of the square and to banded ash and sand in the north, which gave out over clean sand only a few cm above the water table, encountered 255 cm below the surface (Figs. 15, 16).

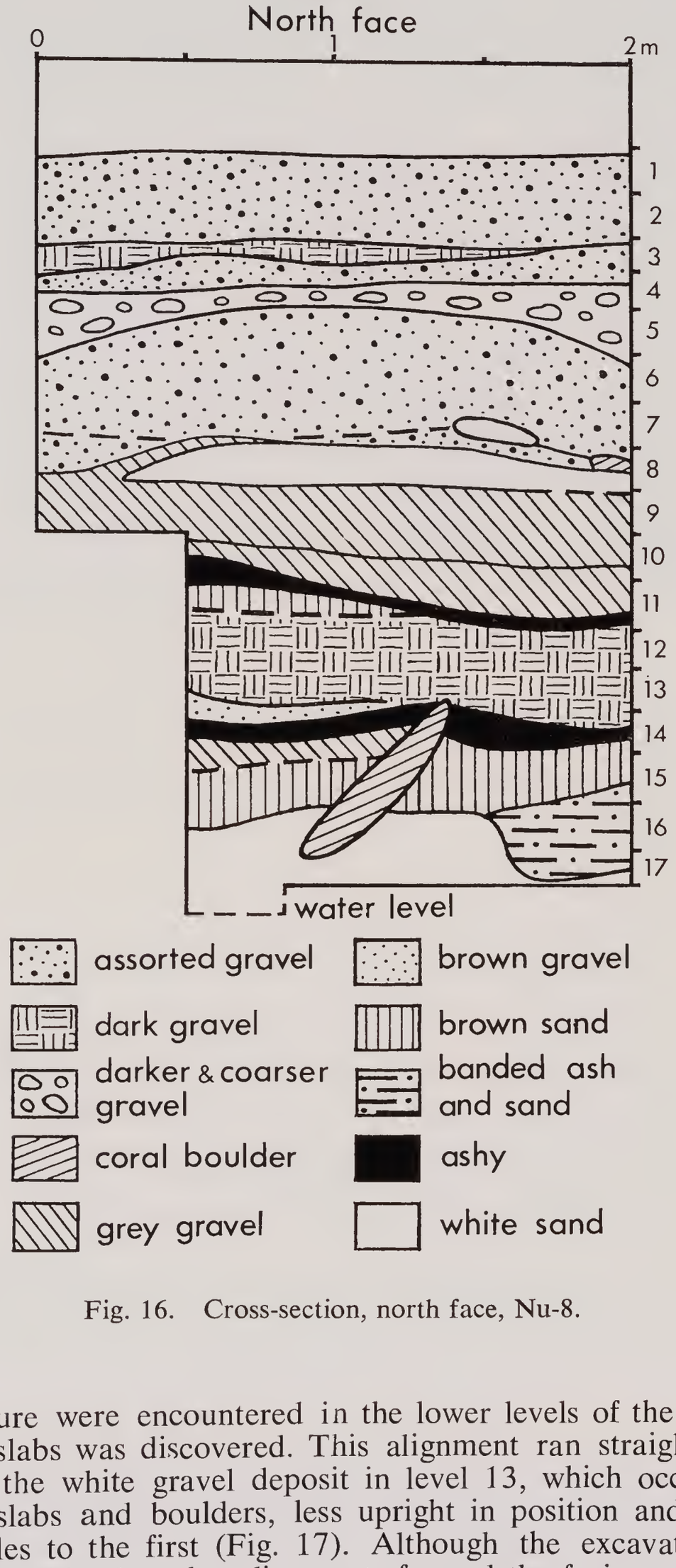

Fig. 16. Cross-section, north face, Nu-8.

Remains of a structure were encountered in the lower levels of the site. In level 12 the top of an alignment of coral slabs was discovered. This alignment ran straight across the excavation and marked the limit of the white gravel deposit in level 13, which occurred only south of the slabs. A second line of slabs and boulders, less upright in position and set slightly deeper, ran more or less at right angles to the first (Fig. 17). Although the excavated area was too small for certainty it seems probable that the alignments formed the facing of a low rectangular platform similar to the modern house platforms described above (p. 4). The white gravel, penetrated by one large posthole, could well represent the house floor. No structural evidence was encountered in upper levels beyond the gravel lenses themselves, some of which, in view of their artifact content, were certainly living floors.

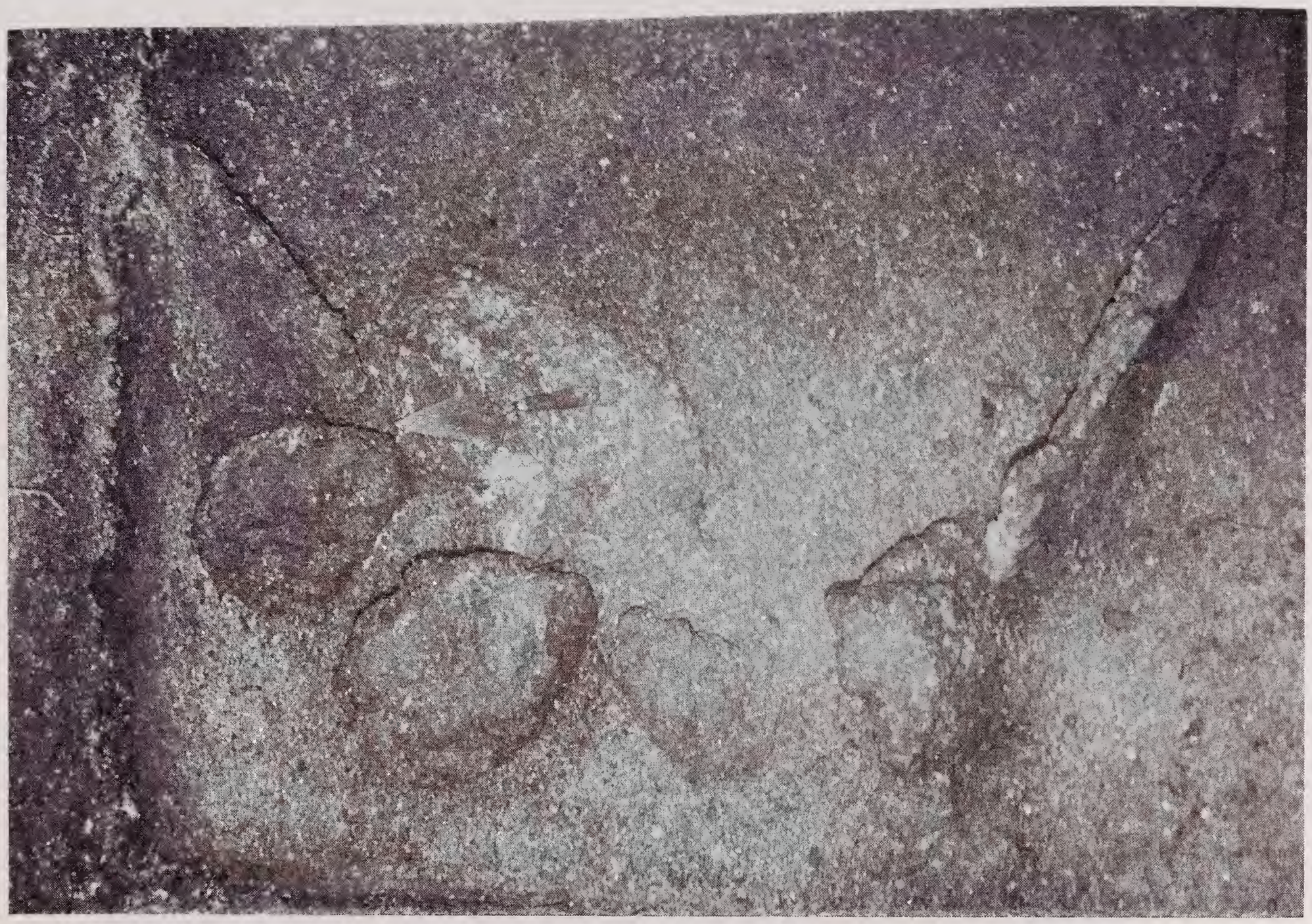

Fig. 17. Alignments of coral slabs in lower levels of Nu-8.

A single radiocarbon date is available for this site. A sample from a concentrated patch of charcoal in level 12 provided a determination of 1530 ± 100 A.D. (Gak-741). The sample came from the layer of cooking debris which accumulated around and on top of the structure described above, and provides an indication of the period of time required for the accumulation of the bulk of the deposit at this location.

Nu-8 yielded more artifacts than any other site except Nu-1. The majority are from contexts more recent than that from which the radiocarbon sample came, and seem to reflect a series of domestic occupations of the site. Two levels were particularly productive and may have been actual house floors. The upper of these, level 3, yielded coconut graters, ornaments, hook fragments, a bone needle, adze fragments, a coral rubbing stone, pumice, useful shells, and fragments of worked shell. From level 7 came coconut graters, a hook fragment, a bead, worked pearl shell, coral files, useful shell, a slab of coral of a type used in food preparation, and a cache of adzes. Other levels, though less productive, also yielded adzes, hook fragments, worked shell and bone, files, pumice and useful shells. *Terebra maculata* shell adzes were particularly numerous at this site.

Items that are chronologically significant help to correlate these deposits with other excavations, and supplement the single carbon date in indicating the relative age of the various levels. Dog bones were found only in level 13 and below, coconut graters only in level 7 upwards, while the few fishhooks recovered seem to fit in satisfactorily with the fishhook chronology discussed below.

The sequence at Nu-8 seems to resemble that at Nu-5 quite closely. The alternate thin occupation layers and white sand of Nu-4 are absent, but the curious brown puggy basal layers of Nu-8 and Nu-5 are similar. The continuation of the deposits at Nu-8 almost to the water table suggests that the site may once have been a taro excavation or a well which fell into disuse and silted up. Whether or not this was the case the structure was built a mere 50 cm above the present water table. After the building of the structure the deposits accumulated fairly rapidly, as they apparently did at Nu-5, although there was less cooking debris and more evidence of residential occupation than at Nu-5.

DISCUSSION

Forty square metres is a very small sample of the total archaeological deposit on Nukuoro. Nevertheless the excavations have provided a considerable amount of information about the nature and formation of the deposits and their differential rates of accumulation, and some indication of the atoll's past settlement pattern, as well as yielding a valuable amount of information about the material culture and economy of the inhabitants which are discussed in greater detail below.

A discussion of the radiocarbon dates and their value and limitations has been published elsewhere (Davidson 1968a). Here it is merely sufficient to point out that the carbon dates cannot provide precise dates for individual events, but do serve to provide a good indication of the approximate time span covered by the excavated deposits, and some general information about rates of accumulation.

More useful in correlating the different locations are certain diagnostic items which consistently occur at early or late levels. Particularly important are the presence of dog bones among midden remains, indicating early levels, pearl shell coconut graters, confined to upper levels, and the appearance and disappearance of various characteristic fishhook types.

In Fig. 18 the positions of the various radiocarbon samples and the occurrences of chronologically significant items are shown, in an attempt to indicate the probable rates of accumulation of different sites, and their chronological relationships.

On the evidence available Nu-4 and Nu-6 were the most frequented localities during the earliest part of the excavated sequence. Use of Nu-6 subsequently declined almost to nothing, but Nu-4 continued to build up more slowly. Nu-5 and Nu-8 both show a slight early build-up and a subsequent more rapid accumulation to their present heights. In both cases there is some possibility that they were on the edges of depressions such as wells or small taro excavations at the time of the first accumulations at Nu-4 and Nu-5, and were subsequently allowed to fill and become occupation surfaces. The bulk of deposits at Nu-1 represent a rapid build-up covering the same period as the upper half of Nu-4, 5 and 8. The late occupation of this site, and the undoubted evidence for considerable progradation of the shore line in its vicinity tend to suggest that, at the beginning of the sequence, the shoreline was back nearer to Nu-4 which was a natural choice for early occupation. As the shoreline advanced, so did the occupation.

Nu-2 and Nu-3, and to a lesser extent Nu-7, provided so few artifacts that it is difficult to relate them with any certainty to the general sequence. It is likely that they are all relatively recent accumulations belonging to the latter part of the sequence.

The deposits in all locations consisted of house and yard floors of fresh coral gravel and accumulations of cooking and other rubbish, showing quite clearly that instead of dumping rubbish in the lagoon the Nukuoro merely covered it up with new floors. Postholes were encountered at various points in the deposits, but the nature of the excavations was such that, except for the slab wall in Nu-8, structures could not be defined. Moreover, the depth of the deposits, and the obstruction of much of the surface by trees and buildings, would make area excavation extremely difficult. Large quantities of burnt coral and charcoal were encountered, showing that earth oven cooking has been intensively practised in the living area. The poor durability of coral in earth ovens, compared with the stone of volcanic islands, was probably a major factor contributing to the build-up of some of the deposits. Large quantities of coral would be required, as the same pieces could not be continuously re-used, and fresh floors of coral gravel and sand would often be needed to tidy up living areas where quantities of cooking debris had accumulated. Archaeological evidence for both practices is abundant.

It is obvious from Fig. 18 that the rate of accumulation of deposits varied from location to location and from time to time. The upper levels of Nu-6, and the lower levels of Nu-1, for example, seem to have accumulated very slowly, and contrast with the majority of the Nu-1 deposit, from layer 5 upwards, and the major parts of Nu-5 and Nu-8. While the carbon dates from Nu-5 do not allow precision in estimating the rate of accumulation they do suggest that the bulk of the deposit could have accumulated in a mere 200 years. It is not unreasonable to suppose that in some parts of the village area unwanted depressions could have been deliberately filled to provide new living areas. The stratigraphic evidence from the excavations, however,

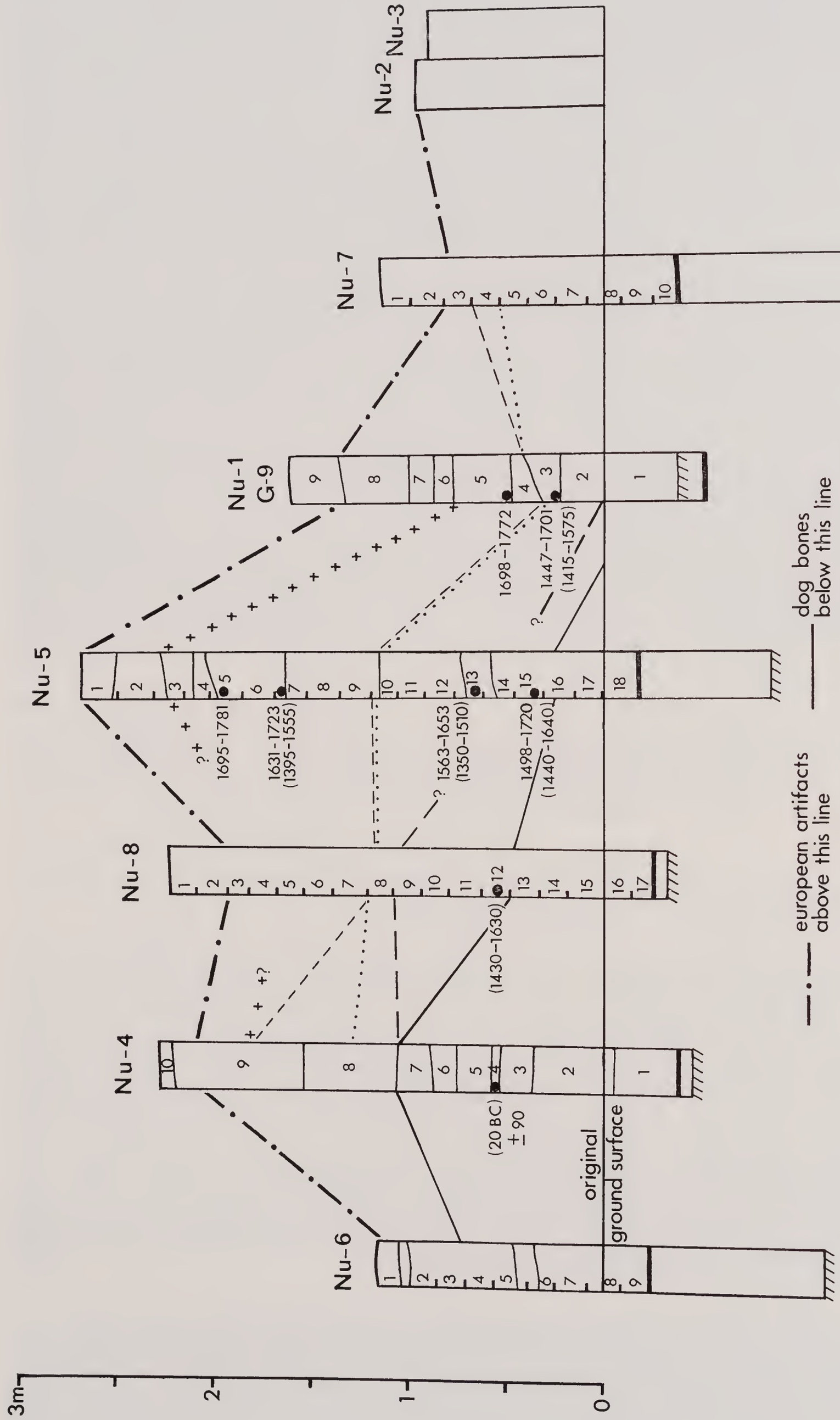

Fig. 18. Correlation of excavated deposits at Nukuoro, showing stratigraphic position of diagnostic artifacts and C14 samples.

argues against such an interpretation of these locations, and it appears that even the accumulations of Nu-5 and Nu-8 were the normal result of the way of life practised in the village. It is interesting to note that European items are confined to the uppermost levels of the deposits. There would seem to have been a slowing down in the rate of accumulation in European times, despite the predominantly traditional appearance of the village. The introduction of iron cooking pots and kerosene stoves, however, has probably affected the use of the earth oven, with a consequent falling off in the rate of accumulation.

The excavations showed that, originally, Nukuoro was a low sandy islet of no greater elevation than other islets. Although the levelling equipment available was not precise enough to make highly accurate measurments, it was sufficient to indicate approximately the conformation of the original ground surface and the present position of the water table. If the theory advanced about the progradation of the shore from Nu-4 past Nu-1 is correct, the shape of the underlying water lens presumably also changed, so that the present position of the water table may not be the same as its position at the time of initial occupation.

As was to be expected, first settlement of the islet seems to have been along the former lagoon shore, with the bulk of occupation always in the present village area, and expansion to the south and the reef shore only at later stages. This is supported by traditional evidence.

Although several traditionally specialised sites were investigated, their functions could be verified from archaeological data only in the case of the alleged *hada,* from which material was recovered which was consistent with the presence of a *hada* and not found anywhere else. The alleged cult sites at Nu-2 and Nu-5, however, could not be identified archaeologically. Nu-2, the site of the presumed whale cult, revealed unusually concentrated deposits of cooking debris, whose interpretation, however, is doubtful. All other sites yielded evidence of domestic occupation with no identifiable evidence of specialised functions.

IV. TECHNOLOGY

As was seen above, numbers of artifacts and fragments of artifacts were recovered from the excavations. The distribution of major categories of artifact in the deposits is shown in Tables 1 - 8. These artifacts may be regarded as a fairly representative selection of the durable material culture of Nukuoro during approximately four centuries before 1900 A.D., although a large proportion probably belongs to the latter half of this period. They have been studied in conjunction with the general collection, the ethnographic accounts of Nukuoro material culture and the descriptions and interpretations offered by modern informants, to provide a fairly full account of some aspects of material culture at the close of the prehistoric period on Nukuoro. Moreover, the archaeological evidence gives some indication of changes in this material culture during the prehistoric period, while the other sources of information mentioned above can be used to show how the durable items were combined with other components of wood or fibre which have not survived archaeologocially, how various items were used and what they were called, and the changes and adaptations that took place as a result of contact with Europeans and increased contact with other island cultures during the European period.

The principal ethnographic accounts are those of Kubary, published in 1900 but based on fieldwork at Nukuoro in the 1870s, when traditional material culture was just beginning to be replaced by European items, and of Eilers, published in 1934 but based on the fieldwork and observations by the 1910 expedition and by Jeschke in 1910 - 1913, when a few traditional items were still in use, supplemented by museum collections of various ages.

No attempt has been made to study Nukuoro artifacts in museum collections other than the few items in museums in New Zealand and Honolulu and those described by Eilers. It is likely that Nukuoro artifacts, particularly fishhooks and shell adzes, are widely scattered, but it seems improbable that they would provide additional information of importance beyond that available from other sources.

The general collection includes surface finds and items in the possession of present day Nukuoro which were given to Carroll. For the most part it reflects the excavated assemblage closely, but in one important respect it adds new information. The excavated assemblage provided a restricted sample of the total range of adzes. In contrast the general collection contained varieties of adze not found in the excavations at all. Reasons for this are explored below.

Although Nukuoro was sporadically visited by Europeans during the 19th century, Kubary's account shows that the culture was relatively unaffected until the 1870s. It was at this time that the most important of the wooden images appear to have been taken from the atoll (Davidson 1968b). Between 1880 and 1910 a number of items were dropped from the traditional material culture, but a few were still in use in 1910, including large shell adzes and metal imitations of the prehistoric fishhooks of pearl shell. Since the traditional material culture survived far longer on Nukuoro than in many Polynesian societies it is hardly surprising that on Nukuoro in 1965 elderly informants could still be found with some knowledge of the names and functions of traditional artifacts. In particular, information was obtained from two men, Hainis and Soses, whom Carroll regarded as highly reliable informants. During the excavations these two men were questioned by myself with Carroll interpreting; subsequently Carroll obtained further information from them. It was found that information from these sources provided a valuable supplement to published information.

The principal aims of a study of Nukuoro material culture through time are an understanding of how the limited resources of a small atoll were used by its inhabitants, and an appreciation of the internal development and external relationships of this material culture. While the study of internal development and use of local resources can be based on Nukuoro material alone, and is consequently fully discussed below, the important field of external relationships requires adequate comparative material. The study of ethnographic items from Nukuoro has shown the dangers of basing comparisons on such material alone. Consequently, while some comparisons will tentatively be suggested in this section a full study of the external relationships of Nukuoro material culture must await the availability of excavated assemblages from neighbouring island groups.

Table 1. Distribution of artifacts by layer, Nu-1.

SQUARE	LAYER	FISHING GEAR			ORNAMENTS			ADZES	MANUFACTURING TOOLS					DOMESTIC TOOLS								UNCERTAIN FUNCTION			MANUFACTURING WASTE				EUROPEAN/JAPANESE
		one-piece hook	lure	sinker	bead	bracelet	pendant	grindstone	flat file	branch coral file	drill point	pumice	coconut grater head	shell container	turtle bone adze	turtle bone fragment	bone pole	coral rasp	needle	other bone artifact	coral disk	perforated shark tooth	hammer/pounder	used bivalve	bone	pearl shell	*Tridacna*	other shell	
G-9	9	45	2	—	1	1	—	1	—	1	—	—	3	—	—	—	—	—	—	—	—	—	1	—	1	11	1	—	x
	8	143	2	—	1	—	—	2	2	24	—	—	—	—	1	—	—	—	—	—	—	2	—	—	—	388	—	1	—
	7	88	1	—	3	1	1	—	1	—	17	2?	—	1	—	2	—	—	—	—	—	—	3	2	2	—	118	—	—	—
	6	31	—	—	—	1	—	2	—	—	1	—	—	—	—	—	—	—	—	—	—	—	3	—	—	—	21	—	—	—
	5	6	—	?	—	—	—	3	—	—	—	—	—	—	—	3	?	—	1	—	—	—	—	—	2	18	—	—	—
	4	11	?	—	—	?	—	—	—	—	1	—	—	2	—	—	—	—	—	—	—	—	2	—	—	—	13	1	—	—
	3	27	—	—	—	2	—	4	—	1	3	—	3	—	—	—	—	—	—	—	—	—	—	—	—	—	39	—	—	—
	2	13	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	17	—	—	—
	1	10	—	—	—	1	—	3	—	—	—	—	—	—	—	—	—	—	?	—	—	—	1	—	3	—	6	4	1	—
E-5	6	15	—	—	—	—	—	—	1	—	—	—	—	1	—	—	—	—	—	—	—	—	1	1	—	—	21	2	—	—
	5	212	2	—	4	—	—	14	2	2	6	—	1	6	—	1	2	1	—	—	1	1	2	2	4	—	349	8	—	—
	4	17	—	—	—	—	—	3	—	—	—	—	—	3	—	—	—	—	—	—	1	—	—	1	—	—	47	3	—	—
	3	14	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	38	1	—	—
	2	53	—	—	—	1	—	4	—	—	—	—	—	1	—	—	—	—	—	—	1	—	1	—	—	—	78	7	—	—
	1	12	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	1	17	3	—	—
surface		10	—	—	1	—	—	3	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	25	1	—	—
well shaft		24	—	—	1	2	—	2	—	—	—	?	2	1	—	—	—	—	—	—	—	—	—	—	—	—	64	10	3	—
no context		27	—	—	—	—	—	1	—	—	—	—	—	2	—	—	1	—	—	—	—	—	1	—	—	—	53	—	1	—

Table 2. Distribution of artifacts by level, Nu-2.

LEVEL	FISHING GEAR			ORNAMENTS			ADZES	MANUFACTURING TOOLS					DOMESTIC TOOLS								UNCERTAIN FUNCTION				MANUFACTURING WASTE				EUROPEAN/ JAPANESE
	one-piece hook	lure	sinker	bead	bracelet	pendant		grindstone	flat file	branch coral file	drill point	pumice	coconut grater head	shell container	turtle bone adze	turtle bone fragment	bone pole	coral rasp	needle	other bone artifact	coral disk	perforated shark tooth	hammer/pounder	used bivalve	bone	pearl shell	*Tridacna*	other shell	
1	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	—	—	—
2	1	—	—	—	—	—	—	—	—	1	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	14	1	—	—
3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table 3. Distribution of artifacts by level, Nu-3.

SQUARE	LEVEL	FISHING GEAR						ORNAMENTS		ADZES	MANUFACTURING TOOLS				DOMESTIC TOOLS										UNCERTAIN FUNCTION		MANUFACTURING WASTE			
		one-piece hook	lure	sinker	bead	bracelet	pendant	flat file	drill point	pumice	coconut grater head	shell container	turtle bone adze	turtle bone fragment	bone pole	coral rasp	needle	other bone artifact	coral disk	perforated shark tooth	hammer/pounder	used bivalve	bone	pearl shell	*Tridacna*	other shell	EUROPEAN/JAPANESE	branch coral file	grindstone
surface		—	—	—	—	—	—	6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—
1	1	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—
	2	2	?	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	1	3	—	—	—	—	—
	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—	—
	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—
	5	—	—	—	—	—	—	2	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	2	—	—	—	—	—
	6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—
2	1	1	—	—	—	—	—	—	—	—	—	1	4	—	—	—	1	—	—	—	—	—	—	5	1	—	—	—	—	—
	2	—	—	—	—	—	—	1	—	—	—	—	1	—	—	—	(1)	—	—	—	—	—	—	1	—	1	—	—	—	—

Table 4. Distribution of artifacts by layer, Nu-4.

LAYER	LEVEL	FISHING GEAR				ORNAMENTS		ADZES	MANUFACTURING TOOLS				DOMESTIC TOOLS								UNCERTAIN FUNCTION		MANUFACTURING WASTE			
		one-piece hook	lure	sinker	bead	bracelet	pendant	—	grindstone	flat file	branch coral file	drill point	pumice	coconut grater head	shell container	turtle bone adze	turtle bone fragment	bone pole	coral rasp	needle	other bone artifact	perforated shark tooth	coral disk	hammer/pounder	used bivalve	bone	pearl shell	*Tridacna*	other shell	EUROPEAN/JAPANESE
10	1	2	—	—	—	—	—	—	—	—	—	—	—	3	—	—	—	—	—	—	—	—	—	—	—	5	—	—	—	1
9	2	1	—	—	—	—	—	1	1	—	—	—	—	5	—	—	—	—	—	—	—	—	—	—	—	10	—	—	1
	3	2	—	—	—	—	—	1	—	—	—	—	—	2	—	2	1	—	—	—	—	1	—	—	—	6	1	—	—
	4	5	1	—	—	—	—	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1	4	—	—	—
	5	—	—	—	—	—	—	2	—	—	—	—	—	—	—	3	4	—	—	—	—	—	—	—	—	2	3	2	1	—
8	6	2	—	—	—	—	1	3	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	6	—	—	—
	7	2	—	—	—	—	1	—	—	—	—	—	—	—	—	1	1	—	—	—	—	—	—	—	—	1	1	—	—	—
7	8	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	5	7	1	—	—
6	9	1	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—
5	10	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	3	—	—	—
4	11a	—	1	—	2	—	—	1	—	—	—	—	—	—	—	1	1	—	—	—	—	—	—	—	—	1	5	—	—	—
3	11b	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2	12	1	—	—	—	—	—	1	1	—	—	—	—	—	—	1	—	—	—	—	—	—	—	1	—	4	—	—	—	—
	13	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—	—	—	—
	14	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	1	—	—	—	—
1	15	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
uncertain context		2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	2	1	—	—	—

Table 5. Distribution of artifacts by level, Nu-5.

LEVEL	FISHING GEAR						ORNAMENTS					ADZES	MANUFACTURING TOOLS					DOMESTIC TOOLS										UNCERTAIN FUNCTION			MANUFACTURING WASTE				EUROPEAN/JAPANESE
	one-piece hook	lure	sinker	bead	bracelet	pendant	grindstone	flat file	branch coral file	drill point	pumice	coconut grater head	shell container	turtle bone adze	turtle bone fragment	bone pole	coral rasp	needle	other bone artifact	coral disk	perforated shark tooth	hammer/pounder	used bivalve	bone	pearl shell	*Tridacna*	other shell	
1	5	—	—	—	—	—	—	—	1	—	—	2	—	—	—	—	—	—	—	—	2	—	—	—	3	1	—	—
2	7	—	1	—	—	—	2	—	—	—	—	2	2	—	—	1	—	—	—	—	—	—	1	1	—	1	1	—	—
3	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	8	1	—	—
4	—	—	—	1	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—
5	1	—	—	—	—	—	1	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—
6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	4	—	—	—
7	1	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
8	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1	—	—	—	—	4	—	—	—
9	1	—	—	—	—	—	1	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
10	—	—	—	—	—	—	3	—	—	—	—	—	—	1	—	—	—	—	—	—	1	—	—	1	2	—	—	—	—
11	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—
12	1	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
13	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—
14	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	—	—	—
15	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	—	—	—
16	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
17	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—

Table 6. Distribution of artifacts by level, Nu-6.

LEVEL	FISHING GEAR		ORNAMENTS	ADZES	MANUFACTURING TOOLS			DOMESTIC TOOLS								UNCERTAIN FUNCTION		MANUFACTURING WASTE								EUROPEAN/ JAPANESE
	one-piece hook	lure	sinker	bead	bracelet	pendant	grindstone	flat file	branch coral file	drill point	pumice	coconut grater head	shell container	other bone tool	turtle bone adze	turtle bone fragment	bone pole	coral rasp	needle	bone artifact	coral disk	perforated shark tooth	hammer/pounder	used bivalve	bone	pearl shell	*Tridacna*	other shell	
1	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	1	—
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—
3	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	4	—	—
4	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	3	—	—
5	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table 7. Distribution of artifacts by level, Nu-7.

LEVEL	FISHING GEAR						ORNAMENTS		ADZES	MANUFACTURING TOOLS					DOMESTIC TOOLS										UNCERTAIN FUNCTION		MANUFACTURING WASTE			
	one-piece hook	lure	sinker	bead	bracelet	pendant				grindstone	flat file	branch coral file	drill point	pumice	coconut grater head	shell container	turtle bone adze	turtle bone fragment	bone pole	coral rasp	hammer/pounder	used bivalve	needle	other bone artifact	coral disk	perforated shark tooth	bone	pearl shell	*Tridacna*	other shell	EUROPEAN/JAPANESE
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—
2	1	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
3	—	—	—	—	—	—	2	—	1	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	—	—
4	2	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—
5	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—
6	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	3	—	—	—
7	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—

Table 8. Distribution of artifacts by level, Nu-8.

LEVEL	FISHING GEAR			ORNAMENTS		ADZES	MANUFACTURING TOOLS			DOMESTIC TOOLS					UNCERTAIN FUNCTION				MANUFACTURING WASTE				EUROPEAN/JAPANESE			
	one-piece hook	lure	sinker	bead	bracelet	pendant	grindstone	flat file	branch coral file	drill point	pumice	coconut grater head	shell container	turtle bone adze	turtle bone fragment	bone pole	coral rasp	needle	other bone artifact	perforated shark tooth	coral disk	hammer/pounder	used bivalve	bone	pearl shell	*Tridacna*	other shell	
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	x	
2	1	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	3	—	—	x
3	3	—	—	4	3	—	3	1	—	—	—	2	2	—	—	2	—	—	1	—	—	—	—	4	—	3	1	—	—
4	1	—	—	1	—	—	3	1	—	—	?	2	—	—	—	1	—	—	—	2	—	—	—	3	—	—	1	—	—
5	—	—	—	1	—	—	1	—	—	1	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6	—	—	—	1	—	—	1	—	—	1	—	—	2	—	1	—	—	—	—	—	—	—	—	1	—	1	—	—	—
7	1	—	—	1	—	—	9	—	—	2	—	—	3	—	—	1	—	1	—	—	—	1	—	12	—	10	—	—	—
8	1	—	—	—	—	—	2	—	1	—	—	—	—	—	—	1	—	—	—	—	—	—	1	4	—	—	—	—	—
9	2	—	—	—	—	—	—	—	—	—	—	1	—	—	1	—	—	—	—	—	—	—	—	—	—	1	—	—	—
10	1	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3	—	1	—	—	—
11	—	—	—	—	—	—	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	6	—	—	—	—	—
12	—	—	—	—	—	—	2	—	—	—	—	2	—	—	—	3	—	—	—	—	—	—	—	—	—	3	—	—	—
13a	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	3	—	—	—	1	—	1	—	—	—	—	—	—	—
13b	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	2	—	—	—	—	—	—	—	—	—	—	—	—	—
14	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	?	—	—	—	—	—	—	—	—	—	—
15	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—
uncertain	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—

FISHING GEAR

Fishhooks of various kinds, and items associated with their manufacture comprised a major part of the excavated assemblage. By far the largest quantity was found in Nu-1, but some hook fragments were found in every site, reflecting the importance of line fishing in the Nukuoro economy. The large collection of simple fishhooks from Nu-1 has already been described in detail (Davidson 1967) and is only summarised below. Hooks from other sites, and the small collection of lures, not previously described, are discussed in more detail. The manufacture of hooks is outlined in this section, but the tools used, and the waste materials resulting, are discussed in greater detail in the sections on manufacturing tools and raw materials.

One-Piece Hooks

Portions of 697 one-piece hooks were recovered from Nu-1, 374 from G-9 and 323 from E-5. There were also 61 from the surface, from the well shaft and from uncertain contexts. All specimens, with one possible exception, were of pearl shell. In addition, one metal hook was recovered from layer 9 in square G-9. By contrast only 61 hook fragments, all of pearl shell, were recovered from the remaining seven excavation sites. On the basis of the large collection from the stratified site of Nu-1, a classification of one-piece fishhooks was devised which was found to have some chronological validity, as well as corresponding quite closely to fishhook types known to Nukuoro informants. All the hooks are rotating rather than jabbing hooks and lack barbs. The classification is accordingly based on overall shape and line attachment device.[1]

Type I (Fig. 19a-b).

This is the best known form of Nukuoro hook and has been widely illustrated in the ethnographic literature (Finsch 1893, p.364,[2] Figs. 5 - 8; Beasley 1928, pl. CLVII). It is defined principally on its line attachment device which is quite distinctive. The type appears to encompass considerable variation in shape, including two distinct subtypes recognised by Nukuoro informants. On the basis of snooded examples in museum collections Type I can be described as follows: the outside of the shank is straight and ends in a barb which points directly downwards. The top of the shank is pointed, while on the inside edge the shank leg and base form a continuous curve. In some examples this curve continues to the point tip forming an almost circular hook, while in others there is a marked angle at the junction of base and point leg. Type I hooks exhibit considerable variation in size and shape. Lengths range from 5.1 to 1.1 cm and widths from 5.5 to 1.2 cm. The most significant variation appears to be in the length/width ratio. This provides the basis for two tentative subtypes which seem to correspond to a functional difference recognised by informants.

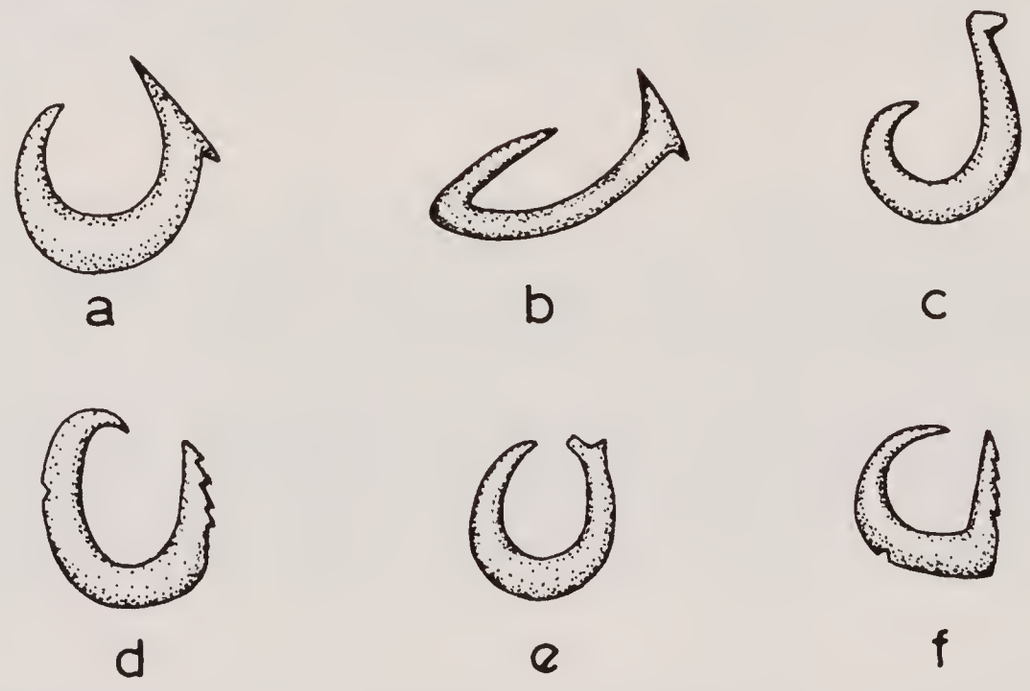

Fig. 19. One-piece fishhooks. a. Type Ia. b. Type Ib. c. Type II. d. Type V. e. Type VI. f. Type VII.

In Type Ia hooks the length/width ratio is approximately 1:1, in other words the hook is almost circular (Fig. 19a). This is the hook illustrated by Beasley (1928, p.102), which occurs in all sizes throughout the Nukuoro sequence (see below). In Type Ib the length/width ratio is more like 1:2 (Fig. 19b). Unfortunately the majority of Type I hooks recovered by excavation were fragmentary and could not be assigned to subtypes.

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[1]This term is used following Anell (1955) to refer to the provision on the hook itself for attachment of the line.

[2]Page references are to the continuous bracketed paging of the whole work (see refs.)

The problem of names and functions of fishhooks has been discussed in detail elsewhere (Davidson 1967, pp.186 - 190). Although the evidence is conflicting it seems most likely that Type Ia hooks were known as *buledango* and used in different sizes for different kinds of fish. Type Ib hooks were confidently identified by informants as *gau dahi*, a specialised form used for fish with long snouts and sharp teeth.

Type I was the only kind present throughout the known prehistoric sequence on Nukuoro. It was found in all excavations except Nu-2, and was widely distributed through deposits of different ages. Some minor variations appear to have chronological significance, notably the presence of an external protrusion at the top of the shank, confined to earlier levels, and one or more grooves on the outer side of the shank, which seem to have been a very late development. In general however, variations in shape seem to have no chronological significance. Type I hooks are fairly common in the general collection. Only one is unusual, a large heavy example made not of pearl shell but of *Tridacna maxima*.

External relationships of Type I hooks are not easily identified. Hooks superficially similar in line attachment are known from Tahiti and the Californian coast (Emory & Sinoto 1965, Fig. 5, no.7; Heizer 1949, Fig. 32a - m). These, however, have a knob on the outer side of the shank leg rather than a lower barb, and resemble each other more than they resemble Nukuoro hooks.

The Type I form of line attachment is found on barbed hooks from other islands in the same part of the Pacific as Nukuoro, including the Ellice Islands (Anell 1955, Fig. 5, no. 2), Ponape (Finsch 1893, p.364, Fig. 11) and some of the other Polynesian outliers, Takuu, Nukumanu, Sikaiana and Luangiua (Anell 1955, p.97). Turtle shell hooks from Ponape resemble the *gau dahi* in shape, although they have different line attachments. Rather similar shaped hooks, again with different line attachment, are wide-spread in Polynesia where they were probably evolved independently to catch similar kinds of fish.

Type II (Fig. 19c)

This type, like Types III to VI, is a variant of the wide-spread U-shaped hook with slightly curved shank and point legs and curved base discussed by Anell (1955, p.115). The five varieties of U-shaped hook on Nukuoro are distinguished primarily by their line attachment. The rarer types are too few and fragmentary for their overall shape to be defined with certainty. Type II has a very simple form of line attachment consisting of an external pointed projection and a flat or slightly convex head top extending from junction of shank and head to outer edge of projection. No two examples are exactly the same. They vary from a head top at right angles to the inside of the shank to one which slopes downwards and outwards. The single complete example of Type II (from Nu-1) has a shorter point leg than shank leg, and an incurved tip. Its length is 3.4 cm and width 3.1 cm.

Hooks of Type II were confined to early levels at Nu-1, Nu-4 and Nu-8, where they were contemporary with examples of Type I and preceded examples of Type V, by which they seem subsequently to have been replaced. Unfortunately no examples of Type II had been found at the time informants were questioned about fishhooks and fishing.

The only complete example of Type II has close parallels in Micronesia. Specimens are known from Kusaie (Sarfert 1919, Fig. 144) and the Marshalls (Beasley 1928, Fig. 37) and small examples in coconut shell from Nauru (Anell 1955, Fig. 4. no. 14). Generally similar forms are wide-spread in Polynesia, but lack the characteristic shape and line attachment of Micronesian examples.

Types III and IV

A small number of fragments from low levels in Nu-1 appear to show a gradual change from the line attachment of Type II to that of Type V. They were not found in other excavations. The single example of Type III is a shank leg and base fragment very similar to examples of Type II. In addition to the Type II head it has three notches on the outer side of the shank leg. It is 40 mm long and, although the point leg is missing, a shape similar to Type II can be inferred. Three shank leg fragments with notches on the sides rather than the outer edge were assigned to Type IV. They were contemporary with the earliest examples of Type V, and like Type III, which was contemporary with the latest examples of Type II, they seem to represent a period of uncertainty or experimentation among fishermen at Nu-1 during the replacement of Type II by Type V.

Type V (Fig. 19d)

This is the most common hook in the excavated assemblage and, once established, continued in popularity until the end of the sequence. It is a U-shaped hook, with incurved tip, and unlike the single complete example of Type II, the point leg in all complete examples is slightly longer than the shank leg. The line attachment device consists of two or more notches on the outer edge of the shank leg. Examples range in length from 4.5 cm to 1.2 cm and in width from 3.1 cm to 1.0 cm, with variations from longer and more slender to shorter and thicker examples. In some examples the shank and point legs are almost parallel while in others they are quite noticeably curved, but these variations seem not to have chronological significance. On the whole there is less variation in shape than in Type I. Some examples, but not all, have a single groove, presumably for bait attachment, near the mid point of the point leg. One small example from E-5, Nu-1, appears to be made in some shell other than pearl shell.

Informants recognised Type V hooks as *maimoni*, a major type of hook popular at the close of the prehistoric period. They believed that small specimens, sometimes called *madau gina* were used for fishing in the lagoon, and larger ones in the open sea. There was some doubt whether the name *maimoni* referred to all sizes of Type V hook.

Some confusion arises from the lack of published examples of Type V hooks attributed to Nukuoro (the only one is an incomplete example figured by Finsch), the use of the name *maimoni* for Type I hooks by Kubary and Eilers and their failure to record the name *buledango*. There is no doubt, however, of the importance of the Type V hook in Nukuoro prehistory, for its popularity at Nu-1 was reflected at other excavated sites. Nor is it absent entirely from the ethnographic record, for it is the most numerous in the kits of hooks attributed to the Society Islands (Edge-Partington 1895, pls. 20, 21; Beasley 1928, pl. LX) which can now clearly be seen to be of Nukuoro origin, as Emory and Sinoto suggested (Emory & Sinoto 1965, p.88).

The sequence from Nu-1 demonstrated a gradual change from the line attachment of Type II to that of Type V, but there was no evidence to show whether this was an independent local invention or a response to a new introduction. Nor are hooks from early levels numerous or complete enough to demonstrate a change in shape from the shorter point leg to the longer point leg of Type V. Like the U-shaped hook, the notched line attachment has a wide-spread distribution in the Pacific, occurring sporadically from Guam to California, and on scattered islands in both Micronesia and Polynesia (Davidson 1967, p.191). Hooks which resemble Type V in general shape are fairly wide-spread in Polynesia, but tend for the most part to be more V-shaped, and the similarities may be more apparent than real.

Type VI (Fig. 19e)

A small number of hooks were found in Nu-1 with a similar shape to Type V but a different line attachment. Type VI is characterised by an unusual head form consisting of a narrow flat-ended internal projection, and a concave head top sloping downwards and outwards. The head was probably intended for a special snood and the hook designed for a particular type of fish or condition or method of fishing. No information was obtained about this, however. There is some resemblance to hooks from nearby Kapingamarangi and a more general resemblance to hooks from the Western Carolines.

Type VII (Fig. 19f)

This most recent type in the archaeological collection has a distinctive shape which is, as far as is known, unique to Nukuoro. The shank leg is quite straight, while the point leg and tip form an almost semi-circular curve which brings the tip almost to the top of the shank leg. Line attachment in all examples is similar to Type V. Most examples have a notch for bait attachment about one third of the way up the point leg. There is much less variation in size in this type than in Types I and V. Examples recovered ranged in length from 3.2 cm to 1.7 cm and in width from 2.9 cm to 1.8 cm.

Both informants and published sources agreed that the name of this hook was *gadenibidi (kai nipiti* in older orthographies) and that it was used for catching small fish in the lagoon. It is the only type for which there is such unanimous information.

Chronology

The remarks above about the wide distribution of the notched line attachment apply also to Type VII. However, since the Type VII hook is clearly more recent than Type V, has the same line attachment, and has no obvious resemblances in shape to hooks from other islands, it seems likely to be a local invention.

The number of fishhooks of each type in each layer of Nu-1 is shown in Table 9. The percentage analysis has been published elsewhere (Davidson 1967, Fig. 3, p.185). The figures show the continuity of Type I throughout the sequence, the replacement of Type II and the transitional Types III and IV by Type V which then dominated the remainder of the sequence, the later appearance of Type VII and its steady increase in popularity and the occasional occurrence in later layers of Type VI. Although too few hooks were found in other sites for percentage analysis, their stratigraphic distribution, shown in Table 10, supports and confims the sequence from Nu-1. Probably earlier than any hooks at Nu-1 are several fragments of Type II from Nu-4. A single example of Type II also precedes Type V at Nu-8. Type I occurs at early levels in Nu-8, Nu-6 and Nu-4, while Type V is restricted to later levels, and Type VII even more so. No hooks were found which did not conform to the typology, although a point leg fragment from Nu-2 is longer and more slender than usual examples of U-shaped hooks from Nukuoro. The occurrence of Types I, II, V and VII in other sites showed them to be in general use and not confined to the occupants of the men's house *(Hadasabugu)* at Nu-1. In particular, the dominance of Type V, despite its lack of published recognition, was confirmed. On the other hand no examples of Type VI were found in other sites. It is thus possible that the few examples of Type VI in Nu-1 were the work of one or two men, perhaps even an immigrant from another island or an innovator whose ideas were not adopted.

Metal hooks

One metal hook and a partly worked nail were found in the top layer of G-9, Nu-1. The metal hook resembled one in a set owned by Soses. The set of 13 included four major types

Table 9. Distribution of fishhook types in Nu-1.

SQUARE	LAYER	I	II	III	IV	V	V?	VI	VII	TOTAL	SHANK	POINT
G-9	9b	3	—	—	—	3	1	—	2	9	—	1
	a	2	—	—	—	7	14	—	13	36	f	—
	8b	9	—	—	—	27	22	—	21	79	f	—
	a	2	—	—	—	31	18	1	12	64	1	—
	7	12	—	—	—	57	15	1	3	88	1	—
	6	2	—	—	—	17	9	—	3	31	—	—
	5	2	—	—	—	2	2	—	—	6	—	—
	4	3	—	—	—	6	2	—	—	11	f?	—
	3	8	—	—	2	14	3	—	—	27	—	—
	2b	7	—	—	1	1	2	—	—	11	—	—
	a	2	—	—	—	—	—	—	—	2	—	—
	1b	5	1	1	—	—	—	—	—	7	—	—
	a	1	2	—	—	—	—	—	—	3	—	—
E-5	6	2	—	—	—	2	6	—	5	15	—	—
	5d	6	—	—	—	9	4	—	5	24	—	—
	c	8	—	—	—	29	10	—	17	64	—	—
	b	9	—	—	—	39	16	—	27	91	f	—
	a	1	—	—	—	13	9	1	9	33	1	—
	4	6	—	—	—	7	2	1	1	17	—	—
	3	—	—	—	—	7	6	—	1	14	—	—
	2b	7	—	—	—	13	22	1	2	45	—	—
	a	2	—	—	—	4	2	—	—	8	—	—
	1	4	1	—	—	5	2	—	—	12	—	—
well shaft		6	—	—	—	8	9	—	1	24	—	—
surface		—	—	—	—	6	3	—	1	10	—	—
no context		3	—	—	—	18	2	1	3	27	—	—

Table 10. Occurrence of fishhook types in sites other than Nu-1.

SITE	LEVEL	I	II	III	IV	V	V?	VI	VII	FRAG.	LURE	POINT
Nu-2	2	—	—	—	—	—	1	—	—	—	—	—
Nu-3 (sq 1)	1	1	—	—	—	—	1	—	—	—	—	—
	2	—	—	—	—	1	—	—	1	—	—	?
(sq 2)	1	—	—	—	—	1	—	—	—	—	—	—
Nu-4	10	—	—	—	—	—	—	—	—	2	—	—
	9	3	—	—	—	—	3	—	1	1	1	—
	8	1	—	—	—	1	1	—	—	1	—	—
	8 or higher	—	—	—	—	—	1	—	—	1	—	—
	7	—	2	—	—	—	—	—	—	2	—	—
	6	—	—	—	—	—	—	—	—	1	—	—
	5	—	—	—	—	—	—	—	—	—	—	2
	4	—	—	—	—	—	—	—	—	—	—	1
	2	—	—	—	—	—	—	—	—	2	—	—
Nu-5	1	—	—	—	—	1	2	—	—	1	—	—
	2	—	—	—	—	3	3	—	1	—	—	—
	5	—	—	—	—	—	—	—	—	1	—	—
	7	—	—	—	—	1	—	—	—	—	—	—
	9	—	—	—	—	—	1	—	—	—	—	—
	12	1	—	—	—	—	—	—	—	—	—	—
	14	—	—	—	—	—	—	—	—	1	—	—
Nu-6	6	1	—	—	—	—	—	—	—	—	—	—
Nu-7	2	1	—	—	—	—	—	—	—	—	—	—
	4	—	—	—	—	1	1	—	—	—	—	—
	7	—	—	—	—	—	—	—	—	1	—	—
Nu-8	2	1	—	—	—	—	—	—	—	—	—	—
	3	1	—	—	—	2	—	—	—	—	—	—
	4	—	—	—	—	—	1	—	—	—	—	—
	7	—	—	—	—	—	1	—	—	—	—	—
	8	1	—	—	—	—	—	—	—	—	—	—
	9	1	1	—	—	—	—	—	—	—	—	—
	10	1	—	—	—	—	—	—	—	—	—	—
	15	—	—	—	—	—	—	—	—	1	—	—

which all have a notched line attachment, but can be clearly seen to correspond in shape to Types Ia, Ib, V and VII. These hooks represent the final stage in the development of the Nukuoro sequence, as traditional hooks have now been replaced completely by Japanese styles. Soses' set of hooks is the later metal equivalent of the fishermen's kits of Heape and Beasley.

Fishing with one-piece hooks

The archaeological evidence provides a good indication of the range of one-piece hooks rendered in durable materials, but no direct evidence of how they were used, or the extent to which they were supplemented by hooks in other materials. No snooded examples were obtained by excavation, but snooded examples exist in museum collections, and demonstrate the correct orientation of hooks as well as suggesting how they were used. Statements by informants are also helpful in explaining the function of hooks, particularly in the case of specialised types such as the *gau dahi,* whose success would depend on its orientation as well as its shape.

Both informants and published sources agree that small hooks were made in turtle shell and that there was a wooden shark hook. *Gau dahi* were sometimes made in *nngie* wood (*Pemphis acidula* Forst.) instead of pearl shell. Soses also mentioned other kinds of small hook, namely *lou* and *hagadaumago*. It appears, therefore, that the archaeological assemblage does not reflect the entire range of one-piece hooks in use in Nukuoro at the close of the prehistoric period.

Informants stated that individual fishermen preferred different types of hooks, and that one fisherman might have a complete set of one kind, in various sizes, and another a complete set of a different type. This was particularly true of Types I and V. In the light of this information it is interesting to look more closely at the set of 39 hooks in Beasley's kit (Beasley 1928,

pl.LX). From the ilustration these appear to consist of three examples of Type Ia, two examples of Type Ib, fourteen examples of Type VII, and seventeen of Type V. The two remaining hooks most closely resemble Type II or Type VI, but appear not to be made in pearl shell, and are differently snooded from all the other hooks. The doubtful history of the kit, which led to its attribution to the Society Islands, means that it may not be one fisherman's kit. All the same, it is interesting to note that the proportions of hook types, except for the two of doubtful type, are very similar to the proportions of different types from the upper levels of Nu-1. The kit also illustrates the variation in size and shape of Type V hooks that is found in the archaeological collection.

Manufacture of one-piece hooks

Large quantities of worked pearl shell demonstrating all stages of hook manufacture were also recovered from Nu-1. Initially shells were divided into workable pieces by filing from one or both sides. A shell was often divided first into long strips, which were then subdivided into square or rectangular blanks suitable for hooks. The next stage was to file the outside of the blank to the shape desired for the hook. An alternative may have been to shape the centre first. Some square pieces of pearl shell with central perforation but unshaped outside edges were recovered, but it is not certain that these were for fishhooks. The usual treatment of the centre was by drilling a single central hole and then enlarging it by filing until the desired shape was reached. When inside and outside edges of the hook were shaped the gap between the tip and the head was filled out. The final stage was the addition of line attachment and bait notch if present.

In cases where the outside of the hook was shaped before the centre was drilled out it is possible to identify a differently shaped tab for each of the three major hook types current at the end of the sequence. Stages in the manufacture of a typical hook and blanks for the three major hook types are shown in Fig. 20.

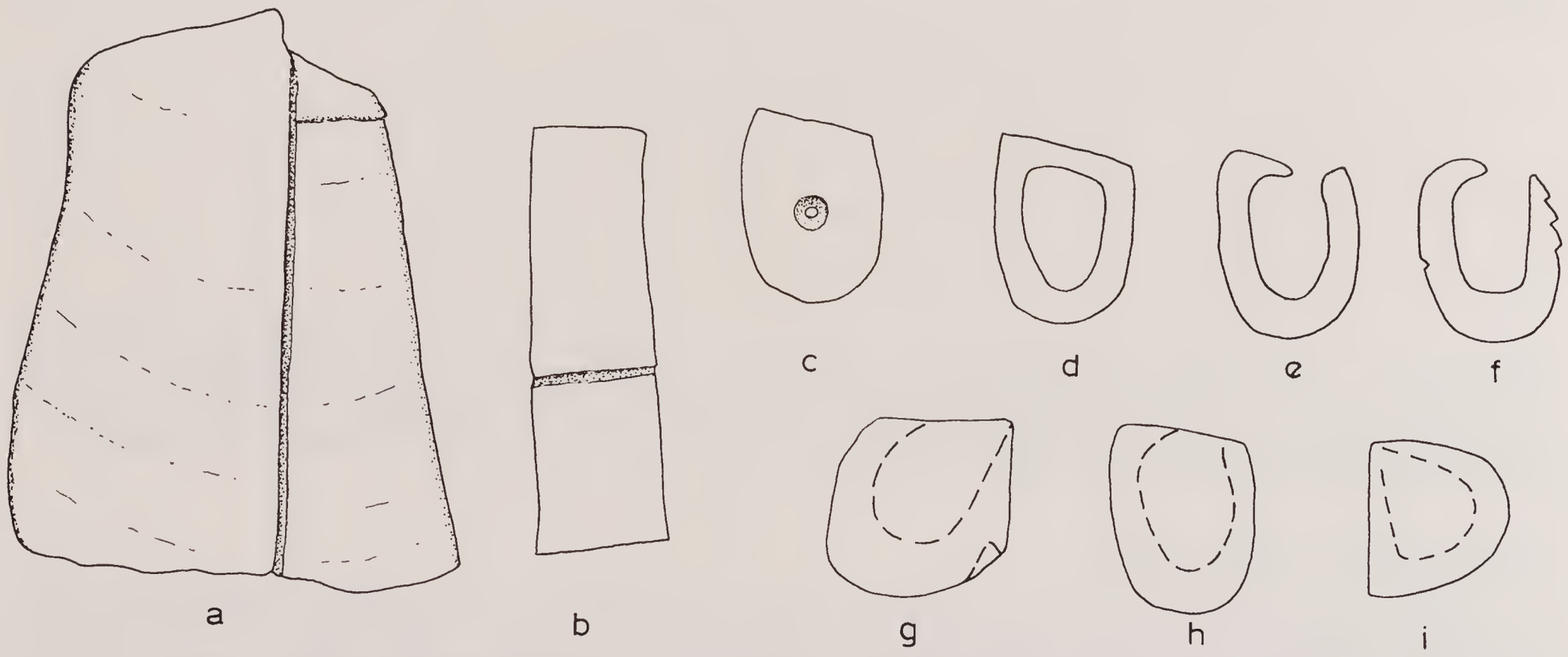


Fig. 20. Stages in the manufacture of one-piece fishhooks. a-b. Division of pearl shell. c-f. Manufacture of Type V hook. g-i. Blanks for hooks of Types I, V and VII.

Insufficient manufacturing waste material was found in early deposits to give much indication of manufacturing processes employed during earlier stages of occupation, although some pieces of pearl shell recovered from layer 1 in square G-9 appear to have been chipped rather than filed. Similar pieces were found in low levels in Nu-4. No chipped pearl shell was recovered from higher levels of either site. Drilled tabs also occurred at early levels.

Tools for working pearl shell were not readily identifiable, although several kinds of coral which had been used as abrasives were found in the excavations. Informants were unsure of the materials used in various parts of the process of fishhook manufacture. A hard thin form of coral with a naturally bevelled edge was identified by one informant as the material for sawing up pearl shells. Numerous branch coral files were found and these were said to have been used for filing the tabs to their final shape and particularly for enlarging the central perforations. Informants said that fish teeth, particularly those of a fish named *maninga,* served as drill points,

but were unable to identify any among the excavated materials. Two fragments of *Terebra maculata* shell from Nu-1, artificially flattened on the sides, were probably used for drills. The finishing of hooks was done with certain bivalves, which were used both for polishing the surfaces and for cutting the notches for line attachment (see p.80).

Composite Hooks

The number of fragments of composite hooks recovered from the excavations was very small. All are from trolling lures. From Nu-1 fragments of seven lure shanks and one point were obtained. One complete shank and several point fragments came from Nu-4, and one possible point from Nu-3. Other sites contained no lures or fragments of lures. There was considerable variety in the size and shape of lure fragments, which are accordingly described individually.

From near the base of layer 9 in G-9, Nu-1, came a distal fragment of a lure shank (Nu-1/70). The cross-section is flat, the width ranges from .8 cm to 1 cm, the thickness is .4 cm and the length from the tip to the break 1.4 cm. There are three notches on either side for attachment of the point. A similar fragment (Nu-1/340) from the top of layer 8 is 1.5 cm long, with a minimum width of .65 cm and a minimum thickness of .45 cm. There are at least three lashing notches on each side.

The proximal end of a lure shank (Nu-1/273) came from layer 5b in E-5. It is 5 cm long, 1.1 cm wide with a maximum thickness of .9 cm It has a trapezoidal cross-section with a rounded tip and no line attachment device. The distal part is very thin and it is likely that the shank snapped before it was completed. There is a rather similar shank fragment in the general collection (Nu-G/39).

One other pearl shell item which may be part of a lure shank (Nu-1/167) came from layer 4 in square G-9. It has a flat base and concave upper surface and thickens towards what would be the proximal end of the shank, which is flat and at right angles to the base.

Three very small shanks in various stages of manufacture complete the collection from Nu-1. Nu-1/286 (Fig. 21b) from near the base of layer 5 in square E-5 is 3.05 cm long with maximum width and thickness of .4 cm. It has a triangular cross-section, flattened distal end and pointed proximal tip with a lateral perforation. There are four tiny lashing notches on either side of the distal end. Nu-1/117, from layer 8 in G-9 is identical in shape, slightly larger, and lacks the perforation and notches. The length is 3.3 cm, maximum width and thickness .55 and .5 cm. The

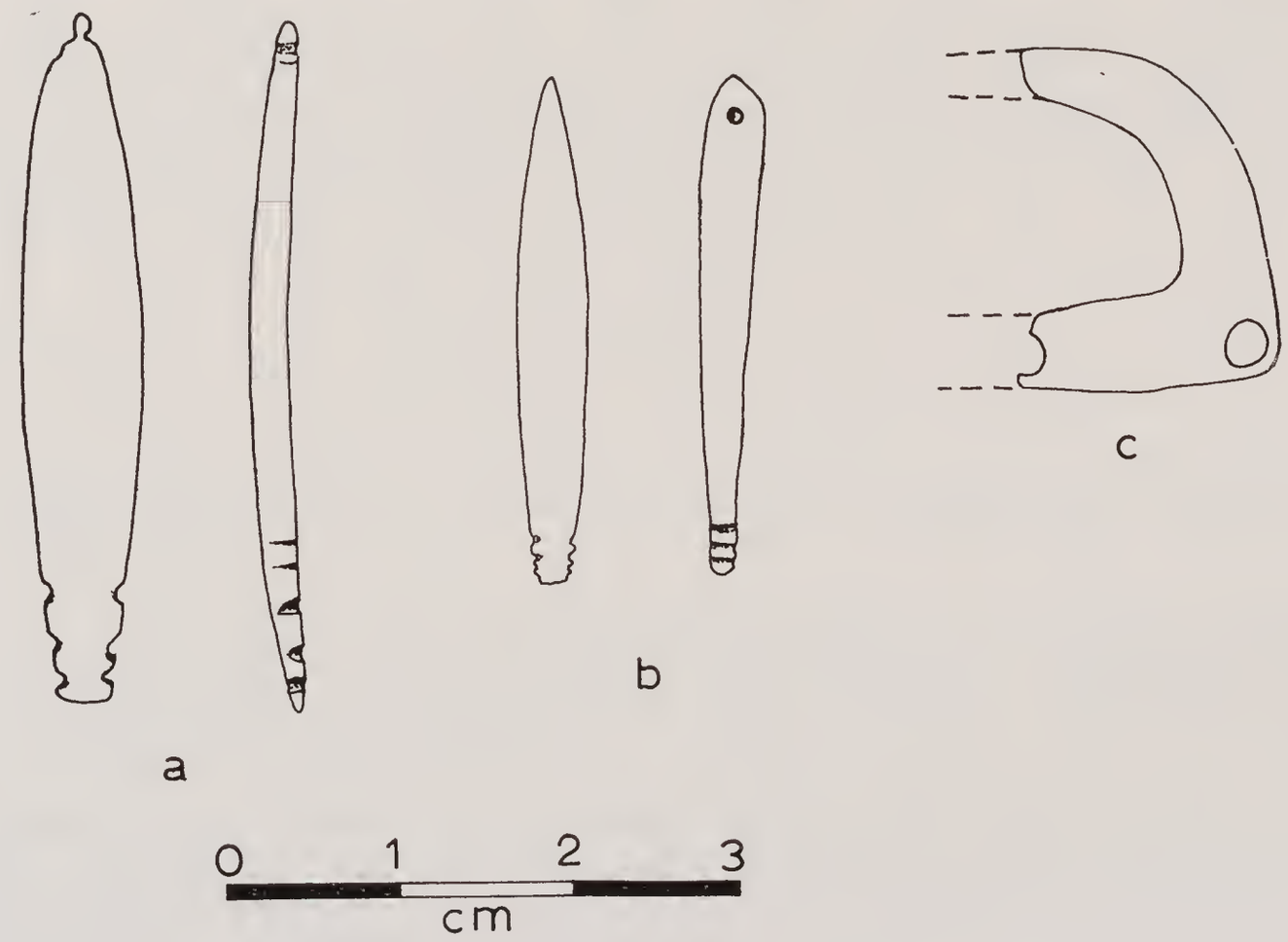


Fig. 21. Composite hooks. a. Shank, Nu-4/21. b. Small shank, Nu-1/286. c. Bone lure point, Nu-4/54.

third small shank, Nu-1/140 from layer 7 in G-9, is more like Nu-1/273 in shape with a trapezoidal cross-section and blunt proximal tip. It is 3.2 cm long with maximum width and thickness of .6 cm, and no perforation or lashing notches.

All the shanks from this site are relatively recent except the doubtful Nu-1/167, and most are unfinished. Among the quantities of worked pearl shell may be other items intended as blanks for lure shanks, but if so they are not readily identifiable.

One pearl shell point, Nu-1/43, was found in layer 9 of G-9, just below the surface. It has a flat expanded base, 1.2 cm long, with neither proximal nor distal projections and two perforations. The tip is broken.

The complete pearl shell shank from Nu-4 (Nu-4/21, Fig. 21a) is quite different from the Nu-1 shanks. It has a flat cross-section and is slightly curved lengthways. There are three deep notches and two lesser ones for lashing at the distal end and two on either side of the pointed proximal tip. It is 4.1 cm long, .65 cm wide and .45 cm thick at the centre. It was found in the disturbed layer 9 at Nu-4. Informants considered it untypical on the grounds that it should have had a perforation for line attachment.

The lure points from this site were found in layers 4 and 5, and are thus among the earliest artifacts yet found on Nukuoro, and clearly earlier than any of the lure shanks. An almost complete bone point (Nu-4/54) was found in layer 5 (Fig. 21c). It has a proximal projection with two perforations. The tip is broken but appears to lie almost parallel to the shank. A small piece of worked bone from the same level also appears to belong to a hook or point, but is too small to be diagnostic. From layer 4, close to the hearth from which C-14 sample Gak-739 was obtained, a fragment of another bone point (Nu-4/58) was found. It also has a proximal projection and at least two perforations but the tip is completely broken off.

A piece of worked pearl shell, Nu-3/10/1, from level 2, square 1, Nu-3, may have been intended for a lure point. It has a proximal projection and has been shaped by filing out the area between the base and tip. There are no perforations and it appears unfinished.

It is apparent, and local informants confirm this, that the small lures could not be used for bonito. Lures, like simple hooks, were used for different fish acording to their size. The small shanks from the excavations were said to be used for *gaade,* and the larger ones for bonito, although the name *baa* was apparently applied to both kinds.

Kubary illustrated only one lure, of the larger type. It has a shank very similar to the larger ones from Nu-1 (Kubary 1900, p.130) and a point apparently of Marshallese type (as defined by Anell 1955, p.153). One of the shanks illustrated by Eilers (1934, Fig. 116) is also not unlike the excavated examples but appears to be associated with a point of Ellice Islands type (Anell 1955, p.157). She also, however, illustrated a Type VII simple hook, erroneously described as a lure point. The shank with which it was supposedly associated is unlike any in the archaeological collection and resembles examples from the Western Carolines. As in the case of simple hooks, the earlier account contains nothing that does not fit the archaeological evidence, while the later account introduces new and different examples with strong Western Caroline affinities.

Informants agreed with Kubary (1900, p.130) that lure points were made in turtle shell or, rarely, turtle bone. Eilers (1934, p.240), however, stated that points were made of shell, bone, or turtle shell. The only bone points found in the excavations are too early to be considered as evidence of recent practices. Thus, although bone points were obviously in use near the beginning of the archaeological sequence, they seem to have been largely replaced by turtle shell points which did not survive archaeologically. It is possible, as Eilers suggests, that one-piece hooks did double duty as lure points, but this seems most unlikely. It must be remembered, however, that lures are so rare in the archaeological record anyway that absence of durable points from excavations need not mean absence from the fishing inventory. The diversification of points to include specimens in pearl shell and bone, as reported by Eilers, may be a post-European development in response to a demand for souvenirs. Today pearl shell points are made for the lures which are attached to model canoes but these are regarded as toys. The pearl shell point found at Nu-1 was associated with European items and could be of this kind.

With so little archaeological evidence the form of the lure point in the latter part of the prehistoric sequence must remain in doubt. Similarly, the nature of the lashing is uncertain. Of the few ethnographic specimens, that illustrated by Kubary seems close to Marshallese style while Eilers' complete example is more like the Ellice Islands style. A modern example, Nu-G/40, made by a Kapingamarangi man living on Nukuoro and given to Carroll, has a turtle shell point with two perforations, and line attachment in the West Polynesian style, but the two perforations occur in a widened point base which lacks proximal projection, thus differing from the true West Polynesian style.

The most comprehensive survey of Oceanic lures available, by Anell, depends heavily on the form of the point and the nature of the line attachment in distinguishing regional types. As line attachments are not likely to be found archaeologically under normal conditions and as points are liable to be absent from areas where they were made in perishable material, comparisons will eventually have to be based on greater refinements in shank classification.

The larger Nukuoro shanks, i.e. the bonito shanks, seem similar to shanks from Samoa and the Ellice Islands (Beasley 1928, pls XXXVIII and XLI; Anell 1955, p. 157; Demandt 1913, pl. VII) and from the Mortlocks (Finsch 1893, p.364, Fig. 2) or Western Carolines (Anell 1955, p.164), although lures are yet to be found in archaeological contexts in these groups. The very small shanks are unusual in that ethnological specimens of small lures from both West Polynesia and the Western Carolines have a flat shank with two dorso-ventral perforations (Anell, 1955, pp. 165-166; Demandt 1913, pl. III) or a rounded shank, but the actual custom of using small lures inside the lagoon is widespread. The abundance of pearl shell in Nukuoro probably accounts for small lure shanks being made in this material and in this form. Flat lure shanks of various sizes occur more rarely in both Polynesia and the Western Carolines, but usually favour the dorso-ventral perforation. However, shanks with a grooved or notched proximal tip are known from as far afield as Pukapuka in Central Polynesia and Pur in the Western Carolines (Anell 1955, pp. 164, 167), while proximal grooves on a rounded shank are not uncommon in the Western Pacific. Shanks similar to Nu-4/21 might be found in archaeological contexts in almost any part of Polynesia or Micronesia without occasioning too much surprise. Anell's discussion of Nukuoro lures (1955, p.165) merely indicates the need for a careful study of ethnological specimens and their probable dissimilarity from archaeological examples. As in the case of the simple hooks, the ultimate interpretation of Nukuoro lures will depend very much on the results of future excavations on other islands.

The sparse evidence on points does nothing to confirm Anell's hypothesis about point development. It seems clear that early lure points on Nukuoro conformed to what Anell classed as the West Polynesian type, which is now also known from early contexts in East Polynesia and seems likely to have been a widespread Oceanic form. The subsequent development of points on Nukuoro may never be determined by excavation. Study of ethnographic specimens, if sufficient localised items exist, might determine whether the predominant form at European contact was a turtle shell variant of the West Polynesian type, or whether the Marshallese type was already established. Without good documentation, however, it would be difficult to demonstrate the suspected diversification of point types in post-contact times.

Sinkers

Informants claimed that sinkers were not shaped. Suitably sized pieces of coral were picked up on the beach and used without any modification. However, one item excavated may have been modified for use as a sinker, and one small shaped piece of coral is reminiscent of the Polynesian octopus lure sinker.

Nu-5/2, from level 2 of Nu-5, is a roughly conical piece of coral limestone, flattened at one end and rounded at the other with an artificially pecked groove around the centre. The total length is 9.1 cm and the flat end measures 5.9 x 4.2 cm.

The octopus lure is unknown in Nukuoro, although octopuses are caught by other means and eaten. Nu-1/153, from layer 5 in G-9, is a small worked piece of coral which resembles the simple ocopus lure sinker recovered from early contexts in Samoa (Green & Davidson 1969, pp. 134-135) and the Marquesas (Sinoto & Kellum 1965, p.43). It is oval in outline and flattened on one side. It is this last feature which causes it to resemble the octopus lure sinker. It is 6.8 cm long, and 3.6 cm thick, with a maximum width on the flat side of 4.8 cm. This artifact could

have been various things. It could be simply a missile, or some kind of small hammer stone, but the possibility of its use as a sinker cannot be discounted, particularly as the octopus or squid lure is known in Micronesia (Thompson 1932, p.48).

Discussion of fishing Gear

The archaeological evidence alone does not furnish much information about fishing in Nukuoro. It merely shows that line fishing was important, since hooks were found in all sites, that fishhook manufacture was concentrated in specialised sites, and that there was some change in the styles of fishhooks through time. We must turn to other sources for an indication of the social aspects of fishing.

From Kubary we learn that nets and spears were also used by the Nukuoro, and that net fishing was a major community activity. Indeed, according to Kubary, the principal fishing was done with the *upena tonu,* (*gubenga* in modern orthography) a communally owned net kept in *Sawae* (*Savae*), one of the several communal buildings in the centre of the village (Kubary 1900, p.111). No archaeological evidence of net fishing was recovered, and the only durable items in net fishing, coral stone sinkers, were not readily identifiable.

The scattered distribution of hooks in sites suggests that line fishing was an individual activity, and that each man probably possessed a number of hooks. This is borne out by Eilers (1934, p.238) and by modern informants. The combination of traditional evidence (identifying Nu-1 as the men's house, *Hadasabugu*) and archaeological evidence (of the activities taking place there) shows that fishhook manufacture was carried out by individuals grouped together in a particular specialised locality.

Sources of information other than archaeology provide an understanding of how the hooks were snooded and used. Both informants were adamant that different individuals preferred different kinds of hooks, although no clear evidence was obtained for the use of lures vis-a-vis one-piece hooks.

According to Hainis, fishing always took place from a moving canoe, either drifting or paddling, regardless of whether a lure or a one-piece hook was used. One-piece hooks were always baited, and each kind of fish was believed to prefer a different bait. Hermit crab, a piece of fish, unripe coconut, even swamp taro (*Cyrtosperma*) or rotten breadfruit were used for bait.

Though many important aspects of fishing were not revealed by excavation, the number and excellence of the fishhooks suggested the importance of fishing and the probable skill of the Nukuoro fishermen, both of which are confirmed by Kubary who observed (1900, p.110):

> Fishing which is done by the men is in general more highly developed than in the Carolines, and is done by hooks, nets and spears. The fishhooks of mother-of-pearl are very solid and well made, and the fish-lines of coconut or hibiscus fibres are the strongest and most beautiful of the archipelago.

PERSONAL ORNAMENTS

A small number of items that were apparently personal ornaments or parts thereof were recovered in the excavations. They occurred in all sites except Nu-3 and Nu-7. They have been grouped into three major categories but their exact use is in many cases uncertain.

Disks and Disk Beads

Small flat shell disk beads were the most common ornament unit and were widely distributed in the deposits, usually occurring singly or occasionally in pairs (Tables 1-8). There are twenty-five beads from the excavations and four in the general collection. They include three specimens more than twice as large as the others, which should perhaps be described as disks rather than beads. One disk and one bead from E-5 in Nu-1 are unperforated, and one bead from layer 4, Nu-4, has a perforation begun but not finished. The remainder are complete. There are also two pieces of pearl shell from layer 4, Nu-4, which show pearl shell beads in process of manufacture. No other evidence of the use of pearl shell for beads was found.

The small beads range in outside diameter from .7 to 1.25 cm with an average of 1.05. There is one larger bead in the general collection with a diameter of 1.55 cm. The width of the central perforation varies from .25 to .5 cm. All beads have quadrangular sections and all are well made. They range in thickness from .1 to .5 cm. Fourteen are orange in colour, seven white, four pink and one mixed pink and white. They appear to be made, for the most part, of *Spondylus*.

The three disks include a complete and an unperforated specimen from Nu-1 and a complete one in the general collection. They have diameters of 3.0, 2.4 and 2.5 cm respectively and a uniform thickness of just over .4 cm. The two complete specimens are pink and the other orange.

Large Shell Rings

Several sites yielded fragments of what are apparently large shell rings. Following the terminology adopted by Poulsen (1967 (I), pp.248-255) these may for the most part be described as narrow bracelets, or individual ornamental units, probably worn on arms, wrists or ankles. No complete examples were found. Poulsen found a number of bracelet fragments and one complete bracelet in his excavations on Tongatapu. He classified his specimens according to the shape of their cross-section, the majority measuring less from inside to outside (thickness) than in width (side to side). They were identified as being made of *Conus* and *Tridacna*.

The majority of the Nukuoro specimens are more thick than wide with an oval to rectangular cross-section. There is one triangular-sectioned specimen, two fragments of which were found in level 16 in Nu-5. This is very similar to Poulsen's class A7, although the Nukuoro specimen is slightly thinner and narrower than those from Tonga. In each case the inside of the ring forms the base of the triangle.

Identification of the shells from which the Nukuoro rings were made has proved very difficult. The triangular-sectioned example is probably made from *Tridacna*. Six of the other fragments and an unusually small specimen (three fragments of which were found in Nu-8) seem to have been made from a medium-sized bivalve such as *Codakia* sp. Other unidentifiable fragments may also have been of this or similar shells. There is one possible fragment of a *Trochus* ring but no definite evidence that *Conus* shells were used for large rings at all. In sum, then, there are fragments of 11 large rings, one of which is probably *Tridacna,* one of which is possibly *Trochus,* one of which is unidentifiable, and the remainder of which are probably from a bivalve such as *Codakia*. In addition there is a much smaller example, also of *Codakia* or similar, which could be a child's bracelet or a ring pendant.

A small curved segment of a (?) nautilus shell from Nu-1 may be part of a bracelet similar to Poulsen's class A5. It is too small, however, to be identified definitely.

Nu-1/141 is the only fragment found which may be part of a broad bracelet in Poulsen's terminology. It is thin, with a maximum width of 2.9 cm. Each rim is slightly expanded in a way sometimes found on broad bracelets from Ponape, and there is also a slight central ridge. The shell from which it is made cannot be identified.

Pendants

A few items were recovered which can be described as pendants. They are from Nu-1, Nu-4 and Nu-6.

Simple rough pendants in shell other than pearl shell were found in level 4 of Nu-6, and layer 6 of Nu-4. The former, Nu-6/4, is a flat piece of shell (probably *Spondylus*), almost 3 cm long, rounded at one end with a maximum width of 1.5 cm, tapering to the other end which is flat with a small perforation. Nu-4/52 is a narrow straight-sided piece of shell with a rounded rectangular section and a perforation at one end. The other end has broken off. The surviving length is 1.7 cm.

Another pendant, Nu-4/43, from layer 8, Nu-4, is a thin flat triangle of shell with a perforation in one corner. It too is broken, but it appears to have been almost an equilateral triangle with each side approximately 2.3 cm.

One piece of worked pearl shell, Nu-1/187, from Nu-1 is probably a pendant. It is roughly triangular in outline. Two straight lines meet at a very obtuse angle while the third and longest side is slightly convex in outline. There is no perforation, but one of the sharp points of

the triangle has a fine groove around it, apparently for suspension. Its maximum length from the sharp point with groove to the other sharp point is 2.5 cm. Despite the abundance of worked pearl shell in the excavations no pearl shell ornaments other than this pendant and the partly worked beads described above, were found.

A single fragment of a small shell ring, Nu-4/34, was recovered from layer 8 in Nu-4. It appears to have had an outside diameter of 2.3 cm, a circular section, and a thickness of .4 cm. It may have been worn as a pendant. The shell from which it is made has not been identified but it is not pearl shell.

The only other ornament unit is a small perforated porpoise tooth from layer 7 of G-9, Nu-1.

Discussion

Both shell rings and beads seem to have been present in small numbers throughout the known sequence on Nukuoro. The antiquity of beads is demonstrated by their presence in layer 4 of Nu-4, and also in Nu-6, and that of rings by their presence in level 16 of Nu-5 and level 4 of Nu-6. Both beads and rings are represented in the uppermost levels of Nu-1 and Nu-8. The pendants tend to come from the early or middle part of the sequence, not from the most recent deposits.

The ethnographic literature is surprisingly uninformative on Nukuoro ornaments. Kubary reported that normally the Nukuoro did not use any finery, and that only on religious occasions, and for dancing, did they wear head-bands and turtle shell ear ornaments (1900, p. 81). He also mentioned a turtle shell arm band (1900, p. 130). Eilers, however, described necklets of alternate turtle shell triangles and red shell disks, and head bands of various simple shell units attached to woven fillets (1934, pp. 270-271). She also figured a complex ornament of shell disks and whale tooth units, a necklace of small shells with a central pearl shell pendant, and a *Conus* disk pendant, as well as the turtle shell items described by Kubary. Her attribution of the necklaces to Nukuoro must be regarded as uncertain, however, since they were not mentioned by Kubary. (See discussion in Volprecht 1968, p. 539).

Informants were shown some of the ornaments and questioned about them. Both Hainis and Soses identified large ring fragments as bracelets, but could not say who wore them, or on what occasion. They did not, however, identify the single fragment described above as a broad bracelet. Neither recognised the pearl shell unit from Nu-1. Hainis suggested that the flat triangular pendant, Nu-4/43, was worn as a single pendant by children, but Soses had never seen such a thing. Hainis said that everyone wore shell beads, and that the shell disks were worn singly as pendants. Soses, however, felt that it was a recent custom for children to wear a single disk as a pendant, but that formerly they formed central units in strings of smaller beads. Such ornaments were worn particularly for dancing and could be worn by anyone who danced.

It appeared from these interviews that only the beads and disks were really well remembered by informants. They freely admitted uncertainty or ignorance about the other items. This tended to confirm the ethnographic reports that ornaments were few, worn only for special occasions, and consisted either of perishable material, or of various arrangements of shell beads.

Both shell beads and shell rings are very widespread in both Melanesia and Micronesia. They are likely to vary in their usefulness to archaeologists, however, for whereas large rings are often complete artifacts, and can be compared as such, so-called beads are often merely minimal units in composite and very complex artifacts, whose significance for comparisons often lies in the way in which the minimal units are arranged rather than the nature of the minimal units themselves. There are, however, some differences in sizes of beads, their shape and the shell from which they are made.

The only part of Polynesia in which shell ornaments comparable to those from Nukuoro have been found is Tonga. Resemblances in large rings or bracelets have already been mentioned. A single shell bead found in Tonga is of the same kind as those from Nukuoro (Poulsen 1967 (II), Fig. 125, no.22). Poulsen also found small shell rings not unlike Nu-4/34 (1967 (I), pp. 257-258). The range of shell ornaments from early sites in Tonga is, however, wider than that reflected by the Nukuoro assemblage. Apart from the Tongan parallels there is no obvious

resemblance between Nukuoro ornaments and those of Polynesia although simple shell pendants occur occasionally in Polynesia (Heyerdahl & Ferdon 1962, p.247). On present evidence the Nukuoro and Tongan ornaments are widely separated in time, the former belonging to the last few centuries, the latter, if current revisions of the Tongan sequence (Groube 1971) are accepted, being as much as two millenia earlier. Under these circumstances the relationship between Nukuoro ornaments and the most comparable assemblage from Polynesia is remote. The Tongan ornaments seem to be derived from a widespread Oceanic tradition which did not survive in Polynesia, but continued in parts of Melanesia and Micronesia until historic times.

Oceanic shell ornaments and shell money have been the subject of some fairly detailed distribution studies. These indicate that the Nukuoro ornaments have close similarities with those from neighbouring Micronesian islands. Finsch showed that red and white shell beads were particularly characteristic of the Caroline and Marshall Islands and widely distributed in those groups (1914, pp.60-71). Specimens from archaeological sites on Ponape, for instance, include *Spondylus* beads similar to those from Nukuoro, and separators not unlike the pendants Nu-6/4 and Nu-4/52 (Hambruch 1936, Figs. 19, 23). Beads were also popular on Truk (Le Bar 1964, p.159). Small shell rings and arm rings also occur in Ponape and adjacent islands (Hambruch 1936, Figs. 28-30), although arm rings had a wide general distribution in Melanesia also (Finsch 1914, pp.72-92). Finsch believed *Trochus* arm rings to be absent from Micronesia (1914, pp.99-100) but they have been reported from some parts of the Carolines (Eilers 1936, p.147; Krämer 1937, p.322), and Jeschke's collection from Nukuoro includes one (Volprecht 1968, p.541). *Trochus* probably occurs in the Nukuoro lagoon, and while it does not seem to have been favoured by the Nukuoro for ornaments, there is some traditional evidence to suggest that it was sought after by traders from the Mortlocks (Carroll pers. comm.).

Possible Micronesian parallels can also be adduced for other Nukuoro ornaments. Strings of porpoise teeth have a rather sporadic distribution in Melanesia and Micronesia but enjoy local popularity in the Gilbert Islands (Finsch 1914, pp.212-213). They are also reported from Vaitupu (Kennedy 1931, Fig. 134). In the rest of Polynesia they are known only from remote parts of East Polynesia (Duff 1956, p.129). Small triangular pendants are known from the Gilbert Islands (Finsch 1914, pl.3, Fig.111), the Marshall Islands (Krämer & Nevermann 1938, Fig. 7), Truk (Le Bar 1964, p.165) and other parts of the Central and Western Carolines (Damm & Sarfert 1935, p.38; Eilers 1936, p.147). In different places they were attached to arm rings, ear pendants, and necklaces.

Other Polynesian outliers seem in some cases to have had ornaments reminiscent both of later Polynesian forms and styles prevalent in neighbouring islands. Ornaments obtained by Buck and others on Kapingamarangi included both shell rings and pendant similar to specimens from the Carolines and Nukuoro, and a necklace of pearl shell lure shanks more typical of the Ellice Islands than the Carolines (Buck 1950, pp. 273-274; cf. Koch 1961, pls. 11-12). Tikopia ornaments are remarkable for the presence of "reel" or "spool" units as well as other forms more typical of the surrounding areas (Firth 1951). Ornaments from Rennell show parallels within the Southern Solomons and also with other outliers, notably Nukumanu and Luangiua (Birket-Smith 1956, pp.173-174), while ornaments from the latter also have resemblances to those from adjacent Solomon Islands (Sarfert & Damm 1929, pp. 81-91).

Excavations on the southern Polynesian outliers of Futuna and Fila in the New Hebrides uncovered a number of burials with ornaments. These consisted, however, mainly of pearl shell plates and pendants and small, rather irregular, *Conus* beads (Shutler & Shutler n.d.; Shutler 1970). There would appear to be no obvious relationship between these ornaments and those of the more northern outliers, particularly Nukuoro.

The distribution of ornaments is obviously a very complex subject, and one prone to all the problems that beset distribution studies of any kind. On present evidence, however, it appears that the Nukuoro range of ornaments, restricted as it is, has no immediate Polynesian relationships and was more probably taken over *in toto* from neighbouring East Micronesians.

SHELL ADZES

Despite the wide-spread occurrence of shell adzes in the Pacific, little attention has been paid to them in comparison with stone adzes. Some attempts to classify shell adzes according to formal criteria have been made by Kennedy (1931, pp.288-293) for the Ellice Islands, Thompson

(1932, pp.53-56) and Spoehr (1957, pp.151-154) for the Marianas, Sylvia Broadbent (in Gifford & Gifford 1959, pp.185-189) for Yap, Osborne (1966, pp.451-457) for Palau and Buck (1950, pp.165-168) for Kapingamarangi. In each case the typology is descriptive, based on the kind of shell used and the shape of the tool, and lacks chronological and functional control (except for Buck's simple classification of Kapingamarangi adzes). More recently a general study of 156 Micronesian shell adzes in the Bishop Museum, Honolulu, has been carried out by Rosendahl (MS.). Again, the study is based on formal criteria only, but has the advantage of representation from a number of different island groups. Rosendahl classified shell adzes according to the material in which they were made, namely *Terebra maculata* (Type I), *Cassis* sp. (Type II), *Cassis cornuta* lip (Type III), *Tridacna gigas* exterior portion (Types IV - X) and *Tridacna gigas* interior portion (Types XI - XIV). Within the category of adzes made from *Tridacna gigas,* types and subtypes were established according to shape.

None of the above classifications has proved completely suitable for Nukuoro shell adzes, although the general approach, particularly in Rosendahl's study, has provided a useful basis. However, it has been found necessary to establish yet another group of descriptive categories for the Nukuoro collection, some of which correspond to types described by previous authors, and some of which do not.

Some information about the function of Nukuoro adzes was available both in published sources, and from present day informants. Although this information is far less detailed than that for fishing gear, it provides an alternative framework for looking at shell adzes, since functional categories to some extent cut across descriptive categories based on material and shape alone.

One hundred and twelve adzes and fragments of adzes were found in the excavations. This number includes six that were found on the surface of Nu-3, and six from the surface or from doubtful stratigraphic contexts at Nu-1. There are 53 adzes and fragments in the general collection, making a total of 165 for analysis. It has not proved possible to distinguish any significant change through time in the different categories of excavated adzes, which are accordingly treated as a single assemblage, although their distribution in the excavations is reviewed.

The number of adzes in different categories of material differs noticeably between the assemblage from excavations (henceforth taken to include surface finds from Nu-1 and Nu-3) and the general collection. In particular, adzes thought to have been made from the thick central part of *Tridacna maxima* were very much more numerous in the general collection (Table 11).

Table 11. Numbers of adzes in excavated and general collections according to raw material.

	EXCAVATED	GENERAL COLLECTION
Terebra maculata	57 (50.8%)	12 (22.6%)
Mitra sp.	2 (1.8%)	—
Cassis sp.	3 (2.7%)	2 (3.8%)
Tridacna maxima ventral lip	44 (39.3%)	24 (45.2%)
Tridacna maxima solid interior	6 (5.3%)	15 (28.3%)

It appears that whereas the smaller, lighter tools made from the ventral edge of shells of *Tridacna maxima* were easily made and fairly readily discarded, tools made from the more solid interior or hinge portion of large shells were regarded as more valuable and handed down from one generation to the next. Many of the examples in the general collection, indeed, were given to Carroll by the present day owners, rather than found on the surface during site surveys as most other items in the general collection were.

Adzes of *Terebra* and *Mitra* (Fig. 22)

These were the most numerous tools in the excavated collection, although not in the general collection. Nearly all examples are made of *Terebra maculata,* but there is one complete example in *Mitra mitra* and one of *M.papalis* in process of manufacture. The finished example

closely resembles the *Terebra maculata* specimens. The majority of tools seem to have been made of fresh shells but there are a few examples of weathered *Terebra maculata* shells being used. These tools, more than any others, appear to be restricted by the shape of the shell and difficulty was encountered in establishing any meaningful variations.

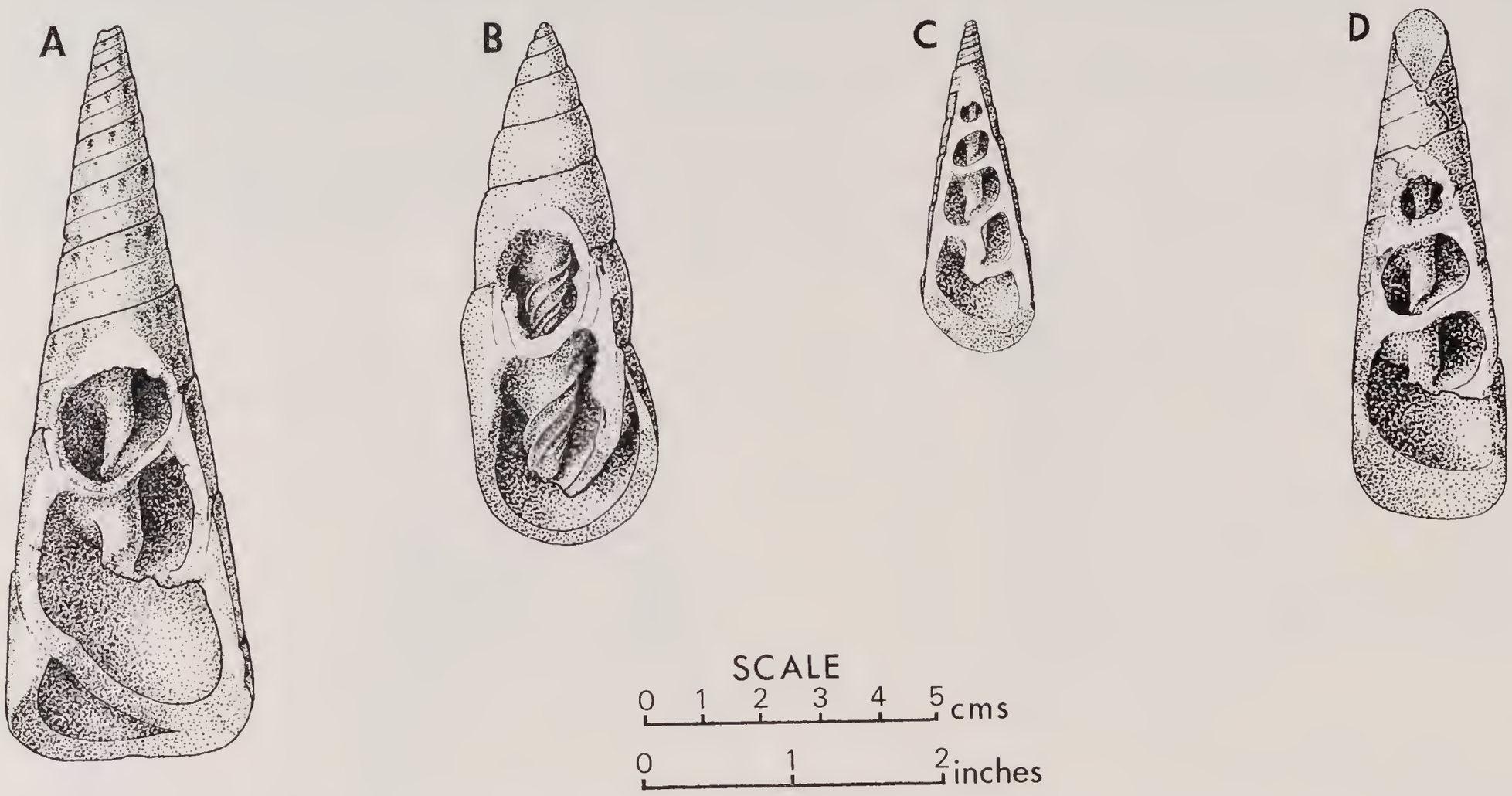


Fig. 22. Adzes made from *Terebra maculata* (a, c-d) and *Mitra mitra* (b). a. Nu-1/46. b. Nu-8/68/1. c. Nu-8/55/1. d. Nu-8/17/1, with cutting edges at both ends.

Terebra maculata shells can be worked in two different ways to form a cutting edge. In the vast majority of Nukuoro specimens a curved cutting edge has been formed on the body whorl of the shell, and the bevel and back shaped by chipping or grinding away the lip and part of one side of the shell, but there are a few specimens on which the tip of the spire has been bevelled instead or as well (Fig. 22). The former type of tool corresponds to Rosendahl's Type I, Broadbent's Class 5, Osborne's Class 1. Thompson classed it as a Type 3 scraper, rather than an adze. Among the Nukuoro tools of this kind two major areas of variation were observed, namely the shape of the cutting edge and the treatment of the back of the tool to provide a flat surface for hafting. The cutting edge may be only slightly curved or markedly circular; the bevel may be steep or short, flat or hollow ground. All these differences were noted by Rosendahl who established four varieties, low bevel with circular cutting edges, steep bevel with oval cutting edge, skewed cutting edge and gouge-like bevel. The Nukuoro specimens exhibit a considerable range of bevels in which there is a strong suggestion that the variation is due to continuous use and re-grinding of some specimens while others are new, rather than to different functional requirements.

The second major area of variation was the treatment of the back. Some specimens appeared to have been shaped entirely by chipping, and had no evidence of grinding except on the bevel. The possibility that these were unfinished tools was shown to be unlikely by evidence of use wear on the cutting edge of several examples. A smaller number had been shaped mainly by chipping and then slightly ground. A third group also exhibited a combination of chipping and grinding, but the grinding was confined to the upper part of the spire. In several instances the ground surface of the spire was on a different plane from the chipped surface, suggesting either that the tool had been hafted at an angle, or that considerable reworking had taken place. In another group of tools the back of the shell had been worked or finished entirely by grinding. This variety was confined to the smaller shells, and may be due to a difficulty in working small shells satisfactorily by chipping. Another feature which varied was the extent of the spire that was worked. The small ground specimens were mostly ground almost to the tip of the spire, but in some of the other groups quite large areas of the spire were unmodified.

None of these varieties appeared to have any chronological significance, and examples of different kinds were found in stratigraphic association. The excavated assemblage contained 12 specimens ground only on the bevel, 6 with minimal grinding on the back, 12 with substantial areas of both chipping and grinding and 9 with grinding only (one of these was the *Mitra mitra* shell). In addition there were 6 broken specimens with intact cutting edges and 4 with cutting edges broken off. Four tools in various stages of manufacture were found, 2 *Terebra maculata* shells worked by chipping, and a *Terebra maculata* and a *Mitra papalis* worked by grinding.

Eleven *Terebra maculata* adzes in the general collection exhibit similar variety in size and shape.

There is little variation in size, since these tools are made on shells of fairly uniform size and shape. The maximum and minimum lengths and average length of each group of complete specimens in the excavated collection are given in Table 12.

Table 12. Lengths of *Terebra maculata* and *Mitra mitra* adzes.

	min. l. (cm)	max. l. (cm)	av. l. (cm)	*n.*
Shaped by chipping	8.3	11.00	9.7	12
Chipped, some grinding	7.75	11.5	9.35	6
Chipped, ground on butt	6.8	12.15	10.4	12
Shaped by grinding	5.5	8.7[1]	7.1	9

[1] The only *Mitra mitra* specimen

The width and length of the tool depend on the size of the shell. The length-width ratio is fairly constant. Thickness varies according to the amount of the shell that has been modified. It is, however, difficult to measure, because of the shape of the shell, and it is doubtful whether comparison of shoulder indices, for instance, would be very meaningful.

A small number of *Terebra maculata* shells was recovered on which the tip of the spire had been filed for use as a chisel or gouge. Four of these had no cutting edge at the aperture end, which had, however, been chipped for hafting. Two specimens had cutting edges at both aperture and spire. One of each group had a slightly but distinctly beaked cutting edge at the tip of the spire. There was also one specimen in the general collection on which the spire and not the aperture had been used.

Terebra (or *Mitra*) shell tools with the cutting edge at the aperture end are wide-spread in Micronesia and parts of Melanesia, being reported from archaeological contexts in the Marianas (Thompson 1932, p.55; Spoehr 1957, p.154), Yap (Gifford & Gifford 1959, pp.187-188), Palau (Osborne 1966, pp.451-452) and the New Hebrides where specimens from Fila are dated to 9th and 17th centuries (Shutler 1970, p.136; Shutler & Shutler n.d. plate 6B; Garanger 1966, pl. IV) and ethnographically from a wide area including the Western Carolines (Eilers 1936, p.237), Central Carolines (Damm 1938, p.320), Mortlocks (Krämer 1935, pl.9), Kusaie (Finsch 1893, p.470), Nukumanu (Sarfert & Damm 1929, p.153), the Admiralty Islands (Nevermann 1934, p.222), St Matthias group (Nevermann 1933, p.53), New Britain and New Ireland (Finsch 1893, pp.21, 54) and the Banks and Northern New Hebrides (Edge-Partington 1890, p.146). I recorded or collected examples on Ponape and neighbouring atolls, while the Auckland Museum collections contain examples from the Gilbert Islands and some of the Solomon Islands. The use of *Mitra* shells seems to be relatively rare. They are particularly documented for Kusaie.

The use of the tip of the spire, however, is so far reported only from Polynesia and parts of Fiji. It is known from the Marquesas (Suggs 1961, p.133), Moorea and other parts of the Society Islands (Green *et al.* 1967, p.198; Emory & Sinoto 1965, p.86), and Tonga (Poulsen 1968, Fig. 2 (1)), and less certainly from Pukapuka (Beaglehole & Beaglehole 1938, p.167). Kennedy figures a similar sort of tool from the Ellice Islands (1931, p.293). Poulsen refers to an example recovered by Smart on Kabara in the Lau Islands of Fiji (Poulsen 1967 (I), p.235). Shutler has recently reported *Terebra* and *Mitra* "gouges" with 17th century dates from the southern Polynesian outliers of Fila and Futuna (Shutler 1970).

In sum, then, while the more common Nukuoro variety is wide-spread in Micronesia and occurs also in those parts of Melanesia where shell adzes normally occur, the other form is largely confined to Polynesia. On Nukuoro the known examples are all late.

Adzes of *Cassis* or *Conus* (Fig. 23)

A small number of bevelled tools made from a section of the outer body whorl of *Cassis* shells were found. The material of these tools has previously been incorrectly described as *Conus* (Davidson 1968a, pp.58, 61). It is possible, however, that similar tools could be made of other shells such as *Conus* and *Trochus* or *Lambis* as reported from other islands (Poulsen 1967 (I), p.236; Koch 1961, p.141). The recently published list of items collected by Jeschke on Nukuoro includes five *Trochus* adze blades (Volprecht 1968, p.542) which is surprising, since none were found in the excavations.

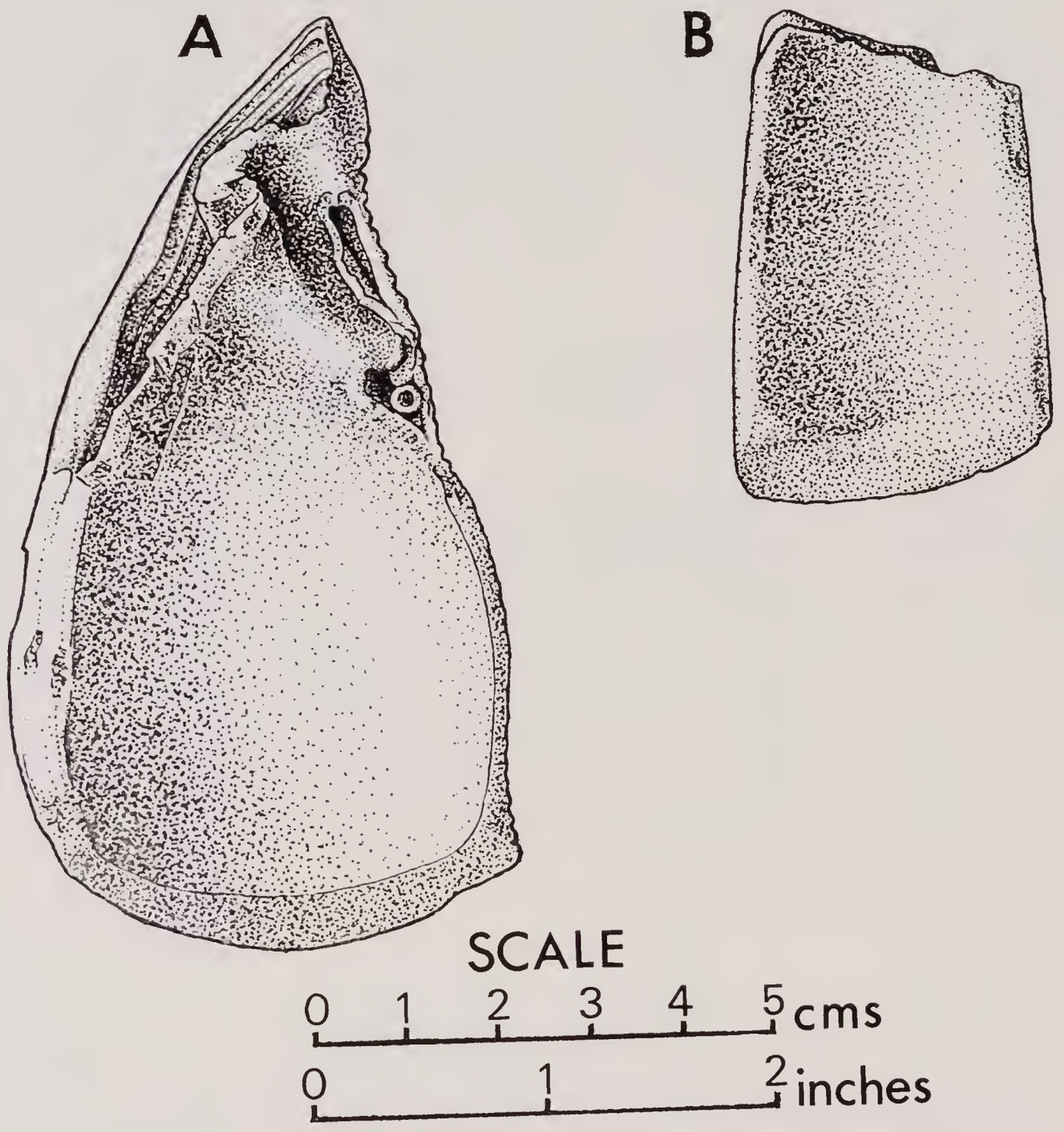


Fig. 23. Adzes made from *Cassis* sp. or similar. a. Nu-1/239/1, made from *Cassis rufa*. b. Nu-3/5, shell not identified.

Two of the excavated specimens are small, consisting of a section of the outer whorl of the shell, with a short bevel on the inside of the shell. One is of *Cassis rufa* while the other cannot be identified and may in fact be a *Conus* shell. The third has a more curved cutting edge, and a more triangular outline and retains part of the anterior tip of the shell at its poll. It is also a *Cassis rufa* shell, as is a fragment in the general collection. A second example in the general collection is *C. cornuta*.

The lengths and maximum widths (at the cutting edge) of the four complete specimens are given in Table 13.

Table 13. Dimensions of adzes of *Cassis* sp.

	Length (cm)	Width (cm)
Nu-1/239/1	9.9	5.0
Nu-3/5	5.3	3.5
Nu-G/107	10.9	8.1
Nu-4/13	6.85	3.7

These tools may correspond to Rosendahl's Type II. They are not reported from the Marianas, Yap, or Palau, but do occur in the New Hebrides (Shutler & Shutler n.d., pl.6 d and f; Garanger 1966, pl.IV (10)). The specimen figured by Garanger was recovered from excavations on Mele, one of the southern Polynesian outliers. The examples collected by the Shutlers were from non-archaeological contexts on Efate. Poulsen recovered several *Conus* specimens from archaeological contexts in Tonga, and reports one in the Meyer collection from Watom (Poulsen 1967 (I), p.236). Kennedy's group 3 is probably related. Ethnographic reports of this type of tool are rare but not totally lacking (e.g. Finsch 1893, p.471 for Kusaie). This is no doubt partly due to uncertainty as to their function, and their insignificance compared with most other kinds of shell adzes. The regularity with which they have turned up in archaeological investigations suggests a wide distribution.

Adzes Made from the Ventral Margin of *Tridacna Maxima* (Fig. 24)

These are probably the most widely distributed of all shell adzes in the Pacific, occurring sporadically from Yap to the Northern Cook Islands. Many of the existing classifications of shell adzes are concerned largely with varieties of tool made from this material; thus they include Rosendahl's types IV to X, Kennedy's Groups 1 and 2, Broadbent's classes 1, 3 and 4 and Osborne's Classes 4 and 5.

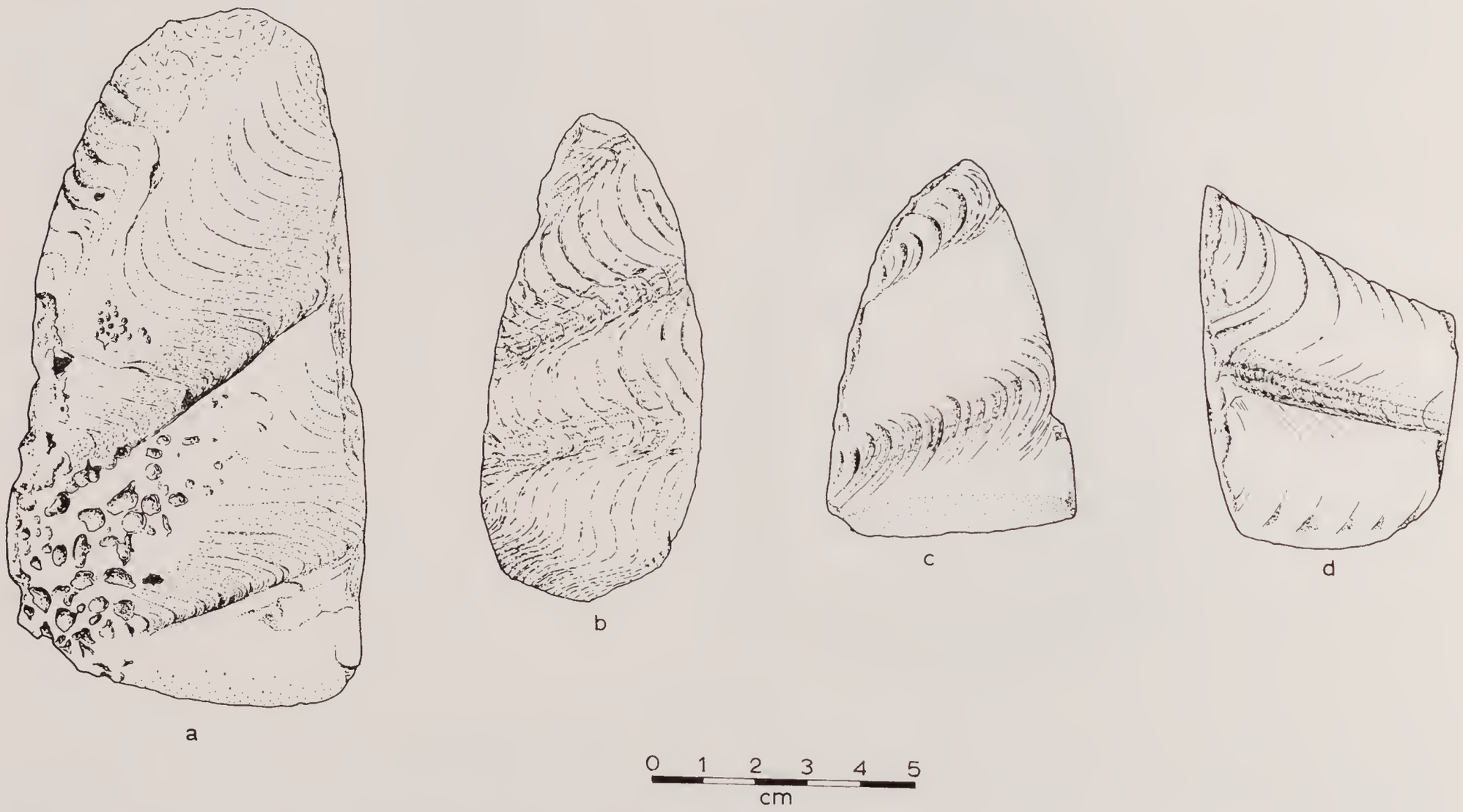


Fig. 24. Adzes made from the ventral lip of *Tridacna maxima*. a. Nu-8/7. b. Nu-4/37. c. Nu-1/305. d. Nu-7/11.

The Nukuoro examples in this material exhibit little variety in size and shape. All are made from the ventral margin of the shell (or exterior portion as Rosendahl called it) with the long axis of the adze roughly parallel to the edge of the shell, as illustrated by Gifford & Gifford (1959, Fig. 5). On finished adzes the bevel is always on the surface formed by the outer side of the shell. Only a small proportion of the examples recovered from excavations exhibited a ground edge, raising the possibility that many of these tools may have been scrapers of some kind rather than adzes. Because of their uniform shape, however, they are all described in this section.

In outline most examples taper slightly from cutting edge to a narrower rounded poll. A few are widest near their mid point and taper towards both cutting edge and poll. Only two taper markedly enough from cutting edge to poll to be described as triangular in outline. On examples with intact cutting edge and bevel both straight and curved cutting edges occur as well as cutting edges skewed both to left and to right. There is a definite tendency for adzes which are widest at their mid point to have curved cutting edges, and for straight edges to occur on adzes which are widest at the cutting edge.

Only 11 examples with complete cutting edge were recovered from excavations, from both

early and late contexts. Of these only four appeared to retain their original length (and of these two had badly chipped edges). The remaining seven had broken at or near their mid point, although they could possibly still have been successfully hafted. In the general collection, on the other hand, there are eight complete examples and three broken ones.

A large number of apparently unfinished specimens was recovered. From the excavations there were nine which were identical to those described above, but which lacked any trace of grinding and appeared to have been chipped into shape. A further five had some grinding on the sides or the exterior shell surface but no cutting edge, suggesting that the bevel was the last part to be worked. These roughouts were well distributed through both early and late levels. The general collection also contained seven roughouts.

Fragments which also belong to this category include butt portions both ground and unground, a small central fragment and a few fragments of roughouts which may be either butt or blade portions.

A possible variant form is indicated by five complete and two incomplete "spoon-like" roughouts shaped in the same way from the same part of the shell, but distinguished by an outline in which the sides and presumed cutting edge form a continuous curve. None of these had any indication of a bevelled edge and it is possible that they are domestic tools complete in themselves and not adze roughouts. They are not represented in the general collection.

While the Nukuoro adzes in this material vary somewhat in size and shape and in the size and heaviness of the shells from which they were made, they are actually very uniform when compared with the total range in Oceania of tools made from *Tridacna maxima* on which traces of the outside surface of the shell are visible.

Maximum and minimum lengths and average lengths of different groups of these tools are given in Table 14. The thickness of the tools is controlled by the thickness of the shell, whose irregular surface makes measurements hard to take. The ratio of width to length seems fairly constant. In studying collections from more than one island group, however, the relationship between width and length might provide a useful means of differentiating styles.

Table 14. Lengths of adzes made from *Tridacna maxima* ventral lip.

	min. l. (cm)	max. l. (cm)	av. l. (cm)	*n*
A. Excavated				
complete adze with bevel	7.2	13.6	10.25	4
broken adze with bevel	3.4	6.8	5.6	7
small well-ground adze	4.9	5.9	5.4	2
unground roughout	9.1	15.0	12.45	9
partly ground roughout	6.9	11.2	8.7	5
"spoon-shaped" roughout	8.4	13.85	10.52	7
B. General collection				
Complete adze with bevel	6.5	11.2	8.9	8
Broken adze with bevel	5.3	6.1	5.7	3
Small well-ground adze			7.6	1
roughout	5.9	13.6	9.7	7

A small group of adzes diverged more markedly from the standard described above. Two excavated specimens and two from the general collection (one incomplete) are much more extensively ground to form small narrow tools on which traces of the surface of the shell are still visible.

Adzes of this kind are very common in the area surrounding Nukuoro. I recorded large numbers in private collections from Ponape and Kusaie, and they are well described from the Marianas (Thompson 1932, p.53), Yap (Gifford & Gifford 1959, pp. 186-187), Palau (Osborne 1966, pp.455-456), Kapingamarangi (Buck 1950, pp.166-168) and the Ellice Islands (Kennedy 1931, pp.289-290). Ethnographic accounts indicate their presence in other parts of the Caroline Islands (Eilers 1936, p.237; Damm 1938, p.320) and Nauru (Hambruch 1915, p.76).

Their distribution in Melanesia is less clear, but they are reported from the New Hebrides (Shutler & Shutler n.d.; Garanger 1966) where some form of *Tridacna* adze is dated to the

9th and 15th centuries (Shutler 1970); from Tikopia (Firth 1959, pl. 1b) and from Rennell Island (Birket-Smith 1956, p.91). Specht recovered examples on Buka (1969 (I), pp.287-8). They are also illustrated from the Admiralties, New Britain and the Solomons (Edge-Partington 1895, pp.97, 120, 132) and are known from Santa Cruz and the Reef Islands (Green pers. comm.). It is sometimes difficult to distinguish descriptions of *Tridacna maxima* adzes of different kinds, and the variety under discussion here may eventually prove to have as wide a distribution as have shell adzes generally.

In Polynesia, however, they are restricted in distribution to the Ellice Islands, the Tokelaus (specimens in the Auckland Museum) and the Northern Cooks (Buck 1932a, b). In other parts of Polynesia where *Tridacna maxima* adzes occur, notably the Tuamotus, Tonga and Niue, a different part of the shell is used.

Adzes From the Central or Hinge Area of *Tridacna maxima* or Other Large Shells

Adzes made from this material fall into two major divisions, those in which some indication of the form of the shell remains, and those in which there is no sign of the original shell surface. The identification of the latter as *Tridacna* is often uncertain. Other large shells such as *Lambis truncata sebae* or *Hippopus hippopus* are also possible. Examples of the former type from Nukuoro tend to use the natural shape of the shell in such a way that the adze has a laterally convex front and a hollow cutting edge and concave back. One small example of this type was excavated (Fig. 25a) and there are two in the general collection.

A single unique specimen in the general collection has a wide thin quadrangular cross-section, a flat front, and traces of shell surface on the back. It appears to be made from a different part of the shell than the ventral lip, and fits neither with adzes in that material, nor with the majority of the group under discussion here.

Shell adzes on which there is no sign of the original shape of the shell are the most interesting of all because they exhibit the greatest range of shape and tend to be larger and heavier than other shell adzes. They are most often made from the enormous fossil shells that occur in some Pacific islands. Because they have seldom been found in archaeological collections they are not well described in the archaeological literature. Ethnographic reports are numerous but scattered, and no comprehensive survey has ever been attempted.

Large shell adzes are known from the Caroline Islands, notably Ponape (Christian 1899, p.399; Hambruch 1936, pp.53-54), Kusaie (Finsch 1893, pp.470-472) and the Western Carolines (Thompson 1932, p.54); the Marshall Islands (Finsch 1893, p.410; Krämer & Nevermann 1938, pp.134-144); the Gilbert Islands (specimens in Auckland Museum); and some parts of Melanesia including New Guinea (Edge-Partington 1898, p.84), parts of the Solomons and the Bank Islands (Edge-Partington 1895, pp.83, 84, 120, 121). Several of the Polynesian outliers in Melanesia are notable for large shell adzes including Tikopia (Firth 1959, pl.II) Sikaiana (Schmeltz & Krause 1881, p.73) and Nukumanu (Sarfert & Damm 1929, p.153). Smaller specimens are very common in Micronesia.

Eilers (1934, p.246) described large shell adzes from Nukuoro. Both the excavated specimens and the majority of those in the general collection, however, are relatively small. This may be evidence in support of Eilers' contention that as the large shells were no longer available on Nukuoro as raw material the larger blades were being reworked to smaller tools as recently as the early years of this century (Eilers 1934, p.192), or may be because the different function of these tools required their use in the bush rather than in dwellings or in *hada*.

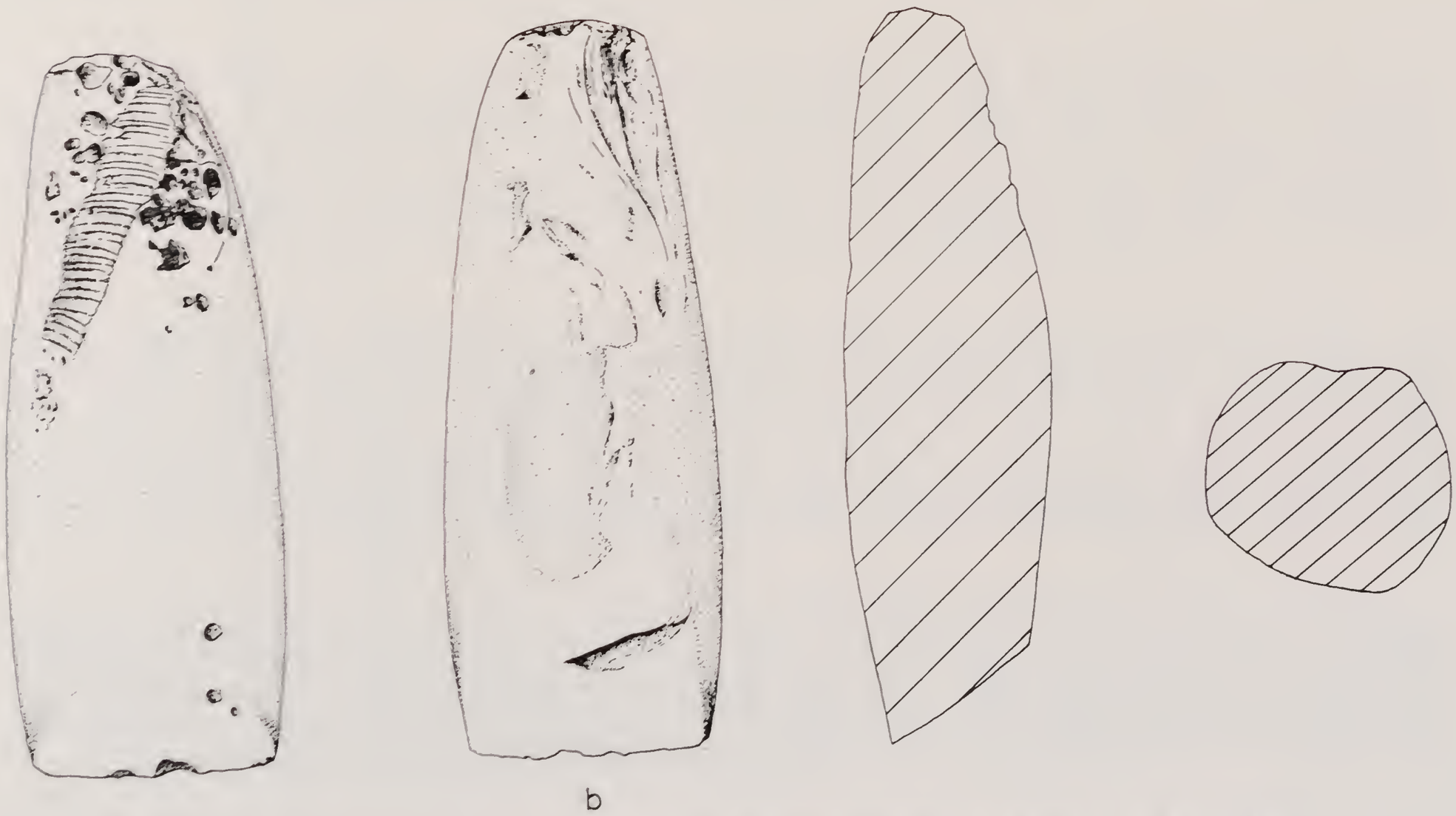
The Nukuoro specimens described here vary according to their cross-section and the shape of their cutting edge and bevel. Butt modification was present on several examples. There need not be a correlation between cross-section and cutting edge. Although the shape of the cross-section is usually regarded as a principal criterion in classifying stone adzes, the shape of the cutting edge was regarded by the Nukuoro craftsman as the crucial characteristic of a shell adze, and they are accordingly grouped and described here by this feature.

The examples described above with curved cutting edge and hollow ground bevel following the natural shape of the shell are paralleled by a similar group with no evidence of the natural shape of the shell (Fig. 26c). There are four examples in the general collection with curved cutting edge and hollow bevel, whose cross-sections range from plano-convex to rounded rectangular. One has butt modification in the form of a shoulder.

Fig. 25. Excavated adzes made from solid portions of *Tridacna maxima*. a. Nu-1/257. b. Nu-1/321. c. Nu-3/18. d. Nu-5/41. e. Nu-1/203.

Fig. 26. Adzes made from solid portions of *Tridacna maxima*. a. Nu-G/103, beaked cutting edge. b. Nu-G/31, curved cutting edge and flat bevel. c. Nu-G/18, curved cutting edge and hollow bevel.

a



0 1 2 3 4 5
cm.

b

Fig. 27. Adzes made from solid portions of *Tridacna maxima*. a. Nu-G/1. b. Nu-G/101.

A second group have a curved cutting edge, but flat bevel. These are represented by one excavated specimen with plano-convex cross-section (Fig. 28f) and one in the general collection with quadrangular cross-section (Fig. 26b).

A very varied group is characterised by straight or almost straight cutting edge and flat bevel surface. The largest adze in the collection has a sharply quadrangular section and is very wide in relation to its thickness (Fig. 27a). Very much smaller, but of similar proportions and cross-section, is an excavated specimen from Nu-3 (Fig. 25c). Two excavated examples from Nu-1 are thicker and have a more rounded rectangular cross-section (Fig. 25b, e). One specimen, Nu-G/101, has a straight but relatively narrow cutting edge in relation to its length, and a round cross-section (Fig. 27b). It differs so much in proportions and weight from other examples with straight cutting edge that it was probably functionally different.

The last group are the so-called beaked adzes with their distinctive cutting edge. These may have a triangular or plano-convex section. There are four examples in the general collection, two of which have butt modification; in one case two transverse lashing grooves on the front, in the other a slight shoulder on the front (Fig. 26a). One beaked adze in the general collection is actually double ended, with a beaked cutting edge at one end and a curved cutting edge, battered by use, at the other end.

One excavated specimen of a large *Tridacna maxima* adze cannot be classified as it is a butt fragment only (Fig. 25d). It has a thick rounded quadrangular cross-section but could have had a beaked or curved cutting edge.

Details of all *Tridacna maxima* adzes other than those made from the ventral lip of small or medium-sized shells are given in Table 15.

Distribution of Excavated Adzes

The occurrence of the various kinds of shell adze in the excavations is shown in Table 16. They are seen to be widely distributed through the different layers of all the sites. There are, however, some interesting variations in distribution. *Tridacna maxima* adzes of both kinds are rare in square G-9, Nu-1, in contrast to *Terebra maculata* adzes, which are present in reasonable quantity. This may be because the specialised function of *Terebra maculata* adzes necessitated their use in some activity carried out at the *hada*. On the other hand, all kinds of adzes were present in square E-5. There was also a lot of worked *Tridacna* shell and adze material from the well shaft. Perhaps there was a distinction between the sort of work carried out in different parts of the *hada*.

Three occupation levels were particularly productive of adzes: layer 5, square E-5, Nu-1; layer 9, Nu-4; layer 7, Nu-8. The assemblages from these layers demonstrate the contemporaneity of different kinds of tools. This is particularly true in the case of layer 7 in Nu-8 where a cache of seven complete adzes and two in the process of manufacture were found together (Fig. 28). From this it would appear that one man's adze kit would include tools of *Terebra maculata* and both lip and solid portions of *Tridacna maxima*.

Adzes were more evenly distributed among the excavated localities than fishhooks. There are more from Nu-1 than from any other site but the excavated area was larger there. If the two squares are considered separately the quantities of adzes are not high compared with other sites, particularly Nu-8. This may indicate that adze manufacture and use were carried out in ordinary occupation sites, or in specialised sites of a kind not identified archaeologically, rather than being conspicuous activities at *hada* sites. The large number of adzes from Nu-8 may indicate that it was the residence of people who specialised in wood working.

So far as can be determined there was little change in adze types during the period documented by the excavations. Certainly the *Tridacna maxima* ventral lip tools and *Terebra maculata* adzes are present throughout the sequence. Examples of other material are too few for their chronological position to be fully understood. There is, however, some evidence to suggest that use of the spire of *Terebra maculata* shells is a late addition to the Nukuoro tool kit

Table 15. Characteristics of adzes made from solid portions of *Tridacna maxima*.

	L. (cm)	W. (cm)	TH. (cm)	S.I.	WT. (g)	X-SECTION	EDGE	BEVEL	SHOULDER
Nu-G/1	18.8	7.8	2.3	.29	692	sharply quad.	slightly curved	short and straight	—
Nu-3/18	7.4	3.7	.8	.22	41	sharply quad.	straight	short and straight	—
Nu-1/203	7.2	4.7	1.9	.40	114	rounded quad.	straight	straight	—
Nu-G/31	7.5	4.6	2.1	.46	120	rounded quad.	curved	straight	—
Nu-1/321	7.0	4.6	1.8	.39	108	quadrangular	straight	straight	—
Nu-G/101	12.9	5.0	3.9	.78	378	round	straight	straight	facet on front
Nu-8/47/1	9.0	4.3	1.9	.44	115	plano-convex	curved	straight	—
Nu-G/18	9.2	4.2	3.0	.71	185	plano-convex	curved	hollow ground	—
Nu-G/30	7.8	4.2	1.5	.36	139	rounded quad.	curved	hollow ground	—
Nu-G/22	7.3	3.3	1.9	.58	79	plano-convex	curved	hollow ground	—
Nu-G/102	11.3	4.6	3.5	.76	318	plano-convex	curved	hollow ground	stepped
Nu-G/104	10.3	3.7	3.5	.95	189	triangular	beaked	slightly hollow	—
Nu-G/8	8.9	3.7	3.0	.81	163	plano-convex	beaked (other end curved)	hollow ground	—
Nu-G/103	7.8	2.7	2.7	1.00	100	plano-convex-triangular	beaked	hollow ground	stepped
Nu-G/94	11.7	4.6	3.7	.80		triangular	beaked	hollow ground	grooved
Nu-1/257	7.3	4.8	2.8	.58	144	concave-convex	curved	hollow ground	—
Nu-G/64	7.0	4.2	1.9	.43	73	concave-convex	curved	hollow ground	—
Nu-G/55	10.3	5.6	1.5	.27	120	irregular quad.	straight	straight	—
Nu-G/52	broken	4.5	2.0	.44		?quadrangular	?straight	?straight	—
Nu-G/65	broken	5.2	2.3	.44		quadrangular	curved	hollow ground	—
Nu-5/41	broken	4.5	3.9	.87		round	?	?	?

Table 16. Distribution of varieties of adze according to site and context.

SITE	SQUARE	LAYER	LEVEL	*Terebra maculata* or *Mitra* sp.							*Cassis* or *Conus* spp.	*Tridacna maxima* ventral lip								*Tridacna maxima* Solid or other large shell
				shaped by chipping	chipped, some grinding	chipped, ground on butt	shaped by grinding	broken, cutting edge intact	broken, cutting edge missing	unfinished	cutting edge both ends	cutting edge apex only	"normal" variety	complete, unground	ground, no bevel	unground butt fragment	ground butt fragment	other ground fragment	other unground fragment	"spoon-shaped"	small, well ground
Nu-1	G-9	9		—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		8		1	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—
		6		—	—	1	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—
		5		1	—	—	—	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—
		3		2	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—
		1		—	—	1	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	1
	E-5	5		—	3	1	1	—	1	—	—	—	1	—	2	1	—	2	—	1	—	1
		4		—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—	—	1	—
		3		—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—
		2		—	—	—	—	1	—	—	—	—	—	1	—	—	—	1	—	—	—	1
		1		1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	surface/well	shaft		—	—	—	1	—	—	—	1	—	—	1	—	2	1	—	—	—	—	—
Nu-3	surface			1	—	—	—	1	—	—	—	2	1	—	—	—	—	—	—	—	1	—
	1		5	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	1
	2		2	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Nu-4		9		—	1	1	—	—	—	1	—	—	1	1	—	—	—	1	—	—	1	—
		8		—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1
		4		—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—
		2		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—

Nu-5	2	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—
	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—
	5	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—
	7	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—
	9	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	10	—	—	1	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—	—
	11	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	12	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Nu-6	6	—	—	—	—	—	—	—	—	—	—	1	—	1	—	—	—	—	—	—
Nu-7	3	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	4	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	5	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—
	6	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Nu-8	2	1	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—
	3	—	—	—	—	—	1	—	1	—	—	—	—	—	—	—	—	—	1	—
	4	—	—	—	—	1	—	—	—	—	—	—	1	—	—	—	—	1	—	—
	5	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—
	7	3	—	1	—	—	—	1	—	—	—	2	—	1	—	—	—	—	—	1
	8	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	10	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	11	—	1	—	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	12	—	—	—	—	—	1	—	—	—	—	—	—	—	1	—	—	—	—	—
General		4	—	4	3	—	—	—	—	1	2	11	7	—	2	—	—	2	—	2	15

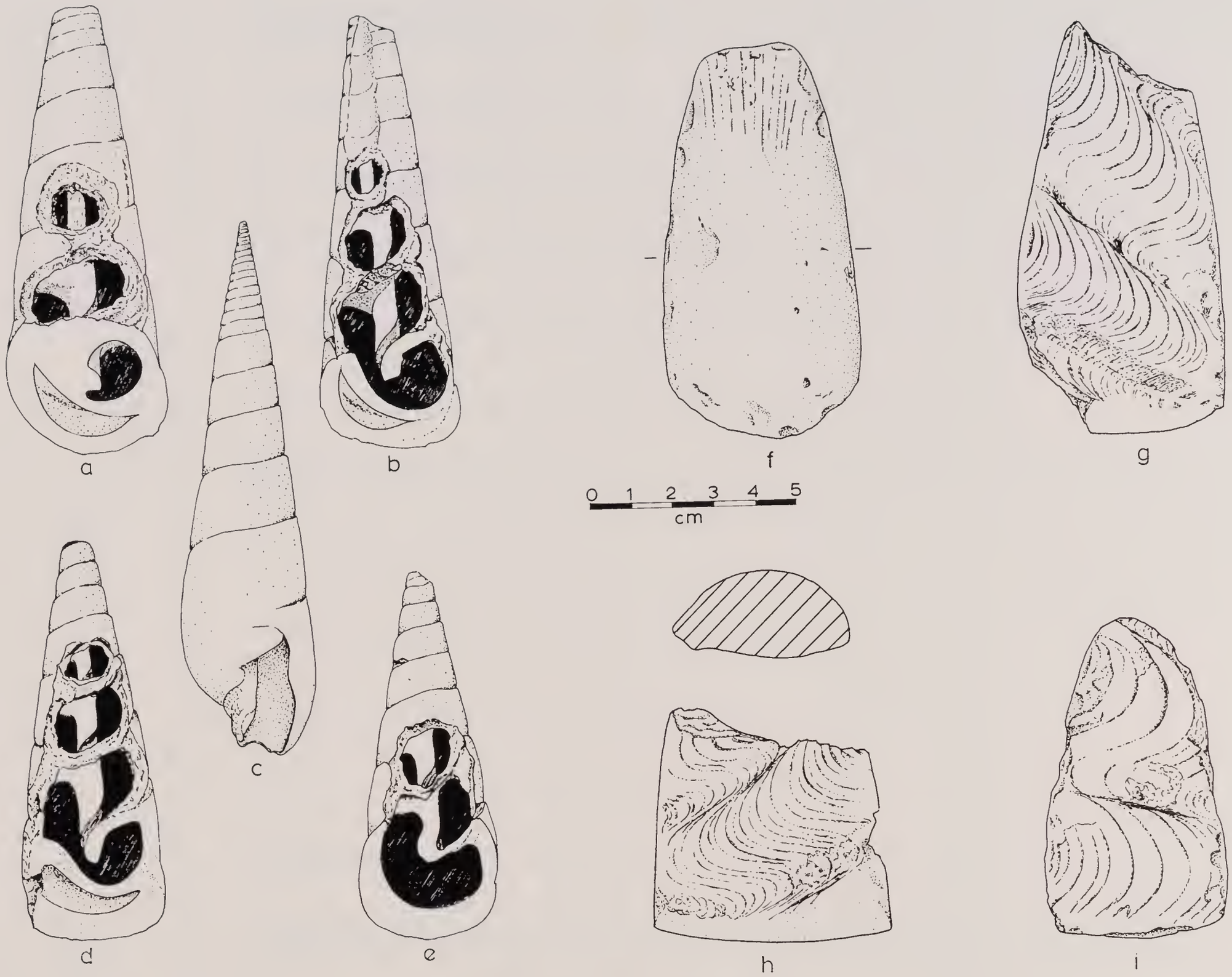


Fig. 28. Cache of adzes from level 7, Nu-8.

Functions of Shell Adzes

Most of the attempts to classify archaeological collections of shell adzes have had to ignore function. Thompson, however, attempted to classify shell implements "according to probable use" as adzes, scrapers, or spoons. Scrapers included *Terebra* tools, *Tridacna* ventral lip tools with curved cutting edges, and tools apparently related to the *Cassis* specimens from Nukuoro, while spoons were mostly *Tridacna* ventral lip tools without bevels. Without ethnographic evidence it is difficult to assess the validity of these assumptions. There would appear to be some justification for the classification of the *Cassis* type and some forms of *Tridacna* tool as graters, however, if parallels from other islands are considered. It is less easy to distinguish between "spoons" and unfinished bevelled tools.

Kennedy was able to show that identically shaped tools could be used for quite different purposes in the case of his groups 3 and 4, the former being bevelled and used as adzes, and the latter having serrated edges and being used as coconut graters. It is likely that in some island groups shell tools of a particular material and shape would be used only for adzes, and in others they might be used as coconut graters.

Scattered through the ethnographic records, however, are references to the function of adzes in various island groups. Kubary collected considerable information on the manufacture and use of the shell adzes on Nukuoro and his account is worth quoting in full (1900, pp.115-116):

> The shell axes are made either from Tridacna or Terebra shells and have special shapes and designations according to the use for which they are intended. The large Tridacna shells are divided by means of the pumice stone (te hohána) into smaller pieces and are then ground into the desired

shape. The tóhi álo tahi consist of a wedge shaped head fastened transversely against the axis of the haft. This type is used only for the trimming and preparation of the surface. The tóhi úli úli are distinguished from the aforementioned in that the head is fastened in a moveable socket and thus its plane can be twisted in the plane of the longitudinal axis and thus becomes an ordinary hatchet, being especially suitable for the felling of trees and cross hewing. Tóhi óhu had a prismatic shape and is used as a chisel, for example for splitting the pandanus trunk. In some of the latter form the head is very long and is used for smaller works. Tóhi hakóróna is a hollow chisel consisting of a Terebra ground down to a half and is used principally for hollowing out.

Thanks to the abundance of cast away pumice stone the Nukuoro shell axes are distinguished by a sharp cutting edge and a consummate polish. The giving of this polish and the grinding of the dulled axes was the job of the old men.[1]

Kubary's account is accompanied by illustrations of the various types, hafted in several cases with the bevelled surface uppermost.

Modern informants offered similar information. Adzes with straight cutting edges were used for dressing and often finishing flat surfaces, and were usually, if not always, hafted with the bevelled surface uppermost. The size of tool used varied according to the scope of the task, but whether a tool was a large heavy one of solid *Tridacna,* or a small light one of *Tridacna* ventral lip, it would be used the same way. These, then, are Kubary's tohi alo tahi. Tools with curved cutting edges, on the other hand, whether of *Tridacna* or *Terebra,* were used for hollowing out and major shaping, and would normally be hafted with bevel downwards. The *Cassis* tools were probably of this type, although informants were not questioned about them. The name toki hakarona (*dogi hakalona*) applies to the *Terebra* shell specimens and means literally *Terebra* adze. The name of other adzes with curved cutting edge is unclear. The beaked adze is probably Kubary's tohi ohu. Modern informants were uncertain about the movable socket, but inclined to the view that it was adzes of curved or beaked cutting edge that were so hafted. Kubary's specimen, however, is clearly a straight edged tool. It is possible that different kinds of adzes could be hafted in this way, and would all be known as tohi uli uli. The rotating socket adze from the Ellice Islands described by Kennedy had a curved cutting edge (1931, pp. 290-291), while that from Truk had apparently a *Cassis* lip blade unknown from Nukuoro (Le Bar 1964, p. 7).

It appears, then, that most if not all the tools discussed in this section were used, on Nukuoro, at least, as wood working tools. As they are all bevelled on one side only they can be properly described as adzes. The possible exceptions are the *Cassis* specimens and some of the *Tridacna* ventral lip tools. Carroll was told that some tools apparently similar to the *Cassis* specimens described here were used as spoons for young coconuts.

The fact that many of these tools were hafted with the bevelled surface on the front raises issues that have not been reviewed for some time in discussions of Polynesian adzes. The general acceptance of the terminology of Buck, Emory, Skinner and Stokes for Polynesian stone adzes (Buck *et al.* 1930) has led to an assumption that Polynesian adzes were always hafted with the bevelled surface downwards and towards the tool user, despite persistent indications to the contrary (see for example Buck 1930, pp. 362-364). In discussions of Polynesian stone adzes, conventions are so well established and so widely understood that it will doubtless prove convenient to continue to use the accepted designations of front, back and bevel. In the case of shell adzes, and particularly *Tridacna* shell adzes on which portions of the shell are still visible, whether ventral lip or other parts, endless terminological confusion is likely to result unless the frame of reference is clearly defined. Kennedy's careful description of his groups 1 and 2, provides a good starting point.

External Relations of Nukuoro Shell Adzes

The assemblage of shell adzes from Nukuoro is probably as varied as any yet known from a single island, and includes most but not all of the many recorded varieties of Oceanic shell adze. There is little in the assemblage that could be derived from triangle Polynesia, and much that can be compared with both the adjacent Micronesian islands, and some of the Polynesian outliers in Melanesia.

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[1]No modern spellings were obtained for these old adze names except *dogi* (tohi) and *hakolona* (hakorona). *Hoohanga* is the modern spelling for hohana.

The distribution of the *Terebra maculata* adze has been summarised above. Its presence on Nukuoro could be due to contact with almost any Micronesian island or one of several parts of Melanesia, but not to Polynesian influence, unless from one of the Polynesian outliers of Mel-anesia. The *Terebra maculata* gouge, using the tip of the spire, however, is on present evidence a Polynesian characteristic.

The distribution of the many varieties of *Tridacna* adze requires a far more comprehensive study than is possible here. It seems that in the availability of *Tridacna* as in the availability of pearl shell, the Nukuoro were exceedingly fortunate. They were able to use both the small shells in early stages of growth, and the very large shells. There are thus two clearly separate groups of tools, those made from the ventral lip of smaller shells, and those made from the solid interior of the large shells.

The ventral lip tool is the oldest in archaeological contexts in Nukuoro, being present in early levels of Nu-4 and Nu-6. Its known distribution is so wide, including parts of Polynesia and most of Micronesia that, until its age is documented by excavations elsewhere, the reason for its early presence on Nukuoro cannot be determined.

The other *Tridacna* adzes provide a more fruitful field for comparisons. Beaked adzes and the varieties with curved cutting edge can be identified as recurring types throughout Micron-esia and into Melanesia. Beaked adzes are documented from Palau (Osborne 1966, pp. 456-7) to the Gilbert Islands (Auckland Museum collections) with examples at least on the fringes of Melanesia (Hambruch 1908, pl. XXII). The Nukuoro examples seem to belong to this trad-ition. Their functional resemblance to certain Polynesian stone adzes is obvious, but historical relationships, if any, are unknown.

Adzes with curved cutting edges and hollow bevel, often associated with plano-convex sec-tion, are also widely distributed in Micronesia and parts of Melanesia. Again they have an obvious resemblance to the early Polynesian plano-convex adzes, but there is as yet no evidence of historical relationships.

There is a very strong resemblance between Nukuoro shell adzes and those of some other outliers, particularly the group of atolls in the Northern Solomons. Adzes from Nukumanu and Takuu belong to the "Micronesian" tradition of beaked and curved edged adzes of giant *Tri-dacna*. Tikopia and Rennell too, certainly have the large adze with curved cutting edge, if not the beaked adze. It is very tempting to see the adzes of these outliers as directly related, but an origin must be sought for them, and as on present evidence this origin is not in Polynesia, or in the Ellice Islands, it may in fact be merely a case of several different outlier communities separately adopting styles wide-spread among their neighbours.

Least comparative evidence is available for the *Cassis* shell specimens. The thin tools with curved cutting edges made variously from *Cassis* or *Conus* shells are now known from Tonga and the New Hebrides. The one major type of shell adze not yet known from Nukuoro is the chisel or adze made from the lip of *Cassis cornuta,* which has a very wide distribution in the Pacific being reported from Polynesia (Suggs 1961, pp. 115-116), Melanesia including Nor-thern New Guinea and Micronesia as close to Nukuoro as Kapingamarangi (Buck 1950, p. 172), Truk (Le Bar 1964, p. 7) and Ponape (Schmeltz & Krause 1881, p. 283). Whether its absence on Nukuoro is due to inadequate sampling, lack of suitable shell (*Cassis cornuta* is present on Nukuoro, however) or cultural preference is unknown, but its absence is remarkable in view of the richness and diversity of Nukuoro shell adzes.

Two large *Tridacna* adzes stand out as having no obvious affinities with Micronesian adzes and strong general resemblances to Polynesian stone adzes. Nu-G/1 and Nu-G/101 (Fig. 27) illustrate the diversity of form possible in shell, and the extent to which shell adzes can parallel stone adzes if suitable raw material is available. Nu-G/101 is identical to some Tongan stone adzes, while Nu-G/1 could be matched with stone adzes from the North Island of New Zealand. As both Nukuoro specimens are from the general collection and not from archaeological con-texts their age is unknown. Polynesian contacts need not necessarily be implied, although the Tongan parallel is very striking.

The very wide distribution of shell adzes in the Pacific is an indication of their general antiquity, while their popularity on some islands, where stone suitable for adzes also occurs,

shows that their use was sometimes determined by cultural preference and not merely by environmental necessity, as ethnographers long ago recognised (Finsch 1893, p. 275). Their antiquity is now beginning to be documented by excavation. Noteworthy are reasonably well dated specimens from Tonga (Poulsen 1967 (I), pp. 231-236), Fiji (Gifford 1951, Fig. 1f), Guadalcanal (Davenport *et al.* MS.) and Buka (Specht 1969 (I), p. 289) for which ages of two to three thousand years are suggested. None of these specimens is of a type found on Nukuoro, however. Some from Tonga, and the Fijian example, are made from the hinge of medium-sized *Tridacna maxima* in a way unknown on Nukuoro. The other Tongan examples and those from Guadalcanal are said to be of *Conus*. These latter, however, may be similar to the *Cassis* specimens from Nukuoro. The Buka specimen is made from the lip of a *Cassis* shell.

Full publication of the well-dated material from the New Hebrides should provide useful data on the age of adzes made from *Terebra maculata* and some forms of *Tridacna* adze, which are reported from contexts varying from 9th-17th centuries A.D. (Shutler 1970).

The assemblage from Nukuoro is not an old one, in terms of the probable antiquity of shell adzes, but its diversity, and the apparent diversity on present evidence of its affiliations, give it considerable interest.

MANUFACTURING TOOLS

Some items could be identified with reasonable certainty as manufacturing tools. Others, whose use was not immediately apparent, were similarly identified by informants. Some, however, which an archaeologist might identify as manufacturing tools, were said by informants to have been used in food preparation. Other tools known to have been used in certain manufacturing processes, on the basis of non-archaeological evidence, were not found in the excavations. There is, therefore, an area of uncertainty in describing those artifacts classified as manufacturing tools.

Coral Grindstones

Several pieces of coral showing use as grindstones were found. Two examples, from Nu-4 and Nu-8, had a number of ground facets. Nu-4/65 is a small prismatic piece of coral with four ground facets. Nu-8/19 is a fairly thin piece of coral with a small area of natural surface and 11 separate ground surfaces. Another specimen, from Nu-3, is shaped rather like a small thin pounder flaring from a narrow poll to a broader base. The appearance of flaring sides is provided by four hollow ground surfaces. One other unusual specimen is a flat piece of coral with part of one edge bevelled by grinding. It is from level 4, Nu-8.

A more common form of grindstone is a fairly thick lump of coral on which one or two slightly hollow surfaces have been formed by grinding while the remainder is unused. Four examples of this kind were found in Nu-1 and one in Nu-4.

Two other much smaller pieces of coral have been classed as grindstones rather than files. They are small flat pieces of coral from layer 7 and 8 of square G-9, Nu-1, which have been used as some kind of abrader.

The range of uses to which these grindstones were put is not clear. They were probably used in working shell of various kinds, including both adzes and other shell artifacts such as ornaments. The small pebble-like abraders may also have been used for working wood. While it is possible that the different types of grindstone were used for different purposes, it seems more likely that most were all purpose tools and vary in form according to amount of use, and size and shape of the original piece of coral.

The distribution of these grindstones as a group is shown in Tables 1-8. Apart from the small faceted example from layer 2 in Nu-4, which was associated with evidence of bead manufacture, they are all from relatively late levels and were often associated with evidence of manufacture of fishhooks or adzes.

Coral Files and Saws

Several thin pieces of hard coral with a bevelled edge appear to have been used as saws. With the possible exception of one specimen from layer 5, E-5, Nu-1, they have all been made

from a similar kind of coral. The majority are from Nu-1, but there is one from Nu-7 and one from Nu-8. Informants said that this kind of file was for cutting up pearl shell. They are very similar in size and shape to a kind of stone file thought to have been used for working bone during fishhook manufacture on some New Zealand sites. On the Nukuoro examples the length of the bevelled edge varies from 4.6 to 9.7 cm. Except for the specimen from Nu-8, all examples of this type of file were associated with sawn pearl shell.

Sixty branch coral files were found, mostly in upper layers of Nu-1. All show some signs of use on the tip, and a few have signs of abrasion also on a knob or bend below the tip. Some have been worn on one facet only, some have two opposing adjacent facets, and others have been worn all round the tip, sometimes with a shouldered effect. Hainis said that these files were used particularly for shaping the insides of fishhooks. Certainly most were found in those layers of Nu-1 where other evidence of fishhook manufacture was abundant.

The quantity of files and grindstones recovered was not large in view of the prolific evidence of shell working, particularly the working of pearl shell, throughout the deposits. The most likely explanation is that many abraders passed unrecognised among the large quantities of coral gravel in the deposits. A similar explanation has been advanced to explain an apparent absence of files in coastal excavations on Moorea (Green *et al.* 1967, p.196).

Various kinds of coral files have been found in archaeological excavations elsewhere in the Pacific. Coral grindstones were found in excavations in Tonga (Poulsen 1967 (I), p.282) and in Eastern Polynesia. Stone grindstones were also used in many parts of Polynesia. The value of coral files for seriation was demonstrated by Suggs for the Marquesas where files of *Porites* coral were deliberately shaped (1961, pp.117-121). Similar files have been found in Hawaii (Emory, Bonk & Sinoto (1959, plate 6) and rarely in the Society Islands (Emory & Sinoto 1965, p.88). The Nukuoro flat coral files have a superficial resemblance to Suggs' category of rectangular files, but it is possible that they are made from a different kind of coral and not deliberately shaped at all.

Branch coral files have been found in small numbers in the Society Islands (Green *et al.* 1967, p.196) and in greater quantity in Mangareva (Green pers. comm.) and Tonga (Poulsen 1967 (I), pp.279-280). In Tonga, at least, they appear to have been used not for working fishhooks or pearl shell, but for other kinds of shell artifacts. Coral files of uncertain type have also been reported for Easter Island (Heyerdahl & Ferdon 1962, pp.247, 262, 268, 326, 410) and the New Hebrides (Shutler & Shutler n.d.).

Abrading tools are probably much influenced by the raw material from which they are made and also by the material they are designed to work. Certainly the present evidence for the distribution of coral files, sea urchin files (not found in Nukuoro) and stone files suggests that this will prove to be the case. On the other hand, the striking similarity between coral files used for the manufacture of shell fishhooks, and stone files used for the manufacture of bone fishhooks in early New Zealand sites, suggests a certain basic similarity in files for fishhook manufacture. Files may not prove very useful, therefore, for comparative or chronological purposes except in rare areas where deliberately shaped flat files were used, as in the Marquesas.

Drill Points

One item from layer 7, square G-9, Nu-1, seems almost certainly to have been a drill point. It is the tip of the spire of a *Terebra maculata* shell broken to a length of 5 cm. Half the length has been ground to form two parallel flat sides for attachment to the shaft of the drill. Examination of the tip under a hand lens showed rounded facets suggesting that the item had been used as a drill. Two other fragments of *Terebra maculata*, one from the same layer and one from Nu-8 may also have been used as drill points, but show less definite evidence.

A fragment of the bivalve *Codakia tigerina* from the well shaft, Nu-1, has been chipped to form a sharp point. This point protrudes from a roughly rectangular piece of shell some 3 cm wide, however, and it is difficult to see how it could have been attached to a shaft. It is more likely to be some kind of hand borer.

Since the use of a drill was obviously essential in fishhook manufacture (numerous drilled tabs were found) it seemed surprising that only one certain drill point was found. Hainis, when questioned about drills said that the tooth of a fish named *maninga* (?) was used. Kubary men-

tioned the use of shark teeth for drills (1900, p.115). Only a small number of shark teeth found showed signs of wear on their tips, but these may indeed have been used as drill points. It is possible that various fragments of shell and fish teeth were used (cf. Le Bar 1964, p.12, for Truk) and that, as with files, many may not have been recognised among the quantities of seemingly unworked shell.

Various kinds of shell are said to have been used for drill points in other island groups. In the Ellice Islands Hedley was told that tips of *Terebra* and *Mitra* had formerly been used, and both he and Kennedy collected or saw drill points made of *Lambis* shell spikes. This material is also used in the Solomon Islands (Green pers. comm.). Shell drill points were used in Hawaii (Emory, Bonk & Sinoto 1959, plate 6). Our failure to find drill points on Nukuoro suggests that in areas where clearly recognisable stone drill points such as those from Samoa (Green & Davidson 1969, Fig. 103d) or New Zealand (Nicholls 1964, Fig. 4) were not made, identification of drill points may have to depend largely on analogy from ethnographic evidence.

The nature of the Nukuoro drill has not been recorded. It may have been like the pump drill described in detail from the Ellice Islands and Samoa (e.g. Hedley 1897, pp.256-259). Although no weights were found in the excavations they were often made in perishable materials and their absence is not proof that the tool was lacking.

Pumice Abraders

Twenty-one pieces of pumice showing use as abraders were found. They all seem to be natural pebble-shaped pieces, and many show only slight signs of use. The largest has a maximum diameter of 6.7 cm. On most examples one or more surfaces appear to have been artificially flattened. Two have pronounced grooves indicating use as hones for small fine objects. Two have several pronounced longitudinal facets; in one case three, in the other five. These are both from Nu-8, while the grooved specimens were from Nu-1 and Nu-4.

Both ethnographic accounts and informants stressed the value of pumice in finishing surfaces. The relatively small quantities recovered are probably because good pieces would be used completely. Kubary stated that pumice was used both for finishing wooden surfaces and for grinding shell adzes (1900, pp.115, 116, 118). Hainis volunteered the information that pumice was used for polishing wood. This certainly seems the most likely use for the excavated pieces, which would be of little use in working shell. The coral files and grindstones, which were not mentioned by Kubary, seem more suitable for working *Tridacna*.

Bivalves Used for Manufacturing

Several shells recovered were shown to either or both informants. Some were identified as manufacturing tools. They are described below (p.80) together with other useful bivalves.

Shell Abraders

Two pieces of solid shell (probably *Tridacna maxima*) in the general collection seem to have been used as grindstones or files. Nu-G/108 is a flat piece of shell 18 cm long, with a maximum width and thickness of 8.9 and 2.8 cm. It is irregular in shape but has one long straight edge unevenly ground on both sides as if it had been used as a file. Nu-G/106 is 13.5 cm long with an irregular quadrangular section and a maximum thickness of 3.1 cm. It has been shaped by the grinding of four uneven and irregular lengthwise facets. No items of this kind were found in the excavations.

Hammer Stones

Several spherical or oblong pieces of *Tridacna maxima* or coral were recovered which appear to have been used as hammer stones or pounders. Informants and ethnographic sources variously describe such items as pounders for fruit, pandanus, resin or turmeric. The appearance of some of the partially worked *Tridacna* and other shell from the excavations, however, suggests that shell was often worked by hammering or chipping as well as grinding, and that, therefore, some of these items may be industrial hammer stones rather than domestic pounders. Eilers (1934, p.245) stated that *Tridacna* shells were broken up with a wooden mallet but it is hard to see how all the chipped shell was worked in this way, especially *Terebra maculata* shells. Items which may have been hammers or pounders are discussed below, because of the uncertainty about their function.

DOMESTIC TOOLS

Coconut Grater Heads

Fifty-five pearl shell coconut grater heads or identifiable fragments were recovered from the excavations, from every location except Nu-2 and Nu-6. A single *Tridacna* grater head was recovered from Nu-2 and there are two in the general collection as well as a number of pearl shell examples.

The pearl shell grater heads are small, flat or almost flat, pieces of pearl shell, usually widest at the working edge and tapering slightly or markedly towards the butt. The grating edge is serrated into a number of comb-like teeth. Many excavated examples are incomplete, having apparently broken during use, but a sufficient sample was recovered to indicate the range in size and shape, neither of which appears, on present evidence, to have any chronological significance.

Twenty-nine specimens complete enough to measure have an average length of 4.8 cm with a maximum length of 7.7 cm and a minimum of 3.5 cm. Some taper to a point at the butt, thus having an almost triangular outline, while others taper only slightly or not at all to a flat poll. Forty-three specimens retain grating edges complete enough to measure, and on all of these it is apparent that the grating edge was the widest part of the tool. The average width is 3.5 cm, with a range from 2.3 cm to 4.7 cm. On some examples the serrated edge is almost straight while in others it is markedly convex. The convex cutting edge tends to occur on specimens which taper towards the poll. In several instances, however, examples of different shapes were found in stratigraphic association. There appears, therefore, to be no chronological significance in the variations. Some graters have finer teeth than others. Two similarly shaped specimens from the same context have 2.8 and 4.2 teeth to the cm respectively.

The single excavated *Tridacna* shell grater head, Nu-2/5, from level 2 at Nu-2, is in every respect like a *Tridacna* ventral lip adze, except for the serrated edge. It is 5.5 cm long with ten comb-like teeth on a slightly curved grating edge which measures 3.0 cm from side to side.

The two specimens in the general collection, however, differ from the varieties of *Tridacna* adze described above. In size and shape they are not unlike the spoon-shaped variety of *Tridacna* ventral lip tools. They are not, however, made from the ventral lip, and since they no longer have traces of shell exterior visible, they cannot be identified with complete certainty as being of *Tridacna,* rather than some other shell. They are probably made from a section of *Tridacna* shell perpendicular to the lip. Both have slightly curved serrated edges, although on one example the teeth have almost been worn away.

Cardium shells (probably *Vasticardium elongatum* (Bruguière)) were found in fair numbers throughout the deposits, and were identified by informants as hand graters used in preparing coconuts for invalids and old people without teeth. They should therefore be considered part of the coconut grating complex on Nukuoro. Some showed signs of wear on the edges.

Pearl shell coconut grater heads were confined to the upper levels of the excavated deposits (Fig. 18). Since they were recovered in considerable numbers from the excavations, it is reasonable to infer that their absence from the earlier deposits is due to the fact that they were not present at Nukuoro at that time, rather than to inadequate sampling. Their position in the deposits in relation to radiocarbon dates suggests that they could have appeared on Nukuoro as recently as the 18th century A.D. *Tridacna* grater heads are too rare for their chronological position to be accurately assessed. *Cardium* shells, however, occur throughout the deposits and it is likely that they were being used for grating coconuts before the appearance of the pearl shell grater heads.

Since the pearl shell grater head is one of the few artifact types which seems clearly to have appeared on Nukuoro in the middle of the archaeologically documented sequence, some discussion of its wider relationships is justified. The grater head itself cannot be discussed in isolation, without considering the stool grater with which it was normally used, although no archaeological evidence of the latter was recovered.

The distinctive stool grater with pearl shell head (later replaced by metal head) is the only form of coconut grater recorded for Nukuoro in the ethnographic literature (Kubary 1900, p.

124; Eilers 1934, p.266). Informants, however, recollected variants of both grater and head. Hainis stated that the stool grater was for men, and that there was an older form, used by women, which consisted of two legs in the front with the back resting on a log. This sounds like the standard West Polynesian tripod form, discusssed below. Carroll was subsequently shown decrepit examples similar to those from the Ellice islands consisting of a board with a raised arm, and was told that these were used by women sitting sideways.

Hainis recollected two types of grater heads, flat and curved. Soses said that pearl shell and turtle shell were preferred materials for coconut grater heads, but that they were also sometimes made in coconut shell. He considered that the *Tridacna* grater head might be an emergency measure, but rather contradicted this by suggesting that it would be stronger, but would take longer to make than a pearl shell head.

If informants' recollections are of traditional Nukuoro artifacts, rather than of styles prevalent on other islands which they may have seen or heard about, it becomes apparent that artifacts associated with coconut grating on Nukuoro were more varied than either the ethnographic account or the archaeological record indicates. In addition to the distinctive Nukuoro grating stool, both the West Polynesian tripod form and an Ellice island form (which is probably fairly widespread also in Micronesia), seem to have been present. Associated with some or all of these were grating heads in turtle shell and coconut shell in addition to the pearl shell and rare *Tridacna* shell examples documented in the archaeological record.

Once more it is apparent that the archaeological record presents only a poor sample of the total range of material culture once involved in a single activity, in this case coconut grating, and it is consequently more difficult to assess the historical relationships of that part which has survived in the archaeological record. Since the grater head is on archaeological grounds a fairly recent introduction, and the stool grater is also traditionally recent, it is tempting to assume a single introduction of the two together. Direct archaeological evidence to support this is lacking, however. The appearance of the pearl shell grater head could also be related to a sudden favourable fluctuation in the availability of pearl shell, which would be possible ecologically, but the distribution of other pearl shell items in the archaeological deposits hardly supports this.

The distribution of various types of coconut grater in Polynesia is fairly well documented in the ethnological record. A low stool grater is reported from the Tokelau Group (Macgregor 1937, p.146) where it was used with a white fan-shaped shell for a head. There is some belief among modern Tokelauans that the stool is a relatively recent introduction from Samoa and that the older form was a leaning stick, or natural tripod (Huntsman pers. comm.) The stool grater is most unlikely to have been introduced from Samoa, but could well have been diffused recently from some other source.

Throughout the rest of West Polynesia both stool graters and pearl shell heads were apparently unknown. In Samoa the coconut grater consisted of a natural tripod stand with a head of coconut shell or stone (Buck 1930, pp.24-25); in Futuna a coconut shell head on a stick or natural tripod stand (Burrows 1936, p.135); in Uvea a serrated piece of wood, or a coconut shell head on a stick (Burrows 1937, p.97). In the Ellice Islands the head was apparently made from a *Lambis* shell, or similar (Koch 1961, p.75), and was not unlike the *Cassis-Conus* category of shell adze. According to Hedley, in Funafuti the shell head was mounted on a simple stand (Hedley 1897, p.262 and plate 14; see also Edge-Partington 1898, plate 49). A specimen in the Otago Museum, D30.1258, from Vaitupu, is a simple low stool, similar to modern Tokelau specimens. It is made with metal tools, however, and may, like the Tokelauan stools, be a modern introduction. It is possible of course, that more intensive enquiry at a time before the traditional forms had given way to the wooden box with an arm to which a metal head is attached, might have revealed greater diversity. On present evidence, however, it appears that a simple stool grater, possibly recent, was present in Tokelau and possibly Ellice, and shell grater heads of any kind were present only in Tokelau and Ellice. Samoa, Futuna and Uvea, of course, do not participate in shell technology to any extent.

The ethnographic evidence on coconut graters in Polynesia has been summarised by Buck (1944, table 4, p.415) as follows:

no graters	New Zealand and Easter (no coconuts)
marine shell hand grater	Hawaii, Tongareva (alternate)
serrated pearl shell hand grater	Mangareva, Manihiki-Rakahanga, Tongareva
tripod grater	Samoa, Tonga, Mangaia, Tuamotu
stool grater	Cook, Society, Austral.

Buck believed the stool grater to be an East Polynesian invention, probably originating in the Society Islands, which diffused at a fairly late stage through central East Polynesia.

Linton also reported a stool grater with shell head for the Marquesas (1923, p.352) but his description does not indicate the exact form that this took. Pearl shell grater heads were found by Suggs in all periods of his Marquesan sequence (1961, p.104) and he inferred that they had been attached to stool graters. His description, however, indicates that they were of the so-called "shoe-horn" type, more often used as hand graters in East Polynesia. Similar specimens have been found rarely in archaeological contexts in the Society Islands (Green *et al.* 1967, p. 196) and Mangareva (Green pers. com.). It is important to emphasise that none of the Nukuoro specimens is of the shoe-horn type.

The form of grater reported by Hedley for the Ellice Islands was apparently present also in the Gilbert Islands (specimen in the Auckland Museum), the Marshall Islands, where it had a curved pearl shell head (Krämer & Nevermann 1938, p.130), and at least some of the Eastern Carolines. Eilers (1934, p.392) illustrates a modern example from Mokil with a metal head. This type of grater is also reported for some of the small islands off the north coast of New Guinea (Cranstone 1961, plate 21a; Hambruch 1908, plate X) which are supposed to be Micronesian in their material culture. In many of these examples the actual grater head was probably a natural shell, similar to the *Vasticardium elongatum* shell used as a hand grater on Nukuoro. Le Bar (1964, p.18) reports half a small *Tridacna* shell attached to a stool as the old form of coconut grater used in Truk, and Krämer illustrated stools used there for grating coconut and other foods (1932, p.126, Fig. 98).

Pearl shell grater heads seem to have occurred on islands where pearl shell was easily accessible. A pearl shell grater, which may have been a hand grater, is reported from Nukulaelae in the Ellice Islands (Edge-Partington 1898, p.49, no.9) emphasising possible differences between islands in this group. On Nauru pearl shell grater heads were used on a tripod grater (Hambruch 1915 (II), p.66).

Many varieties of coconut grater are known from Melanesia and would require a more thorough survey than has been attempted here. Shell hand graters (serrated) and spoons (unserrated) of the shoe-horn type are wide-spread in the Solomon Islands, and flatter, serrated edge, pearl shell grater heads are also not unknown. Serrated edge graters of both pearl shell and *Tridacna* are reported from New Britain, the former, at least, attached to some form of stool or stand (Schmeltz & Krause 1881, p.73). Similarly, in the Admiralty Islands, pearl shell grater heads very similar to those from Nukuoro were attached to fairly elaborate stool graters (Nevermann 1934, pp.192-3). In Northern Melanesia there is, moreover, quite a range of stool graters, even if none identical to the Nukuoro stool. From the St Matthias Group, for example, several forms of grater typical also of Polynesia are reported, particularly the simple stick propped up, the natural tripod, and a four-legged stool, all used with *Cardium* shell heads (Nevermann 1933, pp.103-104). Stool graters with *Cardium* shell heads are also reported from some of the Polynesian outliers in the Northern Solomons, in particular Luangiua and Takuu (Sarfert & Damm 1929, p.109). Tikopia apparently had stools similar to those from Takuu on which pearl shell heads may have been used. There is in addition the wide range of Melanesian stools and head rests, some of which may be related to coconut grating stools (cf. Birket-Smith 1956, p.171). Finally, more like the Nukuoro grating stool than any of the other Melanesian specimens referred to previously, is a stool grater attributed to Rotuma in the Fiji Museum.

Although stool graters certainly existed on some of the Polynesian outliers they seem to have been lacking in others. Only hand graters of pearl shell or turtle bone, without serrated edges, are reported from Rennell, and a natural shell on a stick for preparing coconut shell cups (Birket-Smith 1956, pp.81-82). On Kapingamarangi, the tripod grater stand was used, usually with a shell (probably *Vasticardium* or similar) but sometimes with a head made of *Tridacna* or of another shell known as *tukima* (? *Hippopus*) that was also used for adzes (Buck 1950, pp.24-25, 165). The *Cardium* shells were also used as hand graters.

The earlier form of Nukuoro coconut grater may have been like those of Kapingamarangi, probably the natural tripod with a *Cardium* shell head and possibly also perishable heads, and an occasional *Tridacna* or other shell head. The Ellice Islands or Micronesian type of board stand grater with similar head may also have been present. While the subsequent introduction of pearl shell grater heads is archaeologically documented and the introduction of the stool grater seems

a reasonable inference it is very difficult to name a source or sources for these introductions. Neither West Polynesia nor East Micronesia seem likely sources unless the Trukese and Nukuoro stools are related, but both stool graters and pearl shell heads have been shown to occur sporadically from East Polynesia through the central Pacific to Northern Melanesia.

The presence of one or the other in various of the other Polynesian outliers again raises the problem of whether the outliers, or some of them, share a common "outlier technology" within the restrictions imposed by varying resources, or whether they have severally borrowed from their neighbours, or indeed, separately received immigrants from remote parts of East Polynesia. Such questions may never be solved by archaeological research, in view of the poor rate of recovery in vital areas of technology.

It is certain that on Nukuoro pearl shell grater heads were used on a stool grater in early historic times, and that the use of pearl shell grater heads, probably on some kind of stand or stool grater, extended for a relatively short time back into the prehistoric past. At an earlier time such grater heads were not used, and the only durable item in the deposits which would have been suitable for the same purpose were *Vasticardium* shells, used for this purpose in neighbouring islands. No more can be inferred from the archaeological evidence.

A review of ethnographic literature on the subject has shown that in addition to durable and recognisable grater heads of pearl shell, *Tridacna* shell, or other worked shells, the following were used in various islands: unmodified shells (which would, however, normally show use marks), turtle shell heads, coconut shell heads, wooden heads, stone heads, coral heads. Any or all of these could be attached to sticks, natural tripods, a wide range of stools, or simply used by hand. In the face of such a mass of unrecoverable evidence, the archaeologist can only review the possibilities and interpret his small sample of material with caution.

Spoons and Scrapers

Various kinds of pearl shell scraper are reported in the ethnographic literature. Kubary (1900, p.106) mentioned the use of pearl shell knives for cutting the umbilical cord. Both he and Eilers referred to pearl shell scrapers being used for scraping fibres (Kubary 1900, p.121; Eilers 1934, p.250). Eilers also listed pearl shell spoons used in food preparation and eating (1934, p.265). Among the large quantities of worked pearl shell recovered in various sites, are many pieces large enough to have been used for these purposes. They exhibit no standard shape, however, and it is impossible to distinguish actual tools from manufacturing waste or stages in the manufacture of fishhooks. The pieces likely to have been used as scrapers or spoons include both sections of the shell with a portion of the hinge at one end or corner (not unlike examples figured by Eilers 1934, Fig. 135, but smaller), and flat pieces of shell of various shapes without any trace of the hinge area. These are further discussed below.

Two small artifacts of unknown use are probably associated in some way with the preparation or eating of food. Nu-1/192, from layer 2, square G-9, Nu-1, is a carefully worked, laterally curved, spatula like piece of shell 7 cm long with a maximum width of 2 cm. It tapers from a wider rounded end to a blunt point at the other end. Soses suggested that it might have been a scraper for pandanus. Nu-G/51 is somewhat similar, but shorter and wider, and made from a more solid piece of shell. It is 5.7 cm long and 3.2 cm wide. The wide end is curved and although it is only chipped and not ground, forms a blunt functional edge. The other end tapers irregularly. This item was first classed as a roughout for a very small adze but it seems more likely to have been a spoon or scraper of some kind.

Apart from the *Vasticardium elongatum* shells, discussed separately above under coconut graters, only one kind of bivalve was identified by Soses as a domestic tool. This was *Asaphis violascens* (Forscal) used for scraping charred breadfruit.

Shell Containers

A water worn piece of a *Cassis* (?) shell was found in level 13, Nu-8. It consists of a hemispherical piece of outer body whorl, rather like a small bowl, and may have been used as a container. Kubary mentioned that coconut oil was kept in hanging *Strombus* shells (1900, p.110) and the use of *Cassis* shell containers is documented elsewhere in the Carolines (Edge-Partington 1898, p.51, no.1). It is also possible that some of the numerous complete *Tridacna*

maxima shells found in the excavations were containers or dishes, rather than raw material awaiting use. A *Tridacna maxima* shell, which had been carefully ground to form a bowl with a flat base, was given to Carroll.

Pounders

No well finished pestles of the kind described by Eilers (1934, p.248) were found in the excavations. There is, however, one in the general collection which measures 7.5 cm in length and has a maximum diameter of 4.0 cm. A larger pounder, Nu-G/96, is somewhat differently shaped, but still well made. It is 13.0 cm long and expands towards the base. The maximum width (at the base) is 7.2 cm, and minimum width (at the poll) 4.0 cm. The pounder has a rounded rectangular section, with a maximum thickness of 4.4 cm. The base is convex. This pounder had clearly been made from *Tridacna maxima* as there are faint traces of shell exterior in the carefully ground surfaces.

The apparent absence from Nukuoro, ethnographically and archaeologically, of the distinctively shaped "poi pounder" shared by East Polynesia (Garanger 1967) and many Micronesian islands (e.g. Sarfert 1919, p.125, Fig. 33a-b) suggests the interesting possibility that this artifact is a late introduction to the latter area. If this kind of pounder had been part of the equipment of the Micronesians who undoubtedly contributed some elements to the material culture of Nukuoro, it is hard to understand why it was not adopted on Nukuoro, which shares similar methods of taro cultivation with atolls such as Pingelap where pounders occurred. The pounders are widely distributed on high and low islands in the Carolines (e.g. Sarfert 1919, p.125, Fig. 33a-b; Krämer 1932, p.125, Fig. 94; Eilers 1934, Figs. 233, 286). However, the wooden pounders illustrated by Eilers may be the only trace of this artifact on Nukuoro (Eilers 1934, Figs. 168-170). Today on Nukuoro food is mashed rather than pounded in wooden bowls with wooden pounders, and it is said that coral pounders would be too heavy (Carroll, pers. comm.). This in itself indicates interesting differences in food preparation between Nukuoro and those islands where heavier pounders, in more durable material, occur.

Turtle Bone Adzes

Worked pieces of turtle carapace were fairly widely distributed in the deposits. In most cases these were fragmentary, but a number of examples were recovered on which a partial or complete bevelled cutting edge was present. The two most complete examples were from layer 7 in square G-9, Nu-1 and layer 9, Nu-4. Nu-1/130 has a cutting edge of 3.65 cm and a length of 8.15 cm. It is rectangular in outline. Nu-4/19/1 has a cutting edge of 4.6 cm and its present length is 7.4 cm, although it may originally have been longer. Both specimens were associated with smaller fragments, some with a bevelled edge and others unbevelled, but similarly worked. Two other pieces from level 10 at Nu-5 and level 9 at Nu-8 had complete cutting edges measuring 3.25 cm and 2.7 cm respectively. Both had broken near the cutting edge and their length could not be measured.

Thirteen small fragments of turtle bone blades with bevelled edges were also found in Nu-1, Nu-4, and Nu-8. In Tables 1 - 8 they are listed together with more complete specimens, as turtle bone adzes. Thirty-two other worked pieces of turtle bone were also found, mostly in Nu-1, Nu-4, and Nu-8. They were probably designed for similar blades. One broken rectangular piece, Nu-8/51, has a perforation in the centre of one end.

From the existing fragments its appears that on Nukuoro, bevelled edge tools of turtle bone were fairly small. This may be because turtles were rare (Kubary 1900, p.129).

Informants suggested that turtle bone tools were used for dividing taro, a use similar to that reported by Kubary (1900, p.130).

Rectangular shaped, bevelled edge tools of turtle bone occur very widely in the Pacific. Edge-Partington figures examples from Fiji (1895, p.59, no. 7), the Gilbert Islands (1895, p. 94), New Guinea (1895, pp. 185, 189), Hawaii (1898, p. 11) and the Reef Islands (1898, p. 65) and refers to other examples from the Ellice Islands and Niue (1895, p. 94). Some of these were hafted as axes or adzes and variously used, sometimes for taro or yams as in Nukuoro, sometimes as hoes; others are described as "scrapers".

Such tools were known in the Ellice Islands and were sometimes perforated for lashing to a handle (Hedley 1897, p. 252). On the other hand Kennedy illustrates some pieces of flat rectangular bone, perforated at one end, from Vaitupu, and describes them as porpoise bone ornaments known as *tui pungapunga* (1931, Fig. 134). These have a strong resemblance to the perforated piece from Nu-8, mentioned above. It is impossible to tell whether this incomplete piece was part of a tool or an ornament.

Long Bone Poles

Four fragments which fitted together to make part of a substantial bone pole were found in Nu-3. Three were in level 1 and one in level 2 of square 2, demonstrating the arbitrary nature of the two levels in this shallow deposit. The four pieces together totalled 37 cm in length, but the pole was still incomplete, with pieces missing at each end. The pole appeared to be made of whale bone, and had a plano-convex cross-section, approximately 4 cm wide and 1.7 cm thick. This artifact was identified by informants as a "wooden spoon" used in preparing food. A beautifully made bone implement, given to Carroll, was said to be for husking coconuts.

Several bone fragments were recovered from Nu-1 which may have belonged to similar, but smaller artifacts. Two fragments from layer 5, square E-5, fitted together to form a slightly tapered shaft, 15 cm long, with a roughly rectangular cross-section 2.5 x 1 cm. Both ends were broken. A small fragment from layer 5, square G-9, is 5.4 cm long with width and thickness of 1.8 and .6 cm.

Coral Rasps and Other Large Coral Items

A substantial piece of hard coral with a rough surface from level 7 in Nu-8 was identified by women watching the progress of the excavation, as the kind of coral used for grating taro to make poi. Kubary refers to coral used in preparing turmeric (1900, p. 100). Eilers mentions crude coral stones used for rasping fruits (1934, p. 267) and a similar use of coral seems to have been wide-spread (e.g. Le Bar 1964, p. 18. Another unusual piece of coral from layer 1 in square G-9, Nu-1, was initially regarded as similar. Its unwieldy shape, however, and coarser surface suggest that it is more likely to have served as a natural anchor stone. A large piece of coral from an upper layer of Nu-5 was found to have a "cup-mark" depression in its surface, for which no explanation was offered by informants.

Needles

A large well made bone needle was found in level 3, Nu-8. It is 11.3 cm long, tapering at both ends, with a maximum width and thickness of .7 and .3 cm. The perforation, .3 cm in diameter, is 1.5 cm from the end. The size of this specimen suggests it was probably a thatching needle. A much smaller needle, apparently made from a fish spine, was found in layer 5, square G-9, Nu-1. It is 4.85 cm long, with a width and thickness of .35 cm. There is a tiny perforation .9 cm from one end. A somewhat similar example from level 3, Nu-6 had broken at the perforation. From perforation to tip it is 3.9 cm long, .35 cm wide and .2 cm thick. Another incomplete specimen, also broken at the perforation, came from layer 8, Nu-4. It measures only 2.1 cm from the perforation to the end, and is .5 cm wide and .2 cm thick. The existing end is not pointed, so this is almost certainly the butt end of a needle of similar size to the complete example from Nu-8.

One bone point from level 14 in Nu-8 is probably the point of a needle. It measures 2.8 cm from tip to break. A number of small pieces of worked bone, possibly central sections of needles, are described in the section on worked bone, as their identification is uncertain.

Eilers (1934, p. 249) describes bone needles from Nukuoro, although Kubary does not. The archaeologocial specimens are smaller, and as far as can be determined, better made than the examples given by Eilers. No awls were found. The examples described above are all proper needles.

Bone needles are well known from archaeological contexts in Polynesia, and will no doubt be found to be widely distributed.

Other Bone Artifacts

Several fragments of carefully worked bone artifacts deserve individual description, although the function of the artifacts is often in doubt. Evidence of bone working was found in small quantities throughout the deposits, with surprising amounts in early levels, as well as late. Neither Eilers nor Kubary makes much mention of bone artifacts, but there is no doubt that the working of small bone artifacts was practised with some skill throughout the time span represented by the archaeological sequence on Nukuoro.

A broken bone bobbin was found in layer 5, square E-5, Nu-1. It is a slender elliptical-sectioned shaft of bone dividing into two prongs at either end. The ends of the prongs have all snapped off close to the two divisions. The existing piece measures 8.2 cm in length. The item may have been a bobbin used in the manufacture or repair of fishing nets or lines.

A small piece of worked bone from layer 1 in square E-5 may have had a similar function. It is one end of a longitudinally straight, laterally curved piece of bone, probably from the shaft of a large bird bone. One end is broken, the other has been carefully cut straight across the bone, and two V-shaped notches cut in from the end.

Very thin flat pieces of carefully worked bone were found in layers 2 and 4 of square E-5. From layer 2 came a flat piece 3.8 cm long with a width of 1.4 cm at the break, tapering to a rounded point at the other end. A similar flat thin piece of bone from layer 4 appeared to be a broken corner of a bone plate of triangular or trapezoidal shape.

Three fragments from Nu-8 all seem to belong to thin flat shafts of bone with one or more perforations. Two pieces came from level 4. One is not unlike the end of a large needle, with a rounded end and a substantial perforation, but it has broken at a second perforation 2.3 cm from the end. The second piece merely consists of a small piece of bone with two closely adjacent perforations. It has broken across both perforations. A third fragment, from level 13 in Nu-8, consists of a small piece of tapering shaft with a broken perforation at one end and another break at the other end.

All the items described above appear to be broken pieces of finished, carefully made artifacts, in contrast to the various bits of worked bone described below. With the exception of the bobbin it is impossible to identify them. Some could be parts of needles; the two from level 4 in Nu-8 could well be ornament units, similar to shell strand separators described from Ponape.

ARTIFACTS OF UNCERTAIN FUNCTION

Coral Disks

Three round coral disks were found in the excavations, all in fairly recent contexts. They resemble bowling stones or pitching disks reported ethnographically from many parts of Polynesia and some other areas. All three are circular with slightly convex opposing sides and a flattened area around the circumference.

Nu-1/260, from layer 5, square E-5, Nu-1, has a maximum diameter of 5.3 cm, and a maximum thickness of 2.8 cm. The thickness of the perimeter varies from 2.7 to 2.2 cm. The disk is made of a fine white coral.

Nu-6/1, from level 1 of Nu-6 has a diameter of 7.7 cm and maximum thickness of 2.1 cm. The sides vary in thickness from 1.0 to 1.6 cm. It is thus wider and thinner than the example from Nu-1.

A third example, Nu-4/15, from layer 9 at Nu-4, has a diameter of 7.4 cm, maximum thickness of 2.4 cm, and thickness at the side of from 1.6 to 2.0 cm.

Neither Hainis nor Soses could identify these objects. A younger man named Anton, however, suggested that they were used in a game. In former times, he had been told, people would gather on a sandy beach at one of the other *modu* and compete in casting these disks along the

hard damp strand. Even without this information, the similarity of the disks to the Hawaiian *'ulumaika* and related forms from the rest of Polynesia would have suggested a similar function.

Poulsen found stone disks in his Tongan excavations which he interpreted as bowling stones similar to the Hawaiian *'ulumaika*. He briefly reviewed the known distribution of similar items in Polynesia, including archaeological examples from Tahiti, Easter Island and New Zealand, and suggested a similar identification for disks from archaeological contexts in the New Hebrides (1967 (I) pp. 275-276). In at least two areas of Polynesia such disks were sometimes made of coral, namely Samoa (Buck 1930, p. 565) and Vaitupu (Kennedy 1931, Fig. 145). The specimens from Vaitupu seem very similar to the Nukuoro examples.

The distribution of bowling stones and pitching disks is complicated by the fact that in some areas they were made of unripe breadfruit, or *kape* (*Alocasia* sp.) or wood. In one form or another, however, the game seems to have been widely known, and may eventually prove to be part of an old Oceanic tradition.

A surface find from Nukuoro is a similar disk made in *Tridacna* shell (M. Hill pers. comm.). This suggests that shell disks from Yap (Gifford & Gifford 1959, p. 191) may also be related, in which case the distribution is a wide one indeed.

Perforated Shark Teeth

Perforated shark teeth were found at various levels in Nu-1, Nu-4, Nu-5 and Nu-8. All have a single perforation and a few have a worn edge or point. They were not present in the earliest deposits, but their absence there could well be due to chance. Kubary records the use of shark teeth for drill points, and for cutting out turtle shell arm rings (1900, pp. 115, 130). The latter use is reported from Truk (Le Bar 1964, pp. 161-162) and was doubtless a common method of cutting turtle shell.

Both Hainis and Soses, however, suggested that shark teeth were used in small knives or weapons. Hainis described a shaft 15 cm long about as thick as a man's finger into which shark teeth were slotted, while Soses said that the teeth would be slung together to make, in effect, a knuckle-duster.

The nature of weapons, if any, on Nukuoro is doubtful. Kubary reported a complete absence of weapons (1900, p. 90). An early description of the use of weapons on Nukuoro by Morrell (quoted by Eilers 1934, pp. 164, 274) appears quite unreliable. The archaeological evidence can contribute no information on this point beyond the undoubted presence of perforated shark teeth which may have been used in weapons.

Shark teeth weapons of various kinds are particularly known from the Gilbert Islands (Edge-Partington 1890, p. 171; Finsch 1893, p. 360), although they have a wider distribution including Hawaii in Polynesia (Buck 1957, pp. 443-455), and Palau at the western edge of Micronesia (Kubary 1895, p. 156, plate XXII, Fig. 8). A knuckle-duster very similar to that described by Soses was an indispensable piece of equipment in Truk (Le Bar 1964, p. 179), and the use of shark teeth in weapons is also reported for Kapingamarangi (Buck 1950, p. 279). Since the wooden shark hook on Nukuoro is attributed to Gilbertese contacts it would hardly be surprising to find a form of Gilbertese weapon also present. There are, however, so many possible uses for perforated shark teeth, including surgical instruments in the Ellice Islands (Hedley 1897, p. 300), that it is impossible to be certain which were known on Nukuoro. Ethnographic evidence and statements by informants suggest a range of uses similar to that reported for Truk as most likely.

Hammers and Pounders

Several artifacts which seem to be hammers or pounders were found. The only carefully shaped pestles are the two in the general collection described above.

Also in the general collection are two roughly round pieces of shell or limestone with maximum diameters of 7.5 and 7.9 cm. They appear to have been deliberately shaped, but clear evidence of bruising is not obvious on their naturally pock-marked surfaces. Five similar items

were found in excavations, three from Nu-1, one from an uncertain context in the upper part of Nu-4, and one from Nu-8. The specimen from G-9 is somewhat egg-shaped, but the remainder are roughly spherical. The specimen from Nu-8 is clearly of *Tridacna*. The material in which the remaining four are made, however, is doubtful.

Four deliberately shaped elongated pieces of *Tridacna* or other large shell, three from Nu-1 and one from Nu-5, may have been intended as pounders. They are straight-sided and flat-ended with either round or rectangular cross-sections.

A solid piece from close to the hinge of a large shell, probably *Tridacna maxima* has an area of pecking or bruising on the convex inside surface. It may have been used either as a hammer or as an anvil, but has certainly been used for hammering shell or other hard material. It was found in layer 4 of square E-5. Similar pieces of *Tridacna maxima* were not uncommon in the excavations, but no others had this kind of wear.

One other item, from Nu-4, was apparently also from the central portion of a *Tridacna maxima*, but had been worked to a roughly circular shape and the inside surface ground flat.

It is not clear what any of these items were used for. The two shaped pounders described in the preceding section seem certainly to have been used for fruit, pandanus, resin or turmeric if the ethnographic evidence is accepted. The elongated examples from excavations may have been similarly used, or they may have been blanks in process of manufacture into finished small pounders or other artifacts. If hard hammer stones were used at all in the preparation of *Tridacna* and other shell artifacts, the round artifacts described above could have fulfilled this purpose.

One other round artifact of unknown use was found in Nu-8. It is a well rounded ball, of similar dimensions to the possible hammer stones described above, but made of a softer kind of coral, similar to that used for grindstones and seems most unlikely to have been suitable for hammers. Similarly shaped balls are used in some islands (eg. Samoa) as mat weights.

Useful Bivalves

Several kinds of bivalves were found with signs of wear on their edges, indicating use. Informants were questioned about these and confidently assigned functions to them. The most numerous were *Vasticardium elongatum* shells, said to have been used as spoons, and for preparing coconut for invalids. These have been discussed in the section on coconut graters. Apparently unmodified shells of this species were also common in the deposits.

The only other shell to which a domestic rather than an industrial use was assigned was *Asaphis violascens,* said to have been used for scraping charred breadfruit. Examples were found in level 12, Nu-4, and in levels 3, 7, 8, 10 and 11, Nu-8.

Shells of *Codakia tigerina* (Linnaeus) were said to be used for cutting string. Specimens with worn edges were found in layer 1, square G-9 and layer 5, square E-5, Nu-1; in levels 3 and 5 of square 1 and level 1 of square 2, Nu-3; and in level 7, Nu-8. One of the specimens from Nu-1 was perforated near the hinge as well as having a worn edge, while another example showed signs of working on one edge as if to make a pointed tool similar to that described above under drill points.

Two kinds of shell were said to have been used for working fishhooks. *Scutarcopagia scobinata* (Linnaeus) has a rough sandpaper-like exterior which would be suitable for use as an abrader, and the two examples found, in Nu-1 and Nu-5, showed clear signs of having been so used. The usefulness of a number of shells of *Cyclotellina discus* (Gmelin) for fishhook manufacture is less apparent, but this was the interpretation offered by Soses for these shells. Examples with chipped and worn edges were found in Nu-1, Nu-3, and levels 7 and 11 of Nu-8.

One example of *Pitar obliquatum* (Hanley) with a used edge was found in level 3, Nu-8. Informants were not asked about it.

Only shells with clear evidence of use on the edges (or in the case of *Scutarcopagia scobinata* on the exterior surface) were collected. It is probable that other examples of these species and perhaps other bivalves, were also used as various kinds of scrapers. Careful examination of the used edges, and experiments with fresh shells and suitable raw materials might lend support to, or cast doubt on, the interpretations offered by informants.

RAW MATERIAL AND MANUFACTURING WASTE

Throughout the deposits were found pieces of bone and shell showing signs of working. This corpus of material sheds little light on artifactual styles, but is of great assistance in providing some information about manufacturing processes, and about the parts of shell and kinds of bone that were being used. It also shows clearly that a good deal of manufacturing activity was concentrated at specialised *hada* sites, and only a small amount, probably mostly repairing and finishing, took place at the other sites.

Worked Bone Fragments

A number of small pieces of worked bone seem to be rejected pieces rather than broken artifacts. These include several pieces that may be human or dog bone from early levels in Nu-4 and Nu-5 and turtle and other bone from more recent levels in Nu-1, Nu-5 and Nu-8. A curiosity from Nu-3 is a piece of bone identified by Hainis as part of a large fish named *balagia,* which had been carefully filed on several surfaces. Hainis said it was of no use.

There were also a number of small worked bone fragments which may have been parts of needles. These were found particularly in Nu-4 and Nu-5, with a few pieces from Nu-1 and Nu-7.

Pearl Shell *(baa)*

Quantities of worked pearl shell were found throughout Nu-1, and there were much smaller amounts in most levels of the other sites. The consistent occurrence of pearl shell throughout the sequence tends to suggest that the Nukuoro were not troubled with fluctuations in its availability. Indeed the development of fishhooks and perhaps also of coconut grater heads can be attributed to its abundance as a suitable material. In the constant availability of pearl shell Nukuoro stands in marked contrast to other islands in the Eastern Carolines.

The worked pearl shell caused problems in its excavation and analysis because of its quantity, its fragile nature, and the difficulty of distinguishing finished artifacts, worked fragments and unworked broken pieces. The approximate numbers of pieces of worked shell in each layer or level of each site are given in Tables 1 - 8.

An attempt was made to divide the worked pearl shell from Nu-1 into recognisable fishhook tabs, drilled tabs, probable knives with and without hinge area, large portions of shell in process of subdivision and remaining pieces. There were 152 drilled tabs, 103 in G-9 (of which more than half were in layer 8) and 49 in E-5. The distribution of these by layer parallelled the numbers of fishhooks. On the other hand there were far fewer recognisable fishhook tabs on which the outside of the hook had been shaped. Probably many of the "remainder" category, however, were also intended for fishhook tabs. Eighty-eight pieces of pearl shell were set aside as possible knives or scrapers, 47 from G-9 and 41 from E-5. Some of these are probably unfinished coconut grater heads. A further 16, (8 from each square), with a portion of the hinge remaining, could also have been scrapers. These possible scrapers cover a considerable range of shapes — elongated rectangular, trapezoidal, rectangular, square, and a modified sickle shape (straight on one side, convex on the other), and grade off into smaller rectangular tabs at one end of their size range. They are distributed throughout the deposits, and tend to follow the general tendency of greater concentration in upper layers. Only a few large pieces of pearl shell in the process of subdivision were found. Several whole but unmodified shells are mentioned below.

The great bulk of the pearl shell consisted of small cut pieces in a variety of shapes. These occurred in all layers at Nu-1 except layers 1 and 9 of square G-9. They included small square tabs, small elongated rectangular tabs, trapezoidal tabs, and quite a number of small pieces of hinge carefully cut off, as if to obtain the maximum possible amount of flat shell for further use.

It was obvious that shells were first divided into long strips which in turn were subdivided into rectangles. During this process a considerable wastage occurred. Once rectangles were converted into fishhook tabs, however, the manufacturing process was usually completed unless the tab broke during drilling.

Most of the pearl shell in other sites consisted of small cut fragments. All the pearl shell in Nu-2, Nu-6 and Nu-7 was of this kind. Drilled tabs were found only in level 2, square 1, Nu-3; layers 7 and 9, Nu-4; level 1, Nu-5; and levels 6 and 7, Nu-8. Other interesting pearl shell items included possible scrapers from levels 1 and 2, square 1, Nu-3; layer 9, Nu-4 (four possible scrapers occurred in level 5); level 6, Nu-5; and level 7, Nu-8, where there were two large pieces with parts of the hinge present as well as several smaller, but well made, tabs. Finally, a substantial portion of a shell in level 5, Nu-3, was in the process of subdivision by sawing to a shape similar to the pearl shell scrapers figured by Eilers.

A remarkable feature of the distribution of pearl shell was its absence from much of Nu-8 which was otherwise rich in artifacts. There was less pearl shell in Nu-8 than in Nu-4 and Nu-5 which were generally less productive of artifacts.

Tridacna maxima (*baasua*)

The majority of worked *Tridacna maxima* came from square E-5 and the well shaft, Nu-1. In contrast to the pearl shell most of this has the appearance of raw material waiting to be used, rather than industrial waste. There were also, however, numbers of whole, fairly small *Tridacna maxima* shells in and around Nu-3, and in upper layers of Nu-8.

Pieces of *Tridacna maxima* were divided into several different groups. Firstly there were several whole or nearly complete shells, with traces of working. Whole shells with slight traces of grinding on the outside centre were found in layer 2, G-9, Nu-1, and level 1, Nu-6. Both of these, and particularly the latter, may have been intended as containers and filed so they would rest on a flat base. Substantial pieces of medium-sized shells with the edges removed were found in level 4, Nu-7, and level 3, Nu-8. In the former the edge of the shell had been removed by hammering, in the latter by grinding. Three *Tridacna maxima* shells with perforations in their centre were found in the well shaft at Nu-1, along with 9 complete shells and a number of broken pieces.

Six central cores of *Tridacna maxima* were found in E-5, Nu-1, from layers, 2, 4, 5 and 6. There was also one in Nu-3. These all consisted of the thick portion (10 cm or more thick) in the centre of the shell, just inside the hinge. Informants said these were raw material stockpiled for use when required. Slightly different, were hinge portions of smaller shells on which a start had been made in removing the rough shell exterior. Two pieces were found in E-5, Nu-1, and one in Nu-5. Fourteen other quite thick pieces of *Tridacna maxima,* in various stages of working, were found in E-5, Nu-1, again well distributed through the different layers. On all of them pieces of shell exterior were still visible, and there was little indication as to what final artifact was intended. There were two similar pieces from Nu-4 and one from Nu-5, all from fairly recent contexts. Some much smaller pieces of *Tridacna maxima,* with the rough shell surface removed, from Nu-1, levels 8 and 9, Nu-4, and level 2, Nu-5, may have been raw material for much smaller artifacts such as beads or shell rings.

Finally, there were a few pieces of ventral lip, or outer edge. The majority were from layer 1 in both squares of Nu-1 and could have been naturally deposited. There were, however, one fragment from layer 4, G-9, one from a higher level in E-5, one from Nu-2 and two from Nu-4. All of these seem to be waste products. A single piece from Nu-8 (level 4) has been cut or broken at right angles to the edge of the shell. There is no indication what it might be used for, but it is matched by several pieces in the general collection.

A survey of the partially worked *Tridacna maxima* leaves little doubt that the working of this material, too, was concentrated at *hada* sites. The concentration of material in square E-5 and the well shaft at Nu-1 suggests that, for at least part of the time Nu-1 was occupied as a *hada,* the actual building stood back in the vicinity of square G-9, enabling certain activities to be carried out in front of it in the area of E-5. The alternative is a strict division of activity within the building. It is unfortunate that so little information survives about the construction of *hada* with their raised floors.

A very striking contrast is provided by the abundance of worked *Tridacna maxima* in the seaward part of Nu-1, and its almost complete absence at Nu-8, which actually yielded more finished adzes than square E-5 at Nu-1. This makes it clear that adzes were probably mostly made at *hada* sites, but could be used in domestic settings as well as in the bush.

Other Shells

Apart from a few worked fragments of unidentified shell, the only other shell to show evidence of working was *Spondylus*. Partially worked shells, or fragments thereof, were found in layers 1 and 8 in square G-9, Nu-1, in the fill of the retaining wall in square E-5, and in the well shaft. There were also three very large, but apparently unworked *Spondylus* shells from the well shaft. As the main use of *Spondylus* was for ornaments, there is thus a suggestion that the rough working of these too, took place at the *hada* site.

A small pecten shell with a rough perforation was found in layer 9, Nu-4. This may, however, be natural.

EUROPEAN ARTIFACTS

No items in materials of European origin were found in Nu-2, Nu-3, Nu-5 and Nu-6. The latter three are in areas not inhabited at present, and it is likely that they have been uninhabited for most or all of the post-European period. The vicinity of Nu-2 has only very recently been re-occupied. It is hardly surprising, therefore, that European items were lacking at these places.

A single tiny fragment of metal was found in level 2, Nu-7. Otherwise European items were lacking at this site also.

More surprising is the lack of recent European items at Nu-4. The hard compacted white coral gravel of layer 10 has evidently remained at its present level with little or no recent accumulation, while the occupants of adjacent houses have not been dropping small items in this particular place. The only European item from this excavation was a tiny piece of clay pipe stem from the top of layer 9.

By contrast a reasonable quantity of European material was found in layer 9 of square G-9 at Nu-1. There was, however, no European material from the sloping upper layer of E-5. Layer 9, G-9, included a number of small pieces of metal, glass and china of recent origin. There were also two pieces of clay pipe, a stem fragment and a bowl fragment, a metal fishhook and a nail which showed some signs of working. The fishhook is obviously a copy in metal of a traditional Nukuoro hook, and can be matched by examples in a set of metal hooks owned by Soses which have been described in more detail elsewhere (Davidson 1967).

The largest amount of European material came from the top layer of Nu-8, as was perhaps to be expected in the most densely settled part of the modern village. Level 1 of Nu-8 yielded a plastic spoon, three buttons, broken teeth from at least two combs, rubber letters MMNO from a do-it-yourself rubber stamp set, fragments of china, green and clear glass, plastic, metal, and a Japanese coin, identified as 1 sen dated Taisho 11, 1922 (Y. H. Sinoto pers. comm.). Level 2 produced three buttons (one pearl), a few fragments of china and glass, a copper thumb tack and some rusty nails, as well as traditional artifacts. There was also a piece of brick or concrete between levels 1 and 2.

Nu-1, Nu-4, and Nu-8 are all in central parts of a village which has been continuously inhabited from the time of first contact with Europeans until the present day. The technology of the 20th century, however, is poorly represented in the deposits.

SUMMARY

If the excavated assemblage from Nukuoro is compared with the durable items of material culture described in the ethnographic record, it is apparent that almost the entire range reported by earlier writers was found in archaeological contexts. The most notable exceptions are certain items made of *Tridacna maxima,* in particular well formed pestles, certain kinds of adzes, and the wedges described by Eilers (1934, p. 267, Fig. 175) for opening coconuts. The full range of

adzes and a pestle are represented in the general collection, however, which also included an item additional to the ethnographic record, an egg-shaped, well polished piece of shell (probably *Tridacna maxima*) perforated at one end. These objects, usually associated with fowling, are known from the Gilbert and Ellice Islands (Kennedy 1931, p. 294).

On the other hand, the archaeological assemblage includes a number of items not formerly reported for Nukuoro, such as shell rings and some simple pendant units, certain kinds of adzes or adze-like tools, notably *Cassis* whorl and *Terebra* apex tools, coral abrasives and possibly coral and shell hammer stones used in manufacturing, and coral disks. The excavations have also suggested that bone artifacts, while still relatively rare, comprise a greater range of forms than hitherto suggested.

In some areas of technology, the size of the archaeological sample and stratigraphic control over it have enabled corrections or improvements to be made to the ethnographic record. In particular, the assemblage of fishhooks has cast doubt on the provenance of some of the forms ascribed by Eilers to Nukuoro, and permitted the correct identification of Nukuoro fishhooks previously attributed to other islands. What is true of fishhooks is possibly also true of other areas of technology, and various items described by Eilers which are not mentioned by Kubary should accordingly be viewed with caution and not readily accepted as genuinely representative of prehistoric Nukuoro technology.

This is not to decry the value of the ethnographic record, however, for it provides invaluable information about perishable materials, both those associated with durable objects found in excavations, such as coconut grater stools, and those belonging to areas of material culture that are normally totally unrecoverable archaeologically, such as weaving.

The relatively large numbers of some artifacts recovered, and the wide range of artifacts generally, indicated the extent to which various resources were used on Nukuoro. Undoubtedly the most important materials from which durable items were made were pearl shell and *Tridacna maxima,* with some other shells, notably *Terebra maculata,* assuming importance for certain specialised artifact forms. All these materials seem to have been readily available throughout the time span covered by the excavations, although it is reported that *Tridacna maxima* had been greatly depleted by the early twentieth century (Eilers 1934, p. 192). The amount of waste material in the deposits does suggest that pearl shell could be used and wasted more extravagantly than *Tridacna,* but it must be remembered that pearl shell is more easily worked, and pearl shell items more easily replaced.

The ready availability of these raw materials has had an obvious effect on technology in encouraging the development of fishhooks, coconut grater heads, and shell adzes, which are the major artifacts recovered archaeologically, and most likely to be of chronological significance.

The extent to which *Hippopus hippopus* or other large shells were also used is difficult to determine, since the shell from which finished artifacts were made is often impossible to identify. No evidence of use of *Hippopus* shells for artifacts was encountered in the excavations; informants, however, insisted that large shells of this species occurred and were often used.

The absence or restricted use of certain shells widely used in other areas is interesting. However, without full knowledge of the availability and accessibility of such shells, it is difficult to decide whether the Nukuoro reluctance to use them was determined by cultural preference or non-availability.

The fairly rare use of *Spondylus* for ornaments is probably due to a general lack of interest in ornaments rather than a lack of suitable material, since *Spondylus* appears to be plentiful at Nukuoro. The few *Spondylus* shells found showed little sign that they had been valued or that attempts had been made to make the fullest possible use of them. The Nukuoro lack of interest in ornaments also seems to be responsible for the absence of pearl shell ornaments. Apart from the two unfinished beads from early deposits at Nu-4, and the single small pendant unit from Nu-1, all of which could have been isolated experiments, there is no indication that the abundant pearl shell was used for personal ornaments at all.

On the other hand, while the lack of interest in ornaments may also account for the general absence of ornaments in *Trochus* and *Conus* it is doubtful whether large examples of these shells occur in any numbers at Nukuoro, although small ones are certainly present. Conditions do not seem to be very favourable for the occurrence of large *Conus* shells, anyway, and no large specimens of *Conus* or *Trochus* species were collected.

Restricted availability of suitably sized *Conus* shells may also account for the lack of tools in this material. Greater use of *Cassis* and *Lambis* shells for tools might also have been expected, but the slight use of both may be due either to a shortage of supply, or simply to the fact that all tools required could be more satisfactorily made from *Tridacna maxima* and *Terebra maculata*.

A knowledge of the availability of various kinds of coral, both on Nukuoro and elsewhere, would seem to be important for an understanding of the relative merits of coral and other materials for files and grindstones, and consequently for an understanding of the economics of supply, — i.e. whether the Nukuoro were falling back on the only materials available to them, or enjoying the benefits of easy availability of highly suitable raw materials. Certain kinds of coral, notably the hard rough surfaced kinds used as saws and for grating taro, were said to be rare and valued, while the branch coral files, uncommon or lacking in some areas of Polynesia, were regarded as too easily obtained to be valued or sought after.

The use of small bivalves for various tasks might seem to be one case in which atoll dwellers do use available material in default of better, but again, this is an area of technology which is poorly documented in ethnographies, and also often in archaeological reports.

On the whole it seems that the Nukuoro made fairly full use of the raw materials available, but are hardly to be pitied as suffering hardships or restriction by virtue of being atoll dwellers. In the abundance of pearl shell and *Tridacna* and the availability of corals to work them with, they enjoyed materials widely used and esteemed not only on atolls, but in many other Pacific islands.

Relatively little change through time could be demonstrated in the archaeological assemblage. The only major area of change was in fishhooks, while a small number of items, such as pearl shell coconut grater heads, and *Terebra maculata* apex tools appear to be innovations or introductions. On the other hand, some areas of technology, notably ornaments and some adze forms, at least, appear to have changed little if at all during the several centuries covered by the archaeological sequence. The Nukuoro thus emerge as rather conservative in some areas of technology, and very enterprising in others. The relatively short period of time during which the distinctively Nukuoro one-piece fishhook assemblage developed, indicates that perhaps only a similar length of time might have been required for the development of other distinctively Nukuoro, but not archaeologically recoverable, artifact forms such as the wooden images.

The external relationships of Nukuoro material culture are of vital interest, but as I have pointed out above, considerable difficulty accompanies any attempt to point to outside parallels. The dubious value of Eilers' discussion of Nukuoro fishhooks as an indication of prehistoric Nukuoro fishing gear shows once again the difficulty of making valid comparisons on the basis of museum collections, or ethnographic reports written long after first European contact. Moreover the undesirability of comparing 19th century ethnographic material, whether representative or not, with archaeological assemblages some centuries earlier is obvious. But in the absence of suitable comparative archaeological collections from the right areas, some attempt must be made to seek parallels in the ethnographic literature and this I have attempted to do, recognising that many suggested sources or comparisons may be proved invalid when more reliable archaeological data from other island groups becomes available.

On present evidence, there is little doubt that at least some items in the assemblage are derived from neighbouring East Micronesian Islands, probably either Ponape or Truk or their satellites. Moreover, such items are among those which have been present on Nukuoro throughout the archaeological sequence, suggesting either prolonged contact with these islands, or indeed, the presence at an early stage of Micronesian inhabitants. On the other hand comparison of Nukuoro material with that known ethnographically from other outliers raises the distinct possibility that some of the northern Polynesian outliers share a common history separate from Polynesia proper, and perhaps also from the Ellice Islands, often advanced as a possible source of outlier settlement. This interesting possibility gains some support from linguistic evidence, but

excavation on other outliers and on areas adjacent to them would be necessary to test it and ensure that the suggested resemblance is not illusory and based merely on separate contacts with similar items of material culture in Melanesia and Micronesia.

Finally, there are items which can be attributed to neither of these origins, or which may appear on present evidence to be of Polynesian origin. The differences between any atoll culture, and a Western Polynesian high island culture are so great, however, that it is difficult to compare an archaeological sample from each and find any sound basis for comparison. Thus archaeological research in the Ellice and Tokelau groups will be vital to the identification of Polynesian elements in Nukuoro material culture, while results from the Ellice Islands would themselves need to be compared with similar excavated assemblages from Micronesian atolls to distinguish truly Polynesian elements from others.

The question of the origins of Nukuoro culture will be examined further in the final section of this report. The above discussion is intended merely to outline the possibilities suggested by a consideration of durable material culture alone.

V. FAUNAL REMAINS

BONE

Small amounts of unworked bone were recovered from the excavations. Bone was well preserved in the coral sand matrix, but most of the pieces recovered were small. I have sorted the bone into several major categories on the basis of previous experience and the fairly restricted comparative material available. Rat and dog bones have been checked by other people. There is considerable scope for specialist work, particularly on the fish bones and to a lesser extent on the bird bones, but such work has not yet been attempted.

The occurrence of bone of various kinds in Nu-1, Nu-4, Nu-5, Nu-6, Nu-7 and Nu-8 on a presence/absence basis, and the relative proportions of fish bone and all other kinds of bone by weight, are given in Tables 17-22. No unworked bone was collected from Nu-2, while the very restricted collection from Nu-3 included only rat, bird and fish in small quantities. Some details about the various categories of bone, and their distribution and significance, are given in the following sections.

Table 17. Occurrence of bone by layer, Nu-1.

SQUARE	LAYER	DOG	PIG	RAT	MAN	CETACEAN	BIRD	TURTLE	OTHER	NON-FISH wt (g)	FISH wt (g)	FRAGS.
G-9	9	x	—	1	—	—	x	x	—	28	33	—
	8	—	—	1	x	—	x	—	—	6	20	x
	7	—	—	1	—	—	x	x	—	8	118	x
	6	—	—	1	—	—	—	x	—	1	34	—
	5	—	—	2	—	—	x	—	—	5	62	x
	4	—	—	2	—	—	—	—	—	<1	54	—
	3	—	—	1	—	—	x	x	—	4	67	—
	2	—	—	1	—	—	—	x	—	1	48	x
	1	—	—	—	—	—	—	—	—	—	24	—
E-5	6	—	x	—	—	x	x	—	—	9	18	—
	5d	—	—	—	—	x	—	x	—	25	36	x
	5c	—	—	2	—	x	x	x	—	84	84	x
	5b	—	—	3	x	x	x	x	—	18	199	x
	5a	—	—	1	—	—	x	—	—	7	229	x
	Wall fill	—	—	1	x	x	x	x	—	4	17	x
	4	—	—	—	—	—	—	—	—	2	45	x
	3	—	—	—	—	—	—	—	—	4	12	x
	2	—	—	1	—	—	x	x	—	25	65	—
	1	—	—	1	—	—	—	—	—	<1	22	—

Table 18. Occurrence of bone by layer, Nu-4.

LAYER	LEVEL	DOG	PIG	RAT	MAN	CETACEAN	BIRD	TURTLE	OTHER	NON-FISH wt (g)	FISH wt (g)	FRAGS.
10		—	—	2	—	—	x	x	—	6	93	—
9	2	—	—	2	—	—	x	—	—	8	131	—
	3	—	—	4	—	—	x	x	—	31	228	—
	4	—	—	4	—	—	x	—	x	22	156	—
	5	—	—	4	x	—	x	x	x	22	125	—
8	6	—	—	1	—	—	—	x	x	20	61	—
	7	—	—	1	—	—	x	x	—	5	61	x
7		x	—	1	—	—	—	x	—	9	171	x
6		x	—	—	—	—	—	—	x	12	44	—
5		x	—	—	—	—	?	—	—	5	10	x
3-4		x	—	1	—	—	x	x	—	35	32	x
2	12	x	—	1	—	—	x	—	—	7	18	x
	13	x	—	1	—	—	x	—	—	15	8	x
	14	—	—	—	—	—	x	x	—	14	3	x
1		—	—	—	—	—	—	—	—	—	1	x

Table 19. Occurrence of bone by level, Nu-5.

LEVEL	DOG	PIG	RAT	MAN	CETACEAN	BIRD	TURTLE	OTHER	NON-FISH wt (g)	FISH wt (g)	FRAGS.
1	?	?	1	x	—	x	x	—	22	41	x
2	—	—	1	—	x	—	—	—	10	34	x
3	—	—	1	—	x	x	x	—	120	60	x
4 north	—	—	1	—	x	x	x	—	36	26	x
4 south	—	—	—	—	—	x	—	—	3	13	x
5	—	—	1	—	—	x	x	—	14	49	—
6	—	—	1	—	—	x	—	—	3	34	x
7 north	—	—	—	—	—	x	—	—	1	17	—
7 south	—	—	—	—	—	—	?	—	3	34	x
8	—	—	1	—	—	—	—	—	6	48	x
9	—	—	1	—	x	x	—	—	8	68	x
10	—	—	2	—	—	x	—	—	13	84	x
11	—	—	1	—	—	x	—	—	10	24	—
12	—	—	4	—	—	x	—	—	12	30	—
13	—	—	1	—	—	—	—	—	6	30	x
14	—	—	1	—	—	—	x	—	3	15	—
15	—	—	—	—	—	—	—	—	8	24	—
16	x	—	1	—	—	x	—	—	11	23	x
17	x	—	1	—	—	—	x	—	33	11	x
18	—	—	1	—	—	—	—	—	5	18	x

Table 20. Occurrence of bone by level, Nu-6.

LEVEL	DOG	PIG	RAT	MAN	CETACEAN	BIRD	TURTLE	OTHER	NON-FISH wt (g)	FISH wt (g)	FRAGS.
1	—	—	1	—	—	—	—	—	7	9	x
2	—	—	—	—	—	—	—	—	—	7	—
3	—	—	2	—	—	x	—	—	16	61	—
4	x	—	1	—	—	x	—	—	9	110	x
5	—	—	1	—	—	—	x	—	6	60	x
6	x	—	1	—	—	x	x	—	58	21	x
7	x	—	1	—	—	x	x	—	55	12	x
8	—	—	—	—	—	x	?	—	20	7	x

Table 21. Occurrence of bone by level, Nu-7.

LEVEL	DOG	PIG	RAT	MAN	CETACEAN	BIRD	TURTLE	OTHER	NON-FISH wt (g)	FISH wt (g)	FRAGS.
1	—	—	1	—	—	—	—	—	<1	16	—
2	—	—	—	—	—	x	—	—	<1	16	—
3	—	—	1	—	—	x	—	—	6	36	—
4	—	—	—	—	x	x	—	—	17	41	—
5	—	—	1	—	—	x	x	—	12	40	x
6	—	—	2	—	—	x	—	—	12	29	—
7	—	—	1	—	—	—	—	—	3	14	—
8	—	—	1	—	—	—	—	—	3	16	—
9	—	—	1	—	—	—	—	—	3	3	—

Table 22. Occurrence of bone by level, Nu-8.

LEVEL	DOG	PIG	RAT	MAN	CETACEAN	BIRD	TURTLE	OTHER	NON-FISH wt (g)	FISH wt (g)	FRAGS.
1	x	—	—	—	—	x	—	—	5	44	x
2	—	x	1	—	—	x	x	—	18	34	x
3	—	—	1	—	x	x	x	—	16	74	x
4	—	—	4	x	x	x	x	—	20	124	x
5	—	—	3	x	—	x	—	—	9	46	x
6	—	—	2	x	—	x	x	—	14	60	—
7	—	—	6	—	—	x	—	—	16	79	x
8	—	—	4	—	—	—	x	—	16	34	x
9	—	—	—	—	—	—	x	—	1	20	—
10	—	—	1	—	—	—	—	—	<1	13	—
11	—	—	—	—	—	—	x	—	22	25	x
12	—	—	1	—	—	—	x	x	9	64	x
13 south	x	—	—	—	—	x	—	—	1	6	—
13 north	x	—	1	—	—	—	x	—	6	80	x
14	x	—	1	—	—	—	—	x	10	51	x
15 NW	x	—	—	—	—	—	—	—	24	10	x
15	—	—	1	—	x	—	—	—	1	9	x

Dog

One of the more surprising results of the excavations was the discovery of dog bones in the bottom layers of four sites, Nu-4, Nu-5, Nu-6 and Nu-8. These have been identified by Miss J. Allo as follows.

Nu-4: shaft of a radius (gnawed by rats); four canines; two carnassials; three deciduous teeth; assorted incisors and premolars; shaft of ? femur; distal end of tibia; assorted metacarpals/metatarsals.

Nu-5: proximal end of a right ulna; two carnassials; one molar; three premolars. Two of these teeth show interesting deformities.

Nu-6: fragments of mandible; three canines; one carnassial.

Nu-8: portion of right mandible; distal end of left ulna; foot bones (not precisely identified in absence of comparative collection); one canine; one carnassial; one premolar; one molar; two incisors.

In addition to these identifiable pieces, a number of very small fragments, often gnawed by rats, from levels 4, 6 and 7 at Nu-6, and a few small fragments from the lower layers of Nu-4, 5 and 8, are probably also dog.

Although this is only a small collection of dog material, the regularity with which bone fragments and teeth occurred in the bottom layers of these four different sites, and the quantity of dog compared with other sorts of bone in these layers, indicate that at one time there was probably a sizeable population of dogs on Nukuoro. The bones are too widely distributed to represent merely a single chance introduction of one dog.

Dogs were unknown on Nukuoro in early European times and the introduction by a trader of dogs, pigs, cats and chickens, caused great astonishment (Carroll pers. comm.). The reintroduction of dogs is reflected by the presence of a single tooth in layer 9, square G-9, Nu-1, and some small fragments of bone that are probably dog, from the top levels of Nu-5 and Nu-8. There are no longer any dogs on the atoll, although the other introductions, pigs, cats and chickens, remain. The post-European introduction left significantly less trace in the archaeological record than the earlier one, suggesting that the earlier dog population was probably larger, and longer lasting.

Documentary evidence for the association of dog and man in Oceania, particularly Polynesia, has recently been summarised by Titcomb (1969). The scanty evidence available on dogs in Micronesia suggests Ponape and Truk as the most certain localities where dogs were present in pre-European times. In both areas they were eaten, although there is little evidence of the use of bones, teeth or hair for artifacts. The apparent absence of dogs from Palau, the Marianas and Yap in early European times has received limited archaeological support from the absence of dog bones in excavations in Yap (Gifford & Gifford 1959, p.162) and their presence only in the uppermost deposits of excavations in the Marianas (Spoehr 1957, p.164). The discovery of dog bones in early levels at Nukuoro is thus an important addition to the known pre-European distribution of dogs in Micronesia.

Although the dog penetrated to some of the most remote parts of Polynesia including Hawaii and New Zealand, it was also absent from a number of Polynesian islands, including Easter, Mangareva, and some of the Cook Islands (Titcomb 1969). Archaeological excavations in the Marquesas, however, yielded dog bones from prehistoric contexts in islands where there was formerly little or no evidence of the dog's presence. Conversely, archaeological finds of dogs have so far been rare in the Society Islands (Sinoto in Titcomb 1969, p.82) where the presence of the dog is well attested on other grounds.

In West Polynesia the dog was present in Samoa, where it was apparently sacred to some if not all families, and therefore not eaten by part of the population. Dog bones were rare in the only excavation in Samoa which produced faunal remains in any quantity (Green & Davidson 1969, pp.239-241). The position of dogs in Tonga is doubtful. They were apparently lacking from at least some Tongan islands at the time of Cook's first visit to Tonga (Beaglehole 1961, p.262) although the Tongans knew and esteemed them. By the time of Cook's third voyage replacements (additional to those left by Cook) had been obtained from Fiji (Beaglehole 1967 (1), p.144).

The reasons for the dog's appearance and disappearance on Nukuoro can only be guessed. The fact that dogs are no longer kept on Nukuoro and there is little interest in reintroducing them suggests that, to the present inhabitants, the disadvantages of dogs outweigh the advantages. This situation may also have obtained in the past. On Kapingamarangi, too, dogs introduced in the 19th century were exterminated fairly recently because they were found to be too much of a nuisance (Emory 1965, p.11). Possibly dogs were introduced to Nukuoro by Micronesians from the surrounding area who prized them as food. They might later have been exterminated by the Polynesian speaking inhabitants of the atoll, as apparently happened in recent times. Alternatively the dog population may have been eaten out, or wiped out by disease.

Pig

One pig tooth was found in layer 6, square E-5, Nu-1. Small fragments that are probably pig bone were found in level 1, Nu-5, and level 2, Nu-8. These are all post-European contexts. The pig was introduced to Nukuoro in post-European times, and there are still pigs on the atoll. There is, however, no evidence of any pre-European introduction of pigs to Nukuoro.

Rat

Rat bones were widely distributed throughout the deposits, including the early levels of Nu-4, Nu-5, Nu-6 and Nu-8, where they were contemporary with dog bones, some of which show clear evidence of having been gnawed by rats. Their occurrence is shown in Tables 17-22 where the minimum number of individuals represented in each layer is also shown. These figures were arrived at by considering each layer or level separately, and counting whatever bone was most numerous in that context. It is possible that bones of one individual could occur in more than one level, and where three left femora were counted in one level, and three right humeri in the next, it is not certain that six individuals were represented in the two layers. The figures should therefore be used only as a rough indication of the quantities of rat bones in various deposits.

The most numerous bones are femora, closely followed by tibiae, with substantial numbers also of humeri, pelvic bones and mandibles. There are a few radii and ulnae, fewer ribs and vertebrae and one scapula. No complete crania were found, although there are some small fragments of crania. No small bones of the extremities were collected, but it is probable that they were present and passed through the sieves. Both immature and mature individuals are represented.

The rat bones have been examined by Mr R. J. Scarlett who states that they are significantly larger than even abnormally large specimens of *Rattus exulans* Peale, the Polynesian rat, and exhibit characteristics of *R. rattus* or *R. norvegicus*. In the absence of cranial material he is not able to distinguish these two species.

The presence of a rat other than *R. exulans* throughout the prehistoric sequence on Nukuoro requires some discussion. The possibility that the bones are intrusive in the deposits can probably be ruled out on the evidence of rat gnawed bones from early contexts. In the 19th century rats were very numerous (Robertson 1877), and were believed to be a pre-European introduction to Nukuoro (Kubary 1900, p.75), although it has sometimes been assumed that the species in question was *R. exulans* (Wiens 1962, p.413). The Nukuoro belief that rats have been present from remote antiquity together with the presence of both the bones themselves and the evidence of rodent activity, combine to argue strongly against the bones being intrusive.

Informants told Carroll that there are now two kinds of rats on Nukuoro, a smaller and a larger variety. The larger is the one that was present in pre-European times, while the smaller one is an introduction from European ships. Unfortunately specimens were not produced to substantiate this claim. There do not appear to be any *R. exulans* bones in the archaeological collection, but bone of any kind is so rare from the European period that absence from the archaeological collection need not mean absence from the atoll in recent years.

Recent work on Micronesian rats has shown that a separate subspecies of *R. rattus, R. r. mansorius,* is widespread in the Marianas and Carolines, where the European *R. r. rattus* has not generally been able to establish itself. Johnson's careful discussion of the origin and means of introduction of murine species to Micronesia (in Storer 1962, pp.25-36) suggests that this subspecies may have been introduced from the Philippines at some unknown date in the past, either by the Spanish, or by earlier travellers.

It is probably impossible to determine what subspecies of rat is represented by the skeletal material from Nukuoro. Both the principal possibilities, *R. r. rattus,* and *R. r. mansorius,* must therefore be considered. *Rattus norvegicus,* not excluded by Mr Scarlett, seems unlikely on present distributional and historical evidence.

The presence of the European *R. r. rattus* in the earliest deposits would require some compression of the time scale of the archaeological sequence, and the acceptance of the uppermost limits of the ranges of the radiocarbon determinations. Even so, since the radiocarbon determinations do not date the earliest deposits, an introduction during the very early days of Spanish penetration of the Pacific would have to be assumed. This interpretation is just possible, but not very satisfactory.

On the other hand, a pre-Spanish introduction of *R. r. mansorius* to Nukuoro would fit the archaeological chronology much better, and would have a number of interesting implications. Nukuoro is towards the eastern end of the known distribution of *R. r. mansorius*. If it were indeed introduced in pre-Spanish times by earlier and simpler means of transport, it could have taken a considerable time to reach the limits of its present distribution. If it was already well established in the Eastern Carolines by the fifteenth century or earlier, a considerably earlier introduction to the more western islands is suggested.

It is unfortunate that other archaeological excavations in Micronesia have not yielded rat bones. Neither Spoehr (1957) nor Osborne (1966) mentions rat bones, and Gifford records his failure to recover any on Yap (Gifford & Gifford 1959, p.162). The Nukuoro bones thus appear to be the first archaeological sample of rat bones from Micronesia. While the bones may be inadequate for subspecific determination, they never-the-less offer hope that archaeology will be able to throw considerable light on the spread of rat species in Micronesia, by the provision of bones from securely dated contexts.

The cultural implications of the possible presence of *R. r. mansorius* on Nukuoro are also important. The presence of Micronesian elements in the earliest recovered material culture has already been mentioned. The presence of a Micronesian rat, particularly one that could not, on present evidence, have been introduced from the Marshalls or the Gilberts, would add to the evidence for early Micronesian influence on what is now regarded as a Polynesian outlier. The apparent absence of *R. exulans,* whether the Polynesian subspecies, or the subspecies occurring in

the Carolines (Johnson in Storer 1962, pp.32-35), is perplexing, since opportunities for its introduction must surely have occurred. One may wonder whether, by curious chance, *R. exulans* did not reach Nukuoro until *R. rattus* was so well established that the former was unable to compete.

The ecological effects of rats on Micronesian atolls are still subject to debate, although *R. rattus* is generally contrasted unfavourably with *R. exulans* in studies of rat damage to coconuts (Wiens 1962, p.414; Storer 1962, p.207). Rats apparently cause more damage to coconuts on atolls than on high islands, but it seems unlikely that such damage would be serious in pre-European times, when copra production was not involved. On the other hand, it is possible that the Nukuoro, sharing their atoll with a substantial and long established population of *R. rattus,* would have been at an economic disadvantage compared with their neighbours on Kapingamarangi, where *R. exulans* is said to have been the only rat present (Wiens 1962, p.414; Emory 1965, p.11).

Whatever economic damage rats caused on pre-European Nukuoro, their extremely aggressive behaviour is indicated by Nukuoro stories relating that sleeping babies had to be held constantly lest rats attacked them (Carroll pers. comm.). Such behaviour may have been promoted by a very high rat population such as that recorded in the 19th century. The quantity of bones in the deposits indicates a considerable population of rats in and around the village throughout the archaeological sequence. There are more rat bones in the upper half of Nu-8 and Nu-4, perhaps reflecting rats caught in or very near houses, but rat bones were the most common bones throughout the deposits.

Neither the economic damage caused by rats, nor the effects of the diseases, if any, that they carried, can be inferred from the archaeological evidence. The early introduction of rats to the atoll, however, and their presence in considerable numbers throughout the archaeological sequence, is clearly demonstrated.

Man

Although there were no human bones in the deposits, a few adult human teeth were found. There were no deciduous teeth. The bulk of the teeth were from Nu-8 and Nu-1. From Nu-8 there were a premolar from level 4, a molar, a premolar and a canine from level 5, and a premolar from level 6. From Nu-1 came a molar from near the bottom of layer 8, G-9, and a canine and an incisor from behind the retaining wall and from layer 5b respectively in E-5. From level 1 of Nu-5 came a single canine, and from the bottom of layer 9, Nu-4, another canine. The last mentioned has a slight worn facet on one side of the root, either the result of abnormal positioning of this tooth or its neighbour, or possibly the beginning of a drilled perforation.

The reason for the presence of these teeth in the deposits is obscure. Only one tooth has definite caries (labial neck caries on a canine from Nu-8). This tooth and several others from Nu-8 show signs of anchylosis on the tips of the roots. The other teeth seem healthy. Nukuoro custom involved burial in the deepest part of the lagoon after a brief mourning period (Kubary 1900, p.101-103), so that post-mortem tooth loss seems unlikely. But the lack of ethnographic evidence of warfare, or of the use of teeth as ornaments, makes pre-mortem extraction of apparently healthy teeth equally difficult to explain.

Cetacean

Despite the apparent existence on the island of a whale cult, no pieces of whale bone were found in the excavations, apart from the staff fragments in Nu-3. There were, however, some porpoise or dolphin remains. These consisted largely of vertebrae, and were mostly confined to upper layers of square E-5, Nu-1, Nu-5 and Nu-8, with a single occurrence in the middle of Nu-5, and a single unworked tooth from the bottom of Nu-8. Rib fragments from Nu-5 and Nu-7 are less certainly identified as dolphin. The Nukuoro today profess little interest in dolphins as food or otherwise, but it appears that they were occasionally caught and brought to the village both in the recent past and in the more remote past. As mentioned above there is some evidence of the use of the teeth in ornaments.

Bird

Small amounts of bird bone were found throughout the deposits. After fish and rat bones, bird bones were most widely distributed, but the quantities involved are small, and in most cases

the bone consists of small fragments of shafts of long bones. The only intact bones are coracoids, of which there are about eight altogether, from small to medium-sized and fairly large birds. There are substantial fragments of some limb bones, both wing and leg bones, but in very small quantity. Two pelvic fragments and three vertebrae complete the recognisable bird bone. Almost none of the bird bone from Nu-1, Nu-6 and Nu-8 is likely to be identifiable, but there may be as many as a dozen identifiable bones from each of the sites Nu-4, Nu-5 and Nu-7. These would, however, require study by a specialist with a comparative collection of birds known to frequent the area.

The largest quantities of bird bone and the majority of the potentially identifiable bones came from the upper layers of Nu-4, the central part of Nu-7, and the central and upper levels of Nu-5. The high proportion of bird bone from Nu-7 was one of the most important features of this otherwise relatively unproductive site.

Kubary listed 16 species of birds known to frequent Nukuoro, including 3 land birds and 13 sea birds. Today birds are not much regarded as food, although occasionally children will catch and eat one. The presence of fragmentary bird bones throughout the deposits suggests a somewhat greater reliance on birds for food in the past than is normal now, although it is difficult to be certain to what extent this bone represents birds consumed as food.

The bulk of the excavated bone appears to represent medium-sized to large birds, although there are a few bones that are obviously from smaller birds.

Turtle

Small amounts of turtle bone were found scattered through the deposits. These are mostly pieces of turtle carapace; very few other bones are represented. The turtle bone may therefore represent industrial waste rather than food remains. It seems unlikely, however, that turtles were not used as food. In historic times turtles, because of their rarity, were regarded as the property of the chief (Kubary 1900, p.129). Methods of division and distribution of turtles, therefore, may be responsible for the preponderance of carapace bones in the excavated localities.

Fish

In view of the importance of fishing gear in the technology, and the obvious importance of fish in the Nukuoro economy, precise identification of fish remains would be desirable. It is to be hoped that at some time in the future such identification will be possible. The collection of fish remains includes a quantity of dental plates and a few distinctive spines, all of which are potentially identifiable, as well as numbers of vertebrae and spines which are not.

I have attempted a preliminary analysis of identifiable fish bones, using Fowler's work on archaeological fishbones from Fiji (Fowler 1955) as a guide. This has proved unsatisfactory, however, for the Nukuoro collection naturally contains some material not represented in Gifford's collection, while it is always difficult to make identifications from illustrations alone without comparative collections.

Three sites, Nu-1, Nu-4 and Nu-8 contain a large proportion of the identifiable fishbones. Identifiable bones from remaining sites were fewer, but tended to reflect a similar range of bones on a smaller scale.

Parrot fish were among the most numerous fish in all sites. Labroids were represented in all sites but by only a few bones in each case. There were substantial quantities of barracuda-like bones in Nu-1 and Nu-4, and a few from Nu-6 and Nu-8, but none from Nu-5 and Nu-7. Bones resembling *Balistes* sp. as figured by Fowler (1955, Fig. 8 a-e) were found in Nu-1 and Nu-4, and distinctive dorsal spines from these two sites and also Nu-5, 6 and 8 provided further indication of the presence of balistoid species in the sites. Dentaries exhibiting the distinctive dentition of *Monotaxis granoculis* (Fowler 1955, Fig. 9 m-q; Munro 1967, pp.308, 310), were among the most common bones in Nu-1, Nu-4 and Nu-8, and were also present in Nu-5, Nu-6 and Nu-7. One or two mandibles or jaw plates like those of *Diodon* species (Fowler 1955, Fig. 8 h-j, 13 o-p) occurred in Nu-1, Nu-6 and Nu-8. These varied considerably in size.

The most difficult bones to identify, apart from those not figured at all by Fowler, were those showing general resemblances to representatives of *Epinephelidae, Lutjanidae* and *Lethrinidae.*

Among the most numerous bones in the collection are dentaries, premaxillaries and other bones not unlike examples of these families figured by Fowler. It is probable, however, that other percoid families are also represented, and without comparative material identification of these bones is uncertain.

There is considerable size variation within some of these groups. This could be more exactly determined with better identification of the species involved. It does appear, however, that the various fishing methods employed by the Nukuoro yielded quite a range of fish, both large and small, of various different kinds.

Cartilaginous fish are represented in the deposits by a single fragment of a caudal spine of a ray from Nu-4, and a number of shark teeth, widely distributed through the deposits. There are two principal kinds of teeth present, but it seems probable that these are upper and lower teeth of a carcharhinid shark, rather than two quite different sharks. The teeth resemble those shown by Munro (1967, Fig. 3J). There may however be more than one species present.

Tentative identifications of fish remains are summarised in Table 23 below. Classification is according to Munro (1967), although such identifications as have been attempted are derived from Fowler (1955).

Table 23. Preliminary identification of some fish remains.

	NU-1	NU-4	NU-5	NU-6	NU-7	NU-8
? *Sphyrenidae* (Barracudas)	some	some	—	few	—	few
Diodontidae (porcupine fish)	few	—	—	few	—	few
Balistoidei (tusk fish and leather jackets)	some	some	few	few	—	few
Scaridae (parrot fish)	many	many	many	some	some	many
Labridae/Coridae (Wrasses and rainbow fish)	few	few	few	few	few	few
Monotaxis granoculis (Nemipteridae) (large-eyed sea bream)	some	many	few	few	few	many
other percoids, possibly:						
Epinephelidae	? many	? many	? some	? some	? many	? few
Lutjanidae	?	?	?	—	—	?
Lethrinidae	?	?	?	—	—	?
Other	some	some	some	some	some	some

Other

Not all the bone has proved identifiable, even to the broad categories listed above. For the most part the remaining bone consists of very small fragments, sometimes worn, or gnawed by rats. The presence of unidentified fragments is shown in Tables 17-22. There are, however, a few perplexing fragments which do not appear to belong to any of the categories listed above. The known fauna of Nukuoro is so restricted that it is difficult to think of other categories of fauna which could be represented in the bone assemblage. Eilers (1934, p.249) refers to the use of dugong bone for artifacts, although there is otherwise little mention of the presence of dugong at Nukuoro. The known range of this animal extends as far east as the Marshall Islands (Carter, Hill & Tate 1946, p.136), and while Nukuoro does not seem a particularly suitable habitat for it, it is possible that dugongs have reached the atoll from time to time. No dugong skeletal material is available for comparison.

No reptilian bones other than turtle have been recognised. It is possible, however, that fragmentary lizard remains have been wrongly included among unidentified fish bones.

In several instances a number of fragments of unidentified bone from one layer appear to belong to a single animal. From layer 5 in E-5, Nu-1, came ten small fragments. These probably belong to a small dolphin since recognisable dolphin bones are also present. There is a somewhat similar collection of even more fragmentary bones from the bottom of layer 9, Nu-4.

Also from Nu-4, from layer 6, are two fragments, apparently of vertebrae. Nu-8 yielded two bones which have not been identified, one from level 12 (a complete small bone) and one from level 14. It is probable, however, that these bones will be shown, on specialist analysis, to belong to one or other of the categories discussed above.

SHELL

A systematic attempt to collect all shell from a portion of an excavation was made only at Nu-1 where all material retained by the sieves from half of each layer or level in square G-9 was kept. The shell samples collected in this manner were sorted and roughly analysed on Nukuoro, since practical problems of transportation made removal of shell samples for further study very difficult. The analysis was thus elementary. The nature of the shell recovered, however, suggested that there would be little value in attempting an exhaustive species analysis.

Many of the shells in the samples from G-9, Nu-1, were water worn, suggesting that they had not been introduced into the site as recently collected food shells. The numbers of small or medium-sized gastropods among the worn shells suggested the possibility that some of them may have been introduced into the deposits by hermit crabs, since live crabs were observed to be inhabiting similar shells. This would not account for all the water worn shells, however, since small bivalves, sea urchin spines, and gastropod opercula were also among the water worn shell constituent. The most likely explanations for these is that they were introduced with the coral gravel. A similar situation has been encountered in Samoa (Green & Davidson 1969, pp.238-239).

Most numerous among the shell remains from G-9 were *Turbo* opercula. Fresh specimens of these far outnumbered *Turbo* shells, both weathered and fresh, in the site. This suggested the possibility that *Turbo* shells were being brought to the site for consumption, and that whereas the shells were mostly removed and dumped elsewhere some of the opercula escaped notice and remained in the site.

Other gastropods included small worn cowries, cones and tops, occasional examples of augers, vases, and fragments of spiders and a possible helmet fragment. There were quite a few very small gastropods including nerites and small shells used in modern times for necklaces. None of these showed signs of working or perforation, however, and since they sometimes occur in large numbers on the beach they may also have been brought to the site with sand or coral gravel. The only shells among the gastropods that seem at all likely to have been used as food were the fairly numerous *Turbo* remains.

Bivalves included many of the shells mentioned above as useful shells. *Vasticardium* and *Scutarcopagia* in particular were represented in most layers, while other useful bivalves occurred more sporadically. *Tridacna* and *Spondylus* fragments were present in small quantities in most layers. There were considerable numbers of very small bivalves whose presence is probably due to the same causes as that of small gastropods.

In view of its specialised nature Nu-1 was perhaps not the most suitable site to experiment with techniques of midden collection and analysis. Observation of shells during excavation of other sites, however, suggests that the shell content of G-9, Nu-1, is not untypical of the shell occurring in the other excavations.

The presence of various kinds of shell by layer in the western half of square G-9, Nu-1, is shown in Table 24. Complete shells were counted, and water worn and fresh shells distinguished where possible, but fragments (usually present only in small quantities) are merely indicated on a presence/absence basis. It is apparent that the amount of shell in each layer was small.

Although shell was not systematically collected from the remainder of Nu-1 and from other sites, the presence of large, fresh or unusual shells was noted wherever possible. In the remainder of G-9 the following shells were noted: three augers from layer 8b, a nautilus-like shell from layer 7, three spider shells, a nautilus, two augers, two broken large *Spondylus* shells, and a larger than usual number of very small shells from layer 5; two *Vasticardium* shells from layer 2b. In square E-5 shells were noted only in layer 5, and included oysters, a small auger and a *Scutarcopagia* from layer 5c, a small auger, a fragment which may be from a trumpet, two *Vasticardium* shells, a large oyster which appears to match one of the oysters from 5c, and a concentration of small shells from layer 5b.

Table 24. Occurrence of shell in part of square G-9, Nu-1.

LAYER	*Turbo* (fresh shells)	*Turbo* (worn shells)	*Turbo* (opercula)	*Cypraeidae*	*Conidae*	*Trochidae*	? *Vasidae*	*Lambis* sp.	*Neritidae*	*Terebridae*	*Mitridae*	? *Cassididae*	small gastropods	*Vasticardium*	*Scutarcopagia*	*Codakia*	*Arcidae*	*Asaphis*	*Spondylus* sp.	*Tridacna maxima*	other bivalves	cephalopod (nautilus)	echinoderm spines
9b (Total square)	2	8	68	x*	x*	—	1	1f	3*	1	—	—	—	5f	ff	—	—	1	2f	9f	x	—	—
9a (half)	—	1	18*	2	—	—	—	—	—	—	—	—	18	1	ff	—	1*	—	3f	—	—	—	—
8b (half)	—	—	50*	1*	1f*	—	—	—	—	1	—	—	2	3f	ff	—	—	—	—	1	—	—	—
8a (half)	—	—	78*	x*	—	1*	—	—	—	—	—	—	—	ff	ff	—	1*	—	1	—	x*	—	x*
7 (half	—	—	99*	10*	1	—	1*	—	—	—	—	—	10	—	ff	—	—	1	ff	2	x	1	x*
6 (half)	2	—	19*	7*	—	—	1*	ff	—	1	—	1	1	—	ff	—	—	—	2f	ff	x	—	x*
5 (quarter)	7	—	6*	3*	—	—	—	ff	2	—	—	—	1	—	ff	—	—	—	1f	ff	x	—	—
4 (half)	2	1	62*	1	—	—	2	—	—	—	—	—	1	—	ff	—	—	—	1f	ff	x	—	x*
3 (half)	ff	—	28*	3*	1*	—	—	1f	1*	—	—	—	—	ff	ff	—	—	1	2	ff	x	—	—
2b (half)	ff	—	8*	2*	—	1	—	—	—	—	—	—	5	ff	ff	—	—	—	—	ff	x	—	—
2a (half)	ff	ff	11*	1*	—	1*	1*	—	—	—	—	—	1	ff	ff	—	—	—	—	—	—	—	—
1b (half)	ff	ff	39*	3*	—	—	—	—	2	—	—	—	—	—	ff	1	—	ff	ff	1	x	—	—
1a (half)	ff	ff	68	1*	—	—	ff	ff	—	—	—	—	—	—	ff	—	—	ff	—	1f	x	—	x*

* some or all water worn
1f one fragment only
x more than one shell, not counted because some or all water worn
ff more than one fragment

No shells were noted in Nu-2, Nu-3, Nu-5 and Nu-6. In Nu-4, layer 9, were pieces of four spider shells, one *Tridacna,* two complete *Vasticardium,* a nautilus and a vase shell; two *Vasticardium* shells were noted in layer 2. A concentrated pocket of *Turbo* shells, resembling a basket-full of food remains, was encountered in one corner of level 1 at Nu-7. The only other shells noted in this site were three *Vasticardium* shells in level 5.

The largest quantity of shell in the excavations was in the upper levels of Nu-8, where concentrations of small shells of *Tridacna maxima* were found. In level 2 were seven complete *Tridacna* and several fragments, weighing altogether 1.2 kg, as well as an auger, a small cone, and two *Vasticardium* shells. Level 3 yielded 16 complete *Tridacna* and 7 fragments, weighing a total of 3.6 kg, one auger, one mitre, and one *Vasticardium.* The largest quantity of *Tridacna* was in level 4, where there were 31 complete shells and 4 fragments, weighing a total of 5.2 kg. The only other shells noted were one auger and a *Spondylus* fragment. From lower levels in this site small amounts of shell were noted, including a cone and a *Spondylus* fragment from level 6; a mitre, a cowrie, a *Spondylus* and two *Tridacna* from level 7; *Spondylus* fragments only from levels 8, 9 and 10, and a nautilus from level 11.

A separate record was kept of the occurrence of pearl shell in all sites, because of the importance of pearl shell in artifact manufacture, and the fact that much of it was worked. All pearl shell was initially kept from all excavations; subsequently it was sorted into worked and unworked pieces and the latter discarded. The weights of worked and other pearl shell fragments are shown in Tables 25-31. It can be seen that very few whole shells were found, and these varied from two very large heavy shells, each weighing more than the total pearl shell constituent from each of the sites Nu-2, Nu-3, Nu-6, Nu-7 and Nu-8, to small shells weighing less than 100 grams. The division into worked and unworked pieces is probably to some extent misleading, since many of the "unworked" pieces are small, and could have broken off "worked" pieces. The concentration of pearl shell at Nu-1, and fact that so much pearl shell from all sites is worked, leave little doubt that pearl shell was in the deposits principally as industrial waste. There is no indication whether the animal, particularly from smaller shells, was eaten.

Table 25. Weight of worked and unworked pearl shell in grams, Nu-1.

					Square G-9					
Layer —	9	8	7	6	5	4	3	2	1	
worked	149	1458	501	32	45	44	229	97	35	
unworked	189	672	203	42	42	28	161	70	133	
					Square E-5					
Layer —	6	5d	5c	5b	5a	4	3	2	1	wall fill
worked	26	212	465	498	494	395	211	375	88	138
unworked	42	364	1001	651	336	161	133	336	63	84
whole shell	—	—	—	—	—	560	— 21	196	420	—

Table 26. Weight of worked and unworked pearl shell in grams, Nu-2 and Nu-3.

	NU-2				NU-3								
						Square 1						*Square 2*	
Level —	1	2	3	4	surface	1	2	3	4	5	6	1	2
worked	2	14	—	—	14	43	37	6	6	p	—	—	—
unworked	—	—	—	—	—	175	28	7	9	—	—	—	70†

p present in minute quantity

† whole shell

Table 27. Weight of worked and unworked pearl shell in grams, Nu-4.

Layer —	10		9				8		7	6	5	3-4	2			1	
Level —	1	2a	2b	3	4	5	6	7	8	9	10	11	12	13	14	15	16
worked	z	z	z	z	116	117	y	y	y	x	x	210	—	x	x	x	—
unworked	9	7	218*	154	98	28	—	—	7	14	7	210*	63	154	42	—	—

z combined weight 15g y combined weight 96g x combined weight 74g * whole shell included

Table 28. Weight of worked and unworked pearl shell in grams, Nu-5.

Level —	1	2	3	4S	4N	5	6	7N	7S	8	9	10	11	12	13	14	15	16	17	18
worked	97	42	16	7	—	26	46	—	—	9	—	24	x	—	—	—	—	—	x	—
unworked	91	56	7	—	—	—	—	91	21	14	7	—	—	—	—	—	49	70	196	7

x combined weight 12g

Table 29. Weight of worked and unworked pearl shell in grams, Nu-6.

Level —	1	2	3	4	5	6	7	8	9
worked	—	—	—	—	—	x	x	—	—
unworked	7	—	—	—	7	105	28	7	—

x combined weight 11g

Table 30. Weight of worked and unworked pearl shell in grams, Nu-7.

Level —	1	2	3	4	5	6	7	8	9
worked	x	—	x	—	x	x	—	—	x
unworked	21	56	p	7	—	—	—	—	—

x combined weight 58g p present in minute quantity

Table 31. Weight of worked and unworked pearl shell in grams, Nu-8.

Level —	1	2	3	4	5	6	7	8	9	10	11	12	13N	13S	14	15	16	17
worked	—	x	x	—	—	x	x	—	x	x	—	x	—	—	—	x	—	—
unworked	7	21	49	21	7	7	14	7	7	—	126	—	—	—	p	—	—	—

x combined weight 152g p present in minute quantity

TURTLE SHELL

Two small decaying pieces of turtle shell were found in level 2, Nu-8. It was obvious from their condition that they would not have survived much longer in the deposit but would have disintegrated completely. This showed that the absence of turtle shell in earlier contexts can be attributed to the perishable nature of this material.

CRUSTACEAN

Two small fragments, apparently from a crab or lobster, were found in the lower part of layer 9, Nu-1. These were the only recognisable crustacean remains. Usually crustaceans do not survive archaeologically, and these fragments are from a post-European context. The absence of crustacean remains from older deposits is likely to be the result of poor durability. Specht, however, reported crustacean remains throughout his Buka sequence (1969 (I), p.300).

FAUNAL REMAINS AND DIET

It would be inappropriate to conclude this section without discussing the possible reasons for the presence in the deposits of the various categories of faunal remains described above, and in particular the extent to which they reflect the past diet of the Nukuoro. It has been suggested above (p.27) that the archaeological deposits in and around the present village at Nukuoro grew up as a result of the inhabitants' tendency to renew and refurbish their house floors and surroundings with coral gravel and sand, thus covering up rubbish rather than removing it. In this way, particularly, the unsightly debris resulting from continuous earth oven cooking under difficult conditions (absence of suitable stone) was covered up, and a certain amount of rubbish of other kinds, including artifacts and faunal remains, also became trapped in the deposits. The amount of faunal material from the excavations is really very small, however, and there are no large bones present. This suggests that most food remains were collected and dumped elsewhere, and that what remained in the deposits were merely the small quantity that was overlooked. None of the deposits could be regarded as a proper rubbish dump, and consequently the food remains in the deposits should be interpreted as only a minute proportion of food consumed in the vicinity of the sites which might under favourable circumstances leave durable remains. Nevertheless, the consistency with which principal categories of bone, and to a lesser extent shell, occur, provides some basis for discussing Nukuoro diet.

The principal kind of bone occurring was fish bone, and this in conjunction with ethnographic evidence for the importance of fishing makes it reasonable to suppose that fish supplied most of the protein in the Nukuoro diet through most, if not all, of the period with which we are concerned. There is no other reason for fish bones to be in the deposits except as food remains. The other kind of animal food mentioned by Kubary (1900, p.108) was birds, and the bird remains in the deposits tend to confirm the occasional use of birds for food at various times in the past.

The dog may have made a substantial contribution to the diet at an earlier time, although it was no longer remembered in the 19th century. The scattered and fragmentary nature of the dog bones, and the absence of any evidence that dog bones or teeth were used for artifacts, suggest that the dog was kept on Nukuoro at one time as a food animal.

The extent to which other animals represented in the deposits were eaten is less certain. There is no ethnographic report of rats being eaten, although they are certainly eaten in some parts of the Pacific. It is a little difficult to understand how so many apparently dismembered rats could be incorporated in the deposits except as food remains, but it is possible that the method of excavation has resulted in a scattering of bones which is more apparent than real.

There is considerable evidence for the use of turtle bone for artifacts, and some evidence for similar use of dolphin teeth. Some of the worked bone described above may be dolphin bone. The presence of bones of these animals in the deposits, then, need not be the result of their consumption as food. It would be surprising indeed, however, if the Nukuoro failed to make secondary use of their meat as food, even if the bones, teeth and turtle shell were their principal object in catching dolphins and turtles. As mentioned above, turtles were rare and a royal prerogative according to Kubary (1900, p.129). Their use for food may have been restricted.

The human teeth can hardly be taken as evidence of cannibalism, in view of the complete absence of any recognisable human bone in the deposits. This absence of human bone, and the fact that no burials were encountered, also suggest that the custom of interment in the lagoon is an ancient one.

Pigs have been present on Nukuoro since the 19th century and are kept for eating. The rarity of pig remains in the European layers shows that today large animals consumed as food leave little trace in the deposits. This tends to suggest that larger bones stand less chance of being left lying around to become included in the deposits, and that thus the rarity of dolphin, for example, may not reflect accurately the importance of dolphin in the past diet.

There is very little evidence for the consumption of shellfish as food. The majority of shellfish in the deposits can be satisfactorily accounted for as old and worn shells brought in with coral gravel and sand, or as useful shells brought to the village either as raw material for artifacts or for immediate use as scrapers and similar tools. This need not mean, however, that shellfish were not eaten, merely that they were not left lying round the village in any quantity. Indeed, it is possible to make out a case for the consumption of *Turbo* as food, and the subsequent removal of much of the evidence, on the grounds of the quantities of opercula in excess of actual shells, found in Nu-1. There might, however, have been some other reason for the collection of opercula in Nu-1, and too much significance should not be attached to them as evidence of food. Similarly, several explanations could be advanced for the *Tridacna* shells in Nu-8. Their presence in the deposit as food remains seems unlikely, although many of them are small enough to be pleasant eating, since they would tend to be unattractive around a house when freshly opened. They are more likely to be there as raw material, or even merely as decorative items around a house or yard perimeter.

Thus while the faunal remains, particularly the rat and dog bones, are of considerable interest, their value as indicators of past diet is somewhat restricted. Inferences about the substantial vegetable diet, of course, are even more limited by the scarcity of botanical remains (see below, p.102), and must, for the most part depend on unsatisfactory assumptions on the basis of domestic artifacts, unless future excavations on the borders of the large taro excavations can establish their antiquity.

VI. OTHER ITEMS FROM EXCAVATIONS

A few small items which were neither artifacts nor faunal remains were encountered in the excavations, besides the great bulk of coral and sand which formed the matrix of the deposits. Some of these items have been identified, while the exact nature of others has not been satisfactorily established.

CORAL AND CORALLINE LIMESTONE

As noted above, by far the greatest quantity of material retained in sieves during excavations was coral, particularly small fragments of coral of the kind favoured for paths, house floors and so on. Only in square G-9, Nu-1, was this kind of coral weighed. The total coral constituent from this square weighed 2,381 kg, divided as follows: layer 9, 439 kg; layer 8, 649 kg; layer 7, 346 kg; layer 6, 434 kg; layer 5, 185 kg; layer 4, 64 kg; layer 3, 113 kg; layer 2, 50 kg; layer 1, 101 kg. The layers were not of identical volume, but even so, the fluctuations in coral fragments large enough to be held in the sieves are marked. The coral was present in greatest quantity in the upper occupation layers, in smaller quantity in the lower occupation layers 3 and 5; and was sparse in the sandier and more sterile layers 1, 2 and 4, which most resembled natural beach deposits.

It will be evident, too, that the presence of so much unworked coral in the sieves was a great handicap to rapid classification. The Nukuoro who sorted the material showed great skill in distinguishing artifacts or other unusual items from the bulk.

The unworked coral also included oven stones of coral limestone. These were less common in Nu-1 than in some other excavations. They were not distinguished from the other coral fragments.

Unusual kinds of coral, or coral with a particular use, were sometimes remarked upon by Nukuoro helping with, or watching, the excavations. These have been described above in the section on technology.

A handful of small pebbles from layer 6, square G-9, Nu-1 were at first thought to be of foreign rock. They have been identified, however, by Dr P. Black, Geology Department, University of Auckland, as coralline limestone, and are thus presumably of local origin. Fragments of soft powdery white material, found in layers 1, 7 and 9 of G-9, Nu-1, and level 17, Nu-5, were probably derived from some kind of coral, possibly coral which had been burnt.

Small fragments of what appeared to be coral, but bright pink in colour, were found in layers 4-6, square G-9, Nu-1. Several pieces were also among the spoil from the well shaft, Nu-1, but no similar material was found in other excavations.

FOREIGN STONE

Small pieces of rock were found in Nu-4 and Nu-8, which appear to have been imported to the atoll. Carroll was told of an outcrop of poor quality rock protruding through the reef on the western side of the atoll, but samples have not been analysed. The material, said to be used for oven stones, may merely be a variety of coral limestone. The rocks found in the excavations have been identified by Dr Black, Geology Department, University of Auckland, from thin sections, as follows: from levels 3 and 4, Nu-4, and levels 2, 4 and 11, Nu-8 — nephelinite and nepheline basalt; from level 3, Nu-4 — olivine-augite gabbro. Dr Black advised (pers. comm.) that the nepheline basalt and nephelinite could have come from oceanic volcanic islands of the Carolines or Polynesia. The gabbro, however, lacks nepheline, biotite and hornblende which makes its derivation from most of these islands unlikely.

Although only the stone from level 2, Nu-8 was found in association with European items, only the stones from level 4 and 11 of the same site can be regarded as indisputedly prehistoric in context. Layer 9 of Nu-4 from which the remaining stones came was a complex and possibly very disturbed layer. Carroll was told that the black volcanic stone said to have been brought to Nukuoro by Vave, the colonising ancestor, was buried for a time in the vicinity of Nu-4. This

stone was formerly kept in the *Amalau* (communal god house associated with the *malae*). The excavated gabbro pebble, a smooth water worn oval pebble, with a maximum diameter of 10.5 cm, could not have been this important cult object, shattered pieces of which were collected by Kubary (Eilers 1934, p. 227), but may have been a sacred stone of lesser importance, buried at the same time.

The occurrence of small pieces of nepheline-rich volcanic rock in the deposits from a level immediately above that dated to approximately the 16th century in Nu-8, as well as from later contexts, suggests that small quantities of volcanic rock may have been brought to Nukuoro, probably as oven stones, at various times in the past. The nearest sources of such rock are Ponape and Truk; the most likely route is probably from Truk via the Mortlock group, with which Nukuoro had traditional trading connections. Volcanic rock could have been an important trade good for the Mortlockese who were supposedly anxious to obtain turmeric and perhaps certain shells or shell items from Nukuoro. These stones are unworked, but could have been used as oven stones.

The single gabbro pebble is more difficult to account for. It does not appear to have been used as an oven stone; moreover its country of origin is more doubtful. Truk is again a possibility, but the other volcanic islands with which the Nukuoro may have had associations either traditional or through propinquity, are less likely, while Samoa is ruled out. However, such rocks occur in Fiji and possibly Tonga. The significance of the stone is obscured by its uncertain context. If it were definitely from a prehistoric context, or if it were certainly identified as a former cult object recently buried, its origin would be important indeed. If, on the other hand, it was a curiosity imported on a 19th century ship, it would be of little interest.

PUMICE

Small amounts of pumice, showing signs of working or use, were found in all layers of G-9, and in layer 5 of E-5, Nu-1; in layers 1 - 4, 8 - 9, Nu-4; in levels 5 and 6, Nu-5; 3 and 5, Nu-6; and 4 and 8, Nu-8. These were probably stockpiled ready for use as abraders, although some pieces were very small.

BOTANICAL REMAINS

Botanical remains were naturally rare, since there is little scope for their survival in these deposits. A piece of decaying wood, probably of very recent origin, was found in layer 9, G-9, Nu-1. Small flecks of charcoal were common throughout the deposits, but at present offer little hope of identification. The distinctive thin hard charcoal derived from coconut shells was noted only in levels 5 and 6 of Nu-5.

Small pieces of resin were found in layer 8, G-9, Nu-1; layer 9, Nu-4; and level 3, Nu-5. These are all fairly recent contexts, and it may be that this material does not survive indefinitely under local conditions. The resin is probably derived from *Calophyllum inophyllum* L. which grows on Nukuoro.

FAECES

Small pieces of what are presumably dog faeces were found in layer 9 - 11, Nu-4; layers in which dog bones were also found. These contained crushed fragments of fish bones, suggesting that fish remains formed part of the diet of dogs, as might be expected.

UNIDENTIFIED MATERIAL

Other small items collected were variously thought to be seeds, resin, or faeces, but on examination have been found to be unlike recognisable examples of any of these. They are lumps of brown material, which would probably pass unnoticed in excavations on a volcanic island, but which appeared anomalous in the coral sand of Nukuoro.

VII. CONCLUSIONS

The survey on Nukuoro showed that most of the surviving archaeological evidence on the atoll is concentrated in the vicinity of the present village. This suggests that the bulk of the population has always lived in or near the present village. Here the excavations revealed unevenly stratified deposits of up to three metres in depth, which had accumulated at different speeds at different times and places, and had been associated with the fluctuations of the lagoon shore on which the village is situated.

The results obtained on Nukuoro demonstrated the unique potential of small atolls for archaeological research. It would not be possible to carry out so comprehensive a survey of archaeological evidence in so short a time on any larger island. Moreover, faced with a situation where all the surviving archaeological evidence is concentrated within a small area, the archaeologist can plan his excavations to sample the total range of evidence, confident that the sample will provide a fuller understanding of the technology and economy of the atoll's inhabitants than would be possible from comparable excavations in one or more coastal sites on a large island with varying resource zones.

The majority of the excavated deposits on Nukuoro were shown by the evidence of carbon dates to belong to the last four or five centuries, although none of the oldest layers encountered has been dated. Artifacts representing many different aspects of material culture were recovered. In only a few instances, however, could change through time be demonstrated. The development of a number of kinds of simple fishhooks from two early forms and the relatively late appearance of pearl shell coconut grater heads and *Terebra* apex chisels are the most significant examples. Similarly, although faunal remains were recovered from most excavations, they showed little or no chronological change with the important exception of the disappearance of the dog from Nukuoro at an early stage, probably before 1500 A.D. The general lack of change throughout the archaeological sequence suggests a population already well adapted to life on a small tropical atoll by the time the earliest levels of the archaeological sequence were deposited.

The use of various raw materials by the inhabitants of Nukuoro has been reviewed above. Undoubtedly of great significance was the availability of pearl shell and *Tridacna maxima* throughout the archaeological sequence, which encouraged the development of fishhooks, coconut grater heads and shell adzes. The use of shells such as *Cassis, Lambis, Trochus, Conus* and *Spondylus* was little developed, although these shells were also present and occasionally used. On the other hand, various small bivalves and different kinds of coral were used for tools. Thus the Nukuoro made fairly full use of the raw materials available to them. They concentrated on two major kinds of shell for many of their artifacts, however, and ignored others that were used elsewhere in the Pacific.

In their use of food resources, too, the Nukuoro were apparently able to be selective. The principal protein was fish, supplemented from time to time by birds, while shellfish seem not to have been a feature of the diet.

It has been possible to compare the archaeological assemblage of artifacts with ethnographic descriptions of Nukuoro to the benefit of both. Most of the items in the ethnographic record were matched by specimens either from excavations or from the general collection; a few new items were added as a result of the excavations. In several instances the complete absence from the archaeological record of items attributed to Nukuoro by 20th century ethnographers suggests that the ethnographic record may be unreliable in some respects. In general, however, the excavations have provided a background of some 400 years of prehistory for most of the durable material culture recorded on Nukuoro in the 19th century. The development of several distinctively Nukuoro forms of fishhook within this period suggests that a similar period of time could also have seen the development of less durable but equally distinctive Nukuoro forms of material culture.

Attempts to explore the external relationships of Nukuoro material culture, and consequently to answer questions posed about the significance of Nukuoro as a Polynesian outlier, are hampered by the lack of comparative archaeological data from adjacent Micronesian islands, from the atolls in West Polynesia, and from other Polynesian outliers. Such comparative material as is available suggests that only a few items of Nukuoro material culture could be characterised as Polynesian. Some artifacts, particularly ornaments, can only be interpreted at the present time as Micronesian. Others again seem to have such a widespread oceanic distribution that they

cannot be regarded as diagnostic of any one cultural tradition. The problem is also complicated by the lack of consideration paid by archaeologists to the differences between atoll and high island cultures within Polynesia, and the differences between atoll cultures across cultural boundaries, for instance between the Gilbert and the Ellice Islands, or between the Tokelaus and the Eastern Carolines. We do not know what the material culture of a hypothetical group of Ellice Island colonists on Nukuoro would have been; it is thus difficult to assess the "Polynesian" nature or otherwise of Nukuoro material culture. Moreover, archaeologists have yet to proceed beyond a preliminary assessment of what might be called shell technology in Oceania; that use of shell for artifacts which is a necessity on a coral atoll, but a choice on the high islands of Micronesia and parts of Melanesia.

Nukuoro is now inhabited by people who speak a Polynesian language. At least some aspects of their social organisation and religious system, as documented by the 19th century ethnographer, Kubary, as well as their vocabulary, were recognisably Polynesian. Their traditions of origin, moreover, suggest a decisive colonisation of the atoll by Polynesians, as well as numerous secondary contacts from a wide variety of islands, only some of which are identifiable. From traditional evidence Krämer in 1910 calculated that the arrival of the principal colonising group probably took place about 1300 A.D. Studies of the language of Nukuoro suggest a fairly long development in isolation from other Polynesian languages, probably longer than that indicated by Krämer's estimate of 600 years of Polynesian occupation before 1900. Linguistic and traditional evidence, then, suggest that Polynesians were already established on Nukuoro at the beginning of the archaeological sequence as it is now known. The relatively small change in material culture throughout that sequence certainly suggests a continuity of occupation, with only sporadic introductions of isolated new traits. But there is little evidence to suggest that this material culture belonged to Polynesians other than the indisputable presence of Polynesian speakers on the atoll today. Indeed, if Nukuoro had been uninhabited at the time of its discovery, the archaeological evidence would probably suggest simply that it had once been occupied by East Micronesians similar to those now inhabiting the other atolls in the Eastern Carolines. The evidence of the material culture would be reinforced by the presence throughout the sequence of rat bones of a species apparently well distributed in Micronesia but unknown in pre-European Polynesia. Even the foreign stones would suggest a derivation from a Micronesian island such as Truk or Ponape, rather than more remote Samoa or Tonga.

It is not yet possible to say whether the Polynesian colonists on Nukuoro came from a high Polynesian island, such as Samoa, a Polynesian atoll such as one of the Ellice islands, or another Polynesian outlier, and whether they found Nukuoro already inhabited by Micronesians, or whether the apparently Micronesian elements are the result of later contacts. At present, viewing the archaeological evidence from Nukuoro in isolation, it is possible to postulate contacts and influence from almost any part of the Pacific with equal plausibility. As comparative data accumulate from the most vital areas, however, neglected parts of West Polynesia, East Micronesia, and the other northern outliers, the possibilities must be reduced.

However desirable comparative material may be, the final answer to questions about the duration and nature of human occupation on Nukuoro must be sought on Nukuoro itself. The brief period of fieldwork described above yielded results far in advance of the expectations most archaeologists held in 1965 for archaeology on coral atolls. But while the excavations provided valuable data on the latter part of Nukuoro prehistory, and brought into focus a number of problems not previously considered by Pacific archaeologists concerning cultural replacement on small islands, they did not answer adequately the questions of when Nukuoro was first settled and by whom. It is to be expected that there should be earlier occupation levels on Nukuoro than any yet found, except perhaps the lowest and inadequately dated levels of Nu-4. Present experience suggests the central part of the present village, in areas comparable to Nu-4, as the most suitable places to investigate. At the same time any future investigation should include some excavation on other *modu* and on sites of a kind not yet investigated, particularly the edges of the taro excavations, and the *malae* area.

To extend the archaeological sequence further back in time is not an end in itself. The challenge offered by Nukuoro to the archaeologist is to interpret the processes by which elements of Polynesian and Micronesian culture fused on Nukuoro, retaining some items unchanged, giving rise in other areas to new and distinctively Nukuoro forms. A similar challenge is posed by any island which appears to span a modern cultural boundary; where language and material culture do not correspond as neatly as they do in most of Polynesia. The challenge must be met if prehistories rather than archaeological sequences are to be written.

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