SUMMARY

A CONTRIBUTION TO THE PREHISTORY
OF THE TONGAN ISLANDS

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**A Contribution to the Prehistory of the Tongan Islands** deals with the planning, prosecution and results of archaeological fieldwork carried out on Tongatapu from September 1963 to September 1964.

**Chapter I.** A review of the status of studies in South Pacific culture history in 1962, following the application of new linguistic principles and the first serious archaeological excavations, introduces a discussion of the importance of Tonga to the examination of current hypotheses. Amongst these two were of particular interest: that all Polynesian cultures were differentiated from a single source and that there existed in the SW Pacific an ancestral culture antedating the differentiation of Melanesian and Polynesian culture areas and straddling the boundary between them. Geographically Tonga was well placed to contribute to the necessary investigations and the demonstrated abundance there of prehistoric pottery promised an adequate vehicle for their prosecution. The immediate problems were seen to be whether pottery was typical of the entire prehistoric period in Tonga; whether more than one ceramic tradition was represented; and what the intra-Tongan developments and extra-Tongan relationships of the pottery might be. In this way Tongan pottery might help in a comparative study of Melanesia, where pottery is common, and Polynesia where pottery was beginning to be found on early sites.
the same time excavations of pottery sites in Tonga might be expected to produce other artifacts for comparison with other areas of the South Pacific. Such material might help in elucidating the question of Western and Eastern cultural differentiation within Polynesia itself.

Chapter II is a general description of the geography and history of Tonga. The archipelago is characterised by a relative richness of land and sea resources and offers a good environment for the food plants introduced by man. A few essential raw materials are available in certain islands only, such as stone for adzes in the Ha'apai group and in 'Eua. Thus inter-island contacts are likely to have played an important role in the economical life of the past. The navigational skills that made possible this exploitation of the resources of different parts of the archipelago were, according to the traditions, put at the service of outside expansion.

Chapter III. Within the archipelago fieldwork was concentrated on the main island of Tongatapu, where shell middens were selected as the most promising category of site for pottery. In order to obtain the desired pottery sequence it was decided to devote attention to a small area and for this purpose a lagoonal district was defined around Pea village. Since the indications from previous work were that the proportion of decorated to undecorated sherds would be larger on
earlier sites, smaller on later ones, sites for excavation were selected on this principle. Only one of the six investigated sites lay outside the chosen district: To.2. It was hoped that excavation here would produce evidence of fishing gear. Of the two other important categories of field monument, mounds and fortifications, a little attention was paid to the former, as opportunity offered itself to obtain some insight into the nature of mounds at sites To.2, 3 and 4. The chapter concludes with a description of the external appearance of the excavated sites and their surroundings.

Chapter IV discusses the arguments for excavating by original layers or arbitrary spits and concludes that in certain circumstances, as with shell middens, spit digging offers an appropriate means of controlling the distribution of the artifactual evidence. Spit digging was used at all the sites investigated, with only few exceptions. The chapter concludes with a description of the internal appearance of the middens. The organisation of the stratigraphic units into horizons which form the basis for the subsequent analysis of artifacts is described.

Chapter V. This opens with a methodological discussion of the analytic procedures employed in the sequel: specifically analysis by individual artifact features. Besides allowing a fuller utilisation of the material than an analysis restricted to whole pieces (however these be defined), this method can exploit the
differential rate of change of specific ceramic features over time. Though in the present work the main emphasis is thus on individual features, certain combinations of features were analysed also.

Apart from a single complete pot, the 500 kg of pottery excavated consisted entirely of sherds, generally of very small size. For practical reasons it was decided to select for analysis only rim sherds and decorated sherds. Together these amounted to some 7900 specimens. Two types of codes were considered for the description of the data: a descriptive and exhaustive code, and an analytical and selective code. The latter was chosen as the most suitable for the purposes in mind. Two codes were compiled, one for rim features and one for features of decoration. A third code was drawn up to record provenance of sherds within the excavations. All three codes are explained in detail in the chapter.

Two types of punch card were tried out for handling the data to be analysed: the type where each card represents a feature and each punch an artifact and the opposite type where each card represents an artifact and each punch a feature. The latter type was chosen as the better alternative, among other things because this type of card can be processed by computer.

In the event it was only possible to analyse a selection of the features coded and carded. The principle of analysis was the frequency of occurrence of specific ceramic features within the excavated sites.
but only material from the four major sites, To.1, 2, 5 and 6 was dealt with in this fashion. The figures were extracted by computer and presented in terms of square metre units and spits. These figures were then consolidated for each of the horizons within a site and the differences between horizons evaluated statistically, also by computer.

Chapter VI deals with the results of the analysis. The relative importance of different ceramic features within individual horizons of the different sites is described, tabulated and graphed. The differences from horizon to horizon in the representation of specific ceramic features are pointed out and their significance evaluated. The stratigraphic evidence of sites To.1, 5 and 6 allow these differences to be interpreted as changes over time. The clearest evidence for such changes comes from the rim analysis. Though some features are present with unchanged frequencies of occurrence, the occurrence of others is marked by changes over time of increased or decreased representation. The observations could be made consistently from site to site and thus the sequence to which they contribute assumes a reliable character. As a result it is possible to correlate horizons between sites by seriation. Early and late levels are thus present at To.1 and To.5, whereas To.2 is an early site, To.6 a late site.

Decorated pottery as such went gradually out of use over the course of time, becoming virtually unknown in the latest phase, represented by To.6. Almost all
features of decoration were used to proportionally the same extent throughout, but a few are likely to have been restricted to the early period. These comprise complex motifs identical with or closely related to the sophisticated motifs on early Lapita sites in the SW Pacific.

Chapter VII. The radiocarbon dates are tabulated and discussed. Those from charcoal range from the fifth century BC, the earliest so far for Polynesia, to the seventeenth century AD, meaning that the sequence is practically speaking in touch with the time of European contact. The early Tongan dates are in accord with the dates for Lapita sites in Melanesia. On the whole the Tongan dates are consistent with the archaeological evidence, but they further our understanding of this, firstly by pointing to the possibility of an hiatus in the excavated evidence between the early and the late periods, secondly by revealing the existence of a very early occupation at the otherwise late site To.6, hitherto not recognisable on the archaeological evidence alone. Restriction of the above mentioned complex decorative motifs to the early period is rendered plausible by the fifth century BC dates at To.6 as these motifs are present at this site exclusively in the bottommost spits.

Chapter VIII. Here the nature of prehistoric pottery in Tonga is reconstructed on the basis partly of the features already dealt with, partly by drawing other features into the discussion, some not exhaustively
analysed, others not incorporated in the codes. Since site To.2 is established as an early one and site To.6 is in the main late, it proves possible to date many of the pottery features now looked at for the first time and also to go further into detail with some of the features treated more generally before.

The main conclusion is that we are dealing with the evolution of a homogeneous ceramic tradition. In many respects, both of style and technology, no change took place, in others changes did occur but for the most part gradually, the trend being one of simplification and standardisation over the course of time. The presumed hiatus in the material is thus not to be explained as a break in development, the two elements of which are unconformable, but simply as a series of missing links in an in reality unbroken chain of change.

The origin of Tongan pottery is seen as the Lapita tradition of the SW Pacific, and Tonga is so far the only example of this tradition continuing undisturbed (in Tonga through 2500 years) up to the time of European contact. On the evidence available no foreign influences are detectable in the Tongan material.

Chapter IX deals with portable artifacts of shell, stone and bone, which have been set out as far as possible in functional categories: adzes, chisels and gouges; scrapers and peelers; fishing gear; needles and awls; ornaments; bowling stones; and industrial tools.
The collection of stone adzes studied comprises excavated and surface specimens; they are grouped in terms of varieties of rectilinear and curvilinear cross section. The excavated and datable specimens show that both main classes were known early and late, though some of the varieties are as yet only known in one or another context. In general the Tongan adze spectrum is similar to that characterising early levels in Samoa, the Marquesas and the Society Islands, which all possess forms looked upon until fairly recently as 'Melanesian'. One feature of the current collection is an adze with Eastern Polynesian-type lashing grip, stylistically and petrologically Tongan. This may mean that the gripped adze was once part of the adze tradition in Western Polynesia, but other explanations are possible.

The artifacts in the other categories are predominantly made of shell. They reflect a range of functional types and activities. Though for the most part they occur in small numbers only, the general impression is one of cultural continuity throughout the sequence. On some points there is also positive evidence of accord with McKern's ethnographic record for Tonga.

A search for parallels in the overseas archaeological record, highly incomplete though this is, shows a number of things. Firstly, some forms known in the early period in Tonga occur on Lapita sites elsewhere, so that it can be concluded that these forms were introduced into
Tonga together with the pottery. Secondly Tonga shares in a technology in shell widely distributed in the W. Pacific in time and space. Within this area parallels are particularly close with the southern New Hebrides. Thirdly, some of the distinctive forms, particularly bracelets of shell, which Tongan has in common with the W. Pacific are unknown in the rest of Polynesia. Fourthly, nevertheless diagnostic Polynesian features are present in Tonga from the outset and throughout its prehistory.

Chapter X is the faunal and botanical section. It deals predominantly with marine shells and bone. Shell sampling took place in all but one midden. The analysis was focused on the two most common types of shell: topo, generally to be found in the lagoon only, and kaloa'a, only to be collected outside the lagoon. As expected, the former type predominated in the lagoonal middens, the latter in the To.2 midden at the entrance to the lagoon. However, the non-lagoonal type, kaloa'a, was not totally absent from the lagoonal sites, neither in the middens nor in the subsoil below. In the subsoil contexts indeed kaloa'a proved significantly more common than in the middens and an environmental explanation of this circumstance is offered.

The excavations yielded a surprisingly small amount of bone. Among the fish bones those of reef and shallow water species were dominant, though deep water species together with turtles are represented, the latter especially at To.2. The problem of prehistoric fishing in Tonga is discussed and, with the assistance of the
ethnographic record, it is concluded that the most common fishing methods in prehistoric as in historic times are likely to have been traps and drives constructed in shallow water. The remaining non-domestic fauna includes bones of a few wild birds and of numerous rats, the latter of course almost certainly introduced by man.

Bones of domesticated animals comprise chicken and pig, both known early and late. The presence of dog is doubtful. Human bones occurred in all levels. There is evidence of a few genuine burials in the middens as well apparently as of cannibalism. Human jaws and teeth were examined in some detail with interesting results of a cultural character.

The only botanical remains documented directly by excavation consisted of charred coconut, datable to the late period.

Chapter XI is concerned with the final interpretation of the sites in terms partly of the evidence reviewed in previous chapters, partly of structural information here described for the first time. The middens were not only places where a variety of rubbish was dumped, comprising food remains and broken and discarded artifacts of all kinds. Other activities also took place within the midden area, simultaneously perhaps with the midden formation in some other sector of the site. The best indication of this comes from the large To.1 midden.

At most sites there is evidence for the use of flat and basin-shaped cooking places, the digging of a variety of pits for food preservation and storage, and finally the
making of postholes, though unfortunately in none of the sites was it possible to establish the outline of any structure.

Another indication that actual living may have taken place on the middens is the presence of finished and unbroken artifacts. Even today one can see houses and huts built on shell middens still in process of formation.

Observations on the subsoil at To.1 and To.5 are used to suggest that at or close to the time of first occupation the lagoon was adjacent to them; further that it was a more tidally influenced lagoon than at present. The shell analyses are brought back into the discussion to support this point.

Chapter XII brings together all the conclusions separately arrived at in the analysis of different aspects of the excavated data and focusses them on the major problems posed in the introductory section but reformulated in the light of concurrent work in South Pacific culture history.

It is concluded that pottery was introduced into Tonga with the first settlers, who, accompanied by pig, chicken and rat, established themselves by the middle of the first millennium BC, at a time when the lagoon was more extensive and perhaps more open than it is at present. This pottery, a branch of the Lapita tradition of the SW Pacific, underwent evolution in isolation in Tonga until it disappeared about or shortly after the time of
European contact. Two general periods in Tongan prehistory are defined and the ceramic characteristics of each listed. The possibility of subdivision of each of these periods on ceramic evidence is discussed.

General support to the hypothesis of cultural continuity in Tongan prehistory is provided by the other artifacts, though these occur only in small numbers.

The general implications of the above conclusions are then reviewed. If the Lapita founder culture is the basis of Tongan society as ethnographically known, it must be in some sense proto-Polynesian. The difficulties in accepting this proposition are emphasised by contrasting the Tongan materials, especially in terms of pottery, with those from Samoa, its close geographical and cultural neighbour in Western Polynesia. Tonga appears to occupy an intermediate position in the South Pacific, possessing different features in common with the rest of Polynesia on the one hand and with parts of Melanesia and Micronesia on the other. Some clarification of this situation is sought in Green's recent evaluation of the cultural evidence for Tonga, Samoa and Eastern Polynesia in the light of new linguistic subgroupings within Polynesia.

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A CONTRIBUTION TO THE PREHISTORY
OF THE TONGAN ISLANDS

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This thesis deals with the results of archaeological fieldwork by the author in Tonga 1963-64 and the subsequent analysis of the data. Specialists in various disciplines have assisted in the analysis of some of these data and they are acknowledged. In all other respects the thesis is my own original work.

Jens I. Poulsen
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CHAPTER I

INTRODUCTION

Up to comparatively recently all the many discussions of the fundamental issues of Polynesian culture history had taken place without the benefit of serious archaeological research within the islands of tropical Polynesia itself. Though an avowedly popular work, Buck's Vikings of the Sunrise,¹ drawing its evidence mainly from the fields of material culture and Polynesian traditions, won acceptance as a classic statement.

In the years following the end of World War II the development of lexicostatistical techniques in linguistics encouraged their application to the closely related languages of Polynesia,² while dirt archaeology made its belated entry on to the Central Pacific scene. Initially archaeological efforts were confined to Melanesia,³ though on the basis of archaeological studies in New Zealand,

¹ P.H. Buck, Vikings of the Sunrise, 1938. The edition cited elsewhere is the reprint of 1960.
³ E.W. Gifford, Archaeological Excavations in Fiji, 1951; E.W. Gifford and Dick Shutler, Jr., Archaeological Excavations in New Caledonia, 1956.
allowing some time depth to be given to the rich material
culture of those islands, Duff attempted a
reinterpretation of the Polynesian evidence in general.\(^1\)

During the final years of the 1950s, however, stimulated
no doubt in part by the successful establishment of the
radiocarbon dating method which promised an absolute
chronology for the prehistory of regions where none had
been thought possible, archaeological research began in
tropical Polynesia itself. In the first round of activity
expeditions were at work in Tonga, Samoa, the Society
Islands, Mangareva, the Marquesas and Easter Island, while
a continuing programme of archaeological research was
under way in Hawaii. A preliminary survey of this work
was made as early as 1959 by Golson.\(^2\) The results
achieved by excavations in the Marquesas were so
illuminating that in 1960, ahead of his excavation report
from that group, Suggs was able to offer a new view of
Polynesian culture history based on the archaeological
findings and their attendant radiocarbon dates.\(^3\)

The tenor of this new work was that Polynesian
communities sprang from a common ancestral culture which
entered the island world from the west in the first
millennium before our era. The islands of West Polynesia,
Tonga and Samoa, were the first to be settled and they


\(^2\) J. Golson, 'L'Archéologie du Pacifique Sud: Résultats et
Perspectives', *Journal de la Société des Océanistes*, XV,
pp.5-54.

constituted the point of departure for the earliest settlements of East Polynesia. This itself was an important modification of the thesis put forward by Buck that the Society Islands of East Polynesia were the dispersal point, or Hawaiiki, for the settlement of all the Polynesian islands, including those of West Polynesia. Indeed, in the light of his archaeological discoveries in the Marquesas, Suggs could claim that within East Polynesia itself an early point of settlement was the Marquesas, which became a centre for subsequent dispersal equally with the Society Islands. He based this conclusion on the similarities of the materials at his earliest excavated site, especially adzes, scrapers and ornaments of shell, and pottery (the first to be discovered in East Polynesia) to archaeological and ethnographic material recorded for West Polynesia and Melanesia. This same evidence for connections between the early Marquesas and West Polynesia and Melanesia Suggs used also to support the argument that the distinctive cultures recorded for West and East Polynesia in modern times had developed in geographical isolation from an ancestral culture initially homogenous and that this ancestral culture shared something in common with the Melanesian cultures to the north and west.

The cultural differences that existed between West and East Polynesia had long ago been made the subject of an important study by Burrows, who suggested that

1 Buck, 1960, pp.65, 67-72, 150.
historical processes such as diffusion from contiguous culture areas of different character, local development, and the abandonment and rejection of ideas could convincingly account for the differentiation.\textsuperscript{1} Looking at this question again in the light of the newly won archaeological data Golson, as opposed to Suggs, was inclined to think that the differences were more basic than this and stemmed from the impact of Asiatic influences in East Polynesia which failed to penetrate the west.\textsuperscript{2} These he saw reflected especially in the gripped adzes and sophisticated bait hook fishing gear of East Polynesia, which appeared to be absent from West Polynesia but paralleled in the maritime regions of East Asia.

However, like Suggs, Golson saw relationships in prehistory between the areas now called Polynesia and Melanesia. These for him were expressed particularly in terms of that apparently non-Polynesian item of material culture, pottery. As a result of the recent archaeological work pottery had been found in the earliest levels in the Marquesas and Samoa. These discoveries prompted a new look at the question of pottery in Tonga. Alone of the Polynesian islands, pottery was described in use in Tonga by early European visitors and during his archaeological survey of 1920-1 McKern found potsherds abundant in kitchen middens on Tongatapu and neighbouring islets.\textsuperscript{3} Two circumstances, the absence of pottery

\textsuperscript{1} E.G. Burrows, 'Western Polynesia, A Study in Cultural Differentiation', \textit{Etnologiska Studier}, 7, 1938.
\textsuperscript{2} Golson, 1959, pp.17-9, 50-1.
\textsuperscript{3} W.C. McKern, \textit{Archaeology of Tonga}, 1929, pp.106-19.
elsewhere in Polynesia and the conflicting reports of early Europeans as to whether the pottery they saw in Tonga was of local manufacture or imported, apparently encouraged in McKern the feeling that pottery in Tonga was abnormal and probably had its origin in Fiji, the Melanesian group to the west with which close relationships were maintained by Tongans during the eighteenth century.¹

Golson's fieldwork in Tonga, however, suggested to him that Tongan pottery was of local manufacture, that it belonged to the one ceramic tradition and that it had nothing in common with the late pottery of Fiji. Instead² he developed an observation made by Gifford and Shutler, who, when discussing the distinctive pottery excavated by them at their site 13 (Lapita) in New Caledonia, pointed to its possible relationships, by virtue of the character and motifs of its pointillé decoration, with McKern's Tongan pottery on the one hand and discoveries within the geographical Melanesian area on the other, comprising surface sherds from a site on Viti Levu in Fiji and especially material excavated in the early part of the century by Father Meyer on the island of Watom in New Britain.³ Golson noted that a considerable antiquity (first millennium B.C.) and an apparent priority in the

³ Gifford and Shutler, 1956, p.94.
local sequence could be ascribed to Gifford's site 13 pottery in New Caledonia on the basis of radiocarbon dates and, after his excavations on the Ile des Pins, from archaeological indications also.\textsuperscript{1} He therefore suggested the existence of an ancient community of culture in the S.W. Pacific antedating the division into Polynesian and Melanesian culture areas and straddling the boundary between them.

There were then a number of interesting hypotheses current in the early 1960s which stood in need of testing. For a number of reasons the Tongan group, and in particular the main island of Tongatapu, seemed to offer good opportunities for doing this. Excavations there could provide data for comparison with the materials being won in East Polynesia and contribute to the problem of cultural differentiation within Polynesia. Being on the western margin of Polynesia and in known contact, at least in the later phases of its prehistory, with parts of Melanesia, Tonga might be expected to reflect the role of such contacts in the development of the distinctive western variety of Polynesian culture. Particularly attractive was the abundant presence of pottery in the archaeological record, the well-tested sensitivity to cultural change of this type of material waiting to be exploited.

The aim of the work should be to recover pottery from as long a time range in Tongan prehistory as possible and to assess whether there was any phase of that prehistory

\textsuperscript{1} Golson, 1961, pp.169-70, 176.
when pottery was not in use. On the basis of adequate pottery collections it should be possible to judge whether the Tongan material in fact belonged to one ceramic tradition, if so what its relationship might be to the material from New Caledonia, New Britain and Fiji with which it had been compared, if not what the extra-Tongan affiliations and intra-Tongan relationships of the divergent traditions might be. The construction of a ceramic sequence would, together with other excavated material evidence, help to illuminate the nature of Tongan culture history and throw light on the larger question of the culture history of the Melanesian and Polynesian areas.

At the same time such investigations would help directly and indirectly in reconstructing the nature of Tongan culture at different times in the past of the main island of Tongatapu where the effort was to be concentrated. The direct contribution would come from the data gathered in the process of establishing the ceramic sequence. Indirectly the successful establishment of such a sequence might be expected to help when other problems in Tongan prehistory, for example the antiquity of fortifications,¹ came to be investigated.

¹ McKern, 1929, pp. 80-9.
CHAPTER II

GEOGRAPHY AND HISTORY

The Tongan archipelago consists of about 150 islands, scattered between latitudes 15°S and 24°S and between longitudes 173°W and 175°W. The majority, however, is situated between latitudes 18°S and 22°S, only the isolated Niuafo'ou, Niuatoputapu and 'Ata being beyond these limits. The total land area is 270 square miles (730 km²). Excluding the outlying islands named, the Tongan islands fall into three groups, the southern or Tongatapu group, the central or Ha'apai group, and the northern or Vava'u group, the Ha'apai group being separated by some 60-70 miles (100-120 km) of open sea from the other two.¹

It is of some importance that, like the islands of Melanesia, Tonga is of 'continental' formation. It is the only Polynesian group situated west of the so-called andesite line of the West Pacific and is thus distinguished from the truly oceanic islands to the east.

¹ The material in this chapter is taken from the following: E.W. Gifford, Tongan Society, 1929; T.F. Kennedy, Geography of Tonga, 1959; Naval Intelligence Division, Pacific Islands, vol. III, Western Pacific, 1944; and Tonga Report 1962-3. Specific references are made in special cases only. See also map, fig. 1.
of this line where basaltic lavas and reef limestones constitute the geology.¹

Within the archipelago there are three types of islands.

Situated on the western side is a series of subaerial volcanic islands which form part of a volcanic chain running from New Zealand through the Kermadecs and Tonga to Savai'i in Samoa. These volcanic islands in Tonga range in height from 350-400 ft (115-135 m) to 3380 ft (1130 m) and include active, dormant and extinct volcanoes. Tofua and Kao, in the Ha'apai group, are used today by Tongans, as they were in the past, for the collection of volcanic stones for a variety of purposes: large stones (makahunu) for use in earth ovens (umu), smaller pebbles (kilikili) for the decoration of chiefly graves.² Today the small pebbles are collected for use as grouting in concrete.

Confined to the southern and the central groups are a number of raised marine volcanic islands, formed from submarine volcanic materials, some additionally also from limestones. They range in height from 150 to 1000 ft (50-330 m) and include the Nomuka group in Ha'apai and

² McKern, 1929, p.31. This was recently done with the grave of the late Queen Salote, Pacific Islands Monthly, April 1966, p.12.
'Eua near Tongatapu. The latter island has been investigated geologically in greater detail than any other island in Tonga. The geological sequence is made up of old volcanic rock at the base, next of foraminiferal limestone followed by red tuff reflecting renewed volcanic activity, and the series is concluded by coral limestone. Later elevations and disturbances have tilted the entire structure with the result that all four strata are now more or less exposed. The two volcanic strata have as a result been open to exploitation for raw materials by Tongans in the past.

The third type of island, which occurs throughout the archipelago, consists exclusively of coral limestone. The type comprises two varieties: the low islands, or atolls, of which the lowest are a mere 20 ft (6.5 m) high, and the raised coralline islands like Tongatapu and Vava'u, the latter with its 670 ft (223 m) being the highest in this category.

The soils of Tonga, derived from volcanic rock and limestone, are rich and fertile and cultivated land occupies a larger portion of the total area than is usual in most Pacific islands. It is significant that in the past some of the coral islands have been showered with red volcanic ash which, mixing with decomposed limestone, has produced soils more fertile than usually found on limestone islands owing to the greater mineral content of the volcanic element. This is for example the case on

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1 J.E. Hoffmeister, Geology of Eua, Tonga, 1932.
2 Or dykes, see Appendix I.
Tongatapu, the only island where the soils have been analysed in some detail. In the low areas of the northern coast and around the lagoon the soil is sandy and often mixed with coral fragments. Everywhere else the soil is of a markedly clayey character, blackish brown or dark red in colour and of a depth up to 40-50 cm. There are two types of clay subsoil, to the west a loose, red coloured clay and to the east a sticky and yellow coloured clay. The total depth of soils varies considerably. From Nuku'alofa and west along the north coast it is shallow, ranging between 50 and 100 cm. South of this and in the centre of the island the depth goes down to about 4 m, whereas in the eastern and higher part of the island the soils attain a total thickness of 12 m and more above the coral rock. On 'Eua the soil is derived from both volcanic and limestone materials and there is the additional element of volcanic ash as on Tongatapu. Concentrated occurrences of volcanic ash of limited extent exist on both Tongatapu and 'Eua. They appear to consist of pure clay and have no doubt been exploited as sources of raw material for pottery making.¹

The climate of Tonga is tropical with a cool, relatively dry season from May to November and a hot and humid season from December to April. The prevailing wind is the southeast trade, but westerly and northerly winds of some significance blow in the hot season, especially in February and March, which is the hurricane period. Rainfall, temperature and humidity are factors of

¹ See Appendix II.
increasing intensity from south to north. The average annual rainfall for Tongatapu and Ha'apai is 60-70 inches (150-180 cm), whereas in Niuafo'ou, northernmost in the group, it is almost twice as heavy. Most of the rain falls in the hot season and spells of drought are not infrequent in the cool season. The temperature is regularly between 70° and 80°F (21° and 27°C), the extreme high and low temperatures never exceeding 90° and 50°F (32° and 10°C).

Natural supplies of fresh water are scarce in Tonga. There is one permanent stream on Niuatoputapu, several ephemeral creeks on 'Eua, and a few lakes on Tofua, Niuafo'ou and Vava'u, plus two open-air pools and several cave pools on Tongatapu. But the normal way of obtaining water is to dig wells and to collect rain water. In former times rain water collecting was done in pits dug in to clay soil or lined with clay.

With good soil and climate the vegetation is fairly luxuriant, except on the atolls, but it is also marked, like the rest of the Pacific island world, by the paucity of its genera. Wild vegetation now occupies a relatively small proportion of the total land area, being mostly confined to mountainous regions and being best seen on

1 See graphs in Naval Intelligence Division, 1944, figs. 11-4.
Vava'u and 'Eua. The latter island is the only one where rain forest occurs.

It is generally accepted that the indigenous flora of the Polynesian islands could not have sustained the well established societies which the Europeans met at discovery. On the contrary these depended on the cultivation of plants brought in at the time of first settlement or introduced later. The food plants of Tonga are those common to Oceanic horticulture as a whole, root crops like taro, yam and sweet potato, tree fruits like breadfruit, banana and coconut, and other plants like sugar cane and kava. But like other groups Tonga occupies a place in regional patterns of varying plant significance. Thus the sweet potato was of less and the yam of much greater popularity in West Polynesia than in East. The kape tubers (Alocasia macrorrhiza) were of particular importance in Tonga and Uvea. It is interesting, too, that apparently the sago palm was known in Rotuma, Samoa and Tonga before European contact, used mainly for building materials. Other important plants were the paper mulberry, its inner bark used in the manufacture of tapa, and the pandanus, whose leaves are used in mat making and whose fruits are edible. Raw

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1 J. Barrau, Subsistence Agriculture in Polynesia and Micronesia, 1961, p.18.
2 Ibid., p.19.
3 Ibid., pp.44-6, 53.
4 Ibid., p.19.
5 Ibid., p.60.
materials for a wide range of construction and handicraft purposes were available in local trees and plants. It is interesting to note that relatively large areas with timber still exist in 'Eua, a resource which is of considerable economic importance today.¹

Like other Pacific islands the terrestrial fauna is poor,² being confined to small animals like lizards and to a variety of insects. Noteworthy members are the fruit bat or flying fox (Pteropus tonganus) and, among the few native birds, the fruit pigeon (Globicera pacifica). This migratory bird was in former times the quarry in the chiefly sport of snaring, in pursuit of which special mounds were built.³ Animal foods appear never to have been of any great importance in daily life, but only on special occasions and then in the main of domesticated animals. These were pig and chicken, both present before European times. It is doubtful, however, whether the third domestic animal of Oceania, the dog, was known.⁴

The Polynesian rat (Rattus exulans) had, however, been introduced in prehistoric times. According to Mariner, it was regarded as a food for people of lowly rank, but it was also a chiefly sport to hunt rats with bow and arrow.⁵

¹ Kennedy, 1959, pp.42-4.
³ McKern, 1929, pp.19-30.
⁵ W. Mariner, An Account of the Natives of the Tonga Islands..., vol. 1, 1827, p.225.
Land resources of every kind, both indigenous and imported, were thus of sufficient variety and extent to sustain flourishing human settlement. It is important to note, however, that some of these resources were not evenly distributed throughout the group, so that the deficiencies of some areas in desired materials gave the impetus to specialised trading within the islands.¹

Richly supplementing the land resources was the ever-present sea. The best fishing grounds are close inshore around reefs and islands. In the Ha'apai group, for example, are extended areas of submerged reefs and shallow water in which not only can fish be caught in plenty, but also turtles. In addition the reefs in general offer good catching grounds for other important items of seafood such as crab, lobster, octopus and certain species of shell fish. The sand flats are rich in shell fish and are visited by schools of small fish. In the deep water areas occur large fish like tuna, bonito, snapper and shark. Inshore seaweed can be collected. From the sea, too, come raw materials that were of some importance in prehistory, especially on coralline islands: shell, coral and pumice.

Navigation among the islands can be difficult owing to reefs and to strong and variable currents, but it is nevertheless still carried out extensively. There is also much evidence that the Tongan navigators of the eighteenth and nineteenth centuries ventured far beyond their home waters to Fiji and Samoa some 250 miles (400 km) and 500 miles (800 km) away respectively, to mention two major

¹ Gifford, 1929, p.131.
examples.¹ The record of the famous voyage of the Tongan Kau Moala at the beginning of the nineteenth century serves to illustrate the navigational skill and seamanship which makes the claims for long distance contacts between Tonga and the external world in prehistoric times plausible.² Exercised within the Tongan group itself, the navigational skills made possible the unification of the scattered islands into a kingdom controlled from Tongatapu in the south, the largest and richest of the islands.³ Since fieldwork was concentrated on this island, it will be useful to have a more detailed description of its geography.

Tongatapu is a raised coralline island, some 150 square miles (400 km²) in area. The particularly fertile soil of the island is, as previously mentioned, due to the mantle of volcanic ash that overlies the decomposed zone of bedrock limestone. Off the north coast are extended areas of sand flats and reefs more or less exposed at low tide, and here are to be found a number of islets. The north coast is made up of sand beaches or mangrove swamps. In a southerly direction the land gradually rises, attaining a maximum height of 270 ft (90 m) in the area of

³ Gifford, 1929, pp.46-7, 181.
the aerodrome near Fua'amotu. The so-called Liku coast to the east, south and west is high and rocky, consisting of old coral formations, often ranged in terraces of varying altitude. In many places it falls steeply into the ocean, at Hufangalulepe beach from a height of 210 ft (70 m). Caves and strips of coral sand beach occur here and there along its entire length, some of the caves on the eastern coast, facing 'Eua, containing considerable fresh water pools close to the entrance. The fringing reef is quite close to land on the Liku coast, some 60-240 ft (20-80 m) out, with the open ocean immediately beyond. It is a very inhospitable coast, however, with only a few passages through the reef where canoes can be navigated in and out.

A major feature of Tongatapu is the extensive lagoon, occupying a large part of the centre of the island and connected with the sea through one main entrance, the strait alongside the villages of Nukuleka, Maka'unga and Talafo'ou. Though tidal movement is very marked along the sea shores, hardly any such movement is observable in the inner parts of the lagoon, particularly at its innermost corner adjoining the district of major investigation at Pea, some 7 miles (11 km) from the open sea. There are a number of reasons for this. The strait which forms the sole connection between lagoon and sea is very narrow compared to the extent of the lagoon; the water in the strait is very shallow at high tide and at low tide is restricted to a few narrow passages along its western margin; finally the lagoon itself is shallow over its entire area - a man can touch bottom in most places. Shell fish can be collected in abundance everywhere, in the lagoon and in its entrance. Two pools are situated on the
lagoon coast inside the mangrove swamp near Pea. The water here is not completely fresh, being composed of lagoon water and fresh water seeping out of the coral rock just beneath the surface of the pool. In most places the lagoon coast is overgrown with mangroves.

The land is generally speaking flat and level with only a few elevations. Quite a good road system connects the modern villages which are kept clean and tidy. Between the villages there are gardens, scrub and bush. In the wet season many of the bush roads become impassable for motor vehicles as the clay soil quickly turns to mud, even from a single shower. The vegetation outside the clearings is rich and dense, making surveys of large parts of the island troublesome and sometimes impossible.

Today the population of Tongatapu is about 32,000 giving a density of 320 persons per habitable square mile (of which there are about 101) or 210 individuals per square mile, the total land area of 150 square miles considered. Population figures collected in the period 1840-1921\(^1\) show a fairly steady population increase from about 8000 to about 9740. The density for Tongatapu in 1921 was about 65 individuals to the square mile, the total land area considered. The difference from the present situation is thus striking. But the relevance of the older estimates to the prehistoric situation remains unknown in view of the period of social and political upheaval following regular European contact that intervenes between the two.

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\(^1\) Gifford, 1929, pp.4-5 and table I.
The Tongan islands were discovered piecemeal by European voyagers: Niuatoputapu by Schouten and Lemaire in 1616; 'Ata and Tongatapu and Nomuka by Tasman in 1643; Vava'u by Maurelle in 1781; Niuafou'ou by Edwards in 1791. Cook visited Tonga three times in 1773, 1774 and 1777 on his second and third voyages. It was during his visit to Ha'apai in 1777 that he coined the name 'The Friendly Islands', though initially this was meant for Ha'apai only. Although Tonga was thus first seen relatively early in the era of European discovery of the Pacific, the real period of European contact did not begin until the very end of the eighteenth century. From that time onwards the number and variety of visiting Europeans and the number and degree of influences from the outside world steadily increased.

Early observers noted the existence of a markedly authoritarian and centralized system of government and a stratified society made up of the royal family, chiefs and commoners. From traditions and genealogies subsequently collected, this seems to have been the case for some centuries previously: on genealogical reckoning the king list can be carried back to the tenth century AD. The same sources further indicate that the islands were already peopled before the appearance of the Tui Tonga dynasty, which was probably preceded by an earlier dynasty. The traditions have also been interpreted to show that over many centuries a steady trickle of immigration took place

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1 Gifford, 1929, pp.48, 108.
2 Ibid., pp.49-51.
3 Ibid., pp.12, 49.
from Fiji, Samoa, Rotuma and Tokelau. More important additions are said to have been made from Fiji about 1200 AD and in the sixteenth and seventeenth centuries, and from Samoa in the sixteenth century.¹ For their own part the Tongans traditionally extended their influence overseas, even establishing sovereignty over some islands, for example Uvea, Rotuma, Futuna, Samoa and Niue, mainly for the purposes of tribute. Rotuma still had to pay tribute to Tonga as late as 1824.² According to the traditions Tongan governors were sent to the overseas territories, in the fifteenth century for instance to Samoa, Futuna and Rotuma.³ Many Tongans are said to have married and settled in Samoa, and before 1250 AD some of the Tui Tonga even had official residences in Upolu and Savai'i. The connections with Fiji were particularly close, at least in the period immediately prior to regular European contact.⁴

About settlement in Tonga itself early European observers described this as a dispersed pattern with family homesteads scattered all over the terrain, placed in the middle of their gardens.⁵ The origin of the present pattern of village settlement is explained by reference to the highly unstable political conditions of

¹ Gifford, 1929, pp.13-4.
³ Ibid., p.12.
⁴ Derrick, 1950, pp.120-5.
⁵ Gifford, 1929, pp.5-8, 45.
the first half of the nineteenth century, characterized among others things by civil wars throughout the islands. Under these circumstances people gathered together to live in centralized settlements for the sake of safety. It is the general belief that Tongan forts with ditch and bank defences\(^1\) reflect this change in the settlement pattern.\(^2\) If so, they should all be late in date. However, the defences at the former royal domain at Mu'a would on genealogical grounds be dated to the fourteenth century AD, an antiquity consistent with the fact that the defence works tie in with an old shoreline of the lagoon.\(^3\) However, being a royal centre, Mu'a may be exceptional, making it impossible to argue from the situation there to that elsewhere on Tongatapu.

The impact of European on Tongan culture in the nineteenth century was swift, severe but not complete. Mainly affected were material culture and religion, though even here the extent of change varied. It is a characteristic feature of modern Tonga that it has succeeded in retaining a remarkable amount of its traditional culture.\(^4\) The sequel will show some of the areas in which change has occurred.

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\(^1\) McKern, 1929, pp.80-89, being a description of 19 fortifications from all three island subgroups, 12 of them situated on Tongatapu.


\(^3\) McKern, 1929, pp.100-1.

CHAPTER III

SITE RECONNAISSANCE

Work was concentrated on Tongatapu for a number of reasons. It is the largest and most fertile of the Tongan islands and traditionally the most important. Archaeologically it appeared to be the most promising. Sites producing pottery, which was to carry the burden of the investigations to be attempted, were evidently abundant here, judging from the fieldwork of McKern and Golson. Indeed Tongatapu with its offshore islets and the neighbouring island of 'Eua is the only part of Tonga for which pottery has been reported archaeologically, though it is also the place where most archaeological reconnaissance has been done. Cook observed pottery on Nomuka in the southern part of the Ha'apai group of the same sort as that on Tongatapu and supposed it to be of local manufacture. Further Mariner saw pottery in use on Vava'u, said to be imported from Fiji. However, McKern, who worked in all parts of the group, reports no pottery

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1 In connection with this chapter see map of Tongatapu, fig. 2.
3 Quoted in McKern, 1929, p.117.
finds from Ha'apai and Vava'u, while members of the Cadastral Survey of Tonga, working through the group for a number of years from 1957, failed to find pottery, though they were on the look for it together with other archaeological information which they reported.¹

A variety of archaeological field monuments had been described for Tongatapu by McKern and Golson² including royal tombs (langi), chiefly burial mounds (fa'itoka), royal and chiefly resting platforms (esi), pigeon mounds (siaheulupe), habitation and/or burial mounds, house platforms (paepae), caves with evidence of habitation and burials, artificial wells and kitchen middens. The best opportunities for the present project were offered by this last category which regularly associated easily recognizable shell with abundant potsherds and other cultural materials.³ Such shell middens possessed an additional advantage for the current project, since they might be expected to record the presence of people who did not use pottery as much as of people who did.

In my own reconnaissance I followed up leads given by members of the Cadastral Survey to Golson and obtained by myself from Tongan and European residents, as well as undertaking straightforward field survey. It soon became apparent that the most numerous and productive midden sites were in the area of the lagoon, the region on which

¹ J. Golson, pers. comm.
² McKern, 1929; Golson, 1957.
McKern and Golson had concentrated. Within this area two localities seemed, from the frequency and nature of the sites, to be promising, the village area of Pea, Ha'ateiho and Tokomololo and the district in which the village of Nukuleka lies.

An effort was made to get some idea of the nature and intensity of habitation evidence in inland areas and along the Liku coast. Members of the Cadastral Survey had reported a few sites with sherds near this coast north of Haveluliku, but these I could not relocate on the available information. Instead I discovered a few sites in the same area where a handful or so of tiny sherds (all undecorated) could be collected on the surface, but where shells were lacking. Some stretches along the southern Liku coast were searched, but no pottery was found. At the utmost point of the Kolovai peninsula a few sherds were found together with a few shells. I also traversed parts of the cleared land belonging to Tupou College, Beulah College and Atele College, all inland environments, and here the situation was identical: an extremely limited number of scattered occurrences of sherds and no shells. When the airport area was cleared and levelled during World War II about one hundred mounds are reported to have been destroyed and various artifacts, including pottery, found, but any such material has been lost. The few caves on the eastern Liku coast were visited, but they did not show any obvious signs of use for habitation at or near their entrances.

As a result of this survey it was decided to concentrate work at the lagoon coast as offering the best opportunities for recovering culturally significant
evidence from sites that had evidently built up over some length of time. Furthermore, the shell element of these middens opened up two possibilities: faunal remains and bone artifacts should be well preserved in the calcareous conditions, while the shells themselves might produce some interesting information of an ecological nature. It was also decided to limit work to a small and compact area. Whatever the assumptions about the prehistoric settlement pattern, concentration on a restricted area seemed a more likely way of producing material for a continuous sequence rather than scattered investigations all over the island.¹

The area of investigation selected comprised the villages of Pea, Ha'ateiho and Tokomololo, situated within a convenient distance of headquarters in Nuku'alofa. Here about 15 possible midden sites were located, while in addition there were numerous mounds of varying types and at least two examples of ditch-and-bank construction, the well-known Pea fortification² and a remnant in Ha'ateiho village apparently comprising more than one line of defensive work.

The district is a flat and lowlying area of about 4 square miles (10 km²), the bed of an old extension of the lagoon, surrounded by the uplifted coral of an old shoreline. The area is so low that severe hurricanes and tidal waves cause parts to be flooded, one such event occurring in 1912. Coming along the main road from

¹ I wish to thank Dr R.C. Green, then of the Department of Anthropology, University of Auckland, for discussion of such problems on the spot in 1963.
² McKern, 1929, 86-7.
Nuku'alofa there is, just at the point where site To.6 is located, a steep descent of 8-10 m into the district just before the village of Pea and a similar ascent out of the district just east of Ha'ateiho at Atele College, not very distant from site To.5. Scattered occurrences of old shore banks are characteristic of the coastal part of the district. The present shoreline is an extensive mangrove swamp. The only two open-air fresh water pools in Tongatapu are situated in Pea village.

The choice of midden sites for excavation out of the number available within the district was in the main guided by the following consideration. Golson had reported the proportion of decorated to undecorated pottery in his sites to be very small (less than 1 per cent),¹ a ratio strikingly at variance with that at the Lapita site in New Caledonia (about 37 per cent)² and apparently also with the situation at Meyer's site on Watom Island.³ If, as appeared, the Tongan pottery was in the same tradition, one could perhaps with reason expect that a greater

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² Gifford and Shutler, 1956, p.71.
proportion of decorated to undecorated sherds than that reported by Golson would identify a site older than those investigated by him and others. In order to select sites for excavation that gave promise of belonging to different stages of Tongan prehistory, attention was paid to the frequency of decorated sherds, and to their decorative complexity, in surface scatters on, or from test pits into, archaeological sites. Equal attention was paid to the possible occurrence of shell middens without pottery, but none such were found.

The only excavation outside the district was at site To.2, Nukuleka, situated at the eastern entrance to the lagoon and thus within easy access of both shallow water lagoon and deep offshore fishing. It was hoped that excavation here might provide good evidence for fishing gear, such as was not provided by the prior excavation at site To.1. In addition, since the midden at To.2 formed part of a circular mound with flattened top, there was here an opportunity of carrying out the investigation of a mound. This aspect was also part of the reason for the limited investigations of two other mound sites, To.3 and 4, in the centre of the district.

A brief note on the mounds of Tongatapu will serve here. Their number is very impressive: they may easily total between 1000 and 1500. They seem to be present everywhere, scattered or in groups of a few or many mounds of varying types and sizes. A few sherds were occasionally picked up from or near a mound, and quite often varying amounts of coral sand could be observed on the mound surface, reflecting the presence of graves beneath. On the whole, however, it was clear that mounds as such
represented an archaeological task in its own right, demanding resources beyond my own if the many and important problems were to be attacked efficiently.

Excavations were made at the following six sites.

1. Situated on the Middle School grounds in Pea village. The shortest distance to the present lagoon coast is 400-500 m in a northeasterly direction. The approximate height above present water level in the lagoon is 2 m. A shell midden has been deposited on the surface of a barely visible elevation in the terrain. This elevation is a natural feature; it is not a result of the formation of the midden on the spot, as the thickness of the midden is the same everywhere. In general the elevated terrain continues to the south and southwest. To the west, north and east is a low-lying and ill-drained area which at some time in the past has probably been part of the lagoon. About 125 m west of the midden is a large mound still used as a cemetery. In the low-lying area north of the midden, some 200 m away, the Pea fortification is situated.

The midden is situated in the open, grass-covered school grounds (fig. 10). The school buildings and various houses and huts have been built on it and coconut palms grow here and there. From the evidence of some 200 test holes in the area there is a continuous cover of shell midden over at least 4300 m². Bulldozing to level the school playground has removed part of it to the north

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1 For some environmental aspects of the site see Appendix III.
and west. The original midden may well have covered some 4500 m². The average thickness of midden deposit is 50 cm and over most of its area its surface is horizontal.

The excavation started with the opening of 6 testpits, each 1 m² in area (see fig. 3). A total of 67.5 m² was finally excavated, i.e. about 1.5 per cent of the total shell midden, in five sections, I-V. Section I was designed to allow the study of the formation of the shell midden in detail. Section II was located at the transition from the shell midden to the area outside. Section III was dug to expose a burial located here. Sections IV-V were dug partly because many fine decorated sherds were found in testholes here and partly to experiment with a new excavating technique (see ch. IV). In addition four small pits, each 1 m² in area, were dug in order to obtain shell samples from various parts of the midden (25/75, 50/94, 90/120, 115/95). Shell samples were also collected from nine columns in section I. Everywhere the excavation was carried well down into the subsoil.

The site was brought to my notice by an old man of Ha'ateiho village, called Sevelo, who showed me sherds which he had collected there when the school was built a few years previously. A few of the sherds were decorated and in the pointillé style. During a subsequent visit to the midden a considerable collection of sherds was picked up from the surface. Roughly 10-15 per cent of these were decorated, also in pointillé style. The high proportion of decorated sherds encouraged excavation, which was started in December 1963 and lasted until April 1964. The working party consisted of 4-6 workmen, all Tongan, headed by the interpreter, Iteni Helu of Nuku'alofa. An
Australian undergraduate student, Nigel Statham of Canberra, was employed during December and January.

To 2. The site is a circular mound, with gently curving sides and flattened top (fig. 25.1). It is about 25 m in diameter and 1.5 m high. It is situated right at the southern end of the village of Nukuleka, bush and gardens starting at the same point. The shortest distance to the beach is about 200 m in an easterly direction. The ground level around the mound is about 1.5 m above high tide mark. The place is owned by Atungia Moala whose hut stands partly on the mound.

The village of Nukuleka is situated on a small peninsula about 1000 m long and 600 m wide, flat and low-lying, on the eastern side of the lagoon entrance. The lively flow of tidal water through this entrance accounts for the many fish traps observable at Nukuleka and further north. With good access to sea and lagoon Nukuleka seemed a good area to recover items of prehistoric fishing gear. These circumstances were, as mentioned above, the reason why a site was sought in this part of Tongatapu.

There are several midden sites in Nukuleka and quantities of potsherds were collected all over the peninsula and on the sandflats exposed at low tide. Moala's mound, however, was selected because of an interesting combination of features: sherds, including decorated ones, and shells were present in abundance on the surface of and near the mound; coral sand graves with skeletons were present in the mound; the top area of the mound was flattened and depressions from former post holes were still visible there. Having gone to Nukuleka in the
The problems posed by the site were clear. Was the mound built directly on the natural ground surface by materials from nearby, including shell midden material? Or was it built on the surface of an existing shell midden on the spot, so saving the mound builders time and effort? What was the relationship of the grave phase of the mound to the habitation phase(s)? Until about 1952 a house had stood on the flattened top of the mound. The depressions visible in the surface here were evidence of the former posts of this house. Moala's father lived in it. For reasons connected with the graves in the mound the house was pulled down. Some of Moala's relatives were believed to be buried in the mound, though Moala himself was sceptical.

It was thought sufficient to open just one trench, section I, 1 by 15 m in dimensions, from the centre of the mound to its northern margin (figs. 20, 21). A small section, II, was opened south of the centre to investigate the extent of a particular element of the mound deposit, the sio shells. In addition to this a number of test holes were dug on and near the mound to gauge the extent of the coral sand grave area and the shell midden. The area of the latter was about 300 m². The grave area of the main trench was not ideally excavated: the villagers insisted that the bones were removed for reburial on the
day of their exposure. Shell samples were collected from two columns.

The investigation of To.2 lasted from the beginning of May 1964 to the beginning of June. The working party was the same as at To.1 except for the Australian participant.

To.3. This mound (fig. 31.1) is situated in the centre of the village of Ha'ateiho, adjacent to the main road and only 500 m distant from site To.1. It is owned by Mrs Samoa Mafi, whose house is on top of it. The shortest distance to the lagoon is about 200 m in a northeasterly direction, the mangrove swamp starting only 80 m away. The ground level around the mound is roughly 1-1.5 m higher than the water level of the lagoon.

The mound at present covers an area of 43 by 50 m and is almost 2 m high. In some places the sides are gently sloping, in others they are steeper; sometimes they are straight, sometimes irregular. There is a large, flattened top. The present form is no doubt a modified version of the original mound due to digging on and near it, especially at the northern corner where quantities of earth seem to have been removed.

During inspection of the mound shells and sherds were collected from the surface and from a small number of test holes dug at random. There were no reports from the local inhabitants of graves in the mound, nor could any evidence of such be observed in the field. The construction of the big living house on top of the mound could hardly have avoided revealing evidence of graves had these existed. Apparently the mound was a large shell midden. This
itself was interesting, in that shell middens normally do not assume mound form. Limited excavation was undertaken to investigate this particular aspect. Any recovered pottery would be valuable for comparison with that from the not very distant site of To.1. Finally I was interested in the potential on midden sites of excavations limited to a few square metres in area.

Section I (see fig. 28) was opened at the northern corner of the flattened top area. It was 2 by 2 m in area. Shells were sampled from one column here. Section II was dug to investigate the stratigraphic relationship between the mound To.3 and the neighbouring mound complex, To.4. It was 0.5 by 8 m in dimensions, (fig. 31.2).

The investigation of this site took place from the end of June to the beginning of July. The working party consisted of 4 workmen and the interpreter.

To.4. This mound complex is situated in the centre of the village of Ha'ateiho, adjacent to the main road and to site To.3. It is owned by Timoti Masima. The shortest distance to the lagoon is about 200 m in a northeasterly direction, the mangrove swamp starting only 80 m away. The ground level around the mound is about 1-1.5 above the water level of the lagoon.

The site designated To.4 in fact consists of two mounds, provisionally called the burial mound and the house mound. Shells were visible on the surface of the latter, but sherds were rare. Interest was stimulated in this complex because the house mound, only 30-40 m away from site To.3, had been tested at its northwestern margin by Golson in 1957. It was hoped that restricted
excavation might reveal something of the history of the house mound and its relationship to neighbouring features, including evidence as to whether in fact the house mound concealed an undisturbed midden deposit or not.

The burial mound is well formed, rectangular in plan with rounded corners, covering an area of 25 by 15 m. The sides are fairly steep, the top almost flat. The height is about 2.5 m. At the southeastern end, where the burial mound and mound site To.3 originally overlapped, a bulldozed road had exposed a cross-section. This section revealed that the burial mound was built up of alternating deposits of coral sand and shell midden (including sherds). The northern part of the burial mound overlaps the house mound. At this end the side of the burial mound is less steep than elsewhere and here a big coral limestone slab is still visible. All the field evidence is therefore in agreement with the opinion of the villagers that the mound was constructed for burial purposes, but whether for chiefly ones, as is also maintained, is uncertain.

The so-called house mound has quite a different appearance. Covering an area of about 30 by 30 m, its ground plan is so irregular as to defy description. The maximum height is 1-1.5 m. Apparently a lot of digging has taken place on and around this mound. On its flattened top stands a living house erected on wooden posts. The occupant informed that he had never seen any traces of human bones or graves, not even when he built the house.

Two sections, each 1 by 2 m in area, were opened in the flattened area of the house mound (fig. 33), section I northwest of the house close to the spot where Golson did
his trial excavation in 1957, section II on the opposite side of the house. Shell sampling was started, but given up later when the stratification showed it to be of no value.

As the burial mound was still respected, no investigation could be carried out there.

Just on the opposite side of the main road a mound had been removed by a bulldozer a few years ago. The owner reported that this mound had been circular in ground plan with steep sides, about 3 m high and 20-25 m across. Pottery was found here.

The investigation of this site lasted from the beginning of July to the middle of the month. The working party was the same as at To.3.

To.5. This midden site is situated in a bush garden west of the village of Veitongo. The land is owned by Leafa'a, widow of the late chief, Tu'ihateiho. The site is 300 m north of the main road passing Atele College at a point midway between the entrance to the headmaster's house and that to the teacher's house, then occupied by Mr L. Lancaster. It is 150 m from the nearest point of the present lagoon shore in a northerly direction and 400-500 m northwest of the northwestern corner of Veitongo village. The height of the midden area above the water level in the lagoon is 1.5-2 m.

The bush garden containing the site is situated on sloping terrain. The slope rises gently from the lagoon but becomes considerably steeper some 50 m south of the midden, beyond which the land is flat. Between the slope and the mangroves is a flat area of varying width. This
topography continues about 500 m east and west of the site and evidently represents an old shore line roughly parallel to the present lagoon shore. It links up at its western end with the old shore line that defines the nuclear area of investigation. Site To.5 is thus not situated within, but rather on the margin of this area, the distance from To.5 to To.3 being approximately 1000 m.

The slope west of the site was under grass and scrub with a few scattered trees. On the few small areas free of vegetation shells and sherds could be collected. The slope east of the site was under cultivation except for areas with coral outcrops and attendant vegetation. In this area reconnaissance was easier and at three different spots concentrations of sherds and shells were visible on the surface. One of these possibly links up with the To.5 midden, but the connection, if any, was concealed under wild vegetation. Between the midden and the mangrove belt was an area of dense grass, in the centre of which was found an artificial well. A similar well is situated only 40-50 m away from the midden to the east, hidden between two coral outcrops, each 5 by 5 m in area and 3-4 m high, and only 3 m apart. The inner faces of each of these rocks from small and narrow shelters. Situated in a garden on the flat area below the eastern slope and about 100 m away from the midden to the northeast is a circular burial mound, about 20 m across and 1.5 m high.

On the flat ground just below the midden, only 50 m away in a northerly direction, is a chiefly burial mound, a so-called fa'itoka. It is about 40 by 40 m in area, almost strictly rectangular in ground-plan. The corners are oriented to the cardinal points. The course of each
side is quite straight. The corners themselves are fairly sharp. The sides are evenly sloping at an angle of 30-45 degrees. The top is relatively flat, being raised about 1.5 m above the surrounding ground.

Situated in the centre of the western quarter of the top of this big mound is a very small and low mound of rectangular plan with rounded corners. It is very disturbed by cultivation. Traces of a ditch are visible northwest and southwest of the mound. At the northern end is a coral slab 50 by 40 by 10 cm, standing on edge possibly in its original position parallel to the side of the mound. The grave in the centre was disturbed, apparently recently.

20 test holes dug in the top area of the big mound did not expose any traces of graves. Only a few shells and sherds were found on the surface here.

The investigation of this site strongly indicated that burial had taken place at one spot only: in the small mound. Whether this happened once or several times is, however, uncertain as no excavation could be carried out here. All evidence thus points to the fact that this large mound is indeed a fa'itoka.

On the flat elevated land behind To.5 were gardens and scrub. Near the edge of this elevated country above the site, and some 300 m away from it, was a circular burial mound, coral sand, the common indicator of graves, being visible on the surface. A few sherds and shells were found on top of and around this mound.
The area is then one rich in archaeological sites. According to Hon. Ve'ehala, Keeper of Tongan Traditions, there is traditional reference to habitation here.

The indications of the site designated To.5 itself were shells and sherds. The surface on which they lay was flat, with no features of relief. The area over which shells and sherds could be collected was about 35 by 35 m, beyond which was dense vegetation. The indications were that the midden continued a little east and west of the open area.

The sherds were collected from the surface and a series of test holes was dug to get some idea of the extent of the midden deposit which was judged to about 1000 m$^2$. In general this proved to be defined by the surface scatter of shell. The test holes also showed the midden to be thickest towards the south, away from the lagoon. Two sections were opened here (fig. 35), section I, 1 by 11 m in area, in the northern part of which a test hole had revealed a thick hearth deposit with charcoal, and section II, a mere 1 by 2 m in area, in which a test pit had indicated a notable concentration of shell. Later section II was extended a little to investigate an occurrence of human bone.

Experience at To.3 and 4 showed that, though restricted excavation of the type tried there was enough to give evidence of site stratigraphy, it failed to produce a large enough pottery sample for analytical purposes. At To.5, therefore, a total of 10 square metres was excavated, this being judged in the light of experience as a minimum size of excavation at this type of midden.
Shell samples were taken from one column.

The site was selected for excavation, in preference to others, because of its morphological similarity to the midden at To.1 and because of its geographical position at the southern margin of the area at the centre of which lay sites 1, 3 and 4.

The investigation of the site was started in the middle of July and lasted the month out. The working party was the same as at To.4.

To.6. Tufu Mahina. This is a midden located just north of Pea, on the main road from Nuku' alofa where it begins its short, sharp descent down the old coral shoreline to the village. The land is owned by the Royal Family. The shortest distance from the site to the present lagoon shore in a southeasterly direction is about 200 m. The surface of the site is 8-10 m above the level of the lagoon.

The midden is situated right on the corner where the old shoreline forming the boundary of the main area of investigation approaches the shore of the present lagoon from the west and turns northeast to follow it towards Nuku' alofa. It stands right at the top of the slope which here is very steep.

Both on, above and below the slope northeast of the site were gardens with scattered concentrations of shells and sherds. At one particular spot below the slope and about 500 m away from the site was a concentration of shells and sherds on completely flat and somewhat swampy ground near the mangrove belt. The slope west of the site could not be surveyed owing to dense vegetation. In the
low area just below the site was scrub and mangrove swamp. About 150 m south of the midden is one of the very few fresh water pools on the island.

Most of the midden was situated in cleared garden. Its original extent was judged to have been about 1400-1500 m$^2$. The southern end was completely removed during World War II when the American army built water storage tanks there. The main road cuts through the northwestern part of the midden, but the northwest corner can just be recognized on the other side of the road. Though it is thicker at the centre than at the margins, the midden is by no means a conspicuous feature of the landscape. In this respect it resembles the middens at sites 1 and 5.

The site attracted attention because, unlike the other excavated sites, To.6 did not produce a single decorated sherd in the surface collection made at it. It promised to be a key site for the establishment of a pottery sequence in the area on the northern boundary of which it is situated.

The history of the excavation is briefly recounted as follows (fig. 40). An initial test pit of 3 m$^2$ produced no decorated sherds. A full section (I) of 14 m$^2$ yielded three decorated sherds only, all from the bottom. The next trench (VI) gave one decorated sherd only, also from the bottom. Excavation here, however, produced four stone adzes, all in the bottom half of the midden. In addition a so-called 'soft horizon' was uncovered within the midden, with evidence of a structure which was thought to continue to the northwest. In order to investigate this, two new sections were opened in the order IV and II. The
intervening sections V and III were then excavated. Further excavation could most unfortunately not be carried out due to lack of time.

The site proved to contain important structural evidence, the nature of which the limited excavations could not elucidate. In other respects, however, important results were achieved: only seventy decorated sherds were found in 69 m$^2$ of excavated midden, but a total of eighteen stone adzes and several fragments was found.

The investigation of To.6 lasted from early August to early September. The working party was the same as at To.5, with the addition of two new workmen.

Summary

In order to obtain sufficient material for the construction of a pottery sequence, work was concentrated on shell middens. Reconnaissance early indicated that the lagoon shores constituted the most promising region. A small area was chosen for intensive work as being more likely to produce material for a sequence than scattered investigations. The district selected, in and near the villages of Pea, Tokomolo and Ha'ateiho, is a flat and low-lying area surrounded on three sides by elevated terrain, on the fourth by the lagoon. The investigated sites cover the northern and the southern border and the centre of the district. All the sites are within a few hundred metres of the present lagoon shore and only 1-2 m above water level in the lagoon, with the exception of To.6 which is 8-10 m above the lagoon. Sites To.1, 3 and
4 are situated in the inhabited area, sites To.5 and 6 are in the bush. Site To.2, the only site outside the district, is also close to the present shoreline and to water level. It lies in an inhabited area.

Sites To.1, 5 and 6 are unmodified midden sites of no great depth and with a flattish surface, thus not constituting a conspicuous feature of the terrain. In contrast sites To.2 and 3 are elevated and the original midden here has been modified in some way. To.4 gave no evidence of original midden at all. All sites except To.4 promised to contribute to the task of establishing a pottery sequence. Sites To.2 and 3 offered the opportunity of investigating at the same time some aspects of mound construction and use, and To.4 was included for the same purpose. To.2, the only site outside the specified district, was excavated with the aim, unfortunately not realised, of recovering items of prehistoric fishing gear.
EXCAVATION TECHNIQUES AND STRATIGRAPHY

Excavation Techniques

Before fieldwork started it was evident that shell middens could be an important source of evidence for the purposes in mind but the character of these middens was practically speaking unknown. The degree of success in obtaining the required information on cultural development was obviously dependent on the character of the middens. This fact caused some preoccupation with the subject of excavation methods before departure for the field. A major consideration was whether any stratification would be recognizable in the middens. Three methods of digging were possible: by original midden layers; in units of arbitrary, standard volume, so-called spits; by a combination of these two basically different methods.

Excavation could proceed normally on sites with clear stratification. The situation would, however, be quite different in the case of middens with unclear stratigraphy. In such cases success would depend on the time available and the skill of the archaeological personnel. The circumstances of this particular project were that time was limited and that labour was to be recruited locally to work under the supervision of a single trained archaeologist. The archaeologist would be responsible not only for the supervision of untrained diggers but for the total record of the excavation. The question therefore
emerged whether some simpler and quicker method than that of stratigraphic excavation might not be possible that would expose stratigraphic relationships within the site equally well. Any such method should enable an analysis of the excavated material to be made aimed at revealing time differences between the various parts of a midden vertically and horizontally.

A further argument supporting the conclusion that great efforts at stratigraphic excavation might not be worthwhile in dealing with difficult shell middens was that the painstaking record of an unclear stratification of midden material might not be of much importance when it came to analysing the artifactual evidence. One cannot be certain that artifacts, in the present case predominantly potsherds, found in specified layers of such middens all have always belonged in the position in which they were found by excavation. The nature of middens in general - the trafficking of people, the digging of various kinds of holes, possibly the wholesale displacement of midden material due to construction activities of various kinds - would make it not only reasonable, but necessary to realise that potsherds may have shifted position several times, both vertically and horizontally, through the life time of a midden. In the specific case of the Tongan middens it became apparent during fieldwork that some of these sites were now being used for gardens and many of them had probably been so used in the past. Therefore a knowledge of the approximate position of the artifactual evidence in such middens was judged to provide enough control for the elaboration of a possible sequence. The same argument in fact applied to clearly stratified middens unless the
layers should prove to be separated by sterile zones, for example of beach sand or volcanic ash.

So-called spit digging thus appeared to be the answer in the light of the objectives which had been set for the research project as a whole. This is equivalent to dividing a midden into pigeon holes, adjusting the volume and orientation of the pigeon holes to the situation on the individual sites. The method of analysing the material from middens excavated in this manner would obviously have to be based on the frequency of occurrence of selected characteristics of the dominant finds and for this purpose adequate samples would need to be excavated.

Such an analysis cannot give a completely true picture, but will show tendencies only. But it is doubtful in view of the nature of middens in general and Tongan middens in particular, whether even the painstakingly stratigraphic excavation of a complex midden will itself reveal more than tendencies. The question therefore is what the qualitative difference between the two sets of differently obtained tendencies will be. It may not be possible to give any definite and absolute answer to this, but the two sets of tendencies for logical reasons ought to be basically identical. From a theoretical point of view it thus would be a matter of indifference which of the two sets to prefer, but from a practical point of view one would evidently choose the latter rather than the former.

With wholly unstratified middens the only possible way of digging of course would be to dig in units of arbitrary volume. Even with a stratified midden it would
be advisable to dig layers of appreciable thickness in spits, too, as this might enable one during analysis to detect the details of a sequence within a particular horizon.

Because of all these considerations the idea of spit digging seemed to offer a good means of controlling the data from shell middens, whether stratified or not.

Before continuing it may be suitable to insert a note on the relationship between the growth rate of middens and the volume of spits. It is quite uncertain with what speed total middens or any part of them built up over time in Tonga. Nor was any attempt made in the field to deal with this question. It is on the whole doubtful whether an analysis of the artifactual data themselves can contribute in any real sense to its solution. There are too many variables involved in the accumulation of a midden through the dumping of shell, ash, earth and perishable garbage and in the presence therein of artifactual waste to allow of any easy answer. In the circumstances it is therefore impossible to know anything about how much time any spit volume is equivalent to, regardless of its position in a midden. Considerations of growth rate were therefore from the very beginning kept completely out of the analysis.

At the start therefore the decision was taken to excavate always in spits, and to dig by original layers only where it was obvious that they could be recognized by the local labour without too much trouble and if other circumstances were in favour of this procedure. In all cases all excavated ground was to be passed through sieves.
At the first site, To.1, both excavation methods were tried out in practice in the main trench, 2 by 19 m in extent and with a midden thickness on average of 50 cm. Each spit was 1 by 1 m in area and 10 cm thick, the depth regularly checked with a dumpy level. Within each square a separation was made at the interface between the two main midden deposits. The workmen did their best, and the results were quite creditable. But the time taken to work the trench in this manner, more than eight weeks including interruptions for bad weather, was too long.

When all the profiles delimiting the trench were drawn, it was evident that an identical sequence of deposits was visible in all: top horizon of midden, bottom horizon of midden, subsoil. The idea then emerged that one might be able with a reasonable degree of accuracy to refer the artifactual evidence as dug in standard spits to its actual distribution within the structure of the site simply by allocating the spits to the original midden layers as recognized in the profiles. The next step was obviously to make the experiment of digging by standard spits exclusively, i.e. to ignore the original layers during the actual digging but to record these on parallel profiles at intervals of 1 m as a compensation for the more destructive way of digging.

The experiment took place in sections IV and V of To.1, and the results were thought to be satisfactory. The decision was therefore taken to apply this technique of excavation as a standard procedure on the midden sites to follow To.1, but with the modification that the dimensions and the gradients of the spits should be adjusted to the local circumstances, particularly on
sloping terrain. Digging by layers should only take place in very exceptional cases. In fact all the sites To.2-6 were dug by spits and no doubt has subsequently arisen that it was perhaps a wrong principle to follow. And it had the immediate practical advantage of allowing excavation to proceed at a reasonable pace, given that a number of sites had to be excavated and an adequate sample of material recovered from each.

Recording and Cataloguing Finds

In all middens a distinction was made between special finds that were exactly measured in three-dimensionally and common finds which were collected by spits. The exact position of a common find within a spit unit is unknown, whereas that of a special find is known.

After experimentation with other systems a simple consecutive number catalogue for each site was adopted. All data relating to each object in the system were entered in a catalogue book. It was found convenient to do the listing in some particular order. The order chosen followed the co-ordinate system of the excavation, the finds numbered by square meter units, the top spit (1) first. This concerns common finds of any kind, sherds, shell, stone, and the like. All special finds were catalogued in the field in the order in which they were excavated. All surface finds made in connection with work on a site were catalogued when all excavated material had been numbered. For example, all surface finds from the Nukuleka peninsula were identified with heading To.2, the numbering starting at 4000.
The bulk of the finds consisted of sherds, the total weight of these being very close to 500 kg. Only a minor portion was catalogued: all rim sherds, all decorated sherds and a great deal of what during preliminary sorting were called notable sherds, such as sherds bearing evidence of pottery making technique. All stone was catalogued whether worked or not. Catalogued also were artifacts of any other material and any shells or shell fragments bearing evidence of work of any kind. All unworked bone was catalogued in a separate consecutive number system, joint for all sites.

Stratigraphy of the Sites

The location and outward appearance of the excavated sites has already been described. Here the observed stratification of the midden deposits is to be dealt with, site by site. The purpose of this description is twofold: to show what the deposits consisted of and to isolate the horizons which form the basis for the artifact analysis. 'Midden horizon' or simply 'horizon' is the term for a stratigraphic unit made up of one or more midden deposits as observed in the profiles. Such horizons may or may not represent significant periods of cultural time in terms of the artifactual evidence they contain. At this juncture the horizons will be described simply as stratigraphic phenomena, their actual interpretation as habitation evidence coming later in chapter XI, when the artifactual analysis has been completed and the basis for wider interpretations thus laid.

The description of the stratigraphy will start from the bottom with the subsoil, horizon I always being the
earliest. As the excavations were not primarily concerned with the study of midden formation in detail, only the essential layers of each horizon will be described.

To.1 (figs. 3-19) The subsoil is made up of a range of clay soils of yellow, red and brownish colours and with an intermixture of coral sand, small pieces of pumice and whole and fragmentary shells. At about a metre below the surface a pure and hard clay begins. An interesting feature are the scattered pockets of shell forming a zone between 10 and 30 cm below the surface of the subsoil. They consist of loose conglomerations of large and complete shells, inside and around which could be seen cemented lumps of clayey yellow soil, coral sand, very tiny fragments of shell and some larger pieces of shell (figs. 11.1, 15.1).

Horizon I on the whole consists of one deposit only, a fairly compact and concentrated midden of shells, showing occasional layering. In general the midden is composed of complete shells, large fragments, and some small lumps comprising very small shell fragments, all mixed together. It was exceptional to see discrete occurrences of fragmented shell. Small pieces of coral and cooking stones of the makalahe variety (i.e. of the local coral rock) are common. The deposit is also characterized by scattered pockets of pure earth without shells. Of rare occurrence are ash (very fine and light grey or dark grey in colour) and finely divided charcoal. Horizon I is on average 25 cm thick, the surface roughly 25 cm below the turf.
Horizon II is 25 cm thick, its surface being the ground surface. It consists of two deposits. The lower is a dark, rather compact and homogeneous deposit consisting of evenly distributed earth and small and large shell fragments. Complete shells are quite rare. Cooking stones are common. The boundary between this deposit and horizon I was quite readily recognizable. The upper deposit, the topsoil, is black earth with only scattered occurrences of complete and fragmentary shells plus crushed shells, and it is infiltrated with roots of grass, recent trees and scrub plants. The border between these two deposits is diffuse.

This sequence was seen in all excavated trenches except in section II where only horizon II is present.

To.2 (figs. 20-7) The subsoil is a homogeneous deposit of coral sand, whose surface is 1.70 m below ground surface at the centre of the mound and 90 cm below at its foot. It is level parallel to the present beach but rises slightly towards this.

At the bottom of the mound is the midden horizon. The boundary between this and the subsoil is quite sharp. At the centre of the mound this horizon is 80-100 cm thick, at the foot of the mound only 30 cm thick. This thick horizon comprises on the whole one deposit only, a typical, dark-coloured shell midden deposit made up of earth mixed with shells in abundance. Sometimes the shells occur in more or less compact lumps. Makalahe cooking stones are common. In the bottom half the deposit is of a blackish-grey colour whereas in the top half it is generally somewhat lighter in appearance and slightly browner. This
could be particularly observed in the southern (inner) half of the trench.

The shell midden is sealed in by the mound horizon. The boundary between the two was easily distinguishable. At the centre of the mound this horizon is 90 cm thick, at the foot of the mound only 30 cm thick. In contrast to the markedly homogeneous and stable midden the mound horizon comprises a number of very different deposits, especially at the centre. These include real midden material; a mixture of sand and earth; earth including some shells; and compact deposits of *sio* shells (*Ostrea cf. sandvichensis*) intermixed with an extremely small amount of earth and sand and with numerous fragments of branch coral. There were a number of *sio* shell deposits of varying dimensions, isolated from each other. Dug into these diversified deposits in the central part of the mound are graves containing coral sand and skeletons. Uppermost, and sealing in the mound horizon, is a compact deposit consisting of earth with a few whole and fragmentary shells.

To.3 (figs. 28-32)

*Section I* The subsoil is pure coral sand, its surface about 1.25 m below ground level.

Horizon I represents the very disturbed remains of the original shell midden on the spot, about 80 cm thick, characterized by four different deposits of typical shell midden material including *makalahe* cooking stones.

Horizon II is represented by the not fully excavated feature called pit A. The fill of this is a loose deposit consisting of yellowish-grey coral sand and tiny fragments
of shell, the intermixture of dark earth being negligible. There are also plenty of whole shells and shell fragments of average size. Some pumice and makalahe cooking stones were seen.

Horizon III in general is made up of two components: some typical shell midden as in horizon I and a compact deposit of earth, sand and shell fragments in the main of very small size.

Section II The subsoil here is also pure coral sand.

Horizon I, representing an original shell midden, includes one deposit only, typical firm dark-coloured midden with shells in abundance, many of them whole.

Horizon II comprises an odd feature called depression F, which was not fully excavated. The stratigraphic relationship between this and the two other horizons was not clarified as the narrow trench made work difficult. The horizon appears to comprise two types of deposits in three layers: two layers of midden as in horizon I separated by a thick deposit of fairly loose medium grey and yellowish sand including some shells, much like horizon II in section I. It is therefore interesting that the base of feature A in section I and that of feature F in section II are almost identical in level.

Horizon III is the fa'itoka grave mound of the To.4 complex. It comprises two deposits: a wedge-shaped layer of light, yellowish-grey fill is surrounded by medium grey fill including some shells. Both fills are represented in the profile exposed along the road cutting through the grave mound at To.4.
To.4 (figs. 33-4) A study of the profiles of section I showed a most complex picture of build-up with sandy earths, none of which evidently had anything to do with shell midden. The excavation of this section was therefore not completed, the profiles not drawn, but only photographed.

Although section II likewise did not reveal shell midden, it was fully excavated nevertheless and the profiles drawn as a clearer picture emerged from their study.

The subsoil is pure coral sand as on To.3. Above it various deposits are present but they seem to belong to one and the same horizon, which thus contains the total sequence. The lower half consists of alternating bands of typical dark-coloured shell midden and loose, very light-coloured sand with some shells, most sharply distinguished from each other.

To.5 (figs. 35-9) The subsoil consists in all trenches of coral rock, the level surface of which is 100-150 cm below present ground surface, covered in part by coral sand containing quite a number of shells, mostly whole. This deposit thins out towards the lagoon, disappearing in the northern end of section I and being almost absent from section II.

Within the coral sand in the southern half of section I only are two discrete cultural layers, identical in composition. They consist of loose coral sand with numerous shells, light to medium brownish-grey in colour and easily distinguishable from the whitish coral sand in
which they lie. These two layers and the natural sand
with which they alternate are jointly designated horizon 0.

Horizon I is of very varying thickness, from 20 to
60 cm; its surface is 40-70 cm below the ground level. It
comprises three deposits. One of these is a very compact
concentration of shells with a minor intermixture of
greyish-yellow coral sand. Most shells are whole. In the
northern end of section I the intermixture of sand is more
pronounced. The second component of horizon I is present
only in the southern five metres of section I. It lies on
top of the shell concentration of which it is clearly a
part. Forming a more or less continuous zone, varying in
thickness between 1 and 10 cm, it consists of earth mixed
with a large quantity of crushed shell fragments. In the
field it gave the appearance of a surface over which much
trafficking had taken place and was called a walking level.
Overlying this is a homogeneous deposit of brown clay
mixed with shells. This third component of horizon I is
also restricted to the southern half of section I. The
occurrence is more or less continuous and of a varying
thickness never exceeding 10 cm. It was dug as a
stratigraphic unit.

Horizon II on average is 20 cm thick, the surface
being 40-50 cm below ground level. In general it consists
of one deposit only, a heterogeneous mixture of dark grey
earth, numerous shells both complete and fragmentary, many
makalahe cooking stones, and powdery ash and charcoal.
This horizon was clearly distinguishable from the horizons
below and above it.

Horizon III, extending upwards to ground surface, is
in the main about half a metre thick, but occasionally
less, down to 30 cm. The surface slopes slightly towards the north. It comprises two deposits. The lower is a homogeneous garden soil of sticky clay, stickier than the upper which is topsoil. Its shell content is generally smaller than that of the top soil and fragmentary shells dominate. The boundary between the lower and the upper components of horizon III is very diffuse. The topsoil is a sticky black garden soil, slightly tinged with brown, with an even scatter of shells, mostly in fragmentary condition. Overall, earth is the dominant component of horizon III, the shells in it being scattered and never concentrated.

To.6 (figs 40-5) At this site, because of the rapid approach of the end of fieldwork and the occurrence of bad weather, only profiles A-E were recorded and the drawing of these concentrated on distinguishing the three observable horizons rather than on detailed recording of every deposit within them.

The surface of the subsoil is fairly horizontal, at the thickest part of the midden about 100 cm below the present ground surface, at the edges only 30 cm below. Subsoil consists of homogeneous and rather compact clay, medium to dark brown in colour.

Horizon I has an average thickness of 20 cm and a horizontal surface. It was found over most of the excavated area, but apparently not to the north. In general it is a homogeneous mixture of earth and shells, of a dark grey colour, sometimes with a more brownish appearance than horizon III. Shells are abundant and more numerous than in horizon III. The general impression of
horizon I is of a compact and concentrated shell midden. Makalahe cooking stones are common.

Horizon II, the so-called soft horizon, has an average thickness of 10 cm and a horizontal surface. It covers a similar area to horizon I, apparently being absent from the northernmost end of the excavated area. Traces of it were hard to recognise in profiles F and G. The main characteristics of this middle horizon are that shells are very rare and that the medium grey to brown soil is soft. It was thus easily distinguishable from the two adjacent horizons. An important feature is that its top surface is level whereas its base is often uneven, filling small concavities in the surface of horizon I. In trench V a most cautious excavation of the surface of the soft horizon showed that only a few holes penetrated it and that only a few depressions are present in its surface. Because of the time factor, however, the original intention of digging the soft horizon out as a stratigraphic unit had most unfortunately to be abandoned apart from this one trench.

Horizon III varies in thickness between 50 cm in the central area of the midden and 20 cm at the edges, its surface sloping down accordingly. Horizon III, which is present in all the excavated area, is thus both thicker and more extensive than the two lower horizons. Only in trench I was horizon III followed right to its edge, the transition to pure garden soil beyond being quite gradual. Basically this uppermost horizon is like horizon I, but generally speaking it is a dark grey, more heterogeneous mixture of earth with whole and fragmentary shells in abundance. There are many compact and isolated shell
pockets of varying dimensions. Makalaha cooking stones are common.

In the above descriptions practically no mention has been made of such features as pits, post holes, fireplaces and the like, which were common on all sites except To.4. The stratigraphic disturbances effected by these features could, with the time and labour available, not be completely isolated in the field and some regard had to be paid to this circumstance in the artifactual analysis. Excluded from this analysis accordingly were those square metre units where the stratigraphy appeared too affected.¹

These features are discussed in detail in chapter XI. But the planting holes associated with the observed and possible use of sites as gardens need some comment here. They represent a factor of disturbance to the stratigraphy, as the digging implied by them is likely to cause movement not only of soil and shells but also of artifacts, and not only vertically up and down a hole, but also horizontally over the ground surface. The digging of such holes being an integral part of Tongan horticulture, the disturbances caused by them cannot be altogether ignored by the archaeologist. Attention is here drawn to the problem as a general guide to others. Its existence was, with other factors, an important reason why the particular excavation techniques employed were in fact adopted.

No effort was accordingly made to discover and isolate planting holes during the actual excavations. Few

¹ The main trench at To.1 formed an exception, as is discussed at the end of chapter VI.
such holes were recognised and these exclusively in trench profiles on sites recently used as gardens (To.1, 5 and 6). These no doubt represent a very small minority of the total planting holes ever dug within the excavated areas. Despite this it was impossible to believe that gardening activities could literally have turned the middens upside down. Excavation proceeded therefore in the hope that such activities would not have altered the original distribution of the artifactual evidence to the extent of making it impossible to derive meaningful results from its statistical analysis. The results justified this hope.

In the early part of the fieldwork when the existence of the problem of gardening was realised, some enquiries were made of Tongans about gardening practice. Their views were sometimes conflicting. Some would never dig into the subsoil, others did so. Some had no objections to cultivating on old shell middens, other had. The dimensions of planting holes seemed to vary considerably depending on the variety of root crop to be grown in them. The smallest holes would be 10-20 cm deep, the biggest 2 m or in rare cases 2.5 m deep. These very deep holes, for early yams, would be 40-50 cm across at top. The holes for late yams would be 35-130 cm deep. The material brought out of a freshly dug hole is apparently left on the ground, the hole being refilled by scraping down the sides and with topsoil. The material dug when harvesting the crop is returned in any odd way.
CHAPTER V

ANALYSIS OF POTTERY: PROCEDURES

Few studies of archaeological pottery from the South Pacific have been published and these have not been particularly exhaustive.\(^1\) Of these only the material from one of Gifford's New Caledonian sites, site 13, is closely related to the pottery from Tonga. Neither from this nor from other Pacific locations where allied pottery has been published is much evidence available for the types of vessel from which the sherds had originated.\(^2\) The analysis which follows, therefore, could draw little on previous work within the general area of research.

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The Aims of Analysis

If the ideal was a full characterisation of Tongan prehistoric ceramics, this was obviously limited by the time available for and the nature of the material under study. The excavated pottery was in a very fragmentary condition, with only one whole pot (a small, undecorated bowl) and a very few partially reconstructable vessels (cf. fig. 64a). Of the great amount of sherdage brought back from the field (about 500 kg), it was quite uncertain where the great bulk had belonged on the pots from which they had come. In these circumstances it was decided to concentrate the analysis on the two most distinctive categories of sherd present in the material, rim sherds and decorated sherds. Study of these might be expected to allow some characterisation of Tongan prehistoric ceramics, document the nature and course of ceramic change, provide data for the comparison of the Tongan material with allied material elsewhere in the South Pacific, and permit cultural interpretations to be made in these three spheres.

The relevant material from the six excavated sites (including sherds collected on the surface of these sites) is set out in text table V.1.

Text Table V.1

Numbers of Rims and Decorated Sherds by Site

<table>
<thead>
<tr>
<th></th>
<th>To.1</th>
<th>To.2</th>
<th>To.3</th>
<th>To.4</th>
<th>To.5</th>
<th>To.6</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>rims</td>
<td>1290</td>
<td>1285</td>
<td>196</td>
<td>63</td>
<td>448</td>
<td>1324</td>
<td>4624</td>
</tr>
<tr>
<td>decorated</td>
<td>722</td>
<td>2026</td>
<td>134</td>
<td>25</td>
<td>328</td>
<td>76</td>
<td>3311</td>
</tr>
</tbody>
</table>

To.3 and 4 were not included fully in the analysis. Not only was the sherd sample from both sites very small,
but also at the former site the midden deposits were disturbed, while at the latter no real midden was present. The other sites seemed to offer adequate samples for analysis, though it was obvious that at any one level of a site the actual number of pots represented by the specific sherdage under study need not be very large.

The Method of Analysis

The analysis proceeded by two paths: firstly, the investigation of the distribution and frequency of occurrence of individual features of the sherds selected for analysis; secondly, a similar investigation of combinations of features.

There are three main reasons why importance was attached to individual features as evidence.\(^1\)

1. Artifacts may be looked on as a combination of a number of individual features, in terms of which they can be described. A normal procedure in archaeological analysis is to isolate as types artifacts representing a recurring combination of features, or more precisely a recurring combination of a limited number of specific features which are judged for one reason or another to be

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the important ones. It is almost inevitable when types so defined are the basis of analysis that certain other features of the artifact are disregarded altogether and that certain artifacts which display few if any of the selected combinations are withheld as atypical. The seriousness of these deficiencies is obviously dependent on the explicit purposes for which the typology has been devised and the extent to which its formulations have been tested. In part the reliability of the established types depends on the total number of artifacts that illustrate them.

If, on the other hand, individual features are considered, analysis is not restricted to particular combinations of features and the artifacts which display these, and the actual amount of data included in the analysis is thereby increased. In circumstances where the material does not lend itself easily to the definition of types, significant patterns other than combinations of specific features may be discovered from an analysis of individual features.

Thus an analysis of the occurrences of a number of individual features may enable the isolation of some as typical, others as not, quite regardless of whether they are represented in artifact types or not. Certain features may emerge as typical of a particular period and/or area because each taken individually occurs with a frequency that is significantly higher here than in an adjacent or quite different period and/or area which may or may not be characterised by other typical features. Such differences might not be seen clearly where the
analysis depended on the existence of particular combinations of traits.

2. This becomes more understandable if we recognise some classes of artifact for what they are, a complex combination of many individual traits, each of which may change at different speeds and occur in different frequencies over time. Only by an analysis of individual features and varying combinations of these can the full potential of, for example, the ceramic evidence from different horizons and different sites be fully exploited. Change in these circumstances is a stream of many channels, each of which must be mapped in its own right.

3. On a practical level an analysis in terms of individual features allows fuller use of the available material to be made when some of this consists of fragments or is damaged. Where all features are not present, those that are can all be included in the investigation.1

In the analysis of traits by frequency of occurrence, it was decided that, whatever its size, each single sherd scored one. A certain amount of caution is therefore required in the interpretation, especially with small samples: if a large rim sherd is broken into five smaller ones, the occurrence of a trait is thereby increased five times.

It would seem logical to expect that on sites which had been used as gardens the occurrence of rim sherds

would, due to breakage, be relatively higher in the upper than in the lower levels. On To.6, however, a site of this type, this does not seem to be the case. This is an impression rather than a documentable opinion. It rests simply on the observation that the same number of rim sherds were excavated from horizons I and III though the latter was a thicker and more extensive deposit. A comparison of weights as well as numbers of rim sherds in the two horizons would have been useful in this connection.

One may, however, be justified in assuming that the size of sherds as excavated is the result of breakage at the time of formation of the midden levels in which they were found. Furthermore, the factors that caused breakage at any one level of a site might, within broad limits, be assumed to operate equally on pots of different types. The fact of breakage itself should not, that is, overly distort the pattern of frequencies within any one level and consequently should not make impossible comparisons between frequencies in different levels of the same or other sites. Since no evidence appeared from a study of the material to challenge these assumptions, it was not felt necessary to devise procedures to compensate for the differing sizes of sherds. Obviously, however, the statistical evaluation of frequencies of occurrence is in this situation the more reliable the larger the samples from which they are derived.

The Techniques of Analysis

The size of the collection to be analysed, and the decision to analyse it in terms of individual characteristics, encouraged consideration from the very start of a punch card system.
Two different methods were tried out in practice: the condensed, where each card represents one artifact attribute and each punch represents one artifact characterised by this attribute; and the dispersed, where each card represents one artifact and each punch represents one attribute characterising this artifact.

The condensed system was tried using French Selecto equipment and proved to have a number of good qualities. With a very small collection of cards one can describe a large number of artifacts, 5000 or 8000 or 15,000 according to card capacity. Within seconds one can get an idea of the frequency of a single feature or a combination of several. It is easy to cancel or to add a feature to the collection simply by pulling out or adding cards. The equipment is cheap and simple and the research worker operates it himself.

There are, however, a number of disadvantages that can be serious. Every artifact must be accorded a number that is punched in the co-ordinate system of the cards. Where artifacts have not been catalogued according to a numerical system, some system for identifying them has to be devised. If several hundreds of holes have been punched on a card, it is disastrous if a large number of wrong punches is made and at great labour the card has to be replaced. If copies of cards can only be made manually then loss of cards can be a serious thing. A card holding a great many punches can become difficult to read.

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Extraction of data from the cards, not being mechanised, can also take a lot of time.

In the event the dispersed system was employed, using IBM 5081 cards. The many facilities allied to this system formed a time-saving factor of the greatest importance, with the data automatically computed and printed out in any form specified and duplicates of cards and results readily made. The major disadvantage, and it is an important one, is that control over operations leaves the hands of the research worker and he finds himself totally dependent on a number of other people.

The Code

To prepare the material for an analysis of the type and by the means decided, it was necessary to reduce the mass of observations possible on it to some sort of order in a code. Two types of code were tried out in practice: a descriptive or exhaustive code, and an analytical or selective one.

The inspiration for the first came from J.-C. Gardin and the publications of the Centre d'Analyse Documentaire pour l'Archéologie. However, the detailed observations that were proper to artifactual documentation proved fatal to the aim of artifactual analysis and after the expenditure of much time and effort the Gardin concept was considerably modified to meet the different requirements.

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The difficulty in drawing up what I have called the analytical or selective code was the almost complete uncertainty as to what the important observations might be. Trials on samples of the material verified the importance of some features and suggested how best they might be described. The completed code is comprehensive rather than exclusive: many of the observations included could be made without too much extra effort because of the organisation of the data on the punch cards. It was nevertheless apparent from an early stage that further selection would have to take place with respect to which features to analyse.

Three codes are reproduced as tables 1-3 and explained below: the rim code, the decoration code, and the sherd record code applicable to both.

The Rim Code

Some concepts incorporated in the rim code need explanation.

1. Definition of a rim

The only criterion that it was possible to employ with the fragmentary material at hand was one based upon observations of a change of direction of the vessel wall. The proposition was therefore adopted from the beginning that a complete and definable rim element is present only if one or other of the following two observations can be made on the vessel wall as counted from the lip.

1 The rim code is set out in table 1. For explanatory illustrations see figs. 46-9.
A. If the vessel wall changes direction and if it is also possible to observe a transition, i.e. a specific point or zone where the change of direction takes place, then the complete rim is that part of the vessel wall which is situated on the lip side of, above, the transition. Conversely the body is that part of the vessel wall which is situated below the transition.  

This rule can also be stated in another way: without change of direction, no transition. If therefore a transition is preserved on a rim sherd, but no more below this, then a change of direction must originally have been present and the rim sherd represents a complete rim. But one cannot say: without transition, no change of direction. An evenly curved vessel wall undergoes a change of direction but it is not possible to point out a specific transition as the change of direction takes place gradually throughout the curve. Definition A therefore does not apply in such cases.

A first impression of the rim sherds under study was that many of them were curved, either inwardly or outwardly. But in fact in the majority of cases the curves involved proved not to be even: for example, two rather straight sections might be connected by a transitional curve. In these and other cases it proved possible to apply the A definition. In addition, this

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1 Were we dealing with whole pots, we might have to put some qualifications on this decision: for example, the change of direction should take place not at any point between lip and base, but at any point which is nearer the lip than the base.
definition could be used whether the exact orientation of
the rim sherd could be established or not.

Whenever definition A is applicable to a rim sherd it
is convenient to use the terms 'complete A rim' or simply
'A rim'.

Success in applying definition A in practice is
partly dependent on one's knowledge of the material. Thus
often a sherd will have a tiny piece of the body-rim
transition present on one side only. This is enough for
identification. The supposition is that the transition
began lower down on the other side and has not been
preserved on the sherd.

B. If a point of vertical tangency\(^1\) can be observed
on an evenly curved vessel wall, and if also no change of
direction of the vessel wall can be observed between the
lip and the point of vertical tangency, as defined under A,
a complete rim is present, comprising that part of the
vessel wall from the point of vertical tangency to the lip.

This B definition is based on a particular use of the
concept of vessel wall orientation. Therefore when
dealing with rim sherds this definition is applicable only
if the orientation of a rim sherd is certain and if the
sherd is big enough to include a point of vertical
tangency.

Whenever definition B is applicable to a rim sherd,
it is convenient to use the terms 'complete B rim' or

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1. A.O. Shepard, *Ceramics for the Archaeologist*, 1963,
simply 'B rim'. It may not be out of place here to mention that very few rims of this type were present in the material.

No attempt was made to use change of thickness of the vessel wall towards the lip in the definition of a complete rim. This was because in the material under study various types of rim thickening are present that promised to make rim definition using thickness complex and arbitrary and difficult to combine with the A and B definitions described.

2. Basic rim form

The concept of 'basic rim form' refers to a particular view of a rim and is applied as a starting point for purposes of description. In accordance with this, any rim will have a basic form. Simple rims are those that have no features extra to the basic form, which thus serves to characterise the rim. More complex rims are those that are characterised not only by a basic rim form but by extra rim features as well.

3. Central axis

An advantage of operating with the concept of a basic rim form is that it is logical to define the central axis of a rim by reference to its basic form only, regardless of whether extra features are present or not.

The central axis is an imaginary line through the middle of a rim and following the general course of this; it will be straight on straight rims and curved on curved rims. The central axis is used for determining the
orientation of a rim, the body-rim inclination and flat lip inclination.

Category 1. Nature of rim sherd

This introductory category of the rim code is of fundamental importance to the understanding and application of the code to which it is so to speak the key. Here the rim definitions set out in the foregoing are used. The proposition is that without knowing the nature of a rim sherd at the beginning, it is not really possible to proceed to describe it adequately. Thus we record whether a rim is:

- a complete rim (classes 1-2);
- an incomplete rim (class 3);
- an uncertain rim (classes 4-8).

Classes 1-2: A rim sherd is described as a complete rim if definition A or B is applicable. Characteristic of such sherds is that the body and/or the body-rim transition is present.

Class 3: A rim sherd is described as an incomplete rim if neither definition A nor definition B can be applied. It is therefore characteristic of such sherds that no body and no body-rim transition are present. Rim sherds of this class are either straight or perhaps evenly and very slightly curved and horizontally oriented, inward or outward. It is assumed that under normal circumstances, as with the present material, such rim sherds could not possibly contain any part of the body or of the body-rim transition and by present definition must be incomplete.
Classes 4-8: It is characteristic of all sherds in these classes that for one reason or another it is uncertain whether the body of the original pot is present or not. They fall into two groups: straight and curved sherds.

Class 4: Straight rim sherds are those that are straight on either both sides of the sherd or, by convention, on one side of the sherd only, the opposite one being slightly curved. Straight rim sherds may originate from pots with inward or outward body-rim inclination or from pots with so-called direct rims (see p. 78), but the sherds themselves do not provide the evidence to decide.

Classes 5-8: Curved rim sherds are those where both sides of the sherd are curved the same way, either inward or outward. Characteristic of these sherds is that their curve is even: otherwise definition A would be applicable. Alternatively the curve may be so irregular that it would be too arbitrary to apply definition A.

Classes 5 and 7: Here fall rim sherds whose orientation cannot be established precisely but only as a range, within which range, however, the point of vertical tangency is present. These rims are called 'possible B rims' and description of them in the code continues as though they were in fact true B rims. This procedure was adopted as more positive and more economical than repeating description of them in terms of classes 6 and 8 to which we now turn.

Classes 6 and 8: If the orientation of a curved rim sherd or its range do not include the point of vertical tangency or if its orientation is uncertain altogether,
then definition B cannot be applied even as a possibility. Despite the uncertainty of orientation, such sherds have information to give and were appropriately recorded in the code.

To summarise, it was found best with the curved rim sherds of classes 5-8 to classify them specifically as curved uncertain rims, distinguishing between in- and out-turned and applying definition B wherever possible.

Class 9: Special rims: All collar and flange rim sherds and any other unusual rim sherds go into this class.

Category 2. Rim orientation, general

A pottery vessel may be resolved into a greater or lesser number of components - base, body, shoulder, neck, rim and mouth. In the generality of pots these components are circular in plan and horizontal in plane. Normally the line connecting the centres of these planes is straight and perpendicular: let us call it the centre line. The material under study does not appear to present any exceptions to this model.

By rim orientation is meant the angle between the centre line and the central axis of the rim. This is easier to establish with whole pots than with rim sherds, since rim sherds must first be put in the position they occupied when part of a complete vessel. The method is to move the rim sherd until the line of the lip is horizontal, then to turn it in this position through $90^\circ$ thus revealing the sherd in cross section and enabling its angle of orientation to be measured. In the present study it is a convention always to view rim sherds as if they
were part of the right side of a whole pot, the centre of the imaginary pot being to the left of the rim sherd.

The course of the central axis of straight rims is easily determined. With curved rims it is the straight line that continues the direction of the central axis at the lip.

The degree of certainty with which the orientation of a rim sherd can be determined depends of course on the preservation of its lip. The longer the preserved lip the better, irrespective of the size of the sherd itself. Also important is the size of the mouth of the original pot. The smaller this, the easier the determination of orientation.

The orientation of a rim sherd can be inward or outward or vertical, determinable either to degree or within a range of degrees only (classes 1, 2 and 3). Sometimes the orientation will fall within a range that reaches from vertical to somewhere on the inward scale (expressed as -) (class 4) or to somewhere on the outward scale (expressed as +) (class 5), or it will sometimes fall within a range that goes from somewhere on the inward scale (-) to somewhere on the outward scale (+) (class 6). In practice this class comprises in the main rim sherds that are of a more or less vertical orientation, not, however, with certainty determinable exactly as degree 0 (class 3), but only as falling within a limited range from -1 to +1. Other sherds of class 6 have a somewhat bigger range but still definable because they have a more or less regular lip line which excludes some possibilities.
The orientation of a rim sherd can, however, be totally uncertain, when it is for some reason quite impossible to say whether it is inward, outward or vertical. Most of such sherds have very little lip preserved, but others are included here because the line of the lip is of a form too irregular for determination. It would be wrong to express uncertain orientation by coding class 6, range $-4/+4$ or the like, as ranges are found by observing positive evidence on a sherd.

With the present material caution must be exercised both in determining the orientation of rim sherds and also in analysing the results. Not only are there many rim sherds with only small lengths of lip but on some sherds with extended lip the lip line is not regular.

**Category 3. Rim orientation - degrees and ranges**

In order to express the orientation a simple clock (fig. 47) was devised. Various divisions were tested but the scale used seemed to be the finest one that could realistically be applied to the material in question. When in use the clock is placed on the wall with the 0 degree at the top and the orientation of a rim held in its proper position is read off it. With the convention of keeping the exterior of the pot to the right, the scale of inward orientation ($-$) is to the left of vertical and the scale of outward orientation ($+$) is to the right of vertical. Sometimes the orientation can be expressed as a single figure, $+1$, $-2$. Sometimes it can be expressed only as a range. Thus if the range of orientation of a sherd is between $+1$ and $+2$, it is expressed as $+1/+2$. The range of orientation means that the extremes are included.
It was found in general easier to find the orientation of rims with flat lips than that of rims with round lips, probably because the former were more deliberately formed than the latter.

**Category 4. Body-rim inclination, general**

This is the angle by which the course of the rim deviates from the course of the body. The observation is therefore possible only when a body can be defined. In the present material this means what are defined as complete rims and curved uncertain rims of classes 5 and 7.

When a rim sherd definitely contains part of the body, then the degree of inclination can generally be determined quite exactly, inward or outward. Inward and outward express the behaviour of the body of the vessel in relation to its rim held vertically, inward meaning bending left, outward bending right. If, however, only the body-rim transition is present on the sherd, then normally the most that can be said is that the original inclination was inward or outward. Sometimes circumstances may allow a range of inclination to be stated.

Theoretically an uncertain rim, whether incurved, outcurved or straight, could have originated from a vessel with either inward or outward body-rim inclination or from a pot with a direct rim. In practice, however, on the material under study the form of the rim on complete rim sherds with outward body-rim inclination is either straight or slightly outcurved and never incurved. Similarly on complete rim sherds with inward body-rim
inclination the form of the rim is either straight or slightly incurved but never outcurved.

This being so, it was decided, in the case of the body-rim inclination observation and this alone, to treat curved uncertain rims of classes 6 and 8 as if they were complete rims by measuring the inclination between the top half and the bottom half of such sherdss. The inclination recorded represented the maximum possible degree of inclination which the sherdss had to offer. The measurement might well prove to reflect something positive about the body-rim inclination conditions of the original pot, should comparisons be undertaken between the class of uncertain and that of complete rims.

On straight uncertain rims there is of course no inclination to measure whatsoever and these were coded 'no observation possible' (cat. 4.4).

A particular body-rim inclination condition is represented by the so-called direct rim,¹ i.e. vessels on which one can point to no change in the direction of the vessel wall anywhere from lip to base. Such a vessel wall can be straight or very slightly incurved or outcurved. No body-rim inclination can be observed on direct rims.

The present material does not seem to include examples of direct rims. This may be due as much to the lack of whole pots in the collection as to anything else. The class of direct rims was, however, included in the category of 'body-rim inclination, general' (cat. 4.3), partly as a matter of form, partly in case a study of rim

¹ Shepard, 1963, p.245.
sherds and body sherds should produce indications of the presence of direct rims in the material. Finally the concept was used in connection with certain types of collar rim (see p. 84).

No complete rims of the present collection with a horizontal orientation outwards have a body-rim inclination which is inwards. Conversely no complete rims with a horizontal orientation inwards have an outward body-rim inclination. With this knowledge of the material it was felt legitimate to code all horizontally oriented incomplete rims as possessing a body-rim inclination outwards or inwards in conformity with their orientation, even though no body part remained on these sherds to make the observation directly. The reasoning is identical to that used in the discussion of the body-rim inclination of curved uncertain rims. Neither of these compromise cases does any harm to the code and its analysis for the simple reason that the initial separation into different classes of rim sherd helps in making the required distinctions when any particular problem is to be investigated.

Category 5. Body-rim inclination - degrees and ranges

Inclination is the angle between straight lines. If the body element and the rim element both form straight lines the measurement of the inclination is simple. If, however, one or both of these parts are curved, then it is necessary first to establish some kind of straight line to represent the curved ones. The straight lines adopted were those connecting the end points of the curves in question. This applied whether it was a true body-rim inclination on a complete rim or the internal curve of an
uncertain rim. The body element in the measurement is that immediately below the rim.

For measuring the degree of inclination a clock was used (fig. 48), graduated more finely than the orientation clock because inclination can be measured much more accurately. The line of the rim element is held against the 0-line of the clock with the body-rim joint at the centre of the clock or at any equivalent point. The next step is to see with which of the rays the line of the body element is congruent. As soon as this is found then the body-rim inclination is known and it can be expressed by the number of the relevant ray.

On most sherds it is possible to state the inclination exactly. This is done in two ways: by a single number where it falls exactly on one of the rays of the clock, by two numbers when it falls between, for example 1-2 (not 1/2 since no uncertainty is involved). Ranges are allowed for where some uncertainty is present, for example 1/3. If a sherd allows us to say only that the inclination is inward or outward, the degree or range being uncertain, this is coded as class 36 in the present category.

Category 6. Body-rim joints

Here there are two simple alternatives only: marked or not marked. By 'marked' is meant a point of transition from rim to body and by 'not marked' a zone of transition primarily, but also any other transition which is not sharp. The description 'marked' applies to complete A
rims only, 'not marked' to some complete A rims and to all complete B rims.

A body-rim joint can be marked or not marked on both sides of the vessel wall or it can be different on either side.

This category of observations only applies to complete rims. It naturally does not apply to incomplete rims and straight uncertain rims and it was not found necessary to consider its adaptation to the curved uncertain rims. Further the category is not applicable to collar/flange rims.

Collar and flange rims

As shown in text table V.2, a considerable number of sherds represented a particular and interesting type of rim consisting of two varieties, to which the terms 'collar' and 'flange' were applied (fig. 73).

Text Table V.2

<table>
<thead>
<tr>
<th>Site</th>
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<th>Flange</th>
</tr>
</thead>
<tbody>
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<td></td>
</tr>
<tr>
<td>To.2</td>
<td>314</td>
<td></td>
</tr>
<tr>
<td>To.3</td>
<td>61</td>
<td></td>
</tr>
<tr>
<td>To.4</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>To.5</td>
<td>123</td>
<td></td>
</tr>
<tr>
<td>To.6</td>
<td>157</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total</td>
</tr>
<tr>
<td></td>
<td></td>
<td>942</td>
</tr>
</tbody>
</table>

Since the collar variety was absolutely predominant, the type is often referred to simply as collar rim.

On some of these sherds the lip is present, on others it is absent. The latter were coded with the former as collar rims, because, despite their incompleteness, they could not possibly have been anything else.
The basic characteristic of the collar rim, strictly defined, concerns the outer wall of the rim which is offset at an angle to the outer wall of the body. The short link between the bottom of the outer wall of the collar and the top of the outer wall of the body is called the collar connection or underside or overhang. This may have served to provide the vessels with a ready grip.

Collar rims are divided into two main groups, A and B, according to the behaviour of the inner wall of the vessel. On simple A collars the inner wall is like that of a normal pot: rim and body join directly and body-rim inclination is inwards or outwards (fig. 46, cat. 7.1). On the more complex B collars the inner wall reflects the offset course of the outer (fig. 46, cat. 7.2).

The rare flange rim is intimately related to the collar rim. They both have an overhang: viewed from below it is impossible to distinguish between flange and collar rims and they may have served the same function. They also seem to have been built the same way, with both flange and collar as a prefabricated section on top of the body of the pot. Another feature that links the two rim forms is the offset course on some examples in both groups of the inner wall of the rim. With some sherds it is difficult to tell whether they represent collar or flange rims.

The main difference between the two varieties of rim is in the profile of the outer wall as counted from the lip to the overhang. On the flange rim this is concave, on the collar rim straight or convex.

This particular feature of the outer wall of the flange rim gives it something in common with rims with
plastic band decoration on the outside. In a few cases these bands are so big that it is difficult to distinguish them from a flange rim proper. The essential difference between the two is that the flange rim is an entire section added to the top of the vessel wall to form a rim, whereas the plastic band is applied to an already existing vessel wall complete with rim.

All special features of collar and flange rims are coded separately in categories 7-11, and all normal features can be described by means of the ordinary code categories, the application of which needs a few comments only.

An important decision had to be made as regards the description of certain standard rim features. The concept of the central axis used with normal rims does not work too well with the collar rims, where the exterior profile describes a course offset from the general course of the body wall. This particular behaviour of the outer wall results in a thickening of the rim and by a convention applied in other cases, such a thickening may be viewed as an extra rim feature with no influence on the determination of the central axis. The line of the inner wall of collar and flange rims has been used for determining such standard rim features as orientation, body-rim inclination and inclination of flat lip.

**Category 1, Class 9**

All collar and flange rim sherds are coded jointly as special rims and practically all rim sherds coded as special are of this particular group.
Category 4, Class 3
Applicable to certain kinds of collar and flange rim (see example in the middle of second page of fig. 46).

Category 4, Class 4
Applies, for example, to C collars.

Category 35
Does not apply to collar and flange rim sherds.

Category 36
Does not apply to C collars where body wall is absent.

Category 37
Does not apply to incomplete collar and flange rims. Rim length is the length of the collar or flange element, that is, the distance from the lip to the collar or flange corner where the overhang begins.

Category 38
Applies only when the body wall is sufficiently represented: it is not applicable to most C collars. The width of the overhang gives some idea of how far the special collar/flange rim element is offset from the general course of the body wall immediately below, or, differently expressed, how pronounced the grip of these pots is.

The specific code for collar/flange rims needs little comment as it is largely self-explanatory. They are both
described by means of the same categories, except for those which make the distinction between them.

The lip is present on complete examples, absent on the incomplete ones.

Category 7. Collars, general

Classes 1-2, 5-6: body wall present.

Classes 3, 7: body wall absent, therefore uncertain whether A or B type collar. All atypical collars are also placed here.

Classes 4, 8: uncertain whether a collar or a flange rim sherd. No further observations are made on class 8 sherds.

Category 8. Flanges, general

Classes 2, 6: sherds marked by a concavity of profile on the inner wall opposite the flange.

Classes 3, 7: uncertain whether A or B type flange.

Classes 4, 8: uncertain whether a flange rim sherd or a sherd with plastic band.

Class 9: a detached moulding, uncertain whether from the flange of a rim sherd or from an applied plastic band. No further observations are made on class 4, 8 and 9 sherds.

Category 9. Ratio between underside and length of collar/flange

Only applied on complete examples. All incomplete examples are coded as class 0.
Category 10. Angle between body wall and underside of collar/flange

Class 6: applies to C collars and to C flanges where body wall is absent and to collar sherds where the observation is impossible because the underside is too short.

Category 12. Basic rim form

With the type of material under study it was not found worthwhile making observations on the straightness or degree of curvature of the rim element of rim sherds as such features too often were marked by irregularity. A relevant observation that could be made, regardless of such irregularity, was the behaviour of the outer and inner rim sides in relation to each other as they approached the lip, whether, that is, they were parallel, convergent or divergent. From preliminary analysis this observation seemed to have importance for the rims under study.

The division into parallel, convergent and divergent rim sides applies to the bulk of the material. Some particular classes have been introduced to cover the remaining cases. Illustrations will show what these classes are. Only two of these require comment. Class 7 is meant for rims that are so short that it is not possible to make the observation under discussion on them. Class 8 is meant for rims that are either too damaged or too irregular to be described under this category.

The part of a rim sherd to be coded in respect of basic rim form may be listed as follows:
Category 1. Nature of rim sherd

Classes 1, 2: the complete A or B rim.

Classes 5, 7: the possible B rim of these curved uncertain rim sherds.

Classes 3, 4, 6, 8: the total rim sherd of these incomplete or uncertain sherds, so that, despite difficulty in their rim status, no rim features that can be described for them should be ignored.

Extra rim features

The basic rim form can be altered by the presence of extra rim features which fundamentally are thickenings or reductions. These features are not mutually exclusive.

It was sometimes impossible with the material under study to decide whether these extra rim features were deliberate or accidental creations of the potter, especially when they were of relatively small dimensions. Any extra feature was therefore coded as such, regardless of dimensions or of any personal assessment of them as deliberate or accidental.

All such features can be adequately described in terms of presence/absence, regularity/irregularity, form and dimensions.

Categories 13 and 21. Presence/absence

These categories are self-explanatory.
Categories 14 and 22. Regularity/irregularity

An extra rim feature may be present with unchanged dimensions over the entire preserved rim sherd or these may be different from one part of the sherd to another. On some sherds an extra feature may be present at one end of the sherd and totally absent at the opposite end. Observations as to regularity or its opposite were thought to be of potential help in distinguishing between deliberate and accidental extra features on rims and/or between careful and careless workmanship.

Categories 15, 16 and 23. Form

These categories refer to the profile of the rim features. The collection under study gave the impression that more attention should be paid to the relative dimensions of extra rim features than to their actual form, especially since this was quite often marked by irregularity. However, a number of classes were set up to describe the form as well as could be.

Categories 15 and 16. Thickening

The straightish and convex forms, viewed in profile, are simple enough to visualise. The convex variety can have its maximum width at or below lip or irregularity of the form can make it uncertain whether it is at or below lip. The stepped thickening has a profile identical to that of the rim side, so that the width of the thickening is fairly unchanged throughout its length. On some of these the transition to the rim side is sharp, on others it is not sharp. The form of some thickenings cannot be defined at all. In addition there are minute thickenings
consisting of additions of clay to the rim right at the lip, of such small dimensions that it would make sense neither to measure them nor further to describe their form. The bead thickenings are like the foregoing, except that they project more from the side of the rim, which they meet in a characteristically marked fashion. Neither dimensions nor details of form are recorded for bead thickenings. Any thickening of unusual form is coded as special and the dimensions measured. Some thickenings present in a damaged condition cannot be described as to form.

Category 23. Reductions

The range of form is restricted to two alternatives: straightish or convex.

Categories 17-20 and 24-7. Dimensions

The same range of possibilities applies to both thickenings and reductions.

It was found best to express their dimensions, length (L) and width (W), relative to the maximum width (MW) of the thickened or reduced rim sherd. This is a measurement that can be always and consistently made (see fig. 46, third page), whereas it was found difficult to operate with wall thickness below the rim, even when this part of the sherd was present.

One qualification must be entered here. Where a rim is thickened on both sides, then the presence of one of these was ignored when making measurements in respect of the other. Without this it would be impossible to compare single thickenings with one element of double thickenings.
The general rule respecting relative dimensions was to measure the maximum width and the maximum length wherever there were differences present within one dimension owing to irregularity of feature.

The intention with the suggested system of relative dimensions was to provide a quick estimate of size for possible comparative purposes.

Categories 29-30. Main classes and subclasses of lip form

As each subclass of lip form is illustrated individually, neither the main classes nor the subclasses need further explanation, except for the following:

Main class 6 includes particular lip forms that cannot be described in terms of the other main classes.

Main class 7 includes cases where lips are either so damaged or of so irregular a form that they cannot be classified.

Subclass 3: In the present collection all grooved lips are only very slightly grooved and could indeed almost be described as flat.

Subclasses 4, 7, 16, 17 and 20: Some lips can still be determined, respectively, as flat, round, hybrid, hybrid or flat, or peaked, although they are somewhat damaged.

Subclasses 21-24: Although some lips cannot be said to have any typical form, it will sometimes be possible to say whether they tend to be flat, round, hybrid or peaked.
Category 31. Horizontality of lips

This observation applies to flat lips and to the flat part of hybrid lips.

Category 32. Symmetry of lips

By this is meant symmetry of lips around the central axis of the rim, and it refers to flat and round lips and to the flat element of hybrid lips only.

Category 33. Inclination of lip

This observation applies to flat lips and hybrid lips only. Lip inclination is the angle between the asymmetrical flat lip or the flat element of hybrid lips and the central axis of the rim. Whether the inclination is inward or outward will appear from observations under category 32.

The degree or range of inclination can easily be measured by the use of a clock (fig. 49), which by convention stops at $45^\circ$ from the central axis: anything steeper than this is no longer a lip but part of a rim side.

The general practice in determining the inclination was to record to the nearest division on the clock. If, however, it was not possible to establish the central axis of the rim properly, the lip inclination was expressed in terms of a limited range (including the extremes). This is recorded for example as 1/2.
Category 34. Transitions of flat lips

This observation applies to flat lips only. The transitions are the corners between the lip and the rim sides. A transition can be marked or not marked. This is quite a simple division. The more important of the two alternatives is the marked variety, which might mean the use of some sharp implement to finish the lip. The not marked variety is by its nature not as distinctive. Finally a lip transition can be damaged, making no observation possible.

As an experiment a series of measurements were taken on the rim sherds, in the hope that an analysis of them might reflect something about the appearance of the original pots. All measurements were taken in millimetres and coded directly as such.

Category 35. Maximum width of rim

This dimension was measured on any rim sherd whether the thickest part was at or below the lip or whether a rim was parallel, convergent or divergent and with or without rim features.

Category 36. Wall thickness

This is the thickness of the wall at the bottom of sherds with incomplete or uncertain rims and at the top of the body of sherds with complete rims (including possible B rims).
Category 37. Length of rim

This measurement was taken in different ways according to the nature of the rim sherd.

Classes 1-2: On complete A and B rims the length is the distance from the lip to the point where the central axis of the rim meets the central axis of the body.

Class 3: On incomplete rims it is the total length of the sherd.

Classes 4, 6 and 8: On these uncertain rims it is the total length of the sherd. This gives the maximum possible length of any such sherd.

Class 5 and 7: On these possible B rims the length is the distance from the lip to the point where the central axis of the presumed rim meets the central axis of the presumed body.

The Decoration Code

There were two limiting factors in the elaboration of the decoration code and the subsequent analysis of decorative features: the total lack of whole pots with decoration and the extremely fragmentary nature of the sherd material. As a result a whole series of questions remain unanswered relating to the general lay-out of the total decoration: whether particular pot forms were characterised by particular decoration features; which combinations of motifs were preferred; whether motifs occurred in particular sequence from lip to base.

1 The decoration code is set out in table 2. For explanatory illustrations see fig. 50.
The great majority of decorated sherds consisted of simple body sherds, with no indication of where on the pot they had originally belonged or even which was upper and which lower on the vessel. This latter difficulty was met with also with many of the decorated shoulder sherds.

These aspects called for cautiousness, and a code was worked out that would enable a general characterisation of the decoration and a practical grouping of the observable features.

Below are a series of comments on those categories and classes of the code which are not self-explanatory.

**Category 2. Type of decoration**

The decoration is clearly divisible into three kinds, called surface, plastic and notch decoration, each of which is described separately in the code.

Surface decoration consists of impressions made into the surface of the wet or leatherhard vessel wall by means of some narrow object. Plastic decoration is any form in which clay has been applied to the surface of the pot but by convention it also includes perforations and the like, which can be interpreted as altering the general appearance of the vessel wall. Notch decoration is something in between the two other types, in that although the notches are impressed, their arrangement often gives a plastic effect. Additionally notches are confined to certain areas of the pot.
Categories 3-6. Position and distribution of decoration on sherds

These concern all three types of decoration. Category 6 is applicable to all sherds displaying a possible shoulder, whether the sherd is a rim or a non-rim sherd (cats. 1, 2 and 6).

Category 7. Nature of surface decoration

If a motif is made up exclusively of straight lines or curved lines it belongs to class 1 or 2 respectively. Straight lines limiting zones of decoration are not disregarded in this determination as the point is to record whether only straight or only curved lines were used in the ornamentation. As soon as both kinds of lines are present classes 4 or 7 apply.

Categories 8 and 9. Technique of decoration

Dentate stamp is the term used to designate a tool of unknown form and material, whose application to the soft clay of the unfired pot produced a dotted line. Shell edge impressions are clearly distinguishable from dentate stamp impressions. Incision is a smooth line, whether made by pressing an even edge into the wet clay or drawing a pointed tool along its surface. Insertion consists of one or generally many dots, each made separately with some pointed object.

Categories 10-3. Surface decoration zones

In spite of the fragmentary condition of the pottery it appears that the decoration of the original pots has been organised in horizontal zones either isolated or
touching each other. Whether such zones continue all the way round the pot is uncertain, though likely. As a rule a zone appears to contain one motif only, cases with two or more motifs alternating being almost non-existent. Category 10 records the total number of zones occurring on a sherd, inside, outside and on the lip, the biggest number recorded being six. The biggest number recorded for category 11 (inside) was two and for category 12 (outside), five.

A sherd is coded as many times as the decoration features displayed by it appear in various categories and classes. Thus a sherd with surface decoration on a plastic band on the outside of a vessel is first coded in category 10, next in category 12, finally in category 13.2.

None of the categories 10-2 applies to cases of fragmentary decoration.

Category 14. Filling of zones

Normally zones are filled in with different motifs, but deviations do occur. When none of the classes 1-3 applies, zero is scored. This is the case when (a) only one zone is observable on a sherd, or (b) only fragmentary decoration is present and no observation is possible, or (c) when both (a) and (b) are the case. Motifs are different when they bear different identifications in the motif list, e.g. A 2 and A 4 or A 2 and B 4; motifs are similar when they have the same identification, e.g. A 2 and A 2.
Category 15. Zone border lines

Sometimes a zone boundary is marked by a horizontal line to one or both sides, sometimes the motif itself forms the border. A border may consist of one or two or three lines close together, the first alternative being the rule. Zero is scored in cases of fragmentary decoration and of surface decoration on lip. Category 15 applies to all variations of the P motif, of which border lines form an integral component.

Category 16. Profile angle as zone border

Any sharp break in vessel profile may be adjacent to a zone of surface decoration and so constitute one of its borders. This break may be the transition from lip to rim side or any so-called profile angle: a body-rim joint, the corner between collar overhang and the outer wall of the collar above or the body wall below, any of the corners of a flange, or a base-body corner.

Categories 17-33. Motifs used in surface decoration

In order to make the illustrations in fig. 50 as uniform as possible, all motifs are shown with zone boundaries and the same way, in spite of the fact that this is not a rule in the material. Each submotif is depicted separately and can be referred to as, for example, A 9 or F 2. The categories of motif are organised in a particular but arbitrary order.

Continuous zone filling is represented by categories 17-29 and a vertical emphasis within zones is represented, transitionally, by category 30 and, fully developed, by category 31.
Categories 17-9 comprise pure arc motifs: vertical A arcs; horizontal B arcs; grouped C arcs which often produce circular figures. Categories 20-5 contain pure rectilinear motifs: horizontal D zigzag and triangles, grouped in a special way in D 20-7; vertical E angles and zigzags, including the unique 'wolf's teeth' motif in E 6; vertical F bars; oblique G bars; horizontal H lines occurring as separate motifs and not as zone border lines; vertical or oblique J bundles of close lines in continuous rows or in groups. Categories 26-7 comprise motifs built up of the curvilinear and rectilinear elements presented in the previous categories. Category 28 shows the labyrinth-like M motifs, category 29 some house-like and some elaborated net or labyrinth-like N motifs.

Category 30 includes the slim column-like O motifs. In category 31 are all the many variations of the panel motif P.

Category 32 assembles all unique motifs that cannot really be fitted into any of the foregoing groups. All fragmentary surface decoration is coded in category 33 and is designated R purely as a matter of consistency. A note is important here. Whenever the knowledge of the material justifies it, an occurrence of fragmentary decoration is coded positively, referred, that is, to the category and class where it seems to belong. Otherwise it is coded as an R motif.

Sometimes two submotifs occur together on the same sherd. In order to be economical with the columns on the punch cards such occurrences were listed as they were found in going systematically through the different categories
of decoration and coded at the end of the motif category to which they belong. The combinations in question are set out after category 33 in the code reproduced as table 2.

**Category 34. Horizontal plastic bands (e.g. fig. 76.13)**

The nature of these did not justify any particularly detailed description. They are generally of rather small dimensions and the cross sections do not seem to exhibit any particular types of standardisation. The few that are similar to flanges are coded with these. Categories 5-7 were inserted as a matter of consistency, but no such examples were found.

**Category 35. Plastic knobs (e.g. fig. 83.3)**

It was thought sufficient to code presence and to ignore whether there were one or more knobs.

**Category 36. Perforations (e.g. fig. 78.2)**

The same observation applies as with category 35.

**Category 37. Sundry plastic decoration**

The vertical bands (class 1) often occur in conjunction with horizontal bands forming panels filled in with surface decoration (e.g. fig. 87.14). 'Special' includes any odd kind of plastic decoration (e.g. fig. 88.15-8).
Categories 28-9. Notch decoration (e.g. fig. 88.1-6 and 19-20)

These categories record the presence, distribution and character of decoration by notches.

The Record Code

This code is a reproduction of the information from the finds catalogue concerning the origin of the sherds in the middens, but is organised differently. The record categories take up the first 22 columns of each punch card, whether this describes a rim sherd or a decorated sherd, each of these codes covering columns 23-71 and columns 23-67 respectively. The record of a decorated rim sherd is thus reproduced twice, on a rim card and on a decoration card, and in both cases category 1.2 of the record code applies.

Category 1. Type of sherd

This serves to isolate sherds without decoration from sherds with and to isolate decorated rim sherds from decorated non-rim sherds. Such entries can be useful.

Category 3. Catalogue number

The numbering of artifacts starts with no. 1 on each site.

Categories 4-5. Square metre units

On all sites these units were 1 by 1 m in area except for a few units on To.6 which were 1 by 0.5 m in area

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Set out in table 3.
(those referred to in category 4.1-8). They were always incorporated in a co-ordinate system which was laid out with the 0/0 point well outside the assumed area of the site, thus avoiding operating with inconvenient minus numerals. Since most of the co-ordinate designations consist of two digits corresponding to two columns on the punch cards, it was found uneconomical to use additional columns to cover the rare cases of three digits. These are therefore coded specially (cats. 4.1-9 and 5.1).

Category 6. General information

Any excavated find is either from the midden or from the subsoil underneath. The finds from the main trench on To.1 are recorded in accordance with the special way in which the excavation took place here.

Categories 7-8. Spit numbering

This always starts with no. 1 uppermost within each square metre unit, category 7. The total number of spits in each of these units is given in category 8. As spit 4, for example, may in some units be situated in the middle of the midden, in some others at the bottom, an analysis of distribution in terms of such differences depends on the combined information from categories 7 and 8.

Categories 9-10. Special origin

These categories apply to any excavated find which does not originate from an ordinary excavation spit. After To.1 stratigraphical layers were but rarely dug out separately, and such exceptional cases are coded in category 9.1 or 3. A fireplace is situated 'in midden' if
not dug into the subsoil; it is situated 'in subsoil'
whether it has been dug wholly into subsoil or only partly. Similarly a hole in subsoil is any hole dug into the
subsoil whether from the surface of the subsoil or from
any higher level in the midden, including ground surface.
In the code holes comprise: post holes, pits, planting
holes, undefinable holes and possibly natural depressions.

All the phenomena mentioned in category 9.1-6 were
designated by letter, coded in category 10.

Category 12. Surface finds

These are all coded as class 1. All excavated finds
score zero.

Units of Distributional Analysis

The analysis of the coded pottery was basically made
according to its distribution in terms of horizons, but
the procedure varied slightly from site to site.

To.1

A. As the midden in section I was in fact dug by
the original layers and the finds referred to these, an
analysis could be based on true horizons, making
operation with spit horizons superfluous.

B. The analysis of the finds from sections IV-V was
based on so-called spit horizons, formed by allocating
spits to stratigraphic horizons. The difference between
the spit and the average horizon (C below) is that the
boundary between the stratigraphic horizons being
irregular, identically numbered spits do not always belong
to the same horizon and each spit has therefore to be
allocated to horizon individually. The nature of this boundary also required operating with a buffer zone between the groups of spits representing horizons I and II. In some square metre units it was necessary to allocate more than one spit to this buffer zone. Finds in the buffer zone were withheld from analysis.

C. An analysis of the finds from section I was also made on the basis of so-called average horizons. These are only appropriate when the lie of the stratigraphic horizons is such that all identically numbered spits belong on the whole to the same horizon. In the present case spits 3-5 roughly covered horizon I, spits 1-2 roughly constituted horizon II. The total number of finds from, for example, horizon I is therefore easily obtained by adding totals from spits 3-5 together. With this operation the figures are averaged rather than precise. Therefore the results produced by average horizons should be looked upon with some reservation, the main idea being to see how they would compare with those of the true and spit horizons. As, however, the boundary between the two horizons was a little irregular, a buffer zone was employed between them, always represented by spit 2. The finds herefrom were withheld from analysis. Horizon II is thus represented by the finds from spit 1 only, but in trench I spit 1 is in fact 20 cm thick, hence the designations, 1 a and b. Horizon I is represented by spits 3-5.

To.2 This was in many respects a special case. Only the finds from the midden horizon were analysed quantitatively. As the original midden here was made up of one stratigraphic horizon only and this was
exceptionally thick, it was arbitrarily divided into three zones, a bottom, buffer and top zone, each analysed, however, as though it was a separate horizon.

**To.5** The stratigraphic horizons I-III were organised into spit horizons I-III and average horizons I-III. In the average horizons, III = spits 1-4; II = spits 5-7; I = spits 8-10.

**To.6** The midden horizons I-III were organised into spit horizons I-III.

**Text table V.3**

**Categories of Horizon for Analysis**

**To.1** Midden horizon I-II = A: true horizons I-II in section I

" " " " I-II = B: spit horizons I-II minus buffer zone in sections IV-V

" " " " I-II = C: average horizons I-II minus buffer zone in section I

**To.2** The single midden horizon = D: bottom - buffer - top zones I-II-III

**To.5** Midden horizons I-II-III = B: spit horizons I-II-III

" " " " I-II-III = C: average horizons I-II-III

**To.6** " " I-II-III = B: spit horizons I-II-III

On all sites those square metre units were excluded from analysis which were too disturbed. The aim with a
buffer zone between two adjacent horizons as on To.1 was that it should absorb some of the intermixture of evidence between them. The same principle applies where three superimposed stratigraphic horizons are recognised, with the middle one acting as a buffer zone and affecting a more pronounced separation of the manifestations of different parts of a possible time scale. If a pottery sequence is to be demonstrated, then the extremes should be examined first. This is also the quickest way to get an idea of the relationship between individual sites in terms of horizons, when the sequence of the sites is quite unknown. A later analysis can clarify the circumstances concerning the middle horizons.

The following three alternative bases of analysis were considered, of which the two first were rejected, the third partly accepted.

1. Analysis of individual square metre units. This was ruled out simply on grounds of the size of sample. On no site was only one square metre of midden excavated and it was found necessary to bring together the biggest possible number of square metre units in order to increase the size of the sample represented by each site.

2. Theoretical models of midden development (fig. 51). This idea arose from theoretical considerations of the relationship between the distribution of artifact features through a site and the evidence on midden build-up as revealed by site stratigraphy or the lack of such evidence where stratigraphic indications were absent or unclear. In so far as artifact features could be shown to change over time, the distribution of such features in the horizontal as well as the vertical dimension in a site
should give information about the build-up of that site unprovided by, supplementary to or perhaps even at variance with the excavated evidence of site structure.

Model A of fig. 51 is an illustration of the basic component of the subsequent models B-E. By combining these possibilities one can work out a number of additional models. A site might for example be at one end like model C and at the opposite end like model D. The unstratified midden horizon at site To.2 could, at least theoretically, have reflected formation of model D type, but in fact it is identical with model A and thus like the individual horizons at the other sites. The excavated part of the To.6 midden is interesting in that a comparison between the lateral extension of horizons III and I can serve to illustrate a model D midden which is characterised by an upper horizon larger than a lower one.

Two conditions necessary for effective operation with models of formation were not fulfilled by the excavations: large samples of material to enable changes in the horizontal dimension to be correctly interpreted in terms of midden growth and not for example differential site use, and closely linked with this, large area excavation of sites to document the horizontal dimension of middens as fully as the vertical.

3. Zone analysis. By the rules of stratigraphy the bottom part of a midden horizon is older than its top part. An analysis of frequencies of occurrence on the basis of so-called spit zones within horizons might document internal changes. In theory a seriation of the results of such analyses carried out on all horizons at all sites should enable correlations between sites in terms of spit
zones: for example, early horizon I on To.1 corresponding to late horizon I or early horizon II on To.5. Apart from such chronological concerns, a close analysis of this type could throw some interesting light on the detailed behaviour of individual pottery features.

Unfortunately, however, the conditions for an analysis of this kind were not good at the sites investigated, with the possible exception of To.2. In general the horizons were not very thick and too often the thickness of the horizons varied too much for a straightforward allocation of spits to one or the other of two adjacent spit zones.

The sherd totals available for the spit zones presented a difficulty since they were on the whole too small for statistical evaluation. The displacement of sherds within a midden, due to whatever cause, is obviously a more serious problem in spit zone analysis than in horizon analysis for this reason. A further difficulty is presented by the arbitrary division of the horizon into spits, which provides the only basis for a zone analysis where stratigraphic indications within the horizon are absent. The spit divisions may quite conceivably cut across the important divisions within the included archaeological material, particularly where the thickness of the midden horizons is small.

The ideal conditions for a zone analysis thus are: numerically big samples, thick horizons allowing for a number of internal zones and for the isolation of buffer zones between horizons, and as little disturbance of the deposits as possible. The To.2 midden, though fulfilling some of these conditions, was not ideal and the isolation
of zones had to be confined to a bottom and a top zone with an intervening buffer zone (see text table V.3).

As an experiment with the average horizon distribution of frequencies, mentioned above, a spit zone seriation analysis was tried with material from To.1 to To.5. All identically numbered spits formed one zone: thus at To.1 the total number of spit zones was 6, at To.5, 10.

**IBM Computation of the Data**

Lists of questions to be asked of the coded rim and decoration data, complete with code references, were submitted for programming, together with instructions about the form in which the answers should be made available from the computer. The latter is dealt with here, the former further on.

The frequencies of occurrence of the analysed features were to be shown by exhaustive distributional tables, examples of which are given in tables 4 and 5. These were to give a full account of the origin of all sherds characterised by the feature(s) in question. The tables asked for thus set out the data according to the pigeon hole system by means of which the middens had been examined. Accounted for also was the distribution of features in terms of any other class of origin, as set out

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1 I would like here to acknowledge the help of the staff of the Computer Centre and the Data Processing Unit of the Australian National University, in particular of the programmer, Mrs B. Davidson, whose assistance was invaluable to one hitherto unfamiliar with computer operations.
in the record code. The tables could thus be used as the basis for many types of investigation, including the ones mentioned in the foregoing section.

The data relating to each horizon were eventually collated by going through the many hundred output sheets adding up the figures from all spits concerned. This was a tedious job and very time-consuming. One of the many lessons learnt during the work with the punch cards was that attribution to horizon should have been coded together with all the other information as to origin. The mistake was discovered too late to be rectified. This is all the more regrettable in that the horizon information would have enabled simpler and quicker programming and allowed extra questions to be asked of the pottery, the answers to which it would have been interesting to get.

Statistics

After having extracted the figures showing the occurrences of a pottery feature\(^1\) through the horizons, the next step was to evaluate these figures. How could similarity or difference between horizons be pointed out in terms of quantified pottery features? How could the significance of observable differences be estimated?

A preliminary indication was obtained by calculating the occurrence of any particular feature as a percentage of the total population for each horizon, as in text table V.4.

\(^1\) The majority of the rim figures were available first, the remaining rim figures and all decoration data not till many months later.
In order to see whether variations in this percentage picture are meaningful, the basic figures should obviously be treated in some statistical way. If it is assumed that a particular feature is equally common in two particular horizons, then the ratio between its frequency of occurrence in these horizons should be approximately identical to the ratio between the total population in each horizon. The latter ratio representing a kind of standard, any deviations from it are assumed to show something abnormal, to a degree of greater or lesser significance. The larger the total population, that is the bigger the sample, the more reliable are the indications provided by such deviations or their absence.

It soon became clear that it was not satisfactory to rely on intuitive evaluation of the degrees of significance of differences of occurrence seen in this way. Expert advice from statistical quarters was felt desirable and eventually the total data on frequencies of occurrence in terms of horizons were submitted to statistical tests by computer.¹ The degrees of significance which could be

¹ I wish to thank Dr B.H. Mayoh, head of the Computer Centre (Regnecenter) at Aarhus University, for help in this respect. I am particularly indebted to Mr B. Isaksen, also of Aarhus University, for advice on selection of an appropriate statistical formula. See Appendix IV.
attached to the individual ratios were divided into three groups: significant, possibly significant, not significant.
CHAPTER VI

ANALYSIS OF POTTERY : RESULTS

The information sought from the pottery under study consisted of the occurrences of specified ceramic features by sites and horizons. From these distributions it was possible to say something about the ceramic situation in each horizon to which these features contributed and about the relative importance of the different features within it.

The next task was to compare, for all sites, the occurrence of features in horizons of the same site, where, that is, a relative chronology had been provided by excavation. Were any general tendencies visible in the varying frequencies, all sites and all horizons considered? Tendencies are present when the original frequencies are labile, i.e. when the figures permit the demonstration of significant or possibly significant differences between horizons, the former alternative called a case of primary significance, the latter a case of secondary significance. Tendencies may be similar or consistent when all under observation are increasing or decreasing, i.e. over time, or they may be different or conflicting when some are increasing while others are decreasing. Depending on whether tendencies are similar or different, cases of primary and secondary significance may or may not be of mutual support. Tendencies are absent when the figures permit the demonstration of insignificant differences only,
whether increasing or decreasing, or of none at all. This is a case of stable frequencies which may mean 'no change', i.e. over time, if they are big enough; otherwise they permit no conclusion. Of particular interest at this stage of the analysis was the position of the middle horizon in relation to the upper and lower horizons on sites To.5 and 6.

The analysis of tendencies within each site having been completed, it was possible to consider the relationship between the different sites and their horizons. This was done by comparing the percentage occurrence of the ceramic features from horizon to horizon and site to site. This comparison, together with the conclusions and considerations derived from earlier stages of the analysis, become the basis for a suggested relative chronology.

Finally an experiment was made involving analysis by spit zones to see how much finer a characterisation of the ceramic sequence could be achieved.

Rim Analysis (tables 6-22)

The first series of rim questions totalled 78. They are summarised by reference to the code designations: all references are to the rim code except when otherwise stated.

All rims whether decorated or not, record code cat. 1.1-2; all undecorated rims, record code 1.1; all decorated rims, record code 1.2.

Complete A rims with inward body-rim inclination, cats. 1.1 + 4.1, or with outward body-rim inclination,
cats. 1.1 + 4.2. Complete B rims in the same way, cats. 1.2 + 4.1 and 4.2 respectively. Further the remaining items of category 1, nature of rim sherd, were asked for, cat. 1.3-9.

Rim orientation: cats. 2.1-3; 2.4 + 3.6; 2.5 + 3.6; 2.6 + 3.10; 2.7.

Body-rim inclination: cat. 4.1-3.


Lip: cats. 29.1-7; 31.1-3; 32.1-3; 34.1-9.

The full distribution was requested for the material from all six sites, i.e. all the possibilities of origin which are embodied in the record code.

Only a selection of these data was analysed: nos. 1-15, 17-24 below, also set out in table 6. At a later stage an additional question, no. 16, was asked, but for practical reasons only of material from To.1, 5 and 6. It concerned the occurrences of convergent rims excluding the collar/flange rims, virtually all of which had this rim form.

The next series of rim questions is related to combinations of features. These questions, nos. 25-58, listed in table 6, were not put to the small samples of material from To.3 and 4. It would have been interesting had they been run on the material from To.2, but for practical reasons this was impossible. For the combination questions nos. 52-8, the basis of calculation was the total of flat lips, instead of the total of rim sherds used for all other questions.
The occurrence of each feature by sites and horizons is set out in tables 7-13 as raw figures and percentages.\footnote{For questions nos. 42, 44 and 46 the occurrences are so small that they have been omitted from the tables, but they are combined in question no. 48.} The tendencies they exhibit are listed in tables 14-7. Tables 18-9 graph the percentage occurrences of ceramic features in the different horizons of the different sites. The conventions used in these tables are explained in Appendix X.

1. **Decorated rim** The consistently decreasing tendencies of exclusively primary significance form a strong case for saying that this feature became less common over time. On To.5 and 6 the middle horizon seems to be equally distant from the two others. There is a reasonable indication of a sequence of the sites: early: To.2, 5 - middle: To.1, 2, 5 - late: To.1, 5, 6.

2. **Complete A rim, inward body-rim inclination** The conflicting tendencies of primary and secondary significance and the many cases of absence of tendencies make it most reasonable to assume that this kind of complete rim was always equally present. On To.5 and 6 the middle horizon appears to be equally distant from the two others. There is no evidence of a sequence of the sites.

3. **Complete A rim, outward body-rim inclination** The almost exclusively primary significance of the consistently decreasing tendencies makes it plausible that this feature became less common over time despite the many cases of absence of tendencies. Both on To.5 and 6 the
middle horizon is perhaps closer to the lower than to the upper horizon. There is a slight possibility of a sequence of the sites: early: To.1, 2, 5, 6 - late: To.1, 5.

4. **Straight uncertain rim** That this 'feature' grew more common over time is quite clearly demonstrated by the consistently rising tendencies and their prevailing primary significance. On To.5 as well as on To.6 the middle horizon seems to be more related to the upper than to the lower horizon. The indication of a sequence of the sites is good: early: To.1, 2, 5 - possibly middle: To.5, 6 - late: To.1, 5, 6.

5. **Special rims** It appears clearly from the almost exclusively primary significance of the similar and decreasing tendencies that such rims, comprising mainly collar and flange rims, became less frequent over time. That the middle horizon is equally distant from the two others is the most reasonable conclusion for To.6 and on the whole the most possible one for To.5. There is some indication of a sequence of the sites: early: To.1, 2, 5, 6 - middle: To.1, 5, 6 - late: To.6.

6. **Inward orientation** Although similar and decreasing tendencies are the case and their significance is more often primary than secondary, the absence of tendencies between horizons I and III on To.5 makes it difficult to go beyond saying that this feature did perhaps become less common. The middle horizon on To.5 is equally related to the two others, whereas on To.6 it is closer to the lower than to the upper horizon. There is only a very slight indication of a sequence of sites: possibly early: To.1, 5, 6 - possibly late: To.1, 2, 5, 6.
7. Outward orientation  The consistent and decreasing tendencies and the absolute primary significance of these is clearly in favour of concluding that this feature became less common. The middle horizon is more similar to the lower horizon than to the upper both on To.5 and on To.6. A sequence of sites is quite possibly present: early: To.1, 2, 5 - middle: To.1, 5, 6 - late: To.6.

8. Approximately vertical orientation  This excludes sherds with exactly vertical orientation and includes those exhibiting the ranges \(-1/0, 0/+1\) and \(-1/+1\). The consistent and increasing tendencies of primary and secondary significance on the whole seem to indicate that this feature became more common, a possibility that cannot quite be ruled out by the virtual absence of tendencies on To.1. The middle horizon on To.5 and 6 is equally distant from the two others. There is good evidence of a sequence of the sites: possibly early: To.5 - middle: To.1, 2, 5, 6 - late: To.6.

9. Combined vertical orientation  This adds all sherds with exactly vertical orientation to those dealt with under no. 8 above. The consistent and increasing tendencies exclusively of primary importance, despite an almost unaltered situation on To.1, support the indications of no. 8 that vertical orientation of rims became more common. On To.5 the middle horizon is closer to the lower horizon and on To.6 it is closer to the upper horizon. The evidence of a sequence, much like no. 8, is good: early: To.2, 5 - middle: To.1, 5, 6 - late: To.6.

10. Uncertain orientation  Although the tendencies present are similar and increasing and of primary significance, the main impression is that rims exhibiting
this uncertainty frequently occur amongst the material from all horizons. What was expected from examining this 'feature' was a possible indication that it was more frequent in upper horizons as a result of gardening activities.

11. **Inward body-rim inclination** Although principally this is a case of some conflicting tendencies of both degrees of significance and more absences of tendencies, there still seems to remain a slight possibility of this feature decreasing over time. But this is all that can be said.

12. **Outward body-rim inclination** The consistent and falling tendencies, more often of primary than of secondary importance, seem to point to this feature becoming less common. On To.5 the middle horizon is equally distant from the neighbouring horizons, on To.6 it is more like the lower horizon. The chance of a sequence of sites is bad: possibly early: To.2, 5 - possibly late: To.1, 2, 5, 6.

13. **Collar rims as a separate group** The dominantly primary significance of the similar and decreasing tendencies, all of them practically identical with those observed with special rims, no. 5 above, clearly shows that collar rims, considered separately, became less frequent over time. The middle horizon on To.5 is closer to the bottom than to the upper horizon. There is some indication of a sequence of sites (To.6 excluded): early: To.1, 5 - late: To.1, 5 - To.2 in between.

14. **Parallel rim** The conflicting tendencies, their differing degrees of importance, and the many cases of
absence of tendencies, all show that this feature was most probably equally well known all the time, but in varying proportions on the individual sites.

15. Convergent rim  The tendencies here in essence are similar and decreasing rather than conflicting. This, added to their predominantly primary significance, makes it possible that this feature grew less common. The position of the middle horizon on To.5 is not clear. There are only limited indications of a sequence of sites: early: To.1, 2, 5 - late: To.5.

16. Convergent rim, excluding collar/flange rims  The almost complete absence of tendencies clearly demonstrates that this feature was equally present all the time. The position of the middle horizon is unclear both on To.5 and 6. There is no sequence of sites.

17. Divergent rim  The many cases of similar and increasing tendencies, almost all of which are of primary significance, make it very clear that this feature became more common over time. On To.5 the middle horizon seems equally distant from the two adjacent horizons, whereas on To.6 it is closer to the upper than to the lower horizon. There is good evidence of a sequence of sites: early: To.1, 2, 5 - middle: To.1, 5, 6 - late: To.6.

18. Inner thickening  Absence of tendencies being almost complete, this feature was no doubt equally present all the time.

19-20. Outer thickening. Inner/outer thickening  The same conclusions as with no. 18 apply.
21. Combined thickenings  This is the sum of the sherds treated in nos. 18-20. The few cases of similar and increasing tendencies and their degrees of importance, viewed against the many cases of absence of tendencies, make it only slightly possible that these combined features became more common. On To.5 the middle horizon seems closer to the upper horizon, on To.6 it is equally distant from the other two. Some indication of a sequence of sites is present: early: To.1, 2, 5 - possibly middle: To.1, 5 - late: To.6.

22. Flat lip  The consistently increasing tendencies, the marked majority of which are of primary significance, give very convincing evidence of this feature becoming more common over time. On To.5 the middle horizon is more related to the lower than to the upper, whereas on To.6 it is equally distant from the two others. A sequence of the sites is obviously present, although some of the details seem a little obscure: early: To.1, 2, 5 - middle: To.1, 5, 6 - late: To.6.

23. Round lip  Though in a minority, the cases of similar and decreasing tendencies and their degrees of significance give an impression that this feature grew less common. The middle horizon seems equally distant from the neighbouring horizons on To.5 and 6. The possibility of a sequence of sites seems to be reasonably good: early: To.1, 2, 5 - late: To.1, 5, 6.

24. Hybrid lip  The very few similar and decreasing tendencies, badly supported in terms of primary degrees of importance, give but weak evidence of this feature getting less common over time. On To.5 the middle horizon is closer to the lower than to the upper horizon. On To.6 it
is equally close to the other two. Some sort of a sequence of the sites may be present, but in rough outline only: early: To.1, 2, 5 - late: To.5, 6.

A brief opening note is in place before we pass over to a consideration of the combined features. The more factors are combined, the less likely is the combination to occur. This fact is clear in the tables of tendency in combined rim features, which are characterised by an increased number of absences of tendency. In order to simplify discussion of the combined features, it is simply noted 'tendencies absent' when this is the case or 'tendencies practically speaking absent' if the one or two cases of positive tendency are considered not to alter the picture suggested by the general absence of tendencies.

There was not time to look at all the combinations that would have been desirable. The majority of those dealt with, nos. 25-48, follow logically on from the analysis of single features and refer to basic aspects of the rim. Of particular concern was to see whether there were any preferred combinations for the two dominant lip types, flat and round. Nos. 49-51 were chosen to see if it was possible to say whether originally the class of straight uncertain rims and of vertical or near vertical orientation had belonged to vessels with inward or outward body-rim orientation. The remaining combinations were meant to explore certain aspects of flat lips.

25. Inward orientation + flat lip 'Tendencies practically speaking absent' seems to characterise the situation best, though the decreasing tendencies on To.6 may be noted.
26. **Inward orientation + round lip** The few consistent and decreasing tendencies of both degrees of significance are found exclusively on To.5.

27. **Outward orientation + flat lip** Tendencies practically speaking absent.

28. **Outward orientation + round lip** The consistent and decreasing tendencies present, of both degrees of significance, might justify a conclusion that this combination became less common. On To.5 the middle horizon is much closer to the lower than to the upper. The possibility of a sequence of sites is small: early: To.5 - late: To.6.

29. **Combined vertical orientation + flat lip** This is the sum of exactly and approximately vertical orientation in combination with flat lip. The consistent and increasing tendencies, mainly of primary significance, make a strong case for this combination becoming more common over time. On To.5 the middle horizon is closer to the lower horizon, whereas the opposite is the case on To.6. A sequence of sites is quite likely: early: To.1, 5 - middle: To.1, 5, 6 - late: To.6.

30. **Combined vertical orientation + round lip** Tendencies absent.

31. **Inward body-rim inclination + flat lip** Tendencies practically speaking absent.

32. **Inward body-rim inclination + round lip** Tendencies absent.

33. **Outward body-rim inclination + flat lip** Tendencies practically speaking absent. The two isolated and conflicting tendencies on To.6 do not make sense.
34. **Outward body-rim inclination + round lip**   The few similar and decreasing tendencies, of which one only is of primary significance, do not show very much beyond a possible indication that this combination became less common. The middle horizon on To.5 is equally distant from the two others. The possibility of a sequence of sites is bad: early: To.5 - late: To.1, 5, 6.

35. **Parallel rim + flat lip**   The similar and increasing tendencies present, equally often of both degrees of significance, tend to show that this combination may have become more common over time. The middle horizon on To.5 is closer to the lower. A sequence of sites is not quite impossible to see: early: To.1, 5, 6(?) - late: To.5, 6.

36. **Parallel rim + round lip**   Tendencies practically speaking absent. The cases from To.1 stand rather isolated.

37. **Convergent rim + flat lip, excluding collar/flange rims**   Tendencies absent.

38. **Convergent rim + round lip, excluding collar/flange rims**   Tendencies practically speaking absent.

39. **Divergent rim + flat lip**   The similar and increasing tendencies of almost exclusively primary significance give very convincing evidence in favour of this combination growing more common over time. The middle horizon on To.5 seems to be equally close to the two others, whereas on To.6 it is closer to the upper horizon. The sequence of sites appears to be: early: To.1, 5 - middle: To.1, 5, 6 - late: To.6.

40. **Divergent rim + round lip**   Tendencies absent.
41. Inner thickening + flat lip  Tendencies absent.

42. Inner thickening + round lip  This combination occurs so rarely that it is excluded from tables 11-3.

43. Outer thickening + flat lip  The few similar and increasing tendencies, of which only one is of primary significance, cannot point to more than a very slight possibility of this combination getting more common. The middle horizon is equally close to the two others on both To.5 and 6. A sequence of sites is not very convincing:
early: To.1, 5 - late: To.5, 6.

44. Outer thickening + round lip  This combination occurs so rarely that it is excluded from tables 11-3.

45. Inner/outer thickening + flat lip  Tendencies practically speaking absent.

46. Inner/outer thickening + round lip  This combination occurs so rarely that it is excluded from tables 11-3.

47. Combined thickenings + flat lip  This is the sum of nos. 41, 43 and 45. The similar and increasing tendencies, to an almost equal extent of both degrees of significance, give quite good indication of this combination getting more common over time. On To.5 the middle horizon is equally close to the other two, whereas on To.6 it is closer to the upper. A sequence of sites is relatively clear:
early: To.1, 5 - possibly middle: To.1, 5, 6 - late: To.6.

48. Combined thickenings + round lip  This is the sum of nos. 42, 44 and 46. The combinations are so rare that it is pointless to look for tendencies within them.

49. Combined vertical orientation + inward body-rim inclination  This is the sum of exactly and approximately
vertical orientation in combination with inward body-rim inclination. The few tendencies present are conflicting and though the isolated cases from To.1 are all of primary significance, there is no real basis for saying anything positive.

50. Combined vertical orientation + outward body-rim inclination Tendencies practically speaking absent. A sequence of sites is not altogether impossible: early: To.6 - late: To.1, 5.

51. Combined vertical orientation + straight uncertain rim The similar and increasing tendencies, almost all of which are of primary significance, make it quite clear that this odd combination 'became' more common over time. On To.5 the middle horizon is closer to the lower, whereas on To.6 it is perhaps equally distant from the two others. A sequence of the sites is clear: early: To.1, 5 - middle: To.1, 5, 6 - late: To.6.

52. Flat lip, symmetrical Although tendencies are present on To.1 only, they are similar and decreasing and all of primary importance. There may be an indication here of this kind of flat lip growing less common.

53. Flat lip, asymmetrical to the interior Tendencies absent.

54. Flat lip, asymmetrical to the exterior Here again the evidence of positive tendencies is from To.1 only, except a single secondary case from To.6. There is thus a possible indication that this kind of flat lip grew more common over time. The evidence of nos. 52 and 54 fit well together, increasing the possibility that they are indicating something.
55. Flat lip, horizontal  The tendencies are a little conflicting.

56. Flat lip, possibly horizontal  The similar and increasing tendencies present, exclusively of primary significance, make it most probable that this kind of flat lip became more common over time. On To.5 and 6 the middle horizon is closer to the upper than to the lower. Some kind of a sequence of the sites may be present: early: To.5 - late: To.1, 5, 6.

57. Flat lip, combined horizontal  This combines the evidence of nos. 55 and 56. On the whole there is a repetition of the picture provided by no. 56. The only difference seems to be that the sequence of sites is clearer: possibly early: To.5 - middle: To.1, 5, 6 - late: To.6.

58. Flat lip, not horizontal  The similar and decreasing tendencies, equally of both degrees of importance, form a reasonable indication of this kind of flat lip getting less common over time. The middle horizon is equally distant from the two others on To.5 and 6. There is only a little evidence for a sequence of sites: early: To.1(?), 5 - late: To.1, 5, 6. There is agreement between the evidence from nos. 57 and 58.

Summary of Rim Results

Virtually all the rim features investigated are present in all horizons of all sites. The exceptions are certain combinations of features found almost never to occur at all, nos. 42, 44, 46, summarised in no. 48.
Some generalisations can be made about the rim features of all horizons (cf. tables 18-9). Decorated rims are less common than plain and of the complete rims the A rims are the single commonest class, those with outward body-rim inclination being commoner than those with inward inclination. Outwardly oriented rims are always more numerous than inwardly oriented ones, but those with vertical or nearly vertical orientation are as common or more common than the outwardly oriented rims. Parallel rims are always more numerous than convergent rims, collar and flange rims excluded, and the same is in the main the case with divergent rims. The last mentioned are almost invariably associated with flat lips. Rim thickenings are present throughout, but almost exclusively on rims with flat lips. Flat lips are always more likely to be horizontal than they are to be definitely not horizontal.

The proportional frequency of occurrence of some of the above features, and of many others not yet mentioned, varies from horizon to horizon. Where these variations follow the stratigraphy of the excavated sites, we can talk of certain tendencies to change over time, of varying degrees of significance.

Some of these changes result in a complete reversal in the proportional representation of one feature as compared with another within horizons. Thus divergent rims begin as less important than convergent ones but over the course of time become more important. At To.5 round lips are at the start more numerous than flat lips but on all sites at the end flat lips are markedly more important. On the whole half or slightly more of the early flat lips are symmetrical about the central axis of the rim.
marked majority of the later flat lips are asymmetrical to the exterior of the vessel.

Other changes over time not involving such reversals may be noted. Decorated rims, collars and flanges become less common with time. Perhaps inwardly and certainly outwardly oriented rims decrease in importance, while those with vertical or nearly vertical orientation become more numerous. The combination of outwardly oriented rim and round lip (which seems always to have been more common than the combination with flat lip) seems to decrease over time; the combination of vertical or nearly vertical orientation and flat lip becomes commoner. Flat lips in combination possibly with parallel rims and certainly with divergent rims increase in importance. The combination of flat lip and rim thickening seems to become more numerous. Flat lips tend increasingly to be horizontal.

The high level of agreement between the tendencies observed over time in the different sites encourages a belief that they reflect general processes of ceramic change. The proportional representation of ceramic features in the various horizons (tables 18-9) could thus be used to set horizons and sites into a relative time sequence (table 20).

As preparation for this, two relevant facts were noted. Firstly, the three zones isolated in the To.2 midden horizon formed a unity in the analysis which did not reveal the presence of a single tendency, either of primary or of secondary significance. Secondly, the position of the middle horizon as compared to the lower and the upper horizons is the same on To.5 and 6.
Sometimes it seems closer to one or the other of these, cases of identity being rare. On the whole, however, it tends to be a separate horizon, generally speaking equally distant from the adjoining horizons.

A good starting point for the relative chronology seemed to be to look for the extremes of the sequence, of which the lower appears present in To.5 and perhaps also in To.2, the upper in To.6.

Comparing To.2 and 5 the former tends to belong somewhere within the range of horizons I and II at the latter. Horizon I on To.1 also seems to be correlated with horizons I and II on To.5, but perhaps with the main weight on the middle horizon of this site. The upper horizons of To.1 and 5 appear to agree with each other. The To.2 midden horizon tends to be like horizon I on To.1, but there is some indication that it may in fact in part be earlier. On the whole the upper horizons on To.1 and 5 correspond to horizon I and possibly at least to part of horizon II on To.6, whereas horizon III of this site appears to stand isolated. There conclusions are illustrated in table 20, which also incorporates the radiocarbon dates. These are to be the subject of special comment in chapter VII. At this point we may note their generally good agreement with the archaeological evidence.

The two early radiocarbon dates for the allegedly late site of To.6 create a problem. Also in terms of decorated rims and collar rims To.6 appears to be in an unusual position, with an almost complete absence of the former and a comparatively large representation of the latter. To.6 is considered again on pp.138, 139-40 and in chapter VII.
In the analysis which has just been described the use of individual features proved a better tool than the combined features for establishing a sequence. It was also found that operating with C horizons led in general to the same result as dealing with A and B horizons (see pp. 102-4).

It now remains briefly to evaluate the experimental analysis in terms of spit zones, the results of which are shown in tables 21-2. As expected, this was of no assistance in providing more detailed information about the relative chronology of the sites and about pottery development in terms of rims. Inevitably the frequencies are small and because of this prevent recognition of valid links in the chain of change. Also the spit zones in question were compiled on the basis of C horizons, a less sensitive vehicle than A or B horizons. At best the tables show no more than was known from the analysis of horizons.

Decoration Analysis (tables 23-7)

One series of questions was asked respecting decoration. Only sites To.1, 2 and 5 were involved, the material from the other sites being too small for analysis. The questions are listed in table 23. As with the rim questions, full information on distributions was requested. The same series of decoration questions was run four times. Run I included all decorated sherds. Run II isolated all decorated rim sherds, record code category 1. 2, with or without 'shoulder'. Run III took all non-rim sherds with decoration, record code category 1. 3, with or without 'shoulder' angle. Run IV covered all decorated sherds with 'shoulder' angle, decoration code category 6. 1-7, whether
rim sherds or not. It was hoped in this way to see whether any particular decorative feature was preferred on particular parts of the original pots and whether this might be of chronological interest.

Runs II-IV gave such negative results that comment is superfluous and the reproduction of the lengthy tables unnecessary. The decoration analysis is thus based solely on the results of run I. The raw data on occurrences in the different horizons are set out in table 24, together with percentages calculated on the basis of the total of decorated sherds. Table 25, the conventions of which are explained in Appendix X, sets out the tendencies exhibited by decorative features in different horizons of the same site. Graphs of the percentages are not presented as in this case they do not help in the correlation of sites and horizons.

**Consistencies**

It is remarkable how generally uniform the decorated pottery is throughout the period represented in the excavated material. The majority of the analysed features occur in all horizons of all the sites where decorated pottery was studied. Their frequency of occurrence does not change at all or, where it does, the consistent or conflicting tendencies are of no statistical significance.

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1 Percentages are not quoted for nos. 15 and 34-6, since in these cases the formula using the total of decorated sherds would appear to be meaningless. As a result the features are not included in table 25.
Decoration on rims (except collar/flange rims) and close to angles in the profile is not infrequent but appears less common than elsewhere on the pot. Plastic and notch decoration is by no means rare, but surface decoration is dominant. The combination of all three types of decoration is more common than combinations of any two but all are rare. Decoration on the lip and inside the rim is very uncommon. Rectilinear and curvilinear decoration are both common, alone and in combination, but the former seems to have been preferred. Amongst the techniques of surface decoration the dentate stamp is absolutely predominant.

Because of the small size of the sherds it is difficult to say anything positive about the number of surface decoration zones used on the pots. It appears that use of zone border lines was fairly commonplace. The decoration was quite often adjacent to angles in the profile, the lip-rim angle and/or a shoulder angle. The range of motifs used in surface decoration is wide but none of them was commonly used, except the A motifs. Plastic bands were used quite regularly, in the great majority of cases on the outside of the pot. Other types of plastic decoration were very rare. Most notch decoration took place on plastic bands.

Tendencies

Four things immediately leap to the eye seeing the picture of tendencies (table 25). There are very few cases of presence of tendencies, equally often of primary and secondary significance. What tendencies there are are more often decreasing than increasing. To.2 is almost devoid of tendencies. The tendencies present are confined
to individual sites: only in three cases can consistent tendencies of a feature be observed on more than one site: nos. 31, 53 and 58. However, it is hard to believe, looking at the rim evidence, that no change did in fact occur in decoration, other than its apparent decline. Perhaps the reason is to be sought in the smaller numbers involved.

Altogether there are only 24 features\(^1\) marked by labile frequencies and these are brought together in table 26. A feature must display one example of a tendency of primary significance to be included. With this evidence thus set out, some hints of support for the conclusions from the rim evidence are forthcoming. Note particularly the situation at To.2, where decoration is characterised by an almost complete absence of tendencies and the evidence suggests, as the rim evidence did, that the midden here represents a single archaeological phase.

Comparing the middle horizon on To.5 with its two neighbouring horizons (table 27) on the whole gives the impression that there are a few differences present. This may make it reasonable to look upon it as a separate horizon, as the rim analysis also suggested. The evidence is not, however, sufficient to show whether it is closer to one or the other of its neighbours or equally distant from them.

A study of the percentages of features showing tendencies (table 24) with the hope of correlating the horizons of the sites by seriation gave a wholly negative result. No meaningful pattern whatsoever emerged.

\(^{1}\) Strictly speaking 23, since no. 58 is not a feature in the real sense of the word.
Neither was it possible to see links with the percentage pictures of rim features. As a result attention was directed to the many cases of absence of tendency, the point being that the percentages of these might form some basis for correlating horizons from one site to another. The frequencies concerned were arbitrarily divided into three groups by reference to the size of their percentages comparing all sites together: stable frequencies (SF), more than 10 per cent; minute frequencies (MF), less than 10 per cent; uncertain frequencies (UF), some more, others less than 10 per cent. Between two sites the stable frequencies might fall within a small range (x), or a more extended one (y). The resultant groupings are:

SF x: features 4, 5, 8, 9, 17, 27, 63.
SF y: " 10, 18, 21, 37, 61, 68.
UF : " 2, 16, 45, 59, 70.

The only possibility of correlation was to investigate cases of differences, i.e. all those listed under SF y, and UF. The result, however, was as negative as with the percentage investigation of cases of labile frequencies.

In the light of the above there was obviously no point in analysing the detailed decoration evidence in terms of spit zones.

Summary of Decoration Results

From the foregoing it will be abundantly clear that hardly any evidence for a chronology of decorative features can emerge from a study of the distribution of these through the stratigraphic horizons of the individual
sites. The marked decline in the use of the complex P motifs is the best indication of chronology that can be pointed out. It obviously becomes impossible to correlate the horizons from one site to another in terms of these features of decoration. The ornamentation of the pottery apparently underwent little development over the course of time, the few observable signs being those of gradual change only, represented more often by decreasing than by increasing frequencies.

Further Analyses involving Decoration (tables 28-33)

Since results from an analysis of the features of decoration themselves were so few, attempts were made to extract something significant from the decoration by handling it in a different way.

1. Proportion of decorated to undecorated pottery

The proportions of decorated to total rims are set out in tables 7-10 as feature no. 1. We have seen how these proportions decline over time (tables 14-5 and 18). However, vessels can be decorated without having decorated rims, so that the rim figures need not be a very good index of the total situation. With fragmentary material like that in question, even complete counts and weights of decorated and undecorated sherds leave questions unresolved: for example is a decline in the amount of decoration due to fewer vessels being decorated or a smaller surface area on the same number of vessels? For practical reasons in the present case complete counts and weights could not be attempted. However, it was considered that results enabling valid comparisons to be made between
horizons of the same and different sites could be achieved by calculating an index of decorated sherds to rim sherds for each horizon. The index is:

\[
\text{total number of decorated sherds} \times 100 \\
\text{total number of rim sherds}
\]

The total number of rim sherds should represent the total of pottery, each vessel having a rim, while the total of decorated sherds should represent the total of decorated pottery. No distinction was made between rim sherds with or without decoration or between decorated rim sherds and body sherds.

The exercise gives some interesting results (table 28). Excluding, as usual, To.2, there is a consistently declining tendency through the horizons, from an index of about 100 at the bottom of To.5 to one of about 0 at the top of To.6. There is a good correspondence between horizon II at To.1 and horizon III at To.5 and a fair one between horizon I on To.1 and horizons I-II on To.3. The extraordinary indices from To.2 first of all confirm the archaeological unity of the horizon but they also suggest that the To.2 midden on a seriation basis may be older than horizon I on To.5 and could not be younger than horizon II at that site. Whatever the explanation is of the peculiar figures from To.2, the older extreme of the decorated pottery sequence is represented at this site, as also at To.5 and perhaps at To.1. The index tells nothing of course about the absolute proportion of decorated to undecorated pottery within any horizon.

The index was then applied to the material from To.1 and 5 by spit zones (table 29), encouraged by the somewhat bigger figures available for each zone. As with the spit
zone analysis of rims, the picture that emerges is on the whole the same as that given by the horizon analysis. It does indeed appear that there is a break in horizon I on To.1 and in horizon II on To.5 where the index drops from about a hundred to about half of that. There were a few hints of the same kind in the rim analysis. However, since the spit zones were compiled on the basis of C horizons (the so-called average horizon, see p.103), it is impossible to say whether the breaks register a drop within one horizon or the change from one horizon to another. More precise excavation techniques could resolve difficulties of this kind.

To conclude this section, reference may be made to some totals for decorated and undecorated pottery at the different sites drawn up for other purposes (table 30). The figures in question are totals of weight and they refer to whole sites: they are the sum total of all horizons. For this reason it is worth looking only at the totals for decorated and undecorated pottery at To.2, a wholly early site, and To.6, an almost completely late one. There is only one-twelfth the decorated pottery by weight at To.6 that there is at To.2 and some of this undoubtedly belongs to an early occupation. It is the general impression that this represents an absolute decline in the number of decorated vessels, not simply a decrease in the area of vessel surface decorated.

2. The relationship between rim decoration and rim form

This was examined solely through the percentage occurrence of the combination of decoration on rims with specific features of rim form. Distributed amongst the
relevant horizons, the data showed little order and it was impossible to correlate the horizons of the four sites, the tendencies being either conflicting or just meaningless. No doubt one of the reasons for this is to be sought in the actual frequencies which very often are too small. A simplified distribution was found worth considering, comprising the total frequency of each combination per site, that is with all horizons summed. The resulting table (table 31) is to be seen in the light of the results of the rim analysis, since observations expressed in this way can hardly stand on their own.

Some interesting differences emerge between To.6 and the three other sites. Decorated rims as a whole are much less common on To.6. The combination with inward orientation looks to be more common, the combination with inward body-rim inclination looks to be less common, though both of these cases could be due to chance. It is interesting to note, however, that the combination with diverging rim form appears to be quite common, that the preference for flat lips is dominant, and that the combination with hybrid lip form was perhaps unknown. The evidence thus indicates that pots with decorated rims were rarer on To.6, and that the features of the decorated rims were somewhat different from those of the other sites. Further the decorated rims of To.6 tend to be different from those of other sites in the same way that rims in general on To.6 differ from the rims of other sites.

The evidence is weak because of the small numbers involved: because of this one might equally well argue that decorated rims as a whole are foreigners in the total situation of To.6. However, the indications mentioned are relevant to any assessment of the status of To.6.
3. Decorative motifs of chronological importance

The frequencies of motifs B, K, L, O and P have already been treated statistically and declining tendencies of primary and secondary significance noted for motifs K, L and P (table 25). As, however, in table 21 many figures are much too small for such treatment, it was decided to look at all the figures in a general, more intuitive, fashion, considering all available data referable to horizons (table 32).

On the basis of the rim evidence a distinction can be made between an early and a late part of the chronological sequence (table 20). If we look first at the evidence from To.1, 2 and 5, it is obvious that motifs B, K, L, M, N, O and P are confined quite or almost exclusively to the early part of the sequence. If we look next at the evidence from To.6, it is striking that supposedly old evidence is present here. It is significant, however, that a clear majority of this is from horizon I, further that most of the sherds come from the bottom or next to bottom spits of the square metre units concerned. Six of the sherds with B motif are rim sherds. The rim evidence of these does no violence to the possibility of their being of early date. Indeed, five of the rim sherds are collar rim sherds. Of the remaining datable decorated rim sherds from To.6, seven display the combination of diverging rim and flat lip, apparently a preference falling late in the sequence. They all have surface decoration entirely limited to a zone on the lip and consisting in four cases of motif D 1, in the other three cases of fragmentary rectilinear decoration. Only three of these seven sherds can be dated in terms of horizons to horizons II and III.
Though the evidence is too weak to form the basis of any firm conclusions, the point is that none of these seven sherds bears a supposedly early kind of decoration.

If we compare the evidence from To.1, 2 and 5 on the one hand with that from To.6 on the other, there are two possibilities: the supposedly early motifs were not confined to an early part of the sequence, the occurrences in the upper horizons of To.1 and 5 bridging the gap to the lower horizon on To.6. Alternatively they were truly early and the occurrences in the upper horizons of To.1 and 5 are due to chance displacement from lower levels. In this event the presence of these particular motifs on To.6 would indicate a chronologically early use of this site, only really detectable otherwise by the number of collar rims there. The artifactual evidence in favour of this explanation is admittedly very thin, and perhaps it would have been ignored were it not for the fact that the only two radiocarbon dates from To.6, both from the fifth century B.C., caused some worry ever since they became known. Chapter VII takes up this question again.

The various Q motifs are very scarce, and only some of them may be of chronological importance, Q1, 4, 8, 13 and 24 possibly being early, Q 22 late. It is interesting that the unique 'wolf's teeth' motif E 6 is known from To.2 alone, with ten specimens; it could perhaps be an early motif.

The conclusions of this particular investigation and those of the study of the proportions of decorated pottery demand a modification of the previous summary of results on analysis of decoration (pp.134-5). A series of particular and generally complex motifs appears not only to become
less common over time, but in fact to be confined to an early part of the sequence as demonstrated by the rim analysis. A few features could perhaps be late: rim decoration confined entirely to one zone of surface decoration on the lip, utilising simple motifs like D 1. The results allow a possible correlation of horizon I on To.1 with horizons I-II on To.5 and the whole midden horizon on To.2; together perhaps with a part of horizon I on To.6. The upper horizons on To.1 and 5 can be correlated, while the remainder of horizon I of To.6, with horizons II and III, appears to fall beyond these. The situation is set out in table 33.

Two further observations can be made at this point, firstly regarding sites To.3 and 4, secondly regarding site To.5. Placing To.3 and 4 in the sequence on basis of rim and decoration evidence is practically speaking impossible owing to the nature of the sites and the small samples of pottery available from them. We can now, however, look at this pottery in search of the supposedly early motifs just dealt with. None of these was found in the deposits on To.4. To.3, however, yielded sherds with motifs B, K, P and Q (table 32), which thus afford an indication that this site was at least in use at an early time.

Below horizon I on To.5, embedded in coral sand, were two separate cultural deposits, the upper one thin, the lower thick. From the coral sand were collected seven rim sherds without decoration, eight rim sherds with decoration and eight other decorated sherds; the cultural deposits, and mainly the lower one, produced seven rim sherds without decoration, six rim sherds with decoration and two
other decorated sherds. The finds from the subsoil originated in the main from in between and above the cultural deposits and from equivalent levels to the north beyond their extension. It seems justified in these circumstances to treat all the finds mentioned as one collection from a stratigraphic horizon, designated 0, clearly distinguishable from the dark midden horizon I above. Because of their small numbers neither the rim sherds nor the decorated sherds from this bottommost horizon of To.5 were included in the main analysis. If we now attempt to determine the relationship between this horizon and horizon I above, it appears that they are identical in terms of both rim and decoration evidence. It is notable that the supposedly early motifs B, M, O, P and Q 1 are all represented in horizon 0 (table 32).

**Final Analyses**

1. **To.2, midden and mound**

These were compared in terms of tendencies and percentages of rim and decoration features in order to see whether the upper horizon contained artifactual evidence of younger age than the lower one (tables 4 and 8). In fact the two horizons are identical. Hardly any tendencies are observable, the few present as a rule being

---

1 Table 1 shows the mound horizon, zones IV and V, and the midden horizon, zones I-III. For reasons of space only the raw data and percentages for the rim evidence have been reproduced, in table 8, to show the identity between the two horizons. The picture is exactly the same for the decoration evidence.
of secondary significance only. There are a few cases of 'reversed' tendencies, i.e. tendencies going the opposite way to those for the same features on other sites. Evidently all artifactual evidence excavated at To.2 originated from the one archaeological period.

2. To.1, disturbed and undisturbed midden

An interesting exercise was made with some of the rim evidence from To.1, section I. In the initial analysis no distinction was made between the square metre units where the early horizon (I) had been disturbed by pit digging during the later occupation of the site, and units not so disturbed. Despite this the results of the analysis by true horizons were consistent with those from the other sites. At first this was thought to be due to the statistically satisfactory size of the sample from the main trench levelling out the effects of the disturbances. However, when attention came to be directed to the later structures that had caused disturbances of horizon I, it appeared possible that they had been dug from the surface of horizon I at a stage when little horizon II midden had accumulated in the area, so that when they were filled in, they were filled in with much older, horizon I, midden. At a later stage horizon II midden was deposited here, sealing in the structures and their earlier fill.

It was obviously desirable to check this hypothesis. Consequently a comparison was made in terms of certain rim features between the contents of pits referable stratigraphically to horizon I in the main trench, called early, and those of pits referable stratigraphically to
horizon II and called late (for this distinction see discussion of pits in ch. XI). The data are set out in text table VI.1.

**Text table VI.1**

Comparison of certain Features of Rims from Early and Late Pits of Section I, To.1

<table>
<thead>
<tr>
<th></th>
<th>Early Pits</th>
<th>Late Pits</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total rims</td>
<td>17</td>
<td>91</td>
<td></td>
</tr>
<tr>
<td>Rim features</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>no. 1</td>
<td>5</td>
<td>11</td>
<td>?</td>
</tr>
<tr>
<td></td>
<td>29</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>no. 5</td>
<td>3</td>
<td>16</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>18</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>no. 14</td>
<td>4</td>
<td>20</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>24</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>no. 15</td>
<td>11</td>
<td>33</td>
<td>?</td>
</tr>
<tr>
<td></td>
<td>65</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>no. 16</td>
<td>8</td>
<td>24</td>
<td>?</td>
</tr>
<tr>
<td></td>
<td>48</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>no. 17</td>
<td>2</td>
<td>24</td>
<td>?</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>no. 22</td>
<td>6</td>
<td>47</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>36</td>
<td>52</td>
<td></td>
</tr>
<tr>
<td>no. 23</td>
<td>6</td>
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<td>+</td>
</tr>
<tr>
<td></td>
<td>36</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>no. 24</td>
<td>1</td>
<td>16</td>
<td>?</td>
</tr>
<tr>
<td></td>
<td>06</td>
<td>18</td>
<td></td>
</tr>
</tbody>
</table>

1 For tests of significance see Appendix IV. + = significant; ? = possibly significant; - = not significant.
If we compare these results with those obtained in the main analysis (tables 7 and 14), we note that on the whole the same tendencies exist between early and late pits here as between horizon I and horizon II there. However, the significance of these tendencies in the present case is much less definite. Whether this expresses a situation where the material in the fill of the two types of pit is not significantly different or one where indeed the late pits contain late pottery but the overall totals are too small for this to be reflected statistically, cannot be decided.

At this point it was found attractive to analyse some of the rim evidence from the main trench, distinguishing between material from 'undisturbed' and 'disturbed' square metres, of which there were about half and half. Some obvious limitations are attached to this procedure. The distance between the controlling profiles here is two metres, so that some small disturbances may have been present without having been recognised and recorded. At the same time a 'disturbed' square metre will only exceptionally be fully disturbed and spit digging does not make it possible to allow for this. Finally there are two samples for each horizon and statistically this is a disadvantage. Table 34 sets out the data and assesses the degree of statistical significance of the differences.

1
'undisturbed': 82/55, 58, 65, 69, 70-2, and 83/55-9, 62-7, 72-3, a total of 20 square metres. 
'disturbed': 82/56-7, 59-64, 66-8, 73 and 83/60-1, 68-71, a total of 18 square metres.
between horizons I and II for 'disturbed' and 'undisturbed' sections. There is no great contrast between the two. On the whole both repeat the picture of the original analysis, though not so sharply. Some support is hereby afforded to the hypothesis presented that the late pits were refilled with material from the early midden. This is not to deny that some late pottery may not have found its way into the infilling, as the analysis of the contents of the pits themselves may be interpreted as suggesting. If, however, the late pits had been refilled entirely, or almost so, with late material, then the data for horizon I of the 'disturbed' square metres would have been identical with the horizon II data.

Another and no less important conclusion from the above is that though a certain intermixture of late with early artifactual evidence in the disturbed parts of the midden deposits in section I is a likely interpretation of the available data, this is not sufficient seriously to distort the picture given by the original analysis which did not distinguish between disturbed and undisturbed areas. On the contrary, the sample is statistically large enough to level out the effects of such intermixture and give a reasonable reflection of the original situation, confirmed as this is by the evidence from the other sites.

Summary

In the analyses of pottery described above, rims are the primary tool. The evidence provided by features of decoration is of secondary importance and produces its best results when used in conjunction with the rim evidence.
As a result of the analyses a ceramic sequence can be offered based on observations of gradually increasing or decreasing frequencies, in the main of individual features, rarely of combinations of features, followed consistently through a number of stratigraphic horizons on various sites, showing these horizons to represent periods of archaeological time.

There are more decreasing than increasing frequencies. Very few rim and decoration features disappear midway in the sequence, though decoration as a whole has disappeared at its end. No new features for certain appear. The majority of features studied, whether rare or common, occur with fairly unchanged frequencies throughout the sequence. The cultural implications of these conclusions will be discussed later in chapter VIII.

The immediate practical point is that generally speaking it will be impossible to place chronologically a single piece of pottery collected from the surface or a few pieces from a small excavation trench in a midden or a mound. It is vital to collect samples big enough for statistical investigation, this being the only way to reveal the position of a site in the sequence. Few features of genuinely restricted range have been indicated by the foregoing analysis, though it is possible that further discoveries will be made.

The chronologically more important features of rims and decoration are summarised in tables 35-6. Table 37 considers the sequence of horizons in association with the radiocarbon dates, to a discussion of which we now turn.
CHAPTER VII

ANALYSIS OF POTTERY: RADIOCARBON DATES

The list of radiocarbon dates appears below: the age ranges are based on two standard deviations.¹

Text table VII.1

<table>
<thead>
<tr>
<th>Radiocarbon Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>K    - 904</td>
</tr>
<tr>
<td>NZ   - 636</td>
</tr>
<tr>
<td>ANU  - 24</td>
</tr>
<tr>
<td>NZ   - 637</td>
</tr>
<tr>
<td>NZ   - 635</td>
</tr>
<tr>
<td>NZ   - 597</td>
</tr>
<tr>
<td>K    - 961</td>
</tr>
<tr>
<td>ANU  - 23/1</td>
</tr>
<tr>
<td>ANU  - 23/2</td>
</tr>
<tr>
<td>K    - 690</td>
</tr>
<tr>
<td>K    - 691</td>
</tr>
</tbody>
</table>

Sample 1 This is the only one of the excavated samples which consisted of shells, all the others being charcoal. They were Gafrarium pectinatum.² The sample was collected from fire layer A 6 of pit A at the northern

¹ H.A. Polach and J. Golson, Collection of Specimens for Radiocarbon Dating and Interpretation of Results, 1966, p.22.
² Identified by Jørgen Knudsen, Zoologisk Museum, Copenhagen.
end of the main trench at To. 1. Stratigraphically this pit belongs to horizon II.

Sample 2 Collected from fireplace K dug into the subsoil at To.6. Appeared to belong to horizon I.

Sample 3 Collected from fireplace DN dug into the subsoil at To.6. Also appeared to belong to horizon I. Fireplaces K and DN were only 1.5 m apart.

Sample 4 Collected from fireplace B situated in the bottom part of horizon II on To.5.

Sample 5 Collected from fireplace M situated in the bottom half of zone III of the midden horizon at To.2.

Samples 6 and 7 Represent an identical sample of charcoal, partly composed of burnt fragments of coconut shell, collected from fire layer A 6 of pit A at the northern end of the main trench at To. 1. This pit belongs stratigraphically to horizon II.

Samples 8 and 9 Represent an identical sample of charcoal, collected from fireplace D situated at the bottom of horizon III at To.5.

It was difficult to collect samples of charcoal in the investigated middens. The ones obtained all came from fireplaces, but in general fireplaces contained sticky greyish ash and burnt soil only, genuine charcoal being rare. Powdered charcoal was often present intermixed with the shell midden material, but it was impossible to separate samples.

Sample 10 The shells originated from *Gafrarium pectinatum* collected alive in the lagoon just off-shore from the village of Pea in early 1965.
Sample 11  The shells originated from Anadara antiquata collected alive at the lagoon mouth just offshore from the village of Nukuleka in early 1965.

The discrepancy between the dates of samples 1 and 7, originating from the same spot, gave rise to some worry and at first it was thought to be due to the frequent unreliability of shell as a dating medium. Samples 10 and 11 of recent shells were therefore sent to the Copenhagen laboratory to provide a modern standard. Mr Tauber concluded from his investigation of these that there was no reason to doubt the reliability of the shell date from To.1.¹ The molluscs concerned had died sometime in the first half of the first millennium BC, whether naturally or through human agency, and their shells survived for more than two thousand years until they became incorporated in the filling of a pit dug into a shell midden not long before European contact. As a check on the date of charcoal sample 7, sample 6, from the same collection, was dated at the New Zealand laboratory and gave an identical result.

Preliminary analysis of the pottery from To.5 and 2 suggested that the dates of samples 4 and 5 should be identical. However, the date of sample 2 was the farthest possible from expectations on the same grounds, as hardly any decorated pottery was present on To.6, which had come to be regarded as a late site. Sample 3 was then submitted to the Australian National University laboratory and its result confirmed the early date of sample 2. The

¹ Pers. comm.
two samples then constituted evidence of a very early occupation at To. 6. Initially it appeared to be impossible to identify any of the excavated artifactual evidence with this occupation and the provisional conclusion was reached, on reasonable grounds, that the early occupation lay barely touched in unexcavated territory.

Sample 8 was submitted to the Australian National University laboratory at a time when the pottery analysis was well under way and the resulting date was no surprise. To. 5 is the only site where radiocarbon dates are available for two different horizons. The dates are in agreement with the site stratigraphy and each is in agreement with a date for an horizon of another site judged contemporary by the evidence of pottery (sample 4 with sample 5, sample 8 with samples 6 and 7). One may note in this connection the highly satisfactory confirmation of the age of sample 8 provided by sample 9.

Most of the dates immediately display a meaningful pattern when they are fitted to the evidence as to chronology provided by the pottery analysis and they confirm the correlation of horizons from site to site.

These horizons are products of human activity, formed by occupation over a period of time, some stage in which is indicated by the relevant radiocarbon dates. They also serve as units of archaeological description because with the data available they are not capable of finer subdivision, for example, in terms of spit zones. Where superimposed horizons on the same site, originally differentiated on the evidences of excavation, prove to differ in the character of their artifactual material, it
is reasonable to suppose that some time interval elapsed between their formation. Taken in conjunction with the other evidence, the radiocarbon dates suggest that quite a long interval separated the upper horizons of To.1 and To.5 from, respectively, the lower and the middle horizons. At To.5 the bottom of the top horizon (III) is dated by sample 8, AD 1620 ± 100, and sample 9, AD 1610 ± 63, an early stage of the middle horizon (II) by sample 4, AD 350 ± 87. At To.1 the top horizon (II), and possibly a very early stage of it, is dated by samples 6 and 7, AD 1486 ± 82 and AD 1530 ± 100 respectively. By the ceramic evidence the bottom horizon (I) at To.1 is the equivalent of horizons I and II at To.5. In other words a continuous sequence seems not to be represented by the excavated material: a central period, during which perhaps the supposedly early decorative motifs disappeared, is missing.

At the nearer end of the sequence, the radiocarbon dates make it highly probable that ceramic development was going on to the time of European contact. The evidence from To.6 strengthens the case since it plausibly places the main occupation of the site later than that of the upper horizons at To.1 and To.5. In terms of rims To.6 carries the tendencies observable over time on other sites substantially further, while decoration, gradually declining anyway, here went completely, or virtually completely, out of use. It is possible then that To.6 was occupied for as little as 200 years, during which pottery change would have been quite rapid. The later limit of occupation is presumed to be set by effective European contact, since no items of European manufacture were found
at this, or other, sites. The sites where McKern found pottery were likewise devoid of European objects, at least in the pottery-bearing levels,\(^1\) with the apparent exception of the kitchen midden on the islet of Motutapu.\(^2\)

The further end of the sequence is more problematical. The difference in age between the dates from To.6 and those from To.2 and 5 from the fourth century AD are of highly probable statistical significance.\(^3\) Since the samples come from genuine fireplaces, there is no doubt that the old dates from To.6 refer to human occupation. Neither would it be justified to doubt the reliability of these mutually supporting dates just because at the first glance they did not fit the picture in terms of pottery. Indeed, the decoration analysis has given some indication that in fact a little early pottery was collected during the excavation, while the relatively large frequency of collar rim sherds in horizon I of To.6 might support the case. More evidence of the early occupation may yet remain in the unexcavated part of the site, although it could have been in part removed by the construction of the main road through this sector of the site.

A further consideration, concerning the occupation of To.5, brings strong support to the idea of an early settlement of To.6. In terms of rim features horizon I of To.5 is marked off from the middle horizon II of the main midden, an early stage of which is dated by sample 4 to AD 350 ± 87. Horizon I is obviously older than this and below horizon I we have horizon 0. These two horizons could occupy the time gap between the dated settlements at

\(^1\) McKern, 1929, pp.102-13.

\(^2\) Ibid., p.110.

To.6 and To.5. The same supposedly early decorative motifs occur in horizons 0, I and II at To.5 as at the bottom of To.6, where they may well belong with the early radiocarbon dates.

It is not possible to throw more light on the very early date from To.1 on basis of the To.6 dates. It is, of course, quite uncertain whether the dated shells have any connection with human settlement at To.1.

The midden horizon on To.2 is by all the evidence an archaeological unit. The evidence of rims and decoration shows that it falls within the range of horizons I and II on To.5. The radiocarbon dates for the top of the To.2 midden and for the bottom of horizon II at To.5 are practically speaking identical. It may perhaps be concluded from this that the occupation at To.2 spanned the interval between horizons I and II at To.5 and possibly extended a little on both sides.

It is now possible to outline the chronology of sites To.1, 2, 5 and 6 as far as it can be determined on the positive evidence of pottery analysis and radiocarbon dates. There are gaps and uncertainties in the story. Table 37 summarises the conclusions in diagrammatic form. The material seems to fall into two main periods: a Late Period comprising horizon II at To.1, horizon III at To.5, and horizons III, II and most of I at To.6 and covering perhaps the five centuries before regular European contact began; and an Early Period made up of horizon I at To.1, the entire midden horizon at To.2, horizons 0, I and II at To.5 and part of horizon I at To.6, which centres around the beginning of our era and contains possibly 500 years on both sides of this. A Middle Period seems to be
unaccounted for and we may presume that materials will be found earlier than the early dates at To.6.

Tables 20 and 33, summarising the chronological implications of rim and decoration evidence respectively, suggest that some subdivision of the periods into phases is possible. Since the indications from rims and decoration are not identical on this score, no attempt has been made to introduce the phases into table 37. Similarly only the concepts of Early and Late Periods will be used in discussions of chronology in the sequel.
The evidence as to relative and absolute chronology set out in the last two chapters may be interpreted to suggest that a period of some length is unrepresented amongst the excavated materials. Since the history of Tongan ceramic development is therefore apparently incomplete, the question might legitimately be raised about the relationship between the pottery before and after the presumed hiatus. Does it represent two segments of an in reality unbroken chain of ceramic development, or is it impossible completely to derive the later from the earlier? Is there, in other words, an intrusive element in the ceramic picture as we have been able to draw it?

The analysed data give no indication of any such intrusive element and suggest that we are dealing with a single ceramic tradition over 2500 years of development. The detailed evidence leading to these conclusions has been set out and the crucial arguments may be summarised as follows:

1. All the features under analysis that are present in the late pottery are already present in the early. There seems to be no indubitable case of a new element appearing. Indeed, compared with the early pottery, the late pottery presents a picture of simplification and standardisation. Some specific elements, especially of decoration, seem to disappear and decoration itself by the end may have
altogether gone. Even so, however, the absolute losses are few.

2. Trends have been described within the early pottery, reflecting the increasing or decreasing frequencies of specific ceramic features over time. These are most reliably indicated at To.5, where two stratified horizons belong to the early period, but by seriation of a number of features the midden at To.2 and the lower horizon at To.1 can be fitted into the picture, without violating any of the other evidence. The late pottery of horizon III at To.5 and horizon II at To.1 display frequencies that represent an intensification of the self-same tendencies that are visible within the early pottery. Site To.6, which offers a well stratified series within the late pottery, expressed in terms of three horizons, carries the tendencies of earlier phases even further.

This established, we can now proceed to a general description of Tongan pottery.

The Nature of Tongan Pottery

In this discussion mention of the chronology of ceramic features will only be made when positive evidence is available. Where this is not the case, the material will be considered as a whole and referred to the prehistoric period in general, where the features appear to occur sufficiently commonly. Otherwise it will be mentioned whether they are rare or occur in uncertain circumstances of some other kind. The features treated in detail in preceding chapters are brought back into the discussion.
Unfortunately time and other practical circumstances did not allow for a detailed study of:

1. other features incorporated in the codes, some of which will be dealt with below. The treatment of these is based partly on the total figures of each feature per site, disregarding that is the detailed information about horizon provenance, partly on a general knowledge of the sherd material. In spite of these obvious limitations it is still possible to get an idea of the chronology of some of the features by looking at the figures for the early site To.2 (tables 38, 40-2) and for the late site To.6 (tables 39-40).

2. other excavated material which offers information about other parts of the complete vessels than the rim and decoration, i.e. parts not specifically catered for in the codes. A number of such features are discussed below but only in some cases has it proved possible to treat them in terms of their horizon provenance. Otherwise conclusions rest on a general knowledge of the sherd material.

For these reasons some of the results presented in the following are of a tentative character and can be used with reservation only.

It seems safe to conclude that the original pots as a rule had rounded bases, as exceptionally few true base pieces were found amongst the thousands of sherds excavated: a mere 37 sherds, of which eight are included as possibles only (see table 43). The vessels to which these sherds once belonged had flat bases meeting the vessel side at an angle (figs. 52; 66.14; 75.7-13; and 84.11). It is striking that the majority of these sherds is decorated and comes from To.2. It seems that the type, whether decorated or not, was predominantly early.
Only a fraction of the sherd material consisted of angled sherds, inbent or outbent, the former category dominating (figs. 53 and 74). Their details were not considered worth examining as a lot of uncertainty attaches to them. It is impossible to see what is upper, what lower. It is uncertain to what part of the original pot they belonged. An inwardsly angled sherd might represent for example a base-body angle, a body-shoulder angle, a body-rim angle or a collar base angle of a marked B type. An outwardsly angled sherd could represent a foot-body angle, a shoulder-neck angle, a body-rim angle or a body-collar base angle of a marked B type collar. The only observation thought essential to make on these angled sherds was that concerning the orientation of the inwardsly angled sherds, this mainly in order to isolate possible occurrences of flat base sherds, in which, as we have seen, some success was achieved. Most angled sherds could not be oriented at all. For those that could, orientation in the main could only be established within a range and the impression they give is that they represent shoulders rather than any other possible profile angle. The decorated specimens were incorporated in the decoration code as 'possible shoulder sherds'. A few of the angled sherds, however, for which orientation could be fairly well recorded, seem to represent, not shoulders, but the base-body angles of pots with flattish or slightly curved bases meeting the body wall at a more or less marked angle (figs. 53.1, 58.4, 59.2, 77.1, and 79.1). It

1 Orientation was determined on the principle that whatever part of the pot the angle represented, it almost certainly sat in the horizontal plane.
is unfortunately impossible to say whether such pots were more often decorated than not.

Both categories of angled sherd obviously point to the presence of various kinds of angle in vessel profile characterizing a minority of the original pots. To judge by the incurved profile of practically speaking all simple body sherds (cf. figs. 54.1-6 and 64a), the pottery as a whole was marked by a gently curved profile from the centre of a rounded base to the body-rim transition or in some cases perhaps even up to the lip, inflected profiles probably being rare.¹

Some development took place in the orientation of rims over time.² Pots with inward rim orientation (cf. figs. 55-6, 72.10-5) became less common and were always the least popular. Pots with outward orientation of the rim (cf. figs. 57-60, 71, 72.1-9) also became less common. At the beginning of the sequence as we have it this class was equally popular with vessels with vertical or near-vertical orientation of the rim (cf. fig. 61). Over time, however, the latter class gained in importance, becoming absolutely dominant at the end. A similar situation appears in pots with decorated rims, where inward rim orientation was always much less popular than outward orientation, but apparently outward and vertical orientation were equally popular all the time (table 31).

¹ Shepard, 1963, p.226, the curvature changing from concave to convex or vice versa.
² For data see tables 7-10, features nos. 6-9; for tendencies tables 14-5, nos. 6-9. All this information is graphed in table 18 and discussed in ch. VI by feature number.
The degree of orientation varies on pots with inwardly and outwardly oriented rims. In the former group it moves between degrees 1 and 2 but never goes beyond 2. The latter group is characterized by more variety. On the whole orientation ranges freely between degrees 1 and 4 inclusively. There is good evidence from To.2 and To.6 (table 44) that pronounced outward orientation, i.e. degree 3 and particularly degree 4, was predominant early and virtually unknown in the latest phase. The relevant sherds from To.6 for the most part derive from the deepest levels and many of them have round lip. Thus they may well belong to the earliest settlement here. Moderate outward orientation, i.e. degrees 1 and 2, was never frequently used but was commonest in the late period. In comparison with these particular figures it is also clear how vertical or near-vertical orientation grew to predominance over the course of time.

Body-rim inclination also underwent some development. The general trend appears to have been that pots with inward and outward body-rim inclination were about equally common early in time, but subsequently pots with outward inclination became more common. This observation also applies to pots with decorated rims (table 3l).

It is suspicious that cases of inward inclination and outward inclination taken individually decreased in number. The solution to this contradiction is no doubt to be sought in the group of straight uncertain rims, the interpretation of which is not quite clear (cf. p.73). On

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1 For data see tables 7-10, features nos. 11-2; for tendencies tables 14-5, nos. 11-2. All this information is graphed in table 18 and discussed in ch. VI by feature number.
the whole the rim lengths of these sherds do not exceed those of complete rims; indeed they are often shorter, so that one might reasonably conclude that originally they had belonged to the same varieties of rims as the complete ones. But why do the uncertain rims occur in increased numbers in the upper horizons of To.1, 5 and 6? Naturally much breakage of sherds happened during the periods when the middens were actually in use. In addition there is the evidence of subsequent gardening on these sites. These normal and additional circumstances might have taken a particularly heavy toll of rim sherds with a specific point of weakness, such as the narrow base of the divergent rims which were predominant in the upper levels of the sites in question. The situation on To.2 may be of support to this interpretation. Here, where there are many fewer straight uncertain rims than rims with inward and outward inclination, the midden, being altogether early, has fewer divergent rims and was at some stage after its formation protected by a burial mound.

As to the degree of body-rim inclination, this varies on pots with inward inclination as a rule between degrees 1 and 4 inclusively. More variety characterizes outward inclination. It very rarely goes beyond degree 8, and this is apparently an early feature. Good chronological indications are given by comparing To.2 and To.6 (table 45). Moderate inclination, i.e. degrees 1 to 4 inclusively, was quite common early but almost absolute in the late period, while pronounced inclination, degrees 5 to 9 inclusively, was not at all infrequent early but was virtually unknown in the latest phase. The latter pots were in the main provided with rims oriented vertically, so that the body diverged away from the rim at a
relatively moderate angle. In other words very bulging bodies were avoided. The body-rim joints were for the most part not marked, the marked variety more often occurring on the outside. On pots with inward body-rim orientation the outer body-rim joint was commonly marked, the inner not marked.

A remarkable proportion of the pots was provided with collar rims (figs. 62.1-23; 63.2; 64a.3; 73 excepting 15, 19-20). Clearly the use of this particular type of pot diminished, though it survived into the latest phase. It was not at all unusual to decorate the collars. This practice was unknown in the latest phase: the five decorated collar rim sherds from To.6 all bear early motifs. The convergent rim form was almost exclusively used on collar vessels. The position with lip type on collar rims is unclear as mostly the lip was not preserved on these sherds.

Although a fair proportion of the collar rim sherds from horizon I on To.6 may belong to the proposed early occupation, nevertheless the total evidence of this rim type at the site, compared with that of To.2, gives the impression that an early preference for making B type collars (figs. 62.11-23; 63.2 and cf. fig. 73.11) gave way to a preference for making the simpler A type collars (fig. 62.1-10 and cf. fig. 73.1) in later times (table 46).

Pots were not frequently made with flange rims (figs. 62.24-5; 63.1; and 73.15, 19-20). They were virtually, if

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1 For data see tables 7-10, feature no. 13; for tendencies tables 14-5, no. 13. All this information is graphed in table 18 and discussed in ch. VI by feature number.
not completely, unknown in the later period: To.2 produced 73 examples, To.6 only one. When made flange rims were not infrequently decorated.

Two rare rim forms are considered in table 47: the so-called swelling rims (cat. 12.4-6 and fig. 46 under that heading); and a series of rather elaborate pieces called 'unique rims', though in truth they may not be rims but some as yet unidentified part of a pot (cf. fig. 64). Swelling rims were always known but in very small numbers: the same observation is true of what has been called the very short rim (cat. 12.7 and fig. 46 under that heading, also fig. 71. 1-4), though the figures for this are not presented here. The 'unique rims', which are always decorated, appear to be exclusively early.

Excluding the special cases dealt with above, pots were commonly given a parallel or convergent rim, the latter perhaps more rarely used in the later stage.1 At the beginning of the sequence as we have it, the divergent rim was barely known, but quite clearly this variety of thickened rim form grew more frequent, becoming in the latest phase to be as popular as the parallel rim. Parallel and convergent forms were equally common on pots with decorated rims, the combination with the divergent form being quite exceptional, except late in time (table 31).

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1 For data on basic rim form see tables 7-10, features nos. 14-7; for tendencies tables 14-5, nos. 14-7. All this information is graphed in table 18 and discussed in ch. VI by feature number.
Adding thickenings to rims always took place, whether purposely or accidentally, but obviously the practice was more pronounced in the latest phase.\(^1\) Probably the many cases of the minute form of thickening were due to chance. The other varieties could well have been deliberate or if not deliberate a by-product of the manufacture of flat lips. This appears from a consideration of the relationship between thickening and flat lips, which, combined as feature no. 47, show a positive tendency to increase together over time.\(^2\) Reduction appears to have been used almost exclusively late in time: it is largely confined to divergent rims.

There is a pronounced trend in lip development.\(^3\) The earlier pots show a roughly equal proportion of flat, round and hybrid forms, whereas on the later pots a preference for flat lips gradually becomes the prevailing fashion. The two other lip forms continue to be used as much as each other. The same picture is given by the decorated rims (table 31). It is difficult to point out any typological relationship between the three lip forms. As between the two main varieties of flat lip, the very flat and the flattish, it appears that the former and more

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1 For data see tables 7-10, features nos. 17-21; for tendencies tables 14-5, nos. 17-21. All this information is graphed in table 18 and discussed in ch. VI by feature number.

2 For data tables 11-3; for tendencies tables 16-7. Information graphed in table 19, feature no. 47.

3 For data see tables 7-10, features no. 22-4; for tendencies tables 14-5, nos. 22-4. All this information is graphed in table 18 and discussed in ch. VI by feature number.
pronounced variety, from being less popular on earlier pots, became as common as the latter variety on later pots (table 48). The grooved variety of flat lip (fig. 46 under cat. 30.3) was always used, but extremely rarely (tables 47 and 48). The inclination of asymmetrical flat lips was more often slight than marked.

The flat lip underwent an interesting development in some other respects. The horizontality was always preferred, but on the later pots it was almost the rule. On earlier pots the flat lip was more often symmetrical than asymmetrical to the exterior, whereas on later pots the reverse is the case. The lip transitions, interior as well as exterior, were always more often of the not marked variety, but there are good indications that the marked variety was getting more and more common with time (table 48). On the exterior transition of the later pots it was in fact as common as the not marked variety.

A reasonable picture of some of the original vessel forms is now emerging (fig. 65):

1) The collar rim and flange rim vessels already mentioned, both with round bases.

2) A particular jar type, whose growing popularity can be followed through the sequence, until eventually it achieved dominance. It had a round base and most probably also an evenly rounded body curving in to meet the rim at a moderate angle. The rim was oriented vertically and of

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1 For data see tables 11-3, features nos. 52-8; for tendencies tables 16-7, nos. 52-8. All this information is graphed in table 19 and discussed in ch. VI by feature number.
a parallel or divergent form, commonly provided with thickenings and terminating in a flat lip. The lip was horizontal and thus symmetrical about the vertical central axis of the rim. Alternatively, and increasingly so in the late period (cf. table 19, features nos. 52 and 54), the lip was slightly asymmetrical to the exterior. In this case the lip was horizontal, meaning that the rim was oriented very slightly inwards (about half a degree on the orientation clock) and the body tended to bulge slightly more than on similar pots with vertical rims. Or the lip itself was not truly horizontal but inclined very slightly outwards on a vertical rim.

These minor uncertainties derive from the fact that the observations on rim orientation and lip inclination could not be made with absolute precision. This circumstance accounts for the apparent contradiction expressed in tables 14-5 and 16-7, where vertical and near-vertical orientation of rim (feature no. 9), flat lips asymmetrical to the exterior (no. 54), and horizontality or near-horizontality of flat lips (no. 57) are all shown as increasing in importance over time.

3) A different pot type, also with rounded base, had a rim with outward orientation, quite commonly to a pronounced degree. The outward body-rim inclination was mostly moderate, but sometimes pronounced. The rim was of parallel or convergent form, never divergent or with additional thickenings, and terminated perhaps mostly in a round lip, though flat and hybrid lips were made too.

4) Possessing features of rim and lip in common with the previous type is a shallow dish or bowl with strongly everted rim. Below the rim the sides move inwards towards the base, the form of which is uncertain.
5) A fifth type of pot seems to have existed. It had round base and slightly rounded body of bowl form, joined with a vertically or inwardly oriented rim by a moderate angle of inward body-rim inclination. The rim was of parallel or convergent form, sometimes with thickenings. None of the three main lip forms was preferred.

The decorated rims appear in general to have occurred most often on the three last mentioned pot types, which seem to have become gradually less common in the course of time.

Other pot forms existed as well. The suggested range of these is illustrated in fig. 66.

As to absolute dimensions very little will be said. The diameter of the vessel mouth varies between as little as 7 cm to as much as 40-50 cm, the maximum diameter of the total pot probably exceeding this in extraordinary cases. The length of normal rims varies between 1 and 3 cm, rarely being less or more than this, though collar and flange rims are not infrequently longer than 3 cm. The width of the overhang on these rims would rarely exceed 1 cm. On rims in general thickness of body wall beneath the rim ranges in the main between 5 and 8 mm, much less frequently between 9 and 12 mm, but exceptionally it can be less or more than these extremes. Maximum width of rim is always just slightly more than wall thickness.

There is some evidence (cf. table 49, feature no. 1), especially from To.1 and 6, for the existence of very thick-walled vessels, though there are no indications of their form. The rims are oriented vertically or slightly outwards and are of parallel form terminating in a
flattish or rounded lip (fig. 68. 7, 12, 14). Thickness of vessel wall and rim would vary between 2 and 3 cm.

All things considered, it may be very plausibly concluded that decorated pots, which appear to have been widely made in the earliest phase, went gradually out of use in the course of time so that in the latest phase they were virtually non-existent and perhaps decorated on the lip exclusively.

The dominant form of ornamentation was always what has been called surface decoration. Nevertheless plastic and notch decoration was used not at all infrequently. Sometimes all three types of decoration were employed together, mostly perhaps at an early stage. Ornamentation was as a rule confined to the outside of vessels. Rims with pronounced outward orientation, belonging for example to pot type 4 (p.167 and fig. 65), were quite frequently decorated both outside and inside (cf. fig. 59.2), and probably this custom was more common early than late.¹

The surface decoration was rectilinear and/or curvilinear, the former dominating early, both perhaps being equally common later. Predominantly it was executed with a dentate stamp, use of shell edge, incision and insertion being very restricted. It was grouped in horizontal zones, the number of which perhaps tended to become fewer in the course of time. The zones normally contained one motif only, probably repeated continuously

¹For this paragraph features nos. 5-17 in tables 24 (data) and 25 (tendencies) and ch. VI (discussion).
all the way around the pot, cases with more than one motif being extremely rare (e.g. figs. 79. 2 and 87. 14).
Mostly the zone boundaries were marked by lines, sometimes with plastic bands, or the zone was adjacent to an angle in the vessel profile, such as lip transition, body-rim junction, or shoulder. A zone was only very rarely placed on the lip. 

The whole range of submotifs was quite wide. The general tendency was for the simpler motifs to be in use pretty well all the time, with the more elaborate and distinctive motifs restricted to the early period. The former group includes motifs A, D, F, G and J, of which the arc motif was the most common and perhaps became increasingly so. The latter group is made up of motifs B, E6, K, L, M, N, O, P and some Q motifs, all previously discussed. Unfortunately the proportion of sherds with fragmentary decoration was quite large. Duplication of a motif seldom took place and perhaps this occurred mainly in the early period.

Plastic decoration, which was quite common, almost exclusively consisted of horizontal bands applied to the vessel side, mostly outside. The number of bands on a pot cannot be estimated, but one pot from To.1 has three bands

1 For this paragraph features nos. 18-33 in tables 24 (data) and 25 (tendencies) and ch. VI (discussion).
2 As for example with A motifs 7-18, the arc element joined together in groups of two or more horizontally (table 2, cat. 17, and fig. 50 under that heading).
3 For this paragraph features nos. 37-60 in tables 24 (data) and 25 (tendencies) and ch. VI (discussion).
near the base corner (fig. 77. 1). It was not unusual in the early period to place a horizontal band on the inside of decorated rims with outward orientation of degrees 3 to 4 (cf. pot type 4, p.167, see figs. 59.2 and 65). Plastic bands were normally decorated with transverse notches. Vertical plastic bands were sometimes used in conjunction with horizontal bands, sometimes without, in both cases as a rule adjacent to a shoulder angle. On the whole they seem to have been known in the early period only. The rare plastic knobs were mostly placed on the lip, otherwise used in between surface decoration motifs and together with horizontal and vertical plastic bands. Whether really a decorative feature or not, perforations were extremely rare. ¹

There are a few very interesting examples of distinctive plastic decoration. Bas-relief triangles, sunk quite deeply into the clay and placed adjacent to a flat base, are seen on two sherds from zones I and III on To.2 and on one sherd collected from the surface at To.1 (fig. 88. 17, 18, 21). A symmetrical group of four large knobs, identically placed, is present on a white-clay sherd from To.2, zone provenance uncertain (fig. 88. 16). On a simple body sherd from zone II, To.2, is a tiny arrangement of clay which looks like a plastic bird figure with outspread wings (fig. 88. 15). It is notable that most of these specimens come from To.2.

As a whole notch decoration was relatively common, in the main, however, confined to plastic bands. Otherwise

¹ For this paragraph features nos. 61-6 in tables 24 (data) and 25 (tendencies) and ch. VI (discussion).
it was used on the lip, this perhaps mostly in the early period, or on various kinds of profile angle.¹

Only limited conclusions can be drawn about the occurrence of specific decorative features in terms of vessel form. Apparently the dishes belonging to the fourth pot type described on p. 167 and illustrated in fig. 65, were not infrequently decorated in a special way on their strongly everted rims. Surface decoration was applied inside and outside, above and/or below the body-rim junction. Just about the junction a horizontal plastic band was placed on the inside, facing upwards. Between this band and the lip, which was often decorated with notches, was a zone with surface decoration (e.g. figs. 59. 2; 76. 4; and 78. 13-4). The type seems to be exclusively early in date. Another pot form seems to have been characterised by a shoulder, and the area apparently immediately above the angle of this was commonly decorated (e.g. figs. 53. 2-7, 9-13, 15, 17; 86. 4, 6-7; and 87. 14).

Examples of some special pottery features are now dealt with.

Devices for facilitating the handling of pots are not common (table 50). They range from lugs at the rim of moderate to large knob form (fig. 75. 1-3) through more elongated (figs. 68. 3-5; 69. 1-2, 7; and 75. 6) to more projecting (figs. 68. 1-2 and 75. 4-5) devices. Somewhat doubtfully some flat and squarish pottery fragments may be interpreted as a kind of ledge grip (fig. 68. 17-9). More confidently a few fragments may be attributed to both tiny

¹ For this paragraph features nos. 67-9 in tables 24 (data) and 25 (tendencies) and ch. VI (discussion).
(fig. 69. 3-6) and quite substantial (fig. 69. 9-11) loop handles, though in no case is any vessel wall preserved. From To.1 and To.6 there seems to be evidence for strong inner ledge handles (figs. 68. 11 and 89. 4; included in table 50 but also listed separately as feature no. 2 of table 49); they possibly belonged to heavy pots. To.1 also yielded a specimen of what could have been an upright grip of extraordinary dimensions, if it was not the leg of some rare and unknown pottery form (figs. 67. 2 and 89. 5). A fragment from To.6 may well represent an identical specimen. Both are included in the totals of table 50 but separately listed as feature no. 3 of table 49.

From To.6 also came six possible specimens of solid vessel legs of roughly cylindrical form, rounded at bottom (table 49, feature no. 4 and figs. 67. 4 and 89. 2).

It is probable that ceramic pot rests were used. Fragments from what are interpreted as such came from To.2, 3 and 6. The pot rests appear to have been of hollow conical form rounded at the summit (table 49, feature no. 5 and figs. 67. 1 and 89. 6-7). The very thick rim and body sherds previously mentioned (table 49, feature no. 1 and fig. 68. 7, 12 and 14) could perhaps represent the other part of such pot rests instead of vessels in their own right. At the same time it cannot be ruled out that, instead of representing pot rests, the sherds in question belonged in fact to some kind of distinctive thick-walled vessel with pointed base and thick rim.

Other thick-walled pot sherds, known from To.1, 2, 5 and 6, look like sharp-angled vessel corner sherds and perhaps originated from some form of very shallow flattish
dish (perhaps a lamp?) (table 49, feature no. 6 and figs. 68. 15-6 and 89. 1 and 3).

In horizon II at To.5 was found a decorated sherd which presents a problem as to interpretation. It carries evidence of two well-made openings in a vessel wall, adjacent to an original margin (figs. 67. 3; 85. 13; and 93. 6). But whether this margin is a vessel lip, the base of a unique foot ring, the top or bottom margin of a detached pot stand, or even the side of a strap handle is unclear. Note, besides the dentate stamp decoration, the small plastic knobs outlining one of the openings (fig. 85. 13).

On the surface of 116 sherds definitely, and of an additional 39 sherds possibly, was a deliberate coating of a whitish or very light greyish substance. The distribution is set out in table 49 as feature no. 7: nearly all examples come from To.1 and 6. The coating (fig. 93. 2-5) is normally very thin, the exceptional cases with greater thickness not exceeding one mm. It was as a rule applied to the outside only. On one sherd, a decorated shoulder sherd, it was on the inside. A few of the sherds were examined by X-ray diffraction⁴ and the coating proved to consist of calcium phosphate in some cases and of calcite in others. It is uncertain whether the intention of smearing these substances on a vessel wall in a presumably continuous layer was for decorative or for some more practical reason.

On some decorated sherds remnants of a similar white material are still visible as infilling in the dentate

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¹ Appendix V.
stamp-impressed lines, the purpose here obviously being to bring the decoration out (e.g. fig. 86. 7). It would seem highly likely that all surface decoration had originally been treated in this fashion, the impressed lines thus in a way serving only as the basis of the ornamentation.

Abundant on all sites were pot sherds with striations on the outer surface (figs. 91-2). There was some variation in the way these had been produced. In the main they were very light and shallow and such as could have been made with a handful of dried grass or coconut husk on the still wet clay surface. In a few cases they appeared to have been produced by scraping, perhaps with the edge of a shell, across a leatherhard surface. Whether these operations were a way of smoothening an uneven surface or of thinning a vessel wall from the outside, or whether the purpose was to produce a rough surface to enable a firmer grip on a pot, cannot be established.

Evidence of polishing and burnishing the vessel surface is present on some sherds, as is apparently the use of a slip.

In all probability the clay used in the manufacture of the pottery was taken from the rich local sources. There are extensive and easily accessible deposits of extremely pure clay on Tongatapu itself (for example at a present quarry at Ma'ufanga) and on the neighbouring island of 'Eua (in the hills near the central east coast). The subsoil under the midden at To.6 was also clay of this kind. The clay being so pure and fine, large quantities of tempering were used to prepare it for pottery making of all kinds. The tempering materials consist, after the
petrological analysis of twenty sherds, of a mixture of pyroxene and feldspar fragments, such as would be possibly available on 'Eua and certainly on volcanic islands of the Tongan group.

Standing strikingly apart from this ware are 43 sherds of whitish clay (e.g. figs. 78. 10; 80. 4, 24-6; and 82. 3). Half of these are decorated, some with rare motifs. Two of the sherds are from To.1, all the others from To.2 where they were recorded from the mound, the midden (all three zones) and the subsoil, while some were collected from the surface. One of the sherds (To.2-5365) was petrologically examined and alone of the sherds so studied showed the presence of hornblende in the filler. The hornblende may have originated in 'Eua or some other island on which continental-type rocks are exposed.

Firing was done at low to moderate temperatures in an oxidising atmosphere. Dark-faced sherds are relatively uncommon.

The excavated material offers some evidence on manufacturing techniques. On numerous sherds from all

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1 Appendix II.
2 Ibid.
sites it can be seen that the wall consists of two layers (fig 94. 1-6). This presumably reflects a slab-building technique. If two such building components were not pressed properly together, the fired pot may have had a weakness at their line of junction within the vessel wall, which caused the pot on breakage to fragment in the step-like way illustrated.

The coiling or ring-building technique was perhaps also known, though only a very small number of sherds can be quoted in possible support. One is illustrated in fig. 93. 1. The interpretation is based upon the fact that the whole of the transverse surface of the sherds is smooth and slightly hollow. Fig. 70. 16 and 18 show diagrammatically what might be expected from the use of such a technique.

Certain parts of pots were sometimes prefabricated and then joined as a unit to the main part of the pot. This practice has been called the joined surface technique. The whole rim of normal pots could be made this way: fig. 70. 15 illustrates the procedure. Fig. 94. 8, which is a view of the underside of the same sherd, shows the division between the smooth base of the prefabricated rim and the rough break of the skin of clay which joined it to the body of the pot. Whether the same technique was used also for building up the walls of a vessel is unknown. Fig. 94. 7 and 9-12 show sherds with the same characteristics, but whether these are simple body sherds or really from rims whose lip is missing, it is impossible

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to say. Table 49 sets out the occurrence of the technique by site and horizon as feature no. 8, 8a representing rim sherds, 8b other sherds. The figures, though small, give the impression that the practice may have been more common early than late.

Most interesting is the application of the idea to making collar and flange rims (figs. 70. 1-7 and 95) and presumably all types of unique rim also (fig. 70. 8-11). The separate sections were joined together by adding fresh moist clay to the spaces between and finally as a skim over the whole joint, inside and outside. These procedures did not always fill all concavities between the sections. Long hollow canals that are sometimes observable on sherds bear witness to this. On the piece illustrated as fig. 95. 5 a length of thread is led right through such a concavity, the ends of the thread being tied together outside. In some cases it looks as though a collar rim vessel has started manufacture with the rim, the lip of this resting on the ground, perhaps right up to completion of the vessel base.

There is possible evidence that a rotary motion was employed to finish some pots. This is to be seen on some rim sherds which have a nicely even profile. Perhaps the pot under construction rested on the rounded base of a broken pot, which, placed on some firm support, was turned round by hand.

To judge from the data on thickness of body wall, coded on rim sherds, this was regularly quite thin, generally between 5 and 8 mm (cf. figures for cat. 36, table 40). The technique applied in thinning the vessel wall was most probably that of paddle-and-anvil. Not only
the thinness of a great many of the sherds, but also their evenly rounded profiles testify to this particular technique. Some sherds furthermore clearly show the traces of the paddle itself (cf. fig. 90). In these cases the paddle had broad, shallow grooves along its surface, separated by hardly visible ridges with slightly curved cross section, a little narrower than the grooves. Whether in the main the paddle had a smooth surface or whether its grooved traces were regularly removed, for example by rubbing with coconut husk, is quite uncertain. Hollows and irregularities observed on the inside of a few body sherds may be traces of the anvil.

The flat lips were probably made by the use of some kind of flat, perhaps, judging by the marked lip transitions, even sharp implement. A further indication of this might be that flat lips tend to be horizontal and using such an implement would probably be easier, if it were held in a horizontal position.

As to technique of decoration, the dentate stamp needs a little comment. The tool producing the dotted line effect seems most likely to have been flat with a straight or slightly curved edge, rather than to have been a small wheel. Fig. 82. 8-9 and 12-3 illustrates varieties of dentate stamp impressions. Perhaps a small bamboo stick cut in two halves lengthwise would have been an adequate tool for making the popular arc elements of,

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for example, the A motifs. Plastic bands were sometimes applied to the surface along a line of dentate impressions, which would afford better adherence to the vessel side (e.g. fig. 86. 7).

From the present investigations little information can be offered on the sociology\(^1\) as distinct from the technology and typology of Tongan pottery. The interpretation of the functions of vessels and the quantities in which they were used is an important avenue of research. Its results will help to clarify such questions as the place of the pottery-bearing midden accumulations in the Tongan settlement pattern and the role of pottery in the only Polynesian society that retained it into modern times, seen in the light of the related societies that abandoned or never knew it. The present project did not address itself to problems such as these and any that did would employ a considerably different strategy.

Table 30 sets out the weight of pottery collected at the investigated sites. The figures show that no less than half a ton of sherds was excavated.

Text table VIII.1 gives estimates of the total amount of pottery present at each site, arrived at by multiplying the excavated sherd weight by the minimum size of the total midden expressed in terms of the fraction of it judged to have been excavated. By using this formula we achieve a total weight of pottery for To.1 of nearly 10

tons, for To.2 of 2-1/4 tons, for To.5 of 2-3/4 tons and for To.6 of between 3-1/4 and 3½ tons.

**Text table VIII.1**

<table>
<thead>
<tr>
<th></th>
<th>To.1</th>
<th>To.2</th>
<th>To.5</th>
<th>To.6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excavated area (m²)</td>
<td>67.5</td>
<td>15.0</td>
<td>15.0</td>
<td>69.0</td>
</tr>
<tr>
<td>Estimated area of site (m²)</td>
<td>4500</td>
<td>300</td>
<td>960</td>
<td>1420</td>
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<tr>
<td>Proportion excavated</td>
<td>1/64</td>
<td>1/20</td>
<td>1/64</td>
<td>1/22</td>
</tr>
<tr>
<td>Weight of pottery excavated (kg)</td>
<td>155.300</td>
<td>113.900</td>
<td>49.100</td>
<td>151.300</td>
</tr>
<tr>
<td>Calculated weight of pottery in site (tons)</td>
<td>9.939</td>
<td>2.278</td>
<td>2.742</td>
<td>3.328</td>
</tr>
</tbody>
</table>

These figures might appear to suggest a considerable use of pottery, but until we know the growth rates of the middens in which the pottery is found, the opposite is just as likely to be the case. It would be beneficial to have an answer to this particular question, amongst other things because it might help to explain why a craft which was being practised on the archaeological evidence so late should have so suddenly and completely disappeared that no memory of it survives and none of its products are extant. Perhaps we shall find that the use of pottery was declining throughout Tongan prehistory.
The Relationships of Tongan Pottery

Parallels with important Tongan pottery features are well attested in excavated material from a few sites situated in islands of the western Pacific:

Watom Island, New Britain. Coastal sites.¹

Saint-François/Saint Maurice, Vao, Ile des Pins, New Caledonia. Coastal shell midden.²

Lapita, New Caledonia. Coastal shell midden, also designated site 13.³

Sigatoka, Fiji. Coastal site.⁴

Surface sherds of the pottery in question have been reported from the island of Efate in the New Hebrides.⁵ Highly interesting are a few sherds found in the islands Tinian and Rota, in the Marianas, western Micronesia. The sherds illustrated are unmistakably from collar rim

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¹ Meyer, 1909 and 1910; Casey, 1936, pp.94-7.
² Lenormand, 1948; Avias, 1950, pp.130-6; Golson, 1961, pp.169-70. This site was first investigated by Lenormand under the name of Saint-François, later by Golson who gave the other name to it.
³ Gifford and Shutler, 1956, p.7.
⁵ Hébert, 1963-5, pp.79-80.
vessels, and the decoration is identical to motifs from Tonga.¹

The similarities between the pottery from these sites and that from Tonga on the whole refer to features of decoration only. This is without doubt a matter of chance, as little is on record about rim and other features in publications made so far on this material. The close relationship in terms of decoration is beyond doubt, as will appear from a comparison between the illustrations of Tongan motifs (figs. 76-88) and those of overseas localities.²

The similarity concerns the overall character of the ornamentation which, being the manifestation of an identical style or tradition, might appropriately be named after the locality where it was first recorded, Watom, were it not now generally called after the site where it was first described, Lapita. Highly significant is the almost exclusive use of the dentate stamp technique.

¹ Spoehr, 1957, pp.112-4 and fig. 50, lower row. Collar rims have recently been reported from Palau, D. Osborne, Archaeology of the Palau Islands, 1966, pp.99, 101, 103, 108, 146, 276 and figs. 15, 19, 21-4. Here they are called flanges and they seem to fall late in the local chronology.

² For Watom Meyer, 1909, p.251 and figs. 3-11 on pp.1093-5; Meyer, 1910, p.1160, figs. 1-4; Casey, 1936, fig. 4, p.94 and pl. VIII. Figs. 96-7 of the present work show a selection of the Watom sherds now in Musée de L'Homme, drawn by the author. Figs. 98-9 are photographs of material from the same collection. For New Caledonia Lenormand, 1948, unnumbered photographs; Avias, 1950, fig. H and pl. III, 1-4; Gifford and Shutler, 1956, pls. 16, 22-3. For Fiji Gifford, 1951, pl. 19 b-d. For New Hebrides Hébert, 1963-5, pl. 6.
Infilling of the motifs with whitish material is also reported for the overseas sites and decoration of rims inside and outside is a common feature there, too. It is only when it comes to the motifs themselves that noteworthy differences can be observed. The elaboration of motifs is extremely marked in the foreign material, at least on the published sherds. This cannot be said for the vast bulk of the Tongan material. It is very important to note that the distinctive motifs belong to the group considered as in all probability confined to the early part of the sequence in Tonga. This group consists of motifs B, E6, K-P and some Q. A few additions, which cannot be dated on the basis of horizons, include motifs A 22-23, 27, 30, C 3, 7 and D 19 (e.g. figs. 76.9 for C 3; 78. 7 for D 19; 79. 17 for A 23 and 80. 4 for C 7 and D 19).

Notch decoration of lips and plastic bands with notches are present in the foreign material. It is striking that plastic band decoration, commonly used in Tonga, appears to be quite rare elsewhere. The Paris collection of sherds from Watom includes a few examples which are referred to as Melanesian, as opposed to the dentate stamped sherds which are designated non-Melanesian, but the validity of this distinction is not clear. Some of the so-called Melanesian sherds have vertical plastic bands with notches (cf. fig. 96. 4) and also plastic knobs. It is interesting to note here that notched plastic bands occur on sherds of different tradition in the New Hebrides.

1 Casey, 1936, pl. VIII, 19; Gifford and Shutler, 1956, pl. 16 aj.
and Fiji, but they are not quite identical to the Tongan examples.

A few sherds found in Tonga may be foreigners in the total material. Four sherds of thin, hard, medium grey ware with plastic bands and/or some comma-like insertions (fig. 82. 4-6), surface finds from To.2, are yet unmatched. One sherd (fig. 82. 2), collected from the surface at Maka'unga, north of To.2, has parallels in material from Fiji and New Caledonia. A sherd collected from the surface of the off-shore islet Monuafé, near Nuku'alofa (fig. 82. 7), has something in common with material from the New Hebrides. A sherd from midden zone II, To.2, has a hardly visible, bas-relief stamped line, motif Q8, without foreign parallels noted as yet (fig. 82. 13). A white-clay sherd from midden zone III, To.2, bears an incised Q24 motif (fig. 81. 18) which resembles some of the generally carelessly incised 'Melanesian' motifs represented in Father Meyer's Watom material (fig. 96. 5) and on sherds from the New Hebrides, New Caledonia and Fiji. Two surface sherds, from To.2 and 3, also look strange. They are both of a bright red ware. The To.3 sherd is a large rim (fig. 60. 1) of very heavily sand-

1 For New Hebrides Hébert, 1963-5, pls. 1-2, 9; Garanger, 1966, fig. 4. For Fiji Gifford, 1951, e.g. pl. 24 q-s.
2 Gifford, 1951, pl. 21, for Fiji, and Gifford and Shutler, 1956, pl. 14, for New Caledonia.
3 Hébert, 1963-5, pl. 9, and Garanger, 1966, fig. 4.
4 For New Hebrides Hébert, 1963-5, pl. 1. For New Caledonia Gifford and Shutler, 1956, pl. 13 f-g. For Fiji Gifford, 1951, pl. 21, lower group.
tempered clay, probably an example of a direct rim, oriented outwards, degree 2. The flat lip is decorated with a D1 motif. Obviously further examples of sherds like these are required in order to determine whether they are really foreigners and to establish their chronological and cultural implications. At the moment they only point to the possible presence of such factors in the Tongan material.

The branch of the Lapita pottery tradition that established itself in Tonga developed as a native style throughout prehistoric times apparently without being influenced by other styles. As would be expected, the early decoration proves, on analysis, to have most resemblance to the mother style further westwards, the trend over the course of time being marked partly by simplification of the range of motifs, partly perhaps by the development of a local preference for plastic band decoration. The early L motif may be an exclusively Tongan combination of elements. It is important to stress that many elements of basic Lapita style decoration have not yet been found in quantity in Tonga. The examples in the present material (e.g. M, N and Q 12-13 motifs) point to the possibility either that future excavations may change the picture or that significant changes had taken place in the pottery before the settlement of Tonga took place.

Foreign parallels to rim and other pottery features do exist, although they are at this stage very few in number, for the reason that decoration has attracted most attention in the available publications. A few observations are still possible. Most important is the
apparent presence of collar and flange rim sherds on Watom, New Caledonia, including the Ile des Pins, and possibly Fiji. On the Lapita site the ratio between straight, outcurved and incurved rims tends to be somewhat similar to the ratio between the equivalents in the Tongan material, rim features 4, 12 and 11 in table 18, in the early period. On the same site flat lips predominate over round lips, which is not wholly in agreement with the equivalent data from the early period in Tonga. Both sets of data from site 13 are available in percentages by weight only, however, so that a real comparison is not possible. The important fact remains that both lip forms belong to the Lapita tradition.

The few examples of flat base sherds from Tonga can be matched in New Caledonia, where some are decorated, others not. There is no doubt that the Lapita style decorated pot sherd collected from the surface of the Sigatoka sand dunes in Fiji is really a flat base sherd.

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1 For Watom Meyer, 1909, p.1094, figs. 5-6. These are illustrated upside down. For New Caledonia Lenormand, 1948, last plate, upper row no. 3 from left; Avias, 1950, pl. III, 3, also upside down; Gifford and Shutler, 1956, pls. 16 aj, 17q, and pp.72, 75, here called gambreled shoulders. For Fiji R.C. Green, 'Two Collections of Pottery from Sigatoka, Fiji', Journal of the Polynesian Society, 72, 1963(a), fig. 1a.

2 Gifford and Shutler, 1956, p.71 and table 42.

3 Ibid.

4 Ibid., pp.72, 75.

5 Gifford, 1951, pl. 19c.
Watoma (fig. 96. 1) seems to be close to Tongan pot type 4 (p.167), for which, however, a flat base is not directly substantiated (cf. fig. 65 but see fig. 59. 2).

In view of the possible occurrence of loop handles in the Tongan material, it is interesting to note that Gifford and Shutler found handle fragments at site 13 in New Caledonia.² A flat lug also from site 13³ has some resemblance to Tongan examples. The possible examples of ceramic pot rests in Tonga are still unmatched in foreign excavated material, but ethnographic examples are available in Fiji.⁴ Other of the rare pottery features previously described are likewise as yet unmatched.

Finally it is worth mentioning that the striation not infrequently found on Tongan sherds is present at site 13.⁵

The extra-Tongan parallels to the pottery under study are primarily to be found in the decoration. Few statements can be made at this stage of investigation and publication about rim and other features. The Tongan analysis being based in the main on rims, it would obviously be of interest and importance to have this feature of Lapita pottery in Melanesia analysed in detail.

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¹ Meyer, 1910, fig. 4; Casey, 1936, pl. VII, 1-2.
² Gifford and Shutler, 1956, p.72.
³ Ibid., p.75 and pl. 22 ah.
⁴ Gifford, 1951, pl. 18c.
⁵ Gifford and Shutler, 1956, pl. 12 q-v, x.
The great deal of archaeological work in progress in the S W Pacific will doubtless produce the comparative data that is at present lacking.

From reports of this work\(^1\) it appears that in the investigated areas of Fiji and New Caledonia Lapita ware characterises the earliest occupation and goes back beyond 1,000 B.C.\(^2\) The early dates for To.6 fall neatly into place in the picture that is emerging of the settlement of Oceania. The unique feature of the Lapita settlement of Tonga is that it seems to have been the sole settlement made, while Fiji and New Caledonia experienced subsequent settlements characterised by paddled decorated ware and late incised ware.\(^3\)

At present there is no basis of comparison possible in terms of pottery between Tonga and the neighbouring and closely related Samoan group, where pottery, unknown at European contact and apparently for at least 500 years before, has been found at one site in contexts dated to the beginning of our era.\(^4\) There are as yet few

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\(^1\) Summarised by J.B. Palmer, R.C. Green and J. Golson at the Eleventh Pacific Science Congress, Tokyo, August, 1965; and subsequently. J. Golson, pers. comm.

\(^2\) The only published dates, and the only ones so far for New Caledonia, are 846 ± 350 B.C. and 481 ± 400 B.C. for site 13, Gifford and Shutler, 1956, p.89.


illustrations and no analysis in print of this pottery.\(^1\)

The examples I have seen\(^2\) are of a dark-faced, rock-tempered ware. The rims have almost exclusively flat lips, in the main with inward orientation, all of the class 'straight uncertain rims'.

Suggs describes the small collection of pottery, ten sherds in all, belonging to the earlier part of his sequence in the Marquesas, another group where pottery was unknown at European contact.\(^3\) All undecorated, the sherds between them display features like flat or shallowly grooved lips, outward rim orientation, slightly striated surface, and a limey concretion on the inside which can be matched in the pottery of Tonga.\(^4\)

Relationships are no doubt to be sought between the Lapita ceramic and the Sa-huynh-Kalanay pottery complex of S E Asia and the Philippines, described by Solheim.\(^5\) For obvious reasons it is outside the scope of the present

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2 From the first (Golson's) excavations at the Vailele site.
4 It is worthwhile noting here that both the uncommon Tongan grooved lip and the sole Marquesan specimen are distinct from the deeply grooved lips of site 13, New Caledonia, Gifford and Shutler, 1956, fig. 4 i-k and table 42.
work to enter into this particular subject. Reference may be had, however, to the ornamental features of this complex in particular.\textsuperscript{1} The example of a cut-out opening in a vessel wall represented by the sherd from To.5 (figs. 85. 11 and 93. 6) may be compared with clear cases of such features from the Sa-huynh-Kalanay complex in the Philippines\textsuperscript{2} and in Celebes.\textsuperscript{3}

Summary and Conclusions

Tongan pottery was made from locally and regionally available raw materials, the fine clay generally tempered heavily with material of volcanic origin. Slab-building and coiling techniques are in evidence in pottery manufacture. Techniques of prefabrication were used with some vessel parts, especially the collar and flange rim types. Sometimes rims were finished by swift rotation of the complete pot in some manner. The thinness and evenness of ware on most pots was achieved by means of the paddle-and-anvil technique. The use of a slip and the burnishing and polishing of a vessel surface were known. Striation of the surface due to different causes was common. The pottery was fired at low to medium temperatures, and the final products were in the main of reddish colour, more seldom dark.

\textsuperscript{1} W.G. Solheim, 'Further Notes on the Kalanay Pottery Complex in the Philippine Islands', in Solheim (ed.), 1959, p.158 and pls. I-III.
\textsuperscript{2} Ibid., pl. IVe.
\textsuperscript{3} H.O. Beyer, 'A Tribute to Van Stein Callenfels', Journal of East Asiatic Studies, 1, 1951, pl. XVI.
The complete vessels had predominantly rounded bases, flat or slightly curved bases being extremely rare. The body was in the main of evenly curved outline up to the body-rim junction or sometimes perhaps right up to the lip. Inflected pot profiles were rare and so were angular shoulders. Some pot forms appear to have been made so often as to represent types: collar rim vessels, jars with vertically oriented rims, bowls or dishes with rims oriented strongly outwards, bowls with rims oriented moderately inwards. Pottery features interpreted as handles, lugs, legs and stands were not common. The pots were probably made for cooking and storage as well perhaps as for less utilitarian purposes. This distinction may be reflected in the manufacture of undecorated and decorated ware but the question was not explored. Decoration certainly became less popular in the course of time. It is uncertain how much pottery was actually in use at any one time.

It is remarkable how little development took place in the two and a half millennia the pottery tradition was established in Tonga. Many rim and decoration features were equally common or rare all the time. What changes did take place were gradual. Some rim features grew more, others less common. The most dramatic change was the virtual disappearance of decorated pottery. Tables 35, 36 and 51 summarise the evidence.

The elements that allow the comparison of Tongan pottery with other prehistoric pottery of the South Pacific are, at the present stage of research and publication, those of decorative style and technique. These are sufficiently distinctive for the Tongan material
to be seen as a particular variety of the Lapita style widespread in the S W Pacific and related to the Sa-huỳnh-Kalanay complex of S E Asia. As is to be anticipated, the earliest Tongan sites show the closest parallels with the Lapita pottery of islands to the west.

It is not to be expected that the parallels between the Tongan pottery and the Lapita ware of other areas will be limited to decoration. Indeed a few similarities in other respects have been pointed out in the foregoing, though the data for thorough going comparisons in respect of vessel typology and pottery technology are as yet lacking. In other words, the term Lapita, now of necessity applied to a distinctive style of decoration, must not be restricted thereto but kept ready for the whole ceramic tradition, when defined, of which the decoration is only one and not necessarily a dominant part.

By this argument Lapita is the correct term to describe the complete ceramic tradition that was imported into Tonga in the first millennium before Christ. Since the evidence is that the entire ceramic history of Tonga involves the development of this same tradition without outside influence or interference, Lapita is still perhaps the correct term for the end product of development at European contact, albeit a distinctive, highly regionalised, uniquely Tongan version.
CHAPTER IX

ARTIFACTS OF STONE, SHELL AND BONE

The material to be described in this chapter has been organised, as far as practicable, into functional classes, so as to give an idea at a glance of the type of material culture that has survived in the archaeological record. Class 1 comprises adzes, chisels and gouges; class 2 scrapers and peelers; class 3 fishing gear; class 4 needles and awls; class 5 ornaments; class 6 bowling stones; class 7 unique pieces and class 8 industrial tools. In each case the distribution of the implements through the Tongan sequence is reviewed and extra-Tongan parallels sought. The general implications of such distributions and parallels are then discussed.

1. Adzes, Chisels and Gouges

1A. Stone adzes

Because of the lack of a published ethnology of Tonga, little is known about the stone adzes of the group. The present collection of 62 adzes constitutes a major addition to the available corpus. For this reason all examples have been drawn (figs. 100-13) and some have also been photographed (figs. 116-21). The 23 excavated adzes

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This is done in the form of text tables setting out sites and horizons. Objects, excluding surface finds, which are not attributable to horizon are classed as 'other'.
(figs. 109-13) are the first with any information as to age and associations to be put on record for Tonga. Unfortunately their small number, and the fact that 18 of them come from the predominantly late site To.6, have limited the statements that might be made on the range of Tongan adze forms, their distribution over time, and their parallels in the South Pacific. This limitation is reflected in the fact that there are a number of forms present amongst the surface adzes which are not found in the excavated material. There are 39 of these surface adzes, 15 collected or donated, the rest in collections in Tonga. In addition eight excavated adze fragments are described, of which two are illustrated.

Technology and raw material

A few statements may be made about Tongan adzes in general. All-over grinding is very common except for the poll, which is usually left rough. There are examples where the flaked sides are left unground or where grinding has only been applied to smooth the worst of the flake scars. On others flaking on front and/or back has not been fully obliterated. But on many adzes an even surface, in some cases obviously prepared by bruising, has been well and completely ground. A not uncommon feature of this grinding is the production of longitudinal facets at

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1 Studied in 1957 by J. Golson, who has kindly made available to me his drawings and accompanying notes. Golson states that few of these adzes are localised.

marked changes of plane in the adze, for example between front and sides or back and sides.

Most adzes have acquired or been given a polish over the grinding. Sometimes it is slight or uneven, sometimes even and complete but not marked. 'Highly polished' describes those specimens that have a glossy surface. 'Unpolished' or lack of reference to polishing means that the ground surface remains matt. In the adze descriptions the colour of the stone is that of the ground and/or polished surface. These observations could only be made on the 38 adzes and 8 adze fragments actually brought back from Tonga.

These 38 adzes, 23 excavated, 15 surface finds, were inspected by Dr A.J.R. White,¹ who chose five of the excavated adzes for detailed petrological examination. Of these, two, To.5: 38 and To.6: 158, are typical pale grey tholeiitic basalts as found on the volcanic islands, Kao and Tofua, in the western Ha'apai group of the Tongan archipelago. Another, To.1: 1914, is an altered fine-grained porphyritic andesite belonging to the association described as occurring on 'Eua. This adze has become almost black with grinding and White suggests that the black adzes common in the collection derive, with the To.1 specimen, from the dykes of 'Eua. Subsequently two other of the excavated adzes were examined by C.A. Key;² To.6: 32, a fine-grained grey adze, proved to be a finely

¹ Department of Geology, School of General Studies, Australian National University. See Appendix I.
² Department of Anthropology and Sociology, Institute of Advanced Studies, Australian National University.
laminated trachyandesite and To.6: 171, an adze of distinctly green colour, an altered dacitic welded tuff. Both these rock types may well have come from 'Eua.

It may be accepted then that the Tongatapu adzes were made of material available within the group, in the main perhaps from 'Eua, but also from the more distant western Ha'apai islands. To anticipate the chronological section, we may note that both sources were being exploited early (To.1: 1914, To.5: 38) and late (To.6: 158, To.6: 171).

Two of the adzes selected by White for close examination are, however, foreigners. To.6: 20 and To.6: 170 are of hawaiite, a rock of the intra-Pacific alkaline olivine basalt type, normally found only beyond the so-called andesite line, within which the Tongan group falls. The raw material could have come from Samoa or Uvea (Wallis Island) to the north, or from the Loyalty Islands or the New Hebrides to the west, to name the nearest sources. The chronological position of the adzes in question will be discussed later.

Description of adzes

The adzes do not readily fall into Duff's classification, largely based as this is on Eastern Polynesian forms. Rather than attempt to erect a typology on the small number of adzes available, the material has been organised into groups by the criterion of cross section. The choice of cross section was

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deliberate. Traditionally Melanesian adzes have been differentiated from Polynesian adzes this way (lenticular to round, as opposed to quadrangular and triangular), while within the Polynesian material itself Duff's typology takes difference of cross section as one of its two major criteria. Buck in his study of Samoan adzes differentiates his types mainly by cross section. The results of recent archaeological work involving adzes in other Pacific islands were also taken into consideration. By organising the Tongan material by cross section some comparability with adzes from other areas of the South Pacific could thus be achieved.

The other major feature of importance in Polynesian adze typology, besides cross section, has been the presence or absence of a lashing grip. The adze kits of both Samoa and Tonga have been noted for their lack of such grips, in contrast to Eastern Polynesia where they are common. Only one of the adzes in the present corpus possesses a lashing grip in Duff's sense.

Three groups are differentiated: adzes with 1) rectilinear, and 2) fully or partly curvilinear cross section, and 3) miscellaneous adzes. Each of the two main groups has a number of subdivisions, thus:

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3 Duff, 1959.
4 In his unpublished manuscript, McKern, n.d., p.422 ff., uses a similar two-fold division of Tongan stone adzes.
Group 1

1a: cross section severely quadrangular to more rounded quadrangular, representing Duff Type 2A and perhaps some of his Type 2B.¹ There is no corresponding category in Buck's typology.² Illustrated in figs. 100 and 109.

1b: cross section trapezoidal with front narrower than back and narrower towards the poll than at the cutting edge. Equivalent to Duff Type 2C, Buck Types I, IIa, IIb and III. Illustrated in figs. 101-3 and 110.

1a/1b: this group is established to include a common variety of Tongan adze, without apparent parallel elsewhere, where a basically quadrangular sectioned adze like group 1a is modified in a manner like group 1b. This modification does not, as in group 1b, affect the entire front to back dimension of the sides but only the corner between sides and front. The modification may be flaked or ground, large (removing the corner in question) or small (an extra facet added to that corner), extending the whole length of the adze or affecting only the butt. Illustrated in figs. 104-5 and 110.

1c: cross section trapezoidal with front wider than back. Compare Duff Type 3C for cross section. Equivalent to Buck Type IVa. Illustrated in figs. 105 and 110.

1d: triangular or subtriangular in cross section, apex to front. Duff Type 4E, Buck Types VI and VII. Illustrated in fig. 106.

¹ All references to Duff adze types are to Duff, 1959.
² All references to Buck's Samoan adze types are to Buck, 1930, pp. 334-53.
1e: triangular apex to back, Duff Type 3G, Buck Type VIII. Illustrated in fig. 107.

Group 2

2a: cross section lenticular, oval or round. There are no true sides and the transverse planes of front and back are strongly curved. No further differentiation is attempted. Not catered for in Duff's or Buck's typologies. Illustrated in figs. 107 and 111.

2b: plano-convex in cross section, back flat. Some of the adzes in this group might be looked upon typologically as a rounded version of group 1b (Duff Type 2C), that is with the corners between narrow front and insloping sides ground away to produce an almost semi-circular cross section. Equivalent to Buck Type V. Illustrated in figs. 108 and 112.

2c: plano-convex in cross section, front flat. Buck Type IVb. Illustrated in fig. 108.

2d: rounded quadrangular in cross section. Duff Type 2B might cover some cases, but there is no relevant category in Buck's typology. Illustrated in fig. 113.

It must be stressed that the above grouping has been made, because of the smallness of the collection under study, in terms of a single criterion. That criterion, cross section, was chosen as potentially the most productive for purposes of cultural comparison. Other features which cut across the division by cross section may well prove to have importance as the corpus of Tongan adzes grows. Some of these other features are mentioned in the discussion that follows.
In this discussion adze descriptions are kept to a minimum since each example is illustrated. The bracketed references, E = excavated, EF = excavated fragment and SF = surface find, are to the number of the specimen in the line drawings.

**Group 1a**

**Excavated (fig. 109)**

To.2 : 73 (E1)  The lower end of a well made, well ground adze with sharp corners between well defined sides and on the one hand a flat back, on the other a somewhat wider front with marked transverse curvature. Polished towards the cutting edge, sparsely above. Stone light grey. Found in midden fill right under the grave area in the centre of the mound. An adze fragment (To.2 : 5) found in the topsoil near the foot of the mound belongs with it. Both specimens, though found in the mound horizon, doubtless belong to the midden horizon whence they have been deposited with potsherds and shells in the make-up of the mound.

To.5 : 38 (E2)  The butt end of a well made adze, ground and polished, with four sharp corners and a back and a front of noticeable transverse curvature. The rounded poll is carefully bruised into shape. Stone light grey, determined by White as tholeiitic basalt. In situ in the lower of the two cultural deposits in coral sand (horizon O) beneath the base of the midden proper.

To.5 : 57 (E3) (figs. 116-8.2)  A complete or virtually complete adze, well ground and polished, with sharp corners and marked transverse curvature of back. Stone grey-green. In situ in horizon II.
To.6 : 29 (E4) (figs. 119-21.4) A complete adze, well ground but unevenly polished, with fairly rounded cutting edge ground flat for resharpening. The four corners are quite marked and there is a noticeable transverse curvature of the front and especially the back. The rounded poll, bearing traces of bruising, is less regular than that of To.5 : 38 above, but very similar. Other features of the two butts bear such a resemblance that we may safely conclude that the adzes are of the same type. Stone grey. To.6 : 29 comes from the bottommost spit of horizon I.

To.6 : 170 (E5) The lower part of a very regularly made adze, well ground and evenly polished, with marked corners, flat back, almost flat front and fairly straight cutting edge. Stone dark grey, determined by White to be hawaiite, a non-Tongan rock. Found in a small disturbed area in horizon I, definitely sealed by a continuation of horizon II.

To.6 : 102 (E6) A small, very thin tool with upper part missing, well ground and evenly polished. Stone dark grey. It seems to belong to the very bottom of horizon II and is certainly not horizon III.

Excavated fragments

To.2 : 9 A fragment from the side and cutting edge of a small well ground and thinly polished adze of grey stone. Found in the top of zone III of the midden horizon.

To.6 : 1514 (EF2) (fig. 109) A fragment of the corner between one face and one side of what must have been a large, well ground but somewhat unevenly polished adze of grey stone. The corner is marked and the face
must have been noticeably convex transversely. Found in horizon I but in the upper part of this.

Surface (fig. 100)

SF1 Picked up in pig disturbances on the site of To.1 midden and catalogued as To.1 : 3421, this is the butt end of an adze with flaked and rounded poll somewhat comparable to To.5 : 38 and To.6 : 29 above. The grinding is more complete and the polish more even on the front than on the back. Stone grey.

SF2 Tupou College collection. Well and regularly made and fully ground. Note the slight concavity of the back in profile, a feature not uncommon on Eastern Polynesian adzes.¹

SF3 Mathieson collection. Ground all over, this adze has a slight break in front profile, differentiating butt from blade.

SF4 Catholic Mission collection, Nuku'alofa, said to have been found about 60 years ago during building of the church. The butt end is broken off. In its undamaged state it was almost certainly fully ground.

SF5 Monuafe Island. Complete except for damaged butt. Grinding and polish are complete except for the upper part of the back. Stone dark grey. There is a ground facet on the face.

¹ Duff, 1959, figs. 2-4, 6.
Group lb

Excavated (fig. 110)

To.6 : 109 (E7) (figs. 116-8.4) A fully ground and well polished example of Duff Type 2C, which because of the grinding would be Type III in Buck's Samoan typology. The inward sloping sides have long ground facets. Stone black. Found in situ in bottom part of horizon III.

To.6 : 165 (E8) This small chisel-like adze, long and narrow, is well made with sharp corners, over-all grinding and thin polish. The lower part with the bevel is missing but the impression is gained from the slight curvature of the different planes that the slightly narrower face is the front of the adze, i.e. it is Duff Type 2C, Buck Type III. Stone black. It was found in hole Y, of uncertain date, but is much more likely to belong to the later than the earlier phase of occupation at the site.

Surface (figs. 101-3)

SF6, SF7 Both from Mathieson collection. Fully ground examples of Duff Type 2C, they would therefore be classified Buck Type III. The slightly convex back of SF7 is made up of three longitudinally ground facets.

SF8 Tupou College collection. Buck Type III. Note, however, that the corners between front and sides have been rounded by grinding, a typological step towards our group 2b (Buck Type V).¹

SF9 Nukuleka (the village of site To.2). This adze is typical of a series within Duff Type 2C, where the

¹ See cross section Buck, 1930, p. 354, no. 2 of V.
front is fully ground and evenly polished and the back and sides have either partial or no grinding or polishing except at the cutting edge. These are the characteristics of Buck Type I. The present example is partially ground and polished on sides and back. Stone dark grey.

SF10 Tupou College collection. An adze of the same kind as SF9. There are another five similar adzes at Tupou College.

SF11 Tupou College collection. An adze of the same sort, but thicker than SF9 and 10. Slight polishing on the sides.

SF12 Tupou College collection. A large thick adze like SF11 with sides unground.

SF13 Unlocalised. The front has presumably been damaged, if only in part, since manufacture. The sides are only partially ground and the transversely convex back is totally unground except on the bevel. Everywhere where grinding is present there is a good polish. It conforms totally with Buck Type II and more perhaps with variety b than variety a. Stone black.

SF14 Catholic Mission collection, said to have been found at Ma'ufanga. A large thick adze, largely unground on the sides, totally unground on the back, except for the bevel. The markedly convex transverse contour of the back puts the specimen into Buck Type IIb.

Group 1a/1b

Excavated (fig. 110)

To.6 : 134 (E9) This adze, for its size wide and thin, lacks the regularity and definiteness of form of the
adzes of group la to which in terms of basic cross section it belongs. It is unground on the back save for the bevel and apart from the bevel polish is patchy. In addition it has two ground facets on the front at the edges of the butt and a linking facet just below the poll which differentiates butt from blade, though the entire front is evenly polished. These are the features which allocate it to group la/lb. Stone grey. Found in hole Y, of uncertain date, but more likely to be the later rather than the earlier phase of occupation at the site.

**Surface** (figs. 104-5)

The adzes which follow exemplify the various ways in which the corners between front and sides of basically quadrangular sectioned adzes are modified in this group.

**SF15** Tupou College collection. The corners between ground front and sides are replaced by flaking for the whole of their length, in the manner of Buck Type II adzes. There are two more adzes like this in the Tupou College collection.

**SF16** Tupou College collection. The corners between the ground front and sides have been carefully flaked off at the butt end leaving two inward slanting facets. There are two similar adzes in the collection.

**SF17** Tupou College collection. Again the flaked facets are restricted to the butt end. Front, sides and back are all ground. In addition the corners between back and sides are flaked away along their entire length.

**SF18** Tupou College collection. If the flaking over half the back is original, which it appears to be, the right side of the adze displays the characteristics of
Buck Type 2b, flaked side and flaked transversely convex back. The left side on the other hand belongs to the new group la/lb, with quadrangular section made up of ground back, side and front and the corner between front and side removed at the butt end in this instance by a ground facet.

SF19 A surface find from Ha'ateiho village, this rather irregular specimen shows, where the well ground and highly polished surfaces are not interrupted by deep original flake scars, a polished facet between left side and front and between the back and both sides. Stone black.

SF20 (figs. 116-8.5) This surface find from Pea village exemplifies the principle under discussion extremely well. The adze is a well made and regular specimen of quadrangular cross section, fully ground and polished, even on the poll which with other surfaces of the adze retains signs of bruising. The corners between sides and front have been rounded on both margins by carefully and symmetrically ground facets which curve evenly to meet below the poll. Stone grey-green.

SF21 An unlocalised find of identical description with wider but less marked facetting beginning nearer the cutting edge. Stone ?grey.

SF22 Tupou College collection. A fully ground adze with less symmetrical facetting and more rounded quadrangular cross section than SF20 and 21.

SF23 A surface find from Vaini village, fully ground and polished, with marked facets the length of the adze on the front and similar but slighter facets between the sides and the back. Stone black.
SF24  Tupou College collection. Here too the front facets run the length of this fully ground adze.

SF25  Catholic Mission collection, Nuku'alofa. Found on the site of the church about 60 years ago, the specimen, the bottom part of a large quadrangular adze, shows a polished facet along one corner that might qualify it for inclusion here rather than in group 1.

Group lc

Excavated (fig. 110)

To.6 : 50/167 (E10)  The lower part of a rather wide and thin adze, found in two pieces. The illustrated specimens of Buck Type IVa are thicker than this or the following example. The back, apart from the bevel, and in part the sides are unground, but polish is present on them as on the smoother front and bevel. Stone pale grey. In situ in horizon II.

To.6 : 158 (E11) (figs. 116-8.6)  The upper part of this adze is missing. The back and sides, not fully ground and polished, still carry signs of bruising. Polish on the front is thin. Stone pale grey, determined by White as tholeiitic basalt. Found in hole AN, the adze belongs to horizon III.

Surface (fig. 105)

SF26  Locality uncertain, this fully ground and polished adze is much thicker than the excavated specimens described above and more like the illustrated example of Buck Type IVa. Stone grey.

SF27  Tupou College collection. A larger version of the last with fully ground back and very lightly ground
sides. The front is ground on the lower half but only roughly so on the butt. Buck Type IVa.

SF28 A surface find from Pea village, this adze, ground and polished on all surfaces, has a proportionately wider back than the previous specimens. It has also a ground facet on the left side of the face of the butt. Buck Type IVa. Stone dark grey.

Group 1d

Surface only (fig. 106)

SF29 Tupou College collection. The lower part of a large adze of triangular cross section apex to the front. Buck Type VI, Duff general Type 4. The narrow front is fully ground, the sides and back only at the cutting edge.

SF30 Tupou College collection. This adze, ground all over, is the equivalent of Buck Type VII and Duff Type 4E. Not strictly triangular in cross section it is nevertheless distinguished from the trapezoid adzes (our group 1b, Buck Types I-III, and Duff Type 2C) by its thickness relative to width.

Group 1e

Surface only (fig. 107)

SF31 Tupou College collection. A fully ground adze of triangular cross section, apex to the back, Buck Type VIII, Duff Type 3G. There is another adze of this type in the collection, cross section, however, subtriangular rather than triangular.
Group 2a

Excavated (fig. 111)

To.1 : 1914 (E12) (figs. 119-21.1) The lower part of a fully ground and well polished adze of oval cross section, with bevel triangular in plan and somewhat curved. The sides converge slightly towards this. Stone black, determined by White as an altered porphyritic andesite. Found in situ in the bottom of horizon I.

To.6 : 108 (E13) A complete adze of oval cross section, differing from the above in having a straight cutting edge and no convergence of the sides towards it. Flake scars interrupt the fine grinding and polish of the front and make up the whole of the back except bevel and central ridge. Stone black. In situ in the middle of horizon II.

To.6 : 27 (E14) A complete adze of broad oval cross section and straight cutting edge, with sides tapering inwards from cutting edge to poll. Original flake scars interrupt the grinding, which is characterised by good polish. Stone black. Found in hole BH which belongs to horizon II or III, the adze may belong to one or other of these horizons also.

To.6 : 172 (E15) This adze, complete except for cutting edge, differs from the above examples since it is thinner in relation to its width. Of lenticular cross section its sides converge slightly towards the cutting edge. Where undamaged, it is well ground and polished. Stone grey. A stray find, probably from horizons I or II, not from horizon III unless deposited in a hole datable to this horizon.
Surface finds (fig. 107)

SF32 (figs. 119-21.5) Unlocalised. An adze of almost circular cross section, obscured by damage to the back. The cutting edge is curved and the bevel triangular in plan. It was presumably fully ground in its original state, except for a number of deep original flake scars. Where ground, it is well polished. Stone black.

SF33 Tupou College collection. The lower part of a well made and fully ground adze of lenticular cross section. The cutting edge, though extensively damaged, seems to have been curved.

Group 2b

Excavated (fig. 112)

To.6 : 25 (E16) This complete adze illustrates well the possibility of typological relationship between group 2b and group 1b, with the distinction between narrow front and insloping sides obliterated by grinding. It is well ground and polished, except for part of the back. Type V in Buck's Samoan adze typology. Stone dark grey. In situ in the bottommost spit of horizon I.

To.6 : 26 (E17) This less carefully made adze, whose bevel and cutting edge are missing, shows the process of obliteration described above less far advanced. It has a thin but even polish. Buck Type V. Stone grey, laminated like To.6 : 32. It was found within hole D, which is undatable but possibly belongs to horizon III.

To.6 : 32 (E18) This adze with bevel and cutting edge missing exemplifies the features described under To.6 : 25 above in an example which is narrower and
thicker. The rectilinear form to which typologically this appears the curvilinear correlate might indeed be said to be, not group 1b (Duff Type 2C), but group 1d (Duff Type 4E). In Buck's Samoan typology, the adze is Type V. It is well ground, thinly but evenly polished. Stone grey, determined by Key as a finely laminated trachyandesite. In situ in the very bottom of horizon II, resting on fire deposit 0.

To.6 : 33 (E19) (figs. 116-8.1) This complete adze is less securely attributed to this group. But for its flat, if narrow, back it might have been put into group 2a. In terms of its bevel and features of its front it bears resemblances to To.6 : 27 and To.6 : 108 in that group. There are parallels within Buck Type V. It is well ground and highly polished. Stone black. In situ in the bottommost spit of horizon I.

To.5 : 10 (E20) If this miniature implement is to be grouped at all, it would belong here by virtue of its flat back and transversely convex front. Its cutting edge is curved and somewhat hollow ground. Where there are no original flake scars, it is well ground and polished. Stone black. Found in situ in the bottom of horizon III.

Excavated fragments

To.1 : 2547 A well polished fragment from the rather curved cutting edge of an adze of light grey stone, which would appear to belong to this category. From horizon I at the site.

To.2 : 21 (EF1) (fig. 112) The very bottom part of a narrow adze of grey stone whose sides taper to the curved cutting edge. This is the one adze in the
collection which, despite its incompleteness, can be compared with Suggs' early Ha'e'e'aka type from the Marquesas.\textsuperscript{1} It has a flat back and even convexly curved front, both evenly ground and polished. It comes from the bottom of zone III of the midden horizon at the site.

To.2 : 38 A fragment from the side of what must have been a fairly large adze of grey stone. It comprises part of the flat back and of the high convex curve of the front, both ground but unpolished. It comes from the top of zone II of the midden horizon at the site.

To.6 : 1193 The semi-circular cutting edge and bevel of what must have been a beautiful highly polished adze of black stone from the bottom of horizon III at the site.

**Surface (fig. 108)**

SF34 Tupou College collection. This fully ground specimen, the butt end of which is missing, has a more transversely convex back than the excavated examples just described. Buck Type V.

SF35 A surface find from Tokomololo, this specimen, fully ground and well polished except for a few deep original flake scars, is like To.6 : 32 above in general proportions and nature of cross section. Type V in Buck's Samoan typology. Stone grey.

SF36 Tupou College collection. A fully ground adze, long, narrow and thick, with cross section like the last and To.6 : 32, except that the back is less flat. Buck Type V.

\textsuperscript{1} Suggs, 1961, p.111.
Group 2c

Surface only (fig. 108)

SF37  Picked up during gardening on the site of To.5 and catalogued To.5 : 1459, this is the lower part of a thick narrow implement with semi-circular cross section, the base of which forms the front of the adze. The narrow tapered cutting edge and to a lesser extent the cross section bear comparison with some examples of Duff Type 3. Compare also the chisels of Duff Type 6. In Buck's Samoan typology the cross section belongs to Type IVb but none of the illustrated examples are as thick and narrow as our specimen. The grinding is good, the polish thin and patchy. Stone ?pale grey.

SF38  ?Pea or Tokomololo. This beautifully shaped and proportioned adze was finished by bruising, including the careful flattening of the poll. Grinding and polishing on front and bevel have deliberately and almost completely removed its traces there, but equally deliberately these have been retained over the rest of the surface by slight but even grinding and polishing. The front of the adze narrows towards the poll, the butt end taking on the characteristics of our la/lb group, where an extra plane supervenes between sides and front, though in the adze under discussion this plane is not differentiated from the evenly convex contour of the sides and back. Stone grey, determined by Key as a uralitised, olivine-free, dolerite-type dyke rock.

SF39 (figs. 116-8.3)  ?Pea or Tokomololo. Given by the same donor at the same time as the last, this is the only gripped adze in the collection. In every other
respect, proportions, shape, manufacture and raw material, it is identical with SF38 though the convex curve of the back of the adze is flatter and a back more differentiated. The grip itself is not so completely different a feature, for it is simply a continuation across the face of the butt of the invasion of the front by the sides seen on SF38. The grip was formed by bruising and is unground. Stone grey, determined by Key as identical with SF38.

Group 2d

**Excavated only (fig. 113)**

To.6 : 20 (E21) (figs. 119-21.3) This adze, with poll missing and a thin sliver removed from the entire front surface, owes its rounded quadrangular cross section mainly to its thick and transversely convex sides. Both of these show ground longitudinal facets and one has traces of bruising still visible. The back is not as wide or as well differentiated from the sides as the front and the adze might be placed in group 2c. Indeed its cross section is quite similar to that of SF39 in that group. In its original state it was evidently a well and fully ground and polished adze. Stone dark grey, determined by White as hawaiite, a non-Tongan rock. Found in situ in the bottommost spit of horizon I.

To.6 : 171 (E22) The transverse curvature of front, back and sides of this specimen is so marked that the cross section is almost oval. Like To.6 : 20, the sides show ground longitudinal facets. There are also two bevels, a modest one being superceded by another of extraordinary size on the other side. The grinding is good, but the polish is virtually non-existent. Stone grey-green,
determined by Key as an altered dacitic welded tuff. Like To.6: 172 of group 2a, the adze comes from either horizon I or II, not horizon III unless deposited in a hole datable to that horizon.

Group 3

**Excavated (figs. 113 and 119-21.2)**

To.6: 30 (23) This is an adze blank in the first stage of manufacture. The final form is hardly predictable but must have been fairly thick, unless manufacture was abandoned because of the difficulty of reducing the block further. Stone a dark grey which might become black on grinding. *In situ* in horizon I, partly in the bottommost spit and immediately beneath horizon II.

**Excavated fragments**

To.2: 2678 A fragment, showing traces of grinding on two sides at right angles, which may be part of an adze of possibly quadrangular cross section. Stone grey. From the bottom of zone III of the midden horizon at the site.

To.6: 69 A fragment of well ground and polished dark grey stone containing parts of two planes of an adze whose characteristics cannot, however, be reconstructed. From horizon I, bottom spit.

**Chronology**

The complicating factor with the chronology of the excavated adzes described above is the certain presence at the base of To.6 of an extremely early horizon which was
not recognised during the actual excavations. Of the 18 adzes and three adze fragments excavated at To.6 no less than five and possibly six of the former and two of the latter come from horizon I, four and one respectively from the bottommost spit of that horizon. Since the chronological status of these particular To.6 adzes is at first sight equivocal, let us look at the surer evidence from the other horizons of To.6 and from the other sites.

**Group la**: early by the evidence of To.5: 38 in horizon 0 and To.5: 57 in horizon II. Also by the evidence of the fragment To.2: 9 from the early midden and of To.2: 73 which, though found in the mound horizon, was almost certainly transferred there from the midden. There is one certainly late example in the group, To.6: 102, which, however, differs from all the other adzes, being small and very thin.

**Group lb**: of the two excavated adzes attributed to this group To.6: 109 is definitely late, while To.6: 165 is almost certainly so.

**Group la/1b**: known in the excavated record by a single adze, To.6: 13, which is almost certainly late.

**Group lc**: both of the excavated adzes in this group, To.6: 50/167 and To.6: 158, are late.

**Group ld**: no dated examples.

**Group le**: no dated examples.

**Group 2a**: early by the evidence of To.1: 191 in the bottom of horizon I; late by the evidence of To.6: 27 and 108. To.6: 172 is also almost certainly late.
Group 2b: of the two (out of four) excavated adzes under consideration here, To.6 : 26, though found in an undatable post hole fill, is certainly to be attributed to the main late rather than to the very early occupation of the site. To.6 : 32, in the bottom of horizon II, is definitely late. Of the four excavated fragments, the one from To.6 (no. 1193) is late. The three others, To.1 : 2547 from horizon I and To.2 : 21 and 38, both from the midden horizon, are early.

Group 2c: no dated examples.

Group 2d: there are only two excavated adzes in this group, somewhat different from each other. To.6 : 20 is one of the adzes held over for later discussion. To.6 : 171 has not impeccable status stratigraphically but can probably be accepted as late.

We can now review, in the light of the above, the six adzes from To.6 withheld from the discussion. Their details are as follows:

Group 1a

To.6 : 29 was found in the bottom spit of horizon I about 5-6 metres away from the south-west corner of the excavations from which the early radiocarbon dates came.

To.6 : 170 comes from a small disturbed area in horizon I immediately adjacent to the south-west corner.

To.6 : 1514 was found in the upper part of horizon I 4-5 metres from the south-west corner.
Group 2b

To.6 : 25 is from the bottom spit of horizon I at least 15 metres distant from the south-west corner.

To.6 : 33, also from the bottom spit of horizon I, is about the same distance as To.6 : 25 from the south-west corner.

Group 2d

To.6 : 20 was found in the bottom spit of horizon I about 7 metres away from the south-west corner.

Group 3

To.6 : 30 was only partly in the bottom spit of horizon I about 10 metres away from the south-west corner.

To.6 : 69 was found in the bottom spit of horizon I, 4-4½ m from the south-west corner.

Since the existence of the early settlement at To.6 was only discovered through the radiocarbon dates and certain indications in the pottery analysis interpreted in their light, it is difficult to know how to interpret the above occurrences. We must presume from the circumstances of excavation that the early settlement was thin and scattered in the area dug. This being so, it is hard to see how genuinely early adzes could have persisted relatively undisturbed, especially if large (as To.6 : 20 and 29) or complete (as To.6 : 25, 29 and 33).

Yet typologically there might be some reason for suggesting that this could have happened. To.6 : 29 seems to be an identical adze with To.5 : 38 which is genuinely
early. All the adzes of group 1a to which To.6 : 29, To.6 : 170 and the fragment To.6 : 151⁴ bear the closest typological resemblance are early. It may also not be without significance that two of the adzes under discussion, To.6 : 20 and To.6 : 170, are the only ones in the collection brought out of the field specifically recognised as being made of a raw material, hawaiite, foreign to the Tongan archipelago.

The problem cannot be resolved with the evidence to hand. From the viewpoint of general adze chronology in Tonga the matter is perhaps of importance only in so far as the evidence for the survival into the late period of Tongan prehistory of the completely ground and decisively quadrangular adzes within group 1a must rest on the single fragment, To.6 : 151⁴, from the upper part of horizon I.

**Extra-Tongan parallels**

Though there are many South Pacific adzes on record, almost all of them are chance finds. The corpus of excavated adzes is not large and many of these have not as yet been published. Comparisons will be made then only in general terms and with emphasis on the sites chronologically and areas geographically relevant.

**Rectilinear adzes**

**Group 1a** (Duff Type 2A and possibly some that would be called 2B) Early and late in Tonga. Duff notes the general distribution of his Type 2A throughout Polynesia and explains his Type 2B (thicker and with more rounded cross section) as a development of Type 2A in areas of resistant stone (especially Fiji and New Zealand's North
One or both varieties are present in the 1st century A.D. pottery horizon at Vailele in Samoa, in the early (9th century A.D.) level at Hane in the Marquesas, and at the important Maupiti burial site in the Society Islands. To the west of Tonga it is known in Lau and Fiji. One Lau island specimen in the Fiji Museum, no. 651/30, is like To.6 : 29.

Group 1b so far found only in a late context in Tonga. Duff notes its wide distribution, as his Type 2C, but numerical preponderance in Samoa. Green has it in his early Vailele horizon and it is present also at the Maupiti burial site. The form is known in Lau, Rotuma, and Tikopia. There can be little doubt that the form will be found in early contexts in Tonga.

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1 Duff, 1959, pp.131, 133.
2 Green 1964, p.24, mentioning Type 2A.
4 Emory and Sinoto, 1964, p.155, form 3A, representing Duff 2A.
5 L. Thompson, 'Adzes from the Lau Islands, Fiji', Journal of the Polynesian Society, 47, 1938, fig. 5 and pl. A3.
6 Gifford, 1951, fig. 3e, i, j, the last from the shell midden at site 26, Viti Levu.
7 Duff, 1959, p.133. Also Buck, 1930, pp.334-44, Types I-III.
9 Thompson, 1938, figs. 6, 8, 9 and pl. A5.
10 Fiji Museum no. 607/30 and no. 658/30.
11 R. Firth, 'Ritual Adzes in Tikopia', in J.D. Freeman and W.R. Geddes, 1959, pl. VI. Pl. VII left is very like To.6 : 165.
Group 1a/1b appears to be a peculiarly Tongan group, so far known only in a late context.

Group lc again only in a late context so far in Tonga. It is impossible to cite close parallels, partly because trapezoidal cross section has not regularly and consistently been isolated in Polynesian adze typologies. Apart from the already mentioned identity with Buck's Samoan Type IVa, the form bears some similarity in terms of cross section to Suggs' Mouaka adze type in the Marquesas, common from beginning to end of his Nuku Hiva sequence. In these same terms the relationship between Suggs' Hai and Mouaka adze types, the former displaying a greater thickness in relation to width, is echoed by that between SF26-28 and To.6:50/167 (E10) and To.6:158 (E11) within our own group lc. The Hai type seems to be confined to the early levels both on Nuku Hiva and at the Hane site on neighbouring Uahuka. If these comparisons have any validity, we might expect group lc adzes to turn up in early contexts in Tonga.

Group ld, Buck's Samoan Types VI and VII, Duff Type 4E, has not yet been found in datable contexts in Tonga. It

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1 Buck, 1930, pp.345-6.
3 Ibid., p.109.
4 Ibid., pp.107, 109; Sinoto and Kellum, 1965, p.21, group 2.
5 Buck, 1930, pp.349-51.
6 Duff, 1959, p.137, where he remarks on distribution.
occurs in the early Vailele horizon in Samoa and may prove early in Tonga. Thompson illustrates a typical example of Duff Type 4E from Lau.

Group 1e, Buck's Samoan Type VIII and Duff Type 3G, not yet found in datable contexts in Tonga. It is present in the early Vailele horizon in Samoa, and may be comparable to the adzes of group 5 from Hane, some of which occur early. The form may well then be found in early contexts in Tonga.

Curvilinear Adzes

Unlike the adzes of rectilinear cross section, those of curvilinear cross section have not attracted much typological attention. This is largely because within the South Pacific area only Polynesian adzes have been typologically studied and not until recently has it appeared that adzes of curvilinear cross section were once a basic and integral part of the Polynesian tool kit. For this reason parallels will be adduced rather less specifically than in the foregoing for the groups concerned:

2 Thompson, 1938, fig. 7 and pl. A4.
4 Duff, 1959, p.137, with comment on distribution.
Group 2a round, oval or lenticular cross section. Early to late in Tonga.

Group 2b plano-convex cross section, back flat, equivalent to Buck's Samoan Type V. Early to late in Tonga.

Group 2c plano-convex cross section, front flat, equivalent to Buck's Samoan Type IVb. Not yet datable in Tonga.

Group 2d rounded quadrangular section. Not yet found in unequivocally early contexts in Tonga.

The first adzes of curvilinear cross section to be reported as such from excavations in Polynesia were Suggs' Hatiheu and Ha'e'eka types restricted to the early part of the sequence on Nuku Hiva. Suggs, who adduces Melanesian parallels for the two types, describes them as very similar, with Hatiheu having oval to circular cross section, Ha'e'eka plano-convex (base at the back). Subsequently the designation Hatiheu has been applied to adzes from other Polynesian excavations, the early Vailele horizon in Samoa, the early Hane horizon on Uahuka and the Maupiti burial site, invariably, however, to adzes described as of semi-circular cross section with flat base.

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1 Buck, 1930, pp.346-7.
2 Ibid., p.346.
3 Suggs, 1961, pp.110-1.
5 Sinoto and Kellum, 1965, p.21, group 1.
6 Emory and Sinoto, 1964, p.156, form 5.
Our group 2a would be, by Suggs' published definition, likened to the Hatiheu type, specimen To.2 : 21 of our group 2b to the Ha'e'eka type. By the other definitions our group 2b is the Hatiheu type, equivalent to group 1 at Hane, form 5 at Maupiti, and Green's adze with base flattened semi-circular section at Vailele. Green, however, refers also to unclassified material with ovoid to elliptical sections from the early level at Vailele, which may correspond to our Tongan group 2a.\(^1\) Emory and Sinoto's form 1 at Maupiti\(^2\) might be compared, admittedly not very specifically, to our group 2d and possibly to some adzes classified by us within group 1a.

Parallels both general and more precise exist therefore amongst early adzes in Polynesia with curvilinear cross section to excavated specimens in Tonga. It is possible that groups 2d and perhaps 2c, so far only definitely known from late contexts there, will be discovered in early ones.

The range of adze forms under review is, as Suggs noted, known also, indeed particularly, from Melanesia, though at present almost exclusively from chance or surface discoveries. The following parallels may be mentioned: group 2a in Lau,\(^3\) Fiji,\(^4\) and New Caledonia;\(^5\)

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3. E.g. Thompson 1938, figs. 2, 4 and pl. A2, and Fiji Museum no. 57/123.
4. E.g. Gifford, 1951, figs. 3m and 4e, both compared by Suggs, 1961, p.111, with his Hatiheu type, fig. 4e being very like our To.1 : 1914, though its cross section is a broader oval. See also Gifford, 1951, fig. 4j, k for round cross section, fig. 3k for lenticular.
5. Gifford and Shutler, 1956, fig. 1c, from the talus slope at the Lapita site.
group 2b in Lau\textsuperscript{1} and Fiji;\textsuperscript{2} group 2c no close parallels; and the rather ill-defined group 2d in Lau\textsuperscript{3} and Fiji.\textsuperscript{4}

Three stone adzes from Watom in Meyer's collection at the Musée de l'Homme may be appropriately mentioned here. Fig. 97.3 (fig. 99.5) is the reworked lower part of an adze like our To.1 : 1914 (group 2a). The other two specimens (figs. 97.1, 2 and 99.4, 3) could perhaps be described as irregularly oval in cross section.

Conclusions

The close similarity in adze types between Tonga and Samoa is evident from the above review. Their range of cross section is seen to parallel that of Eastern Polynesian adzes, though the predominance amongst the better known Samoan adzes of the adze of trapezoid cross section, front narrower than back, has tended to obscure this fact. Recent excavations have shown the occurrence on early sites in the Marquesas, the Society Islands and Samoa of the same types of adze covering a variety of forms, some of them traditionally thought of as characteristic of the different culture areas of the South Pacific, Melanesia, Western and Eastern Polynesia. Though

\textsuperscript{1} E.g. in Fiji Museum, no. 652/ illegible. Thompson, 1938, fig. 3, has the cross section but is somewhat unusual.

\textsuperscript{2} E.g. Gifford 1951, fig. 3c. Emory and Sinoto, 1964, p.156, fn. 17, refer to Hatiheu adzes (defined by them as a plano-convex cross section) in the Fiji Museum.

\textsuperscript{3} E.g. Thompson, 1938, fig. 10 and pl. A6.

\textsuperscript{4} E.g. Gifford, 1951, fig. 4i.
the number of early excavated adzes in Tonga is small, Tonga would appear to share in this early adze continuum.

The one factor that might still hinder full acceptance of the proposition that the Western and Eastern Polynesian adze kits sprang from a common source is the lashing grip, so well-known in Eastern Polynesia, so uncertain for Western Polynesia. Buck classes Samoan adzes as 'tangless'.¹ There is, it is true, a record of two gripped adzes collected in Tonga in the 19th century,² but this is no guarantee that they were made and used there. Amongst adzes in the present corpus there is one gripped specimen, SF39, the gift of a Tongan donor. This could be accepted as a genuine Tongan piece on typological grounds, particularly since it was given in company with an ungripped adze of otherwise identical form and apparently material, SF38.

To test the proposition that the gripped specimen could not have been an inport, old or new, from Eastern Polynesia, it was examined petrologically by Mr Key, together with SF38, its ungripped counterpart. Both adzes proved to be of a uralitised, olivine-free, dolerite-type dyke rock, which might well have come from 'Eua but almost certainly did not originate in the oceanic alkaline basalt region east of Tonga.

It is possible then that gripped adzes were an integral part of the adze kit of the Polynesians in the

¹ Buck, 1930, p.355.
South Pacific, becoming important in Eastern Polynesia but disappearing in Western Polynesia. The grip as exemplified by SF39 is after all only one device for facilitating the lashing of the adze head to its haft. The practices grouped above under lb (trapezoid cross section, front narrower than back) and la/lb (frontal facets either flaked or ground) are alternative procedures. The chronological and typological relationship between these various methods is at present unknown through insufficient data from Western Polynesia and particularly areas further west where the discovery of Lapita pottery should guarantee the presence of a similar adze tradition.

Text table IX.1 spells out the distribution of the different adze groups by site and horizon and totals the adze finds for both. The richness of To.6 in adzes is very clear. Text table IX.2 sets out the distribution of whole adzes and those that are broken, fragments and unfinished. The column for fragments is somewhat misleading from a quantitative point of view, since with two exceptions it includes only examples that can be typed and ignores the occurrence of polished flakes from adzes. However, the intention of the table is to emphasise the large proportion of whole adzes in the excavated collection: two of the three examples from To.5 and eight of the 21 examples from To.6. The implications of this for the interpretation of the sites will be discussed in chapter XI.
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### Text table IX.2

**Distribution of Whole and Not Whole Adzes by Site and Horizon**

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1B. **Shell adzes** (figs. 114-5, 122 and 123.3)

Ten of these were found, all of *Tridacna* shell. The characteristic feature is that they are made of the hinge part of the *Tridacna*, the natural corrugations or grooves on the inside of this being preserved on the back of the adzes to a greater or lesser extent depending on the amount of grinding to which they have been subjected. An interesting contrast is provided by the *Tridacna* adzes of Yap and other parts of the Pacific which are made from the body of the shell, the natural surface of which is preserved.¹ Like the stone adzes, they are ordered in terms of rectilinear and curvilinear cross section, but without any attempt to set up subdivisions within the two groups. The determining factor is the relationship between front and sides: since the back is normally irregular, it is ignored. The letter designation SE prefixes the number of the adze in the line drawings.

**Rectilinear cross section** (figs. 114, 115)

To.1 : 2293 (SE 1) (fig. 122.2) A complete adze, associated with burial AK belonging to horizon II (fig. 18.1, 2). It has an offset cutting edge which is slightly hollow ground.

To.1 : 2294 (SE 2) (fig. 122.1) A complete adze, most probably referable to horizon I. The cutting edge, which is hollow ground, is ground flat for resharpening.

¹ Gifford and Gifford, 1959, pp.185-8 and pl. 37. Cf. Spoehr, 1957, fig. 81, for the Marianas.
To.1 : 2388 (SE 3) A fragment from the hollow-ground cutting edge of what would appear to have been a well ground and shaped adze. The two broken margins seem to have been subsequently ground and one carries signs of wear. Found in horizon I.

To.2 : 77 (SE 4) (fig. 122.3) The lower half of an adze rather thicker in relation to width than the rest of this group. The cutting edge is very slightly hollow ground. Found in zone III of the midden horizon.

To.2 : 3696 (SE 5) (fig. 122.4) A complete adze with hollow-ground cutting edge. There are ground facets running along the margins of the front from near the cutting edge and widening half way along the adze to distinguish butt from blade (compare group la/lb among the stone adzes). This adze was not excavated in the main trench, but in a test hole 2 metres from coordinate 50/50 about 10 cm below the surface. Its chronological status is therefore somewhat uncertain, but it may be a transference into the mound horizon from the early shell midden.

To.6 : 117 (SE 6) (fig. 122.7) An unfinished adze from horizon III. Its manufacture may have been abandoned because of breakage and/or because of the impossibility of reducing the thick bulk of the shell. The ground front and one ground side suggest an intention to create a quadrangular cross section, even perhaps a trapezoidal one with front narrower than back.

To.6 : 173 (SE 7) (fig. 122.5) A complete adze from horizon III, very well made, with an offset cutting edge slightly hollow ground.
Curvilinear cross section

To.1 : 1881 A fragment of a chisel, found in horizon I.

To.1 : 2484 (SE 8) (fig. 123.3) The butt portion of a long narrow chisel-like tool of round cross section with somewhat flattened back. It most probably belongs to horizon I.

To.2 : 44 (SE 9) (fig. 122.6) A well ground oval-sectioned adze with damaged cutting edge. Found in the sio shell layer of the mound horizon and thus possibly a transfer from the early shell midden.

Chronology and comparisons

From the stratigraphic evidences reviewed above it appears that shell adzes were known both early and late, those of rectilinear cross section used in both periods, the three of curvilinear cross section possibly known from early levels only. It may be noted here that McKern refers to the use of shell-bladed adzes, though he does not describe them in detail.¹

Shell adzes are well known, if not well described, for the South Pacific.² Specimen 2484 from To.1 (SE 8) resembles Suggs' cylindrical type in Cassis shell from Nuku Hiva where it is restricted to the early levels.³ The wider adzes with quadrangular and oval cross sections

¹ McKern, n.d., p.422.
³ Ibid., pp.115-6 and fig. 35m.
may be compared with archaeological examples in Gifford's Yap series¹ and others recently put on the archaeological record for the New Hebrides.² Of particular interest is an excavated shell adze from Fiji,³ identical with the Tongan examples under discussion, since it was manufactured from the hinge part of Tridacna with the grooves preserved.

The distribution of the Tongan specimens is set out in text table IX.3. We may note that five of the ten described are complete, one of those five being apparently a grave gift.

Text table IX.3

Distribution of Shell Adzes (1B) of Rectilinear (I) and Curvilinear (II) Cross Section, Terebra Shell Chisels (1C) and Conus Gouges (1D) by Site and Horizon

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¹ Gifford and Gifford, 1959, pp.186-7.
² Hébert, 1963-5, pl. 7.
³ Gifford, 1951, fig. 1f.
1C. Terebra shell chisels (fig. 123.1, 2)

Two examples were found, distributed as in text table IX.3. Specimen To.4 : 2 (no. 2 in the figure) is of T.maculata, To.6 : 3079 is T.dimidiata. The artifacts were made by bevelling the long thin shell at the pointed end. The To.6 example has one bevel and its short working edge is somewhat damaged. The other specimen is double bevelled and its short straight sharp working edge is 6 mm long between the marked corners. The two specimens were not found in secure chronological position. Archaeological parallels are known from Kabara in the Lau Islands, the Society Islands and the Marquesas. Terebra gouges from Yap, the Marianas and the New Hebrides are a different implement, the shell being split longitudinally and the half circle at the top used as the working edge.

1D. Conus gouges (fig. 123.4)

These pointed- or narrow-butted implements may have taken the place of the Terebra gouges mentioned above.

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1 These and all other identifications of the shells of artifacts were made by Mr W.G. Buick, then of the University Library, Australian National University.
2 C.D. Smart, pers. comm.
4 Suggs, 1961, p.133.
5 Gifford and Gifford, 1959, pp.187-8 and pl. 37r.
6 Spoehr, 1957, p.154 and fig. 81 bottom right.
7 Garanger, 1966, pl. IV. 11, 12.
Seven examples were found: six broken out of the outer whorl of a *Conus* shell, one, included here because it is of identical type, from the outer whorl of *Trochus*. They all have a curved working edge with a bevel ground on the inside of the shell: one example (To.5 : 7) has a double bevel. The width of the working edge ranges from 2 to 3.5 cm, the length of the implement from 4.5 to 6 cm. All seven examples are complete.

The use of the implement is unknown, but there are archaeological parallels from the Watom site in New Britain (fig. 97.4)\(^1\) and from the New Hebrides.\(^2\) The two Tongan examples in securely dated context are both early, see text table IX.3.

### Text table IX.4

#### Distribution of Shell Scrapers and Peelers by Site and Horizon

<table>
<thead>
<tr>
<th>class 2</th>
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<th>horizon</th>
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<th>B</th>
<th>C</th>
<th>D</th>
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<tr>
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<td>0</td>
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</table>

\(^1\) Meyer collection, Musée de l'Homme, Paris.
2. Shell Scrapers and Peelers

2A. Tonna scrapers

Suggs found such scrapers, interpreted as vegetable peelers, only in the early part of his Marquesan sequence. He cites an ethnographic parallel from Samoa (used for scraping taro and breadfruit) and notes the presence of shell scrapers made on the same principle, that is the perforation of the whorl of the shell and the abrasion of the edges of the hole, in Fiji (ethnographic), New Caledonia (archaeological) and the Marianas (archaeological). The last mentioned example is a species of Turbo, and similar specimens are now on record archaeologically for Yap, the New Hebrides and Samoa.

There are two specimens of Tonna shell from the Tongan excavations, both T. perdit. The scraping perforation in one specimen (To.6: 2011) is filed, as in the example illustrated by Suggs from the Marquesas. On the other specimen (To.6: 349) the perforation is unfiled. Both come from horizon I at To.6, but not from the bottommost spits and are thus likely to be late.

1 Suggs, 1961, pp.127-8 and fig. 29g.
2 Buck, 1930, pl. 4C.
3 Spoehr, 1957, p.157 and fig. 83.
4 Gifford and Gifford, 1959, pp.190-1 and pl. 40g.
5 Shutler and Shutler, n.d., pl. 3E.
2B. **Anadara paring knives** (fig. 132.12)

This artifact, made on the same principle as the foregoing, is known by four specimens from Tonga. The only two in secure chronological position are late, but the To.2 specimen, found in the mound horizon, is likely to be early. The type has a possible parallel in an archaeological specimen figured by Gifford from Yap but not interpreted by him as a paring knife or scraper.¹

2C. **Strombus paring knives** (fig. 131.9)

Only four specimens of this type, made from *S. luhuanus*, are here recorded from the excavations. The paring perforation appears to have been abraded by use rather than deliberately, since it is of rather irregular shape. Examples are known both early and late in the sequence. The type is recorded archaeologically for Yap² and New Caledonia.³ In New Caledonia it is not reported for the Lapita site but is present on a number of the later sites.

2D. **Oyster scraper-knives** (fig. 133.4)

There is one possible example in To.5 : 53, a shell which is unmodified except for some abrasion at the broader end. It conforms in part to the description given

¹ Gifford and Gifford, 1959, pl. 41d and p.192.
² Ibid., pp.190-1 and pl. 40h.
³ Gifford and Shutler, 1956, p.65 and pl. 8 ac, ad.
by Suggs\textsuperscript{1} for examples recovered by him in small numbers from all periods of Marquesan prehistory.

Throughout the middens there were many fragments of \textit{Gafraarium} and \textit{Anadara} shells, originally thought of as scrapers (fig. 132, 7-8, 10). They proved, however, to be indistinguishable from naturally fractured shells. It is possible that close microscopic examination might demonstrate the use of some examples as implements.\textsuperscript{2}

With the other examples, however, we are evidently dealing with Tongan representatives of specific types of shell artifacts widely distributed through the island cultures of the South Pacific. The evidence adduced by Gifford\textsuperscript{3} and Suggs\textsuperscript{4} suggests that these were implements for the preparation of tree fruits and root crops for food and their presence in Tonga, as elsewhere, is the best evidence we have in the archaeological record for the presence of the vegetable foods which do not themselves survive.

\begin{enumerate}
\item Suggs, 1961, p.129.
\item J. Edge-Partington, \textit{An Album of the Weapons, Tools, Ornaments, Articles of Dress...of the Natives of the Pacific Islands...}, 1890-8, series II, pl. 43, no. 8, shows an \textit{Arca} shell from Samoa used in tapa manufacture. His series I, part I, pl. 67, no. 10, is a similar example from Niue.
\item Gifford, 1951, p.220; Gifford and Shutler, 1956, p.65; Gifford and Gifford, 1959, p.190.
\item Suggs, 1961, pp.127-9.
\end{enumerate}
3. **Fishing Gear**

**Text table IX.5**

**Distribution of Items of Fishing Gear by Site and Horizon**

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<th>C</th>
<th>D</th>
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3A. **Fishhooks**

The only certain specimen (To.2 : 24) is a small, complete one-piece hook, made of shell, just 2 cm long, with a slight thickening at the end of the shank. It is well polished all over, especially at the point, which is without barb (fig. 125.19). It was found in the **sio** shell
layer of the mound horizon at the site and may have been derived from the early midden. It has parallels in the Marianas\(^1\) and Samoa.\(^2\)

Fig. 125.12 is a fishhook blank of pearl shell, 2.5 cm in length, from horizon II at To.1 (catalogue no. 2107).

A doubtful case is represented by an unmodified shell edge fragment of *mehingo* (*Quidnipagus palatam*) of otherwise unique shape, To.6 : 2656, from the later occupation of that site (fig. 125.9).

Whether the modified piece of shell, To.2 : 66, fig. 125.10, from the mound horizon, is the point of a composite hook or a fish gorge of the bent variety known in Micronesia\(^3\) or something quite different again is unknown. It is well polished all over, especially at the sharply pointed end; it may be broken at the other end. As preserved it measures 2.5 cm from tip to tip.

3B. Fishgorges

The sole definite example, To.1 : 3544, fig. 125.11, from the early occupation at the site, is made of fish bone and is of slightly bent form with tapering ends, well polished all over. An almost identical example is on

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1. Spoehr, 1957, pp.157-8 and fig. 85 top row.
2. I thank Miss Janet Davidson, War Memorial Museum, Auckland, for a photograph of a similar shell hook excavated by her in Samoa; see Green, 1964, p.36.
record for Hawaii, also of bone.¹ A possible early Marquesan gorge of pearl shell is described by Suggs as obtuse-angled,² but in the absence of an illustration it is impossible to say whether it is more like the Tongan example under discussion here or the possible gorge mentioned in the last section.

Fishgorges are widely distributed in the South Pacific:³ Anell describes Micronesian gorges as bent, the Polynesian type as straight. A straight gorge of coral has recently been reported archaeologically from the New Hebrides.⁴

3C. Octopus lures

The specialised octopus lure of the South Pacific is now well represented in the archaeological record of the same region in the shape of its stone weight (of various types) and/or the cowrie shell (Cypraea) caps which form its lure.⁵ The device now in use in Tonga is like that described by Buck for Samoa, which has a stone sinker

² Suggs, 1961, p.84.
³ Anell, 1955, pp.72, 77.
⁴ Shutler and Shutler, n.d., pl. 3F.
shaped like a spinning top and two cowrie caps, one with a perforation in the centre. In Tonga it is called makafeke and according to McKern both caps are perforated. The Hawaiian and Marquesan caps from archaeological contexts are perforated but no information on this score is yet available for the recently reported Tahitian and Samoan archaeological specimens. Notched examples are known ethnographically from the Loyalty Islands.

When seen against this ethnographic and archaeological record, there are two peculiarities about the excavated Tongan material. No definite stone octopus lure sinkers were found, a circumstance reported also for New Caledonia. Also none of the cowrie shell caps interpreted as belonging to octopus lures have perforations or notches for attachment. Similar unperforated and unnotched examples have been recovered archaeologically in New Caledonia, both at the Lapita and other sites, and are attributed to octopus lures.

Thirty-nine shell caps were found in Tonga (fig. 23.6). They measure from five to seven cm across and were probably all broken out of the shell of the large cowrie,

1 Buck, 1930, pp.434-6.
3 Edge-Partington, 1890-8, series II, pl. 64, no. 3, with four notches along the edge of the cap.
4 Gifford and Shutler, 1956, p.66. In historic times Tahitians did not use sinkers with their octopus lures and Emory wonders whether the few surface finds on record are truly Tahitian, Emory and Sinoto, 1964, p.158.
5 Gifford and Shutler, 1956, p.66 and pl. 7 j,l.
Cypraea tigris, their edges being left unsmoothed. The fact that they were recovered from all four main sites and in both early and late contexts (text table IX.5) suggests that they represent finished implements, not ones awaiting perforation or notching.

In addition three cowrie shells were found, from which a cap had been detached (fig. 123.5): they are listed in brackets in text table IX.5 under column 3C. Numerous parallels to these are to be found in New Caledonia, though none from the Lapita site itself.¹ From Yap Gifford records so-called pottery smoothers looking exactly like Tongan cowrie shells worked to detach the cap, but the caps themselves are not recorded.²

The Tongan tradition of non-perforated octopus lures is documented for the early as well as for the late period. Five of the nineteen caps found in horizon I at To.6 derive from bottommost spits and may belong to the very early occupation of the site.

3D. Anadara net sinkers (fig. 132.9, 11)

No fewer than 214 of these artifacts were found, predominantly at To.2 and To.5 and in both late and early contexts (text table IX.5). The hole was easily knocked through the top of the valve where the shell is thin. The interpretation of function seems safe, since shells worked in the same way are still occasionally used in Tonga and

¹ Ibid., p.66 and pl. 7 i.
² Gifford and Gifford, 1959, pp.192-3 and pl. 38 d, e.
also in New Caledonia. McKern describes the use of small shell-weighted nets in Tonga, although he does not specify the kind of shell. Archaeological parallels are on record from the New Hebrides and from New Caledonia, where they were found at the Lapita site and at other sites. Identical specimens from Yap were said by Gifford's informants not to be sinkers.

3E. Stone net sinkers (fig. 136.10)

Only two specimens were recovered, one from the surface at To.1, the other from the latest occupation at To.6. Both are made of volcanic pebbles of the type called makahuna from the islands of the western Ha'apai group. They are slightly flaked at the ends or at the centre of the long sides, probably to provide notches for a line. Some hammer dressing of the edge can also be seen. The To.6 specimen has both faces flattened and made slightly concave by grinding.

These are not highly specialised artifacts and are widely distributed in the South Pacific, persisting up to present times.

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1 Cf. Gifford and Shutler, 1956, pl. 3a.
3 Shutler and Shutler, n.d., pl. 7B.
4 Gifford and Shutler, 1956, p.63 and pl. 7h.
5 Gifford and Gifford, 1959, pl. 41c and p.192.
6 Cf. for Hawaii P.H. Buck, Arts and Crafts of Hawaii, 1957, fig. 235a, which may be a converted 'ulumaika. For Samoa Buck, 1930, pl. XLI, A2.
The types of fishing gear in use in Tonga will be discussed in chapter X in relation to the fish remains found in the excavations.

4. Needles and Awls

Text table IX.6

Distribution of Needles (4A) and Awls (4B) by Site and Horizon

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<tr>
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<th>B</th>
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<tr>
<td></td>
<td>other</td>
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</tr>
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<tr>
<td></td>
<td>I</td>
<td>0</td>
</tr>
<tr>
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<td>other</td>
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</tr>
<tr>
<td>total</td>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>

4A. Needles (fig. 125.18)

Only two examples were found, To.6 : 3401 and 3402, both made of smoothed bird bone 2 mm thick, with the perforation through one wall only, the edges of which are finely polished. To.6 : 3401, complete except for the tip, is 4.1 cm long. The point is formed by a single well polished bevel. The other example is broken and 4.7 cm long as preserved. Both examples were found in late
contexts. Within the South Pacific needles are reported archaeologically for Easter Island\(^1\) and New Zealand.\(^2\)

4B. **Awls** (fig. 125.8)

Six specimens were found, four of bird bone, two possibly of fish bone. The two unbroken specimens are 5 cm and 7.1 cm long, the four broken examples being shorter. All are from 4-5 mm thick. The pointed end is formed by a single bevel, which is well polished together with the rest of the implement. The type comes from both late and early contexts in Tonga. Duff records awls of bone from early archaeological contexts in New Zealand\(^3\) and Emory and Sinoto interpret as awls some shell artifacts from Tahiti.\(^4\)

5. **Ornaments**

McKern devotes some attention to the question of ornaments in Tonga.\(^5\) Most common was the use of perishable items like flowers, fruits, leaves, seeds and feathers for garlands round the neck, waist, wrist, elbows, etc.

\(^1\) T. Heyerdahl and E.N. Ferdon, Jr., *Archaeology of Easter Island*, vol. 1, 1961, pp.247, 412-3.
\(^3\) Duff, 1956, pp.217-21 and fig. 56.
\(^4\) Emory and Sinoto, 1965, p.86.
\(^5\) McKern, n.d., pp.150-218 in various contexts.
ankles and knees, some types being restricted to persons of rank. But other materials were also employed for a variety of body ornaments. Some of these, turtle shell, wood and human hair, are themselves perishable: others, like marine shell, whale ivory and boars' tusks, are not. Unfortunately ornaments in these materials, whether perishable or not, are rarely described, presumably because they were no longer in use when McKern worked. By default he has reference to the writings of the early explorers and visitors where these are relevant. In what follows reference to McKern can only be made when positive evidence is recorded by him but it may be noted now that only rarely are ethnographic types duplicated in the archaeological record.

The excavations produced a quite large collection of ornaments, mainly in shell, but also in bone and stone. They have been classified into 17 groups, 5A-Q, and their distribution by site and horizon is set out in a number of text tables (IX.7-11).

Groups A and B comprise narrow and broad bracelets, these representing individual ornamental items worn on wrists, arms or ankles. Groups C, D, E, F and G include respectively small rings and long, squat, rectangular and circular ornamental units. These probably all represent parts of composite ornaments worn around the head, neck, wrist or arm. Perhaps most of them were units in necklaces, as this type of ornament was apparently very

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1 But note his description of necklaces worn by people of rank, using boars' tusks with the curve upwards or the teeth of the sperm whale, ibid., pp.194-5.
popular in Tonga, and though many necklaces consisted entirely of perishable items, some included units made of material like shell. The neutral term 'ornamental unit' has been used in preference to any more specific one, partly because we simply do not have the information, partly because the same type of unit may have been used in different types of ornament. Group H, comprising a single specimen, may be either a unit of a composite ornament or an integral ornament in its own right. Groups I, J and K include respectively pearl shell, pule shell and trumpet shell pendants, all probably representing individual ornamental items, suspended around the neck in a braid for example of human hair, a common practice according to McKern. Groups L, M and N include respectively small shell beads, bone beads, and stone beads which may have been used singly and/or as part of composite ornaments like those suggested for Groups C-G. Group O consists of a single item, a pottery disc. Group P includes some incomplete pieces. Group Q comprises tattooing chisels and introduces an aspect of bodily adornment of quite a different character.

5A. Narrow bracelets (figs. 126, 127)

77 fragments were found, made of Tridacna and Conus shell, designated respectively (a) and (b) in text table IX.7 which sets out their site distribution.

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2 Ibid., p.194.
3 Ibid., pp.150 and 196.
Text table IX.7

Distribution of Narrow Bracelets of (a) Tridacna and (b) Conus by Site and Horizon

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</tr>
<tr>
<td>total</td>
<td></td>
<td>15</td>
<td>62</td>
<td>77</td>
</tr>
</tbody>
</table>

The type is predominantly an early period form. Of the 42 pieces in securely dated contexts, only three are from the late period, the example from horizon I at To.6 being withheld. This circumstance alone could account for McKern's lack of mention of shell bracelets, apart from a reference to Cook who saw a pearl shell bracelet worn on
the upper arm. Of the 39 early period examples, only seven are of *Tridacna*, a clear preference for *Conus* as raw material.

Little information about manufacturing procedures is provided by the archaeological specimens, which seem to represent fragments of complete and well polished ornaments. The two fragments, To.5 : 23 and 24, found half a metre apart in the midden, join together to make the only complete bracelet in the collection (fig. 127.1). As a result it is impossible to say whether some of the *Conus* fragments were part of a fully closed or slightly open bracelet form.

Cross section is variable and provides the means of a tentative classification into nine categories, the distribution of which is set out in text table IX.8.

**Class A1 Roundish cross section** (figs. 126-7. 5)

There are three specimens in *Tridacna* and two in *Conus*, varying from 4-7 mm in thickness (inside to outside) and 4-6 mm in width (side to side).

**Class A2 Semicircular cross section** (figs. 126-7.10)

There are 17 specimens, all in *Conus* shell. In cross section they are always wider than they are thick, width varying from 4-9 mm, thickness from 2-7 mm. The inner surface of the bracelet forms the base of the semicircle.

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1 McKern, n.d., p.194.
### Text Table IX.8

**Distribution of Narrow Bracelets of Different Cross Section by Site and Horizon**

<table>
<thead>
<tr>
<th>Class 5A</th>
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</tr>
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</tr>
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<td>2</td>
<td>2</td>
<td>19</td>
<td>6</td>
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</tr>
</tbody>
</table>

**Class A3: Domed cross section (figs. 126-7. 1,2,6,9)**

There are nine examples in *Tridacna* and five in *Conus*. Thickness is on the whole the same as width, both varying from 8-10 mm. To.3: 262 (figs. 126-7.2) is exceptional in that width and thickness are 15 mm. On the complete specimen from To.5 (figs. 126-7.1) thickness is 10 mm, width 8 mm and the inner diameter is 6.8 cm. All specimens are finely polished on all surfaces.
Class A4 Thick cross section

Two examples only are represented here, one in Tridacna, one in Conus. Cross section is semicircular at the top (outside of the bracelet) and slightly convex at the base (inside of the bracelet) and has flat sides between. Thickness is greater than width, the former 6 and 10 mm, the latter 4 and 7 mm.

Class A5 Thin cross section (figs. 126-7. 3, 4, 7)

The eleven specimens classified here are all of Conus. For the most part in this group the cross section has no laterals, the overside of the bracelet meeting the base directly in a rounded corner. Width is always much greater than thickness, the former varying between 7 and 14 mm, the latter between 2 and 4 mm. To.2 :25 (figs. 126-7. 7) is an exceptional specimen, being 16 mm wide but only 3.8 cm in inner diameter.

Class A6 Square cross section

The two examples are of Conus shell. The cross section exhibits four flat sides with sharp corners. Width and thickness are 5 mm.

Class A7 Triangular cross section (figs. 126-7. 11)

There are two specimens, both of Tridacna. The base of the triangle is the inner surface of the bracelet. Thickness is 16 and 22 mm, width 13 and 15 mm. To.1 : 1749 is of uncertain chronological status; To.2 : 19, the illustrated specimen, was found in the top of the mound horizon and may be a transference from the early midden.
Class A8 Unstandardised cross section (figs. 126-7,8)

All 19 specimens are made of Conus shell and the cross section varies greatly in shape due to the nature of the thick end of the shell used as raw material and the amount of work applied to it. This is restricted to smoothing the surfaces and no attempt has been made to eliminate the natural configuration of the shell on the inner surface. Thickness varies from 2-6 mm, width from 4-8 mm.

Class A9 Indefinite cross section

The indefiniteness rests in the small size of the fragments, of which one is of Tridacna, five are of Conus. Thickness varies between 2 and 5 mm, width between 2 and 7 mm.

On present evidence no parallels for narrow Tongan bracelets of shell exist elsewhere in Polynesia. We must look to the archaeological record of Melanesia and Micronesia. Two examples are on record for Fiji, one of Trochus, the other of Conus, similar to Tongan specimens of class A8.1 Fragments, also likely to be of class A8, have been found in New Caledonia, made in Conus and Trochus shell, both on the early Lapita site and on later sites.2 Golson reports fragments of shell bracelets from the Lapita site of St. Maurice on the Ile des Pins,3 but

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1 Gifford, 1951, p.220 and fig. 1d,i.
2 Gifford and Shutler, 1956, pp.63-4 and pl. 6d,e from Lapita, pl. 8 r-t from site 26.
no details are available. One Conus bracelet, like A8, has been found in the New Hebrides. An ethnographic specimen in wood with triangular cross section (class A7) from this island group may also be noted. Excavations in Yap have yielded fragments of Conus shell bracelets, some of which seem to have cross sections like class A3 and A7. Finally an archaeological specimen from the Marianas appears to have a cross section of class A5 and similar examples are known ethnographically from the Carolines.

Text table IX.9

Distribution of Various Shell Ornaments by Site and Horizon

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<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
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</tr>
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</tr>
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</tr>
<tr>
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<td>5</td>
<td>27</td>
<td>6</td>
<td>1</td>
<td>9</td>
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</tr>
</tbody>
</table>

1 Shutler and Shutler, n.d., pl. 5 I.
2 Edge-Partington, 1890-8, series I, pl. 146, no. 2.
3 Gifford and Gifford, 1959, p.191. Nos. 36165 and 36542 = A3. No. 36201 = A7. See also pl. 38 i-1.
4 Spoehr, 1957, fig. 86 and p.160.
5B. Broad bracelets (figs. 128-9, 8, 9, 11 and 13)

Only seven specimens are represented in the collections, of which three are less certainly assigned to the class. They have all been made from the broad end of the Conus shell, the inner configuration of which is preserved to a varying extent on all examples. They are all well polished on the outside.

The four certain examples are To.2 : 2405 from zone III of the early midden at the site; To.2 : 3355 of uncertain chronological status; To.6 : 127 (fig. 129.8) from horizon II at the site; and To.6 : 1942 (fig. 129.11) also from horizon II. They are all fragments respectively of width 14 mm, 26-45 mm, 22 mm and 48 mm, the original ornament having an inner diameter respectively of 4-5 cm (child size), 5.5 cm, 5 cm (? child size) and 6.5-7 cm.

The three less certain examples are distinguished by being perforated. They comprise 16 fragments of possibly the same artifact from horizon I at To.1; To.2 : 30 (fig. 129.13) of uncertain chronological status; and To.6 : 14 (fig. 129.9) from horizon II at the site. To.6 : 14, 38 mm wide and with an inner diameter of 7 cm, has a perforation in the middle of each end of the 5 cm long perimeter, one conical and bored from the outside, the other biconical. Since the ends are roughly broken, while the sides and surfaces are smoothed, the specimen is possibly better interpreted as the repair or refashioning of a broken broad bracelet than an ornamental unit in its own right. Perhaps a similar explanation can be offered for To.2 : 30, 18 mm wide with inner diameter of 7-7.5 cm. Here one end of the 3 cm long piece is squared off and two conical perforations bored from the outside.
The interpretation of the To.1 fragments is difficult since none of them fit together, though thought to be from the same artifact because all found in an area of two square metres. One of the fragments is perforated. If really from a broad bracelet, the width of this would have varied from 20 mm to more than 35 mm.

Broad bracelets, though known both early and late in Tonga, were clearly much less popular than the narrow variety. Amongst the foreign parallels to be noted, none is from elsewhere in Polynesia. Broad bracelets are widely distributed in Micronesia and Melanesia, forming an important item in the kula ring exchange of the Trobriand Islands.\(^1\) Archaeological parallels, however, are few and all from New Caledonia, where they exist at both the early Lapita and later sites, always in *Conus* shell.\(^2\)

5C. **Small rings** (fig. 130. 3, 4, 6)

Made from the broad end of univalve shells (unidentified) of small size, five specimens were recovered by excavation, their distribution summarised in text table IX.7. Three examples from To.1, nos. 1891 (fig. 130.4), 1893 and 3055, are all early. The first of these, ground on the outer surface and both laterals, has an inner diameter of 12 mm; the second one of 17 mm; the third, found in pieces, has a reconstructed inner diameter of 15-20 mm. Of the two examples from To.6, no.16 (fig.

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1 Gifford and Shutler, 1956, p.64. Ibid., pl. 6b. Edge-Partington, 1890-8, series II, pl. 65, no. 4.
2 Ibid., respectively pl. 6g and pl. 6a, c, f, h.
130.3) could be early, since it was found in the bottom spit of horizon I. Highly polished on all surfaces, it has an inner diameter of 22 mm. To.6: 338 (fig. 130.6) also comes from horizon I, though not from the bottommost spit, which probably means it is late. It has an inner diameter of 15 mm.

The dimensions recorded above indicate that the artifacts in question can only with difficulty be interpreted as finger rings, unless they were worn exclusively by children. They may more plausibly be considered as units of a composite ornament. They seem to have been known both early and late in Tonga. Only one parallel for them has been found: a small Conus ring from the New Hebrides found with a burial of unknown date.\(^1\)

5D. **Long units** (fig. 124-5.2 and 128-9.1-7)

Like the shell adzes, these units, 27 in number, were made from the inner hinge part of the Tridacna, by the evidence of the broad natural groove on their bottom surface. They tend to be wider than thick and cross sections (fig. 124.2 and 128.1-7) are in the main rounded, sometimes with slightly flattened upper surface. Triangular, trapezoid and circular cross sections are rare and exemplified by four, one and two examples respectively. All four triangular specimens come from To.1, two (To.1: 1884, a burnt example, and To.1: 2618) from horizon I, two (To.1: 257 and 2111) of uncertain chronological position. The trapezoid specimen is To.6: 35, from

\(^1\) Shutler and Shutler, n.d., pl. 5B.
horizon I at the site, but not the bottommost spit, and therefore probably late. The two circular examples are To.5 : 19 from horizon I and To.6 : 3162 of uncertain chronological position.

Finished examples, well polished on all surfaces except the underside which is naturally smooth, are provided with a biconical perforation at each end, leading from the top side to the end facet, which is normally flattened. Text table IX.10 sets out the distribution of finished, unfinished and broken examples by site and horizon. The numbers in brackets refer to burnt examples.

The surprising feature is the proportion of specimens in the middens which are, so to speak, ready for use: 11 out of 27, only one of which may have been discarded because burnt. Together with the presence of other complete implements at the sites, this suggests that other activities apart from dumping took place at or immediately adjacent to the middens. We shall return to this question in chapter XI. To be noted is the complete absence of long units from To.2, an otherwise productive site, unless the fragmentary specimen, To.2 : 23 (fig. 125.4), described under class 5 P below, is accepted as related.

Table 52 completes the description of these artifacts by setting out their dimensions: length, width (side to side), and thickness (upper side to lower side).

Three long units were found in definitely late contexts and 11 in definitely early ones. Of the six from horizon I at To.6, two from the bottommost spit may be early, the other four are probably late. All this suggests that the type was in use throughout the prehistoric period.
### Text table IX.10

**Distribution of Finished, Unfinished and Broken Long Units by Site and Horizon**

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<th>finished broken</th>
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<td>11 (1)</td>
<td>7 (2)</td>
<td>4 (3)</td>
<td>3 (2)</td>
<td>2 (2)</td>
<td>27 (10)</td>
</tr>
</tbody>
</table>

\(^1\) = burnt specimens.

Two examples (To.6: 61 and 72) come from the bottommost spit and are possibly early.
Though there is no ethnographic information from Tonga, it may be suggested that they formed units of a necklace strung by means of the biconical perforations. McKern found five segments of bird bone associated with skeletal material in a burial cave on Kao presumably strung in necklace fashion.\(^1\) The units measured between 3.25 and 4.15 cm in length and were cut off square at the ends.

The only real parallels to the Tongan long unit of shell are to be found in the Marianas, for which *Tridacna* and stone examples are on record.\(^2\) They differ from the Tongan specimens only in being slightly curved or angled.

5E. **Squat units** (figs. 124-5.5-7 and figs. 128-9.12)

Six specimens are allocated to the category, one from To.2 (no. 1661, midden zone III), five from To.1, one of which (To.1 : 1607) is of uncertain chronological position, the remainder (To.1 : 1866a, 1866b, 1870 and 1871) all found within a few square metres of each other in horizon I and all marked by fire. To.1 : 1866a (fig. 125.6) and 1871 (fig. 125.5) may represent the type. They are made of *Tridacna* and are respectively 19 mm by 19 mm and 18 mm by 16 mm in dimensions and 2-5 mm and 5-7 mm thick. In the case of To.1 : 1866a there is a biconical perforation at each end, leading from the underside to the flattened end facet. On To.1 : 1871 the two perforations are in the corners at the two ends of the same side and go from

\(^1\) McKern, n.d., p.197.
\(^2\) Spoehr, 1957, p.147 and fig. 77.
underside to flattened edge. The form of both is a rounded quadrangle. To.1: 1607 (17 mm by 13 mm and 4-5 mm thick) is identical except for the absence of perforations. To.1: 1870, also without perforations, differs in shape: it is 25 mm by 13 mm and 3-4 mm thick and may be a fragment.

To.2: 1661 (fig. 129.12) is rather different again. Rather angular in form, it measures 25 mm by 19 mm and is 2-3 mm thick, but it may be a part of a larger piece. Another difference lies in the biconical perforations, three in three corners, bored from upper to lower surface, and a trace of a fourth in one of the occupied corners. The type of shell could not be determined.

To.1: 1866b (fig. 125.7), possibly of Conus, has in common with the To.2 piece the biconical perforations in the two preserved corners running from upper to lower surfaces, and the angular form. The preserved dimension is 29 mm, the incomplete one 12 mm; the thickness is 5 mm. It bears some similarity to form 5F discussed below.

All specimens are finely polished.

No foreign parallels could be found, but it is worth mentioning that small bracelet segments of various materials with one or two perforations are on archaeological record for Hawaii and a perforated shell tab for the Marquesas.

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1 Emory and Sinoto, 1961, fig. 69 and pp.72-3.
2 Suggs, 1961, fig. 35 b and p.134.
5F. **Rectangular units** (figs. 128-9.10)

Only one specimen was found, To.2 : 26, from the mound horizon. Measuring 52 mm by 31 mm in dimensions and 2-4 mm in thickness, the artifact is slightly curved in both directions and has clearly been made from the outer whorl of a large *Conus* where this meets the broad top. The form is almost strictly rectangular with marked corners in each of which is a perforation, three conical and one biconical. The specimen is well polished over all. It bears a striking resemblance to the archer's wrist-guard of Bronze Age Europe, but the use of such a device in Tongan archery, at least at the time of discovery, is not revealed by our authorities.

The only two reasonable overseas parallels are archaeological specimens from the Lapita site in New Caledonia and the Watom site in New Britain (fig. 97.5). Other archaeological pieces with some resemblance are on the record for the New Hebrides and Easter Island.

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3. Gifford and Shutler, 1956, p.64 and pl. 8e.
5. Shutler and Shutler, n.d., p.8, burial 2, the rectangular perforated shell pendant.
6. Heyerdahl and Ferdon, 1961, fig. 109 r.
Ethnographic examples with common features may be noted from the Marquesas\(^1\) and New Guinea.\(^2\)

5G. **Circular units** (fig. 130.1, 2, 5)

Nine specimens are classified here. They are all the detached caps of broad-topped univalves, which have been identified in only a few cases. The fullest extent of modification is represented by To.1 : 1890 (horizon I) (fig. 130.2), To.2 : 661 (zone I of the midden), and To.6 : 1631 (horizon III), where the underside is ground smooth, the upper surface is ground flat or flattish and a perforation is made through the centre. The dimensions of the three specimens are respectively 25 mm, 20 mm and \(2^\frac{1}{4}\) mm in diameter and 5-6 mm, 10 mm and 7 mm in thickness. On two examples there is a central perforation but no flattening of the upper surface. These are To.1 : 1892 (horizon I), 15 mm in diameter and 5-6 in thickness, and To.6 : 610, of uncertain chronological status, 17 mm in diameter, 5-10 mm in thickness.

The other four pieces may be unfinished examples of the type. To.2 : 1590, of uncertain chronological status, is made of *Conus*, and, though provided with flattened top and central perforation, has not been smoothed on the underside. It has a diameter of 47 mm. To.6 : 68 (fig. 130.5), made from a large *Conus* and found in horizon I but not the bottom spit, is ground on top and below but lacks

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1. E.S.C. Handy, *The Native Culture in the Marquesas*, 1923, fig. 24b.
2. Edge-Partington, 1890-8, series II, pl. 26, no. 1, and pl. 174, no. 5.
the central perforation. Its diameter is 68 mm, its thickness 8-15 mm. To.2 : 590, from zone I of the midden, is unmodified except for smoothing of the lower surface. It is 16 mm in diameter, 9 mm in thickness. To.6 : 995 (fig. 130.1), from horizon II, is at a similar stage. It is of Strombus shell and has a diameter of 32 mm and a thickness at the centre of 17 mm.

The ornament type occurs both early and late in the Tongan sequence and is one of the few to be established for the Tongan ethnographic record. It is mentioned by McKern¹ as occurring in necklaces containing also several strings of small shells intermixed with seeds, fish teeth and opercula from a variety of marine shells, some of them as large as crown pieces. A composite necklace from Tonga is depicted by Edge-Partington,² which terminates in a shell disc of the type under discussion, measuring about 50 mm across and thus bringing specimen To.6 : 68 (fig. 130.5) to mind.

The form is widespread in Melanesia and Micronesia as far as the ethnographic record goes.³ Archaeological parallels are by no means unknown and are on record for

¹ McKern, n.d., p.194.
² Edge-Partington, 1890-8, series I, pl. 89, no. 3.
³ Ibid., series I, pl. 174, no. 2 (Gilberts), series II, pl. 82, nos. 8-9 (New Hebrides), pl. 92, nos. 1-2 (Gilberts), pl. 145, no. 1 (New Guinea), pl. 153, no. 6 (New Guinea), pl. 158, no. 10 (New Guinea).
the Lapita site in New Caledonia,¹ the New Hebrides² and also Yap.³ An object of similar character is also known archaeologically from Hawaii,⁴ but since it is without perforation and notched at the side, it is probable that it had quite a different function.⁵ Pearl shell discs with two perforations, interpreted as ornamental units related to ethnographic forms, are reported by Suggs from the earlier part of his Marquesan sequence.⁶ A similar example was found at the Maupiti burial ground.⁷

5H. Curved segment (figs. 126-7.12)

This unique artifact of Tridacna, To.1: 2560, from horizon I, is a complete specimen. Of roundish cross section, it forms a segment of a circle of 13 cm diameter and has a biconical perforation at each end, from the flat end facet through to the surface. It may be a crescentic ornament in its own right, strung as a chest ornament from

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¹ Gifford and Shutler, 1956, p.63 and pl. 8 (both apparently unperforated).
² Shutler and Shutler, n.d., pl. 1B and 7A (both perforated).
³ Gifford and Gifford, p.192 and pl. 41k (unperforated Conus cap, ground top and bottom surfaces).
⁴ Emory and Sinoto, 1961, fig. 71 and p.76.
⁵ In shape it is almost identical with a group of so-called pitching discs from Hawaii described by Buck, 1957, p.373 and fig. 246b, second from right, though considerably smaller.
⁶ Suggs, 1961, fig. 35a and pp.133-4.
⁷ Emory and Sinoto, 1964, pl. 2h and pp.150-1.
the neck, or it may have formed an element in a composite piece. It seems to be without close formal parallels.

Text table IX.11

Distribution of Other Ornaments by Site and Horizon

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51. Pearl shell pendants (fig. 130.7, 9, 10)

Four fragments of pearl shell, with the hinge part preserved, probably represent breast pendants suspended by a fine braid of human hair, as described by McKern.¹

To.1 : 3507 (fig. 130.9), To.1 : 3501 and To.4 : 8 (fig. 130.7) have one perforation; To.1 : 3502 (fig. 130.10) has two. All three specimens from To.1 were found in the subsoil below the main midden and belong to an early stage of occupation at the site in circumstances to be described in chapter XI.

¹ McKern, n.d., p 196.
Very similar objects are on record for Yap, ethnographically as shell money,\textsuperscript{1} archaeologically as presumed shell money.\textsuperscript{2} The Shutlers record a parallel from the New Hebrides, with burial 1, in a shelter where other burials were associated with other types of pearl shell pendant.\textsuperscript{3} Duff, describing possible stone copies in New Zealand, comments on the occurrence of whole pearl shell pendants in tropical Polynesia.\textsuperscript{4} More recent finds in Polynesia of a related kind have been made at the Maupiti burial ground in the Society Islands\textsuperscript{5} and in the Marquesas.\textsuperscript{6}

5J. \textbf{Pule shell pendants} (fig. 130.8)

Only one such ornament was found: To.1: 3475, from horizon I and therefore early. The pearly white shell has a rounded perforation at the narrower end. Pule shells are difficult to find and are much appreciated in Tonga today. Mrs Helu, mother of my interpreter, possesses such a shell worn as a pendant from the neck.

5K. \textbf{Trumpet shell pendants} (fig. 130.11)

To.6: 9, a \textit{Charonia tritonis} shell provided with one circular perforation of 8 mm diameter near the mouth, is

\begin{itemize}
\item Gifford and Gifford, 1959, p.193 and pl. 35.
\item Ibid., p.193 and pl. 41 i.
\item Shutler and Shutler, n.d., p.8.
\item Duff, 1956, pp.127-9.
\item Emory and Sinoto, 1964, p.150.
\item Suggs, 1961, p.135 and fig. 35d.
\end{itemize}
from horizon I at the site, but not the bottommost level, so that it is likely to be late. It is 14 cm long. It is uncertain whether an original perforation existed where there is now a large irregular hole on the spire. If so, the specimen might have been a shell trumpet of the widely distributed South Seas type, with suspension hole.

5L. **Small shell beads** (figs. 125.20, 22 and 131.4, 5)

Four examples only were found. To.2 : 5715 (fig. 125.20), from the surface, is a well polished specimen, 7 mm long, 7 mm thick, with rounded triangular cross section and biconical perforation. To.3 : 584 (fig. 125.22) is a thin disc-like bead, 6 mm in diameter and 2 mm thick, with cylindrical perforation of 1.5 mm. It has archaeological parallels in the New Hebrides\(^1\) and Yap.\(^2\)

To.2 : 5734 (fig. 131.4), from the surface, is the perforated top of a tiny univalve, somewhat decayed, 7 mm across and 2-4 mm thick, for which a parallel can be found in the New Hebrides.\(^3\) To.1 : 1753 (fig. 131.5), of uncertain chronological status, is the longitudinal half of a well polished bead of round cross section and slightly conical form. The complete specimen must have been 13 mm long and 6 mm in diameter. The perforation is biconical.

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1 Shutler and Shutler, n.d., pl. 5G.
2 Gifford and Gifford, 1959, pp.191-2 and pl. 38 especially m.
3 Shutler and Shutler, n.d., pl. 3G.
How beads such as this were used is not clear, but McKern refers to belts decorated amongst other things with beads cut out of shell.¹

5M. Small bone beads (fig. 125.21)

The only specimen is To.6 : 260, from horizon III, perhaps made from bird bone polished into a barrel-shaped form. The cross section is circular, the length 12 mm, the external diameter 5 mm.

5N. Stone beads (fig. 131.1-3)

To.1 : 1910 (fig. 131.1), of uncertain chronological status, and To.6 : 125 (fig. 131.2), from horizon II, are the same type, circular in form and rectangular in cross section with flat edges, the central biconical perforation complete on the former specimen, unfinished on the latter. The To.1 piece is 13 mm in diameter and 3 mm thick; that from To.6 18 mm across and 5 mm thick. The form resembles somewhat shell bead no. 584 from To.3 (fig. 125.22).

To.6 : 98 (fig. 131.3), from the bottommost spit of horizon I and possibly therefore of early date, is a broken piece, 18 mm in the preserved dimension and 5 mm thick. It is flat on one side, slightly convex on the other, of trapezoidal form with rounded corners and flattened and rounded edges. Breakage has occurred at the biconical perforation in the centre.

¹ McKern, n.d., p.194.
All three specimens are made of yellowish calcite, a material that occurs in veins on 'Eua.¹

50. Pottery disc (fig. 54.7)

Perhaps related to the type of ornament represented by stone bead To.6 : 98 (fig. 131.3), described above, is the pottery disc To.1 : 218, from horizon I. With a diameter of 38 mm and a thickness of 6 mm, it is a roughly trimmed disc, about 20 mm of whose circumference has been smoothed into a convex side. A perforation has been begun but not completed on the inner surface and there is a slight possibility that a start on another has been made rather eccentrically on the outside.

5P. Incomplete pieces (figs. 124-5.1, 3, 4)

The three objects of Tridacna shell to which the pieces under discussion here belong were no doubt ornaments, possibly related to the long unit type, class 5D, discussed above.

To.6 : 1814 (fig. 125.3), from horizon II, may indeed be a broken and/or unfinished specimen of long unit. Its similarity can be seen by comparing it with the long unit figured beside it as fig. 125.2. Its dimensions are at the top end of the range for long units (see table 52): broken at both ends, its length is more than 40 mm, its thickness is 12 mm; width, at 12-16 mm, is beyond the range.

¹ Identifications by Dr White.
To.1: 1881 (fig. 125.1), from horizon I, is similar in shape to the last but bigger. Broken at both ends but well polished on all surfaces, its preserved length of 47 mm, width of 15-20 mm and thickness of 12 mm and its tapering form might justify putting it into a different class from the long units.

To.2: 23 (fig. 125.4), from zone III of the midden, deviates further still from the long unit class, while still retaining some similarity to it. The fragment appears to represent rather less than one half of an object barrel-shaped in plan but wider than thick. Dimensions are: preserved length 40 mm, width 17-28 mm, thickness 11 mm at the end, 18 mm in the middle. A biconical perforation extends from the flat end facet to the face.

If related to each other and to the long units, it is interesting to note that these objects, like the long beads, are found in both early and late contexts.

5Q. Tattooing chisels (fig. 125.14-7)

Four examples were recovered in the excavations, all at To.1. They are all made of bone and seem to represent an identical form, rectangular in outline with straight sides and slightly convex butt end, and possessing six to ten teeth. The cross section is rectangular with sharp corners, flat edges and flattish surfaces. In general they are highly polished.

To.1: 1886 (fig. 125.15) is 32 mm long, 7 mm wide and 1 mm thick. The teeth are damaged.
To.l: 1887 (fig. 125.14) is 29 mm long, 6-7 mm wide and 1 mm thick. The teeth are damaged.

To.l: 1888 (fig. 125.16) is 27 mm long, 6 mm wide and 1 mm thick. The functional end has been ground flat as a preparation for the recutting of the teeth.

To.l: 1889 (fig. 125.17) is merely a fragment, with, however, a number of fully preserved teeth, 5-7 mm long, thin and pointed. The preserved dimensions of the fragment are length 19 mm, width 6 mm, and thickness 1 mm.

All four tattooing chisels were found within an area of one or two square metres, three of them in the bottommost spits of horizon I, the fourth, the fragmentary specimen no. 1889, in the fill of pit A nearby. It is of interest that the only complete pot recovered during the excavations, the so-called Pea cup (To.l: 197, fig. 64a.2), was found in the same area as the tattooing chisels, in a bottom spit of horizon I (fig. 17.2).

Now not only are the tattooing chisels McKern describes for the contact period in Tonga of the same type as the excavated specimens, but also the pigment used for tattooing was contained in a coconut cup.\(^1\) One wonders whether these containers could not at some stage have been ceramic. Perhaps the circumstances as we have described them allow the suggestion that a tattooist worked for a time at the northern end of the main trench of To.l. The only implement from his tool kit not documented by the excavation would be the mallet, ika, with which he struck the tattooing chisel, hau, but this would have been made

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\(^1\) McKern, n.d., pp.218, 439 ff.
of wood. An in situ placement of the chisels in horizon I could have been disturbed in the late period when pit A was cut, displacing one of the chisels, possibly damaging it and incorporating it finally, with other old materials, in the pit during its refilling. McKern reports that chisels were made of turtle shell, human bone or the wing bone of the wild duck. Possibly the excavated specimens were made of human bone.

Tattooing chisels of a type known in the Tongan ethnographic record were thus present in Tonga in the early period. Almost identical foreign parallels are known from Hawaii where they are considered to be of considerable age. Other parallels are also in the archaeological record from the Marquesas, where they occur both early and late, Easter Island and New Zealand. Ethnographic parallels may be noted for New Zealand, Samoa and Fiji.

1 Emory and Sinoto, 1961, p.56 and fig. 70.
4 Duff, 1956, fig. 58 especially no. 1222, and p.223.
5 P.H. Buck, The Coming of the Maori (2nd ed.), 1950, fig. 85.
6 Edge-Partington, 1890-8, series I, pl. 76, nos. 3-4.
7 Ibid., pl. 122, no. 3.
There are seven specimens so interpreted, all made from basaltic pebbles of the kind called makahunu from the volcanic islands of western Ha'apai. The pebbles were worked into round to broadly oval shape, with rounded quadrangular cross section achieved by hammer dressing and consisting of slightly convex faces and intervening side. Two specimens are from the early horizon at To.1: no. 1912 (fig. 136.7), 7.5 cm in diameter and 4.2 cm thick, and no. 1913, 9.1 cm in diameter and 3.5 cm thick. One, To.6: 164, is from the fill of fireplace CW which may be early (see chapter XI): it is 7.3 cm across and 4.1 cm thick. Three, To.6: 4, 19 and 24 (fig. 136.8), are from horizon I at the site, but not the bottommost spit: diameters are 11 cm for both nos. 4 and 24, thicknesses 3.5 cm (no. 4) and 4.7 (no. 24). The seventh example, To.6: 1356, is from horizon II, 6.8 cm across and 3.8 cm thick.

The type was thus known in Tonga both early and late. It is the equivalent of the well known Hawaiian ʻulumaika, whose use persisted into the 19th century.¹ The disc need not be made from stone, as the Hawaiian name (ʻulu = breadfruit) clearly indicates and the use of discs of breadfruit and other materials in Samoa and the Cook Islands as well as Hawaii is discussed by Buck.² McKern, who does not mention stone discs, nevertheless records for Tonga that boys had a game resembling bowling in which

¹ Buck, 1957, pp.372-3 and fig. 246a.
² Buck, 1930, p.663.
they used the *teka*, a disc-shaped slice of *kape* root (*Alocasia macrorrhiza*) or indeed any other thing that would roll.¹ The archaeological record extends the distribution of the game within Polynesia to Tahiti,² Easter Island³ and New Zealand,⁴ where stone discs have been found, and also to the Ellice Islands, where the stone discs described by Skinner appear to be archaeological.⁵

As a result of recent archaeological finds, the New Hebrides can now be included in the area of distribution.⁶

7. **Unique pieces** (figs. 124-5, 131, 6 and 135)

Three pieces are included here, whose function is unclear.

To.1: 289 (fig. 125,13), in the top of the subsoil and therefore belonging to an early stage of horizon I, is a 1 mm thick object made from the inner part of the outer edge of an oyster shell. Triangular in shape, it is 25 mm long and 20 mm wide. Perhaps it had an ornamental function.

¹ McKern, n.d., p.666.
² Emory and Sinoto, 1965, p.91 and fig. 12b.
³ Heyerdahl and Ferdon, 1961, fig. 45a,b.
⁵ Ibid., p.245.
To.1 : 3047 (fig. 131.6), also from horizon I, is a fragment, 20 mm long, 7 mm wide and 2 mm thick, of a bone artifact. One of the two breaks cuts across a perforation. One face has a series of artificial longitudinal scratches.

To.6 : 213 (fig. 135), of coral, has undoubtedly been modified by man. Seven cm high and 4½ cm across the flat base, it was found in the bottommost spit of square 24/20, on the very margins of fireplace DN, which gave the early radiocarbon date, ANU-24, 400 BC ± 200. Its shape has some similarity to a bird's head on a conical neck.

8. Industrial Tools

Text table IX.12

Distribution of Industrial Tools by Site and Horizon

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<tr>
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<td>1</td>
<td>3</td>
<td>20</td>
<td>14</td>
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</tbody>
</table>
8A. **Stone cutters** (fig. 136.3, 6)

Four specimens were recovered, of various rock types which were not identified. They are thin pieces of stone, 8-10 mm thick, the sides of which curve in to the straight or convexly curved dullish cutting edge. To.2 : 16 (fig. 136.3), from zone I of the midden, and To.6 : 2627, from the fill of fireplace E, a possibly early feature subsequently disturbed, have a single working edge. To.2 : 700, of uncertain chronological status, and To.6 : 154 (fig. 136.6), also chronologically uncertain, have two working edges. Cutting edges vary in length from 46 mm on To.6 : 2627 to 110 mm for the straight edge on To.6 : 154.

The closest parallels are on record for Easter Island, but implements with in part a similar function are represented for example in the files and saws of Hawaii.²

8B. **Hammerstones** (figs. 136.9 and 137.2)

8B1. Definite hammerstones are represented by four excavated specimens, all made of volcanic pebbles. To.1 : 42 (fig. 136.9), from horizon I, is very small, being 4.3 cm in diameter and 2.5 cm thick. It has a broad belt of coarse hammer dressing along the edge. To.6 : 163 (fig. 137.2), of uncertain chronological position, is very large being 26 by 20 cm in dimensions and 10 cm thick. The cross section is somewhat oval. There are large flake scars on both faces at both ends, which are bruised by hammering.

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¹ Heyerdahl and Ferdon, 1961, fig. 100 c, d and pl. 73h.
² Emory, Bonk and Sinoto, 1959, pl. 5a, no. 15. Emory and Sinoto, 1961, fig. 48 d, e, of coral.
To.1: 3057, of uncertain chronological status, and To.2: 425, from zone I of the midden, are fragments with traces of utilisation at one end.

8B2. These are fragments of hammerstones or, in some cases, perhaps of bowling stones. There are seven of them, distributed as in text table IX.12.

8C. Combined hammers and files

There are two specimens in this category. To.6: 1569, from horizon I but not the bottom spit, is a piece of branch coral, 6 cm long and 4 cm thick, with traces of use as a file on its surfaces and with both ends flattened from hammering. To.2: 536, from zone III of the midden, is a likely fragment from a similar implement. The type is thus known in Tonga early and late but appears to be without overseas parallels.

8D. Coral files (fig. 134.1-3, 5, 7)

No less than 90 specimens were found by excavation, mostly small fragments. Branch coral was employed and the bigger specimens show how one end was used as a handle, the other as the file. Through use this section of the coral has been flattened on both sides to an elliptical cross section with sharp edges. Perhaps these edges in turn served as cutters for working shell. The file itself was probably used amongst other things for flattening the elevated top of Conus and other univalves.

The implement is well documented throughout the sequence as text table IX.12 shows. Parallels are on
archaeological record for Hawaii,¹ Tahiti² and the New Hebrides.³ The files of porites coral recorded for Tahiti,⁴ the Marquesas,⁵ and Hawaii⁶ are unknown in Tonga. An Easter Island coral file⁷ resembles some of Suggs' Marquesan series.

8E. Stone files (fig. 136.5)

The only example is To.2 : 3990, of uncertain chronological status. It is a broken artifact of sandstone, some 6 cm long, with rounded quadrangular cross section and showing use on all four sides. It tapers longitudinally from a width of 3 cm down to 1 cm. It is doubtless the equivalent of the Marquesan pebble coral files, whose forms are dealt with in detail by Suggs.⁸ The Tongan specimen bears some resemblance to his Long Triangular type,⁹ well represented throughout his sequence, though the similarity may simply reflect the way the Tongan example has been worn.

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¹ Emory, Bonk and Sinoto, 1959, pl. 6, nos. 4-12.
² Emory and Sinoto, 1965, fig. 5, nos. 9-10.
³ Shutler and Shutler, n.d., pl. 5A.
⁴ Emory and Sinoto, 1965, p.88.
⁶ Emory and Sinoto, 1961, pp.53-4 and fig. 48d-g.
⁷ Heyerdahl and Ferdon, 1961, pl. 73g.
⁸ Suggs, 1961, pp.117-21 and fig. 32.
⁹ Ibid., p.118 and fig. 32e-g.
8F. **Sea urchin files** (fig. 134.4)

The three excavated examples are all worked at one end, with a bevel at an angle of $45^\circ$. Two are complete, the third broken. The type was apparently rare in Tonga, though possibly known both early and late. Archaeological parallels are widely distributed in the Pacific, where they are on record for the New Hebrides, Fiji, Samoa, Marquesas, Tahiti and Hawaii.

8G. **Coral grinders**

The twenty excavated specimens include various fragments of coral, but not branch coral. Some bear clear traces of having been used for grinding, on others these are less in evidence. Only one specimen, To.6 : 368, from the bottommost spit of horizon I, is at all extensively modified, having a trapezoidal shape and cross section with sharp corners. It is 19 cm long, 3.5 cm wide at one end and 7.5 cm wide at the other end. Both ends are slightly curved. All surfaces are smooth.

These simple grinders were in use throughout the sequence in Tonga and are well known elsewhere in

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1 Shutler and Shutler, n.d., p.5.
2 Gifford, 1951, p.220.
3 Green, 1964, p.35 ff.
5 Emory and Sinoto, 1965, fig. 5, no. 8, and p.88.
6 Emory, Bonk and Sinoto, 1959, pl. 6, nos. 15-27, and pp.19, 21. Emory and Sinoto, 1961, fig. 48b, c, and p.56.
Polynesia, as in the Marquesas, Tahiti, Hawaii and Easter Island.¹

8H. **Pumice grinders** (fig. 138)

The 14 excavated specimens show evidence of having been used for grinding and polishing in the form of facets and grooves of varying dimensions. Only one example has been modified into a specific shape. This is specimen To.6 : 2254, which is sausage-shaped (fig. 138.2). It is 8 cm long and 3 cm thick. Interestingly enough all 14 specimens came from To.6, throughout all three horizons except for the bottommost spits of horizon I.

Pumice grinders are on archaeological record for other Polynesian islands, for example the Marquesas, Tahiti, Hawaii and Easter Island.²

8I. **Stone grinders** (fig. 136.1, 2, 4 and fig. 137.1)

Fifteen examples from both early and late periods were found by excavation, in the main fragments showing various traces of grinding and polishing. Two examples have a more specific form. These are To.6 : 162 (fig. 136.4), of sandstone, from horizon II, and To.5 : 1406 (fig. 137.1), of uncertain chronological position, which is made of a feldspathic type of rock. The latter displays one, the former two grinding hollows. For Easter Island


² See last footnote.
Heyerdahl records dished stone grinders similar to the piece from To.5.1

Conclusions

1. Technological

The range of artifacts described above includes tools for woodworking, food preparation and fishing, a wide variety of ornaments, bowling stones and a number of implements used amongst other things for the production of these.

The poverty of the bone industry and the richness of the shell work are understandable but striking. Tridacna and Conus were the chief raw materials, the former used for adzes and various kinds of ornaments, the latter for gouges and ornaments. Tridacna and Conus waste was present at all sites. Unfortunately this was not quantified, but a selection was made of pieces showing techniques of workmanship. Fig. 133.1-3, 5, 6 illustrates the type of Tridacna waste present. Fig. 131.8 shows long polished facets near the hinge of a Tridacna under manufacture. The division of the Conus for the manufacture of bracelets, rings, discs and beads is illustrated by fig. 132.1 and 3-4 and fig. 134.6. These represent the detached top, often ground flat and sometimes with the centre piece cut away; the remaining part of the shell, showing one side of the groove by which the shell wall has been weakened until a gentle blow could cleanly break it; and the complete shell ground flat on top and sometimes with central disc

1 Heyerdahl and Ferdon, 1961, pl. 79a,b.
removed. The distribution of these items of shell technology, as well as of smaller univalves worked in a similar way (cf. fig. 132.2) for the production of small beads and discs like forms L (figs. 125.20, 22 and 131.4, 5) and G (cf. fig. 130.1, 2, 5) of class 5 above, is shown in text table IX.13.

**Text table IX.13**

Distribution of Worked Conus Shell (A), Other Worked Univalves (B), Obsidian (C) and Ochre (D) by Site and Horizon

<table>
<thead>
<tr>
<th>site</th>
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<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
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</tr>
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<td>0</td>
<td>3</td>
</tr>
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<td></td>
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<td></td>
<td>33</td>
<td>12</td>
<td>2</td>
<td>40</td>
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</table>
McKern makes no mention of shell technology, only of craftsmen using whale ivory, the Tongan gold, and turtle shell as raw materials, no reflection of which is found in the excavated record. However, the range of industrial tools recovered is appropriate to the technological processes apparent on the worked shells and to the final forms that were produced: hammerstones for breaking up Tridacna, stone cutters for grooving Conus, perhaps the sharp edges of coral files for more delicate grooving, the files themselves, of coral and sea urchin spine, for different types of shaping, and the grinders and polishers of coral, pumice and stone for the final stages. Some of these tools would probably be employed in carpentry, for which we have no data, and appropriate processes in stone technology. What tool was used to drill shell and bone does not appear from the evidence.

Industrial tools are not abundantly represented in the excavations, but there are some at all sites. Coral files are the most frequent item, occurring at all sites and being very numerous at To.2. To.6 shows the best representation of the range of industrial tools and was the only site at which pumice grinders were found.

Apart from coral which was locally obtainable but of restricted use, all stone had to be imported, from neighbouring 'Eua and the more distant volcanic islands of western Ha'apai. The proportion of 31 excavated stone adzes to ten of shell suggests that such import posed no problem. Petrological analysis of a number of stone adzes

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1 McKern, n.d., p.420.
shows that the two sources of supply were being exploited in the early as well as the late period. Two of the analysed adzes came from even further afield, from some region of oceanic basalts.

Pieces of siliceous rock were occasionally met with in the middens. Unfortunately these have not been quantified. None of them had been worked, but it is possible that they provided the raw material for drill points, as in New Zealand.¹ Two pieces of obsidian, both unworked, were found: To.1 : 3551, from horizon I, and To.3 : 261. The source of this is unknown.

Forty pieces of red ochre, available on 'Eua, were excavated. Their distribution is set out in text table IX.13, where it is seen that they were imported in both the early and the late periods. The material is soft and most of the recovered pieces show shiny facets where they have been rubbed. They doubtless provided colouring material for various kinds of decorative purpose, including tapa cloth and pottery.

2. Cultural: within Tonga

Since the conclusion from the pottery analysis has been that it represents an unbroken process of development, we should expect other aspects of material culture to show a similar continuity, even to their appearance in the ethnographic record. Unfortunately few of the items dealt with in this chapter occur in sufficiently large numbers

¹ J. Golson, pers. comm. Cf. the drill points recorded for Easter Island, Heyerdahl and Ferdon, 1961, e.g. fig. 49, a-f, and p. 155.
for firm conclusions about cultural continuity and change to be based on them. We may take warning from the example of tattooing chisels which, present archaeologically in the early period and ethnographically in the period of European contact, were not recovered from the period in between, where of course they must be present. At the same time the ethnographic record is deficient in the very data needed for archaeological comparisons.

Continuity from early to late period has been argued for some of the stone adze forms: group 2a, round, oval or lenticular cross section, group 2b, plano-convex cross section, back flat, and, less clearly, group la, quadrangular cross section. The same can be claimed for shell adzes with rectilinear cross section and for paring knives of Strombus as well, less certainly, as of Anadara. Awls are known early and in all probability late. The single one-piece fishhook is almost certainly early: the single one-piece fishhook blank is late. Anadara net sinkers, well represented in both periods, are in use up to the present. The same distinctive type of cowrie cap for the octopus lure, lacking either perforation or notching, is, if correctly interpreted, a strong indication of continuity.

Amongst the ornaments narrow bracelets and broad bracelets are known in both periods. The narrow bracelet is one of the few artifacts present in sufficient numbers for us to be able to propose a real change in its representation over time. It is much more popular in the early than the late period. The small ring is probably but not unequivocally present late as it was early. Long and circular ornamental units are known in both periods.
and the latter is one of the few ornament types established in the ethnographic record. Bowling stones, files of branch coral and possibly sea urchin files complete the tally of artifacts known in both periods. However tattooing chisels and pearl shell and pule shell pendants, though not found in late period contexts, are present in the early period and in the ethnographic record.

Because of the smallness of their numbers, we cannot argue from the absence of the other items from one or other of the major periods of Tongan prehistory. In these circumstances the positive indications above, accounting for something like half of the items under review, tend to support the arguments for continuity derived from the pottery evidence.

2. Cultural: beyond Tonga

Not enough comparative material yet exists to make a realistic appraisal of Tongan relationships in terms of the artifacts here under review, but a number of extremely interesting indications appear.

If we look first at the known Lapita sites of the Western Pacific, we find from Watom, besides adzes of curvilinear cross section, a Conus gouge and a rectangular ornamental unit of class 5F, and from site 13 in New Caledonia rectangular and circular ornamental units (classes 5F and 5G), broad and narrow bracelets (classes 5B and 5A), cowrie octopus lure caps without perforation and Anadara net sinkers. Except for the two ornamental units, all these forms occur also in New Caledonia on later sites of different ceramic tradition. In addition, one item, the Strombus paring knife known in Tonga, was
not found at site 13 but is present on later New Caledonian sites.

The rich shell industry of New Caledonian sites in general is very reminiscent of Tonga, though no work on Tridacna is reported and the emphasis is on Conus and other univalves. A similar shell technology has been reported for Yap and is now appearing for the southern New Hebrides. With such islands to the west, Tonga proves to share a number of specific forms of artifact, irregardless of the chronology and context of their occurrences: Tonna/Turbo scrapers (New Hebrides, Yap, Marianas), Anadara paring knives (Yap), Strombus paring knives (Yap, New Caledonia), Conus gouges (New Hebrides, Watom), unperforated octopus lure caps (New Caledonia), Anadara sinkers (New Caledonia, New Hebrides, Yap), narrow bracelets (Fiji, New Caledonia, New Hebrides, Yap), broad bracelets (New Caledonia), small rings (New Hebrides), long ornamental units (Marianas), rectangular units (site 13, New Caledonia, Watom), circular units (New Caledonia, New Hebrides, Yap), pearl shell pendants (New Hebrides, Yap), small shell beads (New Hebrides, Yap), bowling stones (New Hebrides), branch coral files (New Hebrides), and sea urchin files (Fiji, New Hebrides). The similarities with the southern New Hebrides are particularly striking. Also notable is the close formal resemblance between the Tongan long ornamental unit (form

1 Gifford and Shutler, 1956, p.64 and pl. 6.
2 Gifford and Gifford, 1959, p.191 and pl. 40.
3 Shutler and Shutler, n.d.
D of class 5) and Marianas pieces in shell and stone, the only parallels that can be found. It will be remembered that collar rims were noted on pottery vessels from this group.

Some of these items occur also of course east of Tonga in the other islands of Polynesia. The practice of perforating the whorl of a univalve to serve as a paring knife is on record. The treatment of *Tonna* in this way is documented, though that of *Anadara* and *Strombus* is not. The use of branch coral and sea urchin files is widespread, as is the bowling stone, all items of fairly restricted distribution outside Polynesia on present evidence. But the shell ornaments which Tonga shares widely with islands in Melanesia and Micronesia are less clearly paralleled in Polynesia. The pearl shell pendant occurs there and the fashion of the composite ornaments made up of units of various kinds was known. But no precise counterparts for the Tongan ornamental units can be pointed out, though general similarities with items in Hawaii, the Society Islands, the Marquesas and Easter Island have been mentioned. The important tradition of shell bracelets is not in evidence at all. At the same time the varied one-piece fishhooks characteristic of early levels in Eastern

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1 Cf. Duff, 1956, ch. IV, with particular reference to early New Zealand forms. For recent finds of similar ornament units in tropical Polynesia as predicted by Duff, see Emory and Sinoto, 1964, fig. 5c, d, pl. 1 and pp.148-9 (whale-tooth pendants) for Society Islands and Sinoto and Kellum, 1965, fig. 4b, 1 (reel), 2-5 (whale-tooth pendants), 8-9 (sea mammal tooth and dog tooth pendants) for Marquesas.
Polynesia\(^1\) find no counterpart in Tonga. Simple one-piece hooks alone have been found there, a circumstance that applies also to Samoa and, further afield, the Marianas. Lack of elaboration of bait-hook fishing gear seems to be as typical of the archaeological as the ethnographic record in Melanesia.\(^2\)

On the other hand Tonga appears to share in the basic Polynesian adze tradition and possesses other items exclusively (up to the present) or mainly in common with the other Polynesian islands. These include the tattooing chisel, the chisel fabricated on the pointed end of the Terebra shell (fig. 123.1, 2, form C of class 1), the bone needle and awl, and the stone file and cutter.

The implications of these and other relevant data will be discussed in the final chapter.


CHAPTER X

FAUNAL AND BOTANICAL REMAINS

Shell

This was the most conspicuous feature of the excavated middens. The predominant types of shell fish in all sites were to'o (Gafrarium spp., including G. tumidum, G. pectinatum and G. gibbia, fam. Veneridae) (cf. fig. 132.6) and kalo'a (Anadara antiquata, fam. Arcidae) (cf. fig. 132.5), still the most important food shells in Tonga. Other species of shell were present in small quantities only, though at times achieving appreciable proportions when added together; they were neither identified nor otherwise analysed. It was thought worthwhile to see if the proportions of to'o and kalo'a varied from horizon to horizon or site to site. A second investigation suggested itself. Tongan visitors to the site of the first excavations at To.1 expressed surprise at the size of the biggest of the excavated to'o shells. Was there a possibility that the shell fish eaten had decreased in size over time due to over-exploitation or some natural cause?

1 Identifications by Dr H.A. Rheder, Smithsonian Institution, Washington, who also gave general information about these species.
2 See figures for the weight of unidentified shell, tables 53-8.
To investigate these problems it was decided to sample all the excavated sites, and though the project was not fully carried out as planned, samples were taken from all sites except To.4. The method was to remove units in a column 50 cm square through the deposit, but the depth of the units varied from site to site.

To.1

Nine columns were taken from the main trench, placed quite arbitrarily. They were dug simultaneously with the current excavation here. The sample units were 5 cm thick, but the distinction between the two main midden horizons was maintained. When the excavation of the main trench was completed, it became apparent that most of the columns were located in disturbed midden. It was realized that future columns should be placed in undisturbed sections of a midden, selected after careful study of the profiles. Sample S 8 (82/58 in the co-ordinate system of the site) is, however, representative of an undisturbed midden sequence, and the relevant figures are spelt out in detail in table 53.

Four more columns were taken, in 5 cm units, at the edge of the To.1 midden, outside the area of excavation. Only one of these (50/94) hit undisturbed midden of typical appearance.

Shell sampling in the subsoil was not carried out in the normal columns as these were thought too small for adequate sampling there. Instead this was done over six square metres (82/57-9 and 83/57-9) in spits 1 x 1 m in area and 10 cm thick. Three such spits were taken from each square metre, see table 54.
At this stage the implications of a systematic midden sampling project began to be appreciated, in terms of the size of the middens, the number of samples required, and the labour of processing. Consequently at all subsequent sites a single column sample only was taken.

To.2

Taken through undisturbed deposits in 10 cm units (50/55), see table 55.

To.3

Taken in 10 cm units through an undisturbed section (21/21) of deposits elsewhere disturbed, see table 56.

To.5

Taken through undisturbed deposits by stratigraphic layers (20/21) see table 57.

To.6

Taken through undisturbed deposits at the thickest part of the midden in 10 cm units (24/19), see table 58.

The number of individuals of to' o and kaloa'a were calculated for each sample. A distinction was made between whole and not whole, left and right valves, the final figures for individuals being the highest number of similar valves. The shells were also weighed and here shell fragments of both shell types could be included. The weighing was meant as a check on the counting and generally speaking the picture by count and weight is the same.
An example of the procedure is given in text table X.1 for sample To.1, S 8, spit 9.

Text table X.1

Specimen Analysis of Shell Samples

(1) count

<table>
<thead>
<tr>
<th>type</th>
<th>whole</th>
<th>incomplete</th>
<th>total</th>
<th>individuals</th>
<th>% of total</th>
</tr>
</thead>
<tbody>
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<td>to'o</td>
<td></td>
<td></td>
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<tr>
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<tr>
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</tbody>
</table>

(2) weight

<table>
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<tr>
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<th>to'o</th>
<th>kaloa'a</th>
<th>unident. shell</th>
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<th>to'o</th>
<th>kaloa'a</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
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<td>405</td>
<td>815</td>
<td>3958</td>
<td>2738</td>
<td>405</td>
<td>3143</td>
</tr>
<tr>
<td>%</td>
<td>69</td>
<td>10</td>
<td>21</td>
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<td>87</td>
<td>13</td>
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</tr>
</tbody>
</table>

(3) summary (as incorporated in tables 53-8)

<table>
<thead>
<tr>
<th>to'o</th>
<th>kaloa'a</th>
<th>to'o</th>
<th>kaloa'a</th>
<th>unident.</th>
</tr>
</thead>
<tbody>
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<td>%</td>
<td>nos.</td>
<td>%</td>
<td>grs.</td>
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<tr>
<td>164</td>
<td>94</td>
<td>10</td>
<td>6</td>
<td>2738</td>
</tr>
</tbody>
</table>
The calculated percentages for each site are summarized below, to'o always quoted first.

To.1 Throughout the midden the ratios are similar:

- count: 92-97: 3-8
- weight: 83-96: 4-17

There is a very slight possibility of difference in the bottommost 5 cm of the midden:

- count: 80:20
- weight: 88:12

In the subsoil there is more variation and the agreement between count and weight is not ideal. The figures, however, show kaloa'a to be much better represented than in the midden:

- count: 55-81: 19-45
- weight: 26-67: 33-74

Though the figures within each horizon are variable, other types of shell fish are somewhat more prominent in horizon I than in horizon II, the proportions by weight being respectively 15 per cent-37 per cent and 6 per cent-25 per cent.

To.2 The figures that follow refer to the midden zone only. Kaloa'a predominates throughout:

- count: 24-41: 59-76
- weight: 8-19: 81-92

Other types of shell fish are fairly well and consistently represented throughout the midden, in proportions of a quarter to a third by weight.

To.3 Here there is a clear difference between the lower and the upper parts of the undisturbed midden (horizon I on fig. 29) with kaloa'a predominating in the former, to'o in the latter:
At the same time the upper midden contains a much
count 41-57: 43-59  count 72-84: 16-28
better representation of other types of shell fish, from
weight 22-41: 59-78  weight 62-77: 23-38
17 per cent-21 per cent by weight, as against 4 per cent-
9 per cent in the lower midden.

To.5 The figures for the three horizons are fairly
similar:

<table>
<thead>
<tr>
<th>horizon III</th>
<th>horizon II</th>
<th>horizon I</th>
</tr>
</thead>
<tbody>
<tr>
<td>count</td>
<td>85:15</td>
<td>80:20</td>
</tr>
<tr>
<td>weight</td>
<td>66:34</td>
<td>81:19</td>
</tr>
</tbody>
</table>

There is an interesting situation, however, in
horizon 0, below the main midden. The upper of the two
cultural lenses in the coral sand here was too thin to be
sampled, but the lower gives a picture very like the main
midden above, with a predominance of to'o:

count 78:22
weight 79:21

However, for the subsoil between the two lenses and
below them, quite a different picture emerges, with
kaloa'a preponderating:

count 18-27: 73-82
weight 11-55: 45-89

To.6 There is some contrast between the bottom and the
top horizons, kaloa'a being somewhat better represented in
the latter. Horizon II was a relatively shell-free zone.

<table>
<thead>
<tr>
<th>horizon I</th>
<th></th>
<th>horizon III</th>
</tr>
</thead>
<tbody>
<tr>
<td>count</td>
<td>84-95: 5-16</td>
<td>67-82: 18-33</td>
</tr>
<tr>
<td>weight</td>
<td>84-89: 11-16</td>
<td>65-70: 30-35</td>
</tr>
</tbody>
</table>
A distinction is also to be seen in the occurrence of other types of shell fish, which account for from 34 per cent-60 per cent by weight in horizon I and 8 per cent-28 per cent in horizon III.

The first contrast to be noted is between the predominance of to'o at the inner lagoonal sites, To.1, To.5, To.6 and, less clearly, To.3, and the predominance of kaloa'a at the lagoon entrance site of To.2.

Many Tongans were asked about the collecting grounds for to'o and kaloa'a. The answers were immediate and consistent: to'o in the lagoon and kaloa'a outside. To'o can be collected on the reef shelf off the north coast of Tongatapu, but only in muddy pools which hold water at low tide; these to'o have a thinner shell and a stronger taste than lagoon to'o. Kaloa'a never occur in the lagoon. If they did, so the Tongans said, they would invariably be collected as they contain more meat than to'o. Kaloa'a occur everywhere on the off-shore mud and sand banks of the reef, but in particular just in front of and at the entrance to the lagoon where there is always a flow of water. There is an apparent contradiction between Tongan statements on the habitat of the two types and Rehder's opinion¹ that they both inhabit much the same environments, quiet waters at the margins of a lagoon, often where there is some brackish influence.

It is, against the background of these somewhat conflicting statements, interesting that kaloa'a is indeed

not absent from the inner lagoonal middens. Does this reflect the collection of this particular type of shell fish directly from the reef environment by the lagoon dweller or was it obtained indirectly by exchange? In the fill at the south end of late pit P at To.l (cf. fig. 4) was a concentration, 10 cm thick and 60 cm wide, of mehingo shells (*Quidnipagopus palatam*), said by informants to be only available on the sand flats off the north coast of Tongatapu. Or did once kalo'a live in the lagoon environment, even though now it does not seem to do so?

On this last point there are three interesting pieces of evidence. Two of these concern the better representation of kalo'a in the subsoil below To.1 and To.5 than in the midden; the third is the greater frequency of kalo'a in the lower than the upper midden at To.3, a site where limited excavations produced only a small sample of pottery, amongst which, however, presumed early motifs are present (p.141). These may be indications that the lagoon environment underwent changes during the human occupation of Tongatapu. Though the shell sampling was neither extensive nor systematic enough to provide decisive evidence, other supporting data from To.1 and To.5 will be presented in the next chapter.

In view of Tongan surprise at the size of the biggest of the excavated *to'o* at To.l, it was decided to measure

---

the length¹ of all complete to'o shells in the shell samples at all sites and of such incomplete ones as preserved the required dimension. Graphs were drawn showing the distribution of the measurements. The results were disappointing in that practically no change, gradual or abrupt, could be seen in any of the sites. The dominant lengths ranged between 2 and 4 cm. On To.3 there was a slight difference between lower and upper parts of the undisturbed midden, the dominant lengths in the former group ranging between 3 and 5 cm, in the latter group between 2 and 4 cm. Lengths from 5-6 cm occurred in all sites and all horizons but were always few. Lengths beyond 6 cm were very exceptional. If a decrease in size has really taken place in to'o, the excavated evidence seems to favour this having happened fairly recently. Unfortunately no measurements were taken of the modern shells before these were sent for radiocarbon dating (p.149).

Bone

Shell middens provide good conditions for the preservation of bone but surprisingly the excavations yielded a very small amount of bone indeed. The material is treated in four sections: non-domesticated, domesticated, rat and man.

¹ Length was the greatest linear measurement the shell had to offer.
1. Non-domesticated

1. Marine

Marine forms were dominant and though the quantity of material was not large, the range exploited was quite considerable. Often the identifications could not be made below family level, so that even where more precise identifications have been made, the material has initially been organised by families. For comments on habitat and habits I have used in the main Herald and Marshall, though because of the nature of the identifications these must remain necessarily general. Similarly close comparison with Gifford's list of excavated fish from Fiji is not easy.

(a) Crustacea

Identified on claw fragments. The following were represented:

1. Family Portunidae - swimming crabs.

2. Family Scyllaridae - beach and mangrove crabs
   A. Scylla serrata.

---

1 Identifications by Dr T. Abe, Tokaiku Fisheries Research Laboratory, Tokyo, except for turtles, whose presence amongst the material was recognized by Professor C.A. Reed, Department of Anthropology, University of Illinois. Unfortunately no further study of the turtle bones was possible.


3. Family Xanthidae - shore crabs
   A. *Etisus laevimanus*
   B. *Etisus* sp.
   Both live in littoral regions and on coral reefs.

Text table X.2\(^1\) sets out the distribution of the archaeological remains. The figures refer to the number of identifiable bones, not the minimum number of individuals.

**Text table X.2**

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<td>8</td>
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<td>2</td>
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</tbody>
</table>

(b) Sharks and Rays

Identified on teeth and caudal spines, The following are represented:

1. Family Isuridae - porbeagles or mackerel sharks
   A. *Isurus glaucus* - mako shark
   Also found archaeologically by Gifford in Fiji.\(^2\)

---
\(^1\) 'Other' in this and subsequent tables refers to material, excluding surface finds, which is not attributable to horizon.
2. Family Carcharinidae - requiem sharks
   A. *Prionarce glauca* - great blue shark
      Both are large, fierce and voracious. *Prionarce* is an inhabitant of the open seas and rarely in the tropics is found at the surface.\(^1\) In New Zealand the Maori took *Isurus* by noose,\(^2\) and the same method was used in Tongan shark fishing.\(^3\)

3. Family Dasyatidae - stingrays.\(^4\)

   The archaeological distribution of sharks and rays is shown in text table X.3, recording the number of identifiable parts.

   **Text table X.3**

   Distribution of Bones of Sharks and Rays by Site and Horizon

<table>
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<th>type</th>
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<th>2A</th>
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<tr>
<td>To.2</td>
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<td>0</td>
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<tr>
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<td>1</td>
</tr>
<tr>
<td>total</td>
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<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

\(^1\) Herald, 1961, p.28.
\(^2\) Ibid., pp.19-20.
\(^3\) McKern, n.d., p.338.
\(^4\) Stingray spines were used as fishing spear points in Tonga, McKern, n.d., p.337.
(c) **Eels**

Identified on premaxillary teeth. The sole representative is the moray or reef eel (Family Muraenidae). These eels are large and pugnacious inhabitants of shallow waters among reef crevices and are regularly eaten in many parts of the world. Only two bones were identified, both at To.1, one in horizon I, the other in uncertain context.

(d) **Triggerfishes, Puffers, etc.**

Many of these fishes, including the families listed below, have poisonous organs and/or flesh but are regularly eaten in some parts of the world, including the Pacific.

Identified on jaw plates, spiniform scales and first dorsal fin. The following are represented in the Tongan material:

1. Family Diodontidae - porcupine fishes  
   Mainly inhabitants of shallow water.

2. Family Ostraciontidae - boxfishes  
   A. *Ostracion* sp.

3. Family Tetraodontidae - puffers  
   Also found archaeologically by Gifford in Fiji.¹


Site distribution is shown in text table X.4, which records numbers of bones identified.

¹ Fowler, 1955, p.22.
### Text table X.4

**Distribution of Bones of Triggerfishes and Related Fishes by Site and Horizon**

<table>
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</tr>
<tr>
<td>To.6</td>
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</tr>
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<tr>
<td>total</td>
<td>18</td>
<td>2</td>
<td>1</td>
<td>6</td>
</tr>
</tbody>
</table>

*(e) Flyingfishes, Needlefishes, etc.*

The sole representative is the needlefish (Family Belonidae), a ferocious and voracious family inhabiting coastal waters and swimming at or near the surface at great speed.

Identified on premaxillary.

Only one bone was identified, from horizon I at To.6.

*(f) Perchlike fishes*  

This rather generalised order accounts for the balance of the fish remains. They comprise the following:

1. **Family Girellidae - nibblers**  
   Abundantly present in shallow water around rocks and reefs, it includes some valuable food fish.
A. *Girellops* sp.
Also found archaeologically by Gifford in Fiji.¹

2. Family Labridae - wrasses
Reef-dwellers inhabiting shallow water, they include some valuable food fish. Also found archaeologically by Gifford in Fiji.²

3. Family Lethrinidae
A small family of fishes swarming on coral reefs, with some species highly valued as food.
A. *Lethrinus* sp.
Also found archaeologically by Gifford in Fiji.³

4. Family Pomadasydae - grunts or sweetlips
Tropical reef fish, most of them good food fishes.
A. *Plectorrhyncus* sp.

5. Family Scaridae - parrotfishes
Known as 'cattle of the sea' from their habit of moving in with the incoming tide to graze over the reef. Marshall notes, with specific reference to Queensland,⁴ that although of good edible quality, parrotfish are rarely seen on sale because their feeding habits preclude capture by hook and line, the best method being a

² Cf. ibid., pp.9-10.
³ Ibid., pp.10-2.

A. *Calotomus japonicus*?
B. *Calotomus* sp. or *Enscarus* sp.
C. *Chlorurus* sp.
D. *Scarus lepidus* or *subroviolaceus*
E. *Scarus aerugemosus* or *scaber*
F. *Scarus* sp.

6. Family Serranidae - gropers and sea basses
Herald says of the Serranids that amongst the 400 species we find many of the world's most important food fishes.\footnote{Herald, 1961, p.160.} On the whole they frequent rocky shores and reefs and are often of large size. Excavated by Gifford in Fiji.\footnote{Cf. Fowler, 1955, pp.19-20.}

A. *Epinephelus* sp.

7. Family Sparidae - porgies and sea breams
Includes some very valuable food fishes.

A. *Monotaxis grandoculis*
Excavated by Gifford in Fiji.\footnote{Ibid., p.13.}

Rather less closely related to the above, or to each other, are:

8. Family Cheilodactylidae - morwongs
Amongst these some are shore visiting and some are good food fish.
9. Family Sphyraenidae - barracudas

The whole family of 18 species is usually considered excellent and tasty food. Some large species are included. Excavated by Gifford in Fiji. ²

All these fishes were identified on jaws, teeth and pharyngeal plates. Their site distribution is shown in text tables X.5 and 6, where the numbers of identified bones are recorded.

**Text table X.5**

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1 Herald, 1961, p.245.
Text table X.6

Distribution of Bones of Parrotfishes by Site and Horizon

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<td>other</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>total</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>10</td>
<td>27</td>
<td>2</td>
</tr>
</tbody>
</table>

(g) Marine turtle (Family Cheloniidae)

This material has not been identified to species. It consists in the main of very small fragments of carapace and plastron and of other bones such as limbs, skull and claws, and it is consequently impossible to give any estimates in terms of numbers of individuals represented. The great bulk of the bones was collected at To.2, the site nearest to the sea, but bones of both large and small individuals were present in all sites and all horizons.

(h) Seasnake (Family Hydrophiidae)

A few vertebrae of seasnake were identified, all from horizon I at To.5.
The total range of identified fish is quite large and comprises edible species from deep water habitats to coral reef feeders and fast moving surface swimmers. But clearly reef and other shallow water species, in particular the varieties of perchlike fishes, predominate. It is interesting to note the indications in text table X.6 that on the inner lagoonal sites these fish were commoner in the early period than in the later. Deep sea species were not totally unknown at inner lagoonal sites. Marine turtles are best represented at the lagoon entrance site, To.2.

2. **Bird**

Little bird bone was found, mainly limb fragments. Some was identifiable only to ordinal level.

1. Gruiformes - rails
   A. *Gallinula chloropus* - a moorhen
   According to Mr Warren Hitchcock, this would appear to be the first record of the species further into the area than the Marianas.
   B. *Porphyrio poliocephalus* - the purple swamphen
   This gallinule is widely distributed through the western Pacific area.

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1 Though by no means commensurate with the impressive list given by McKern, n.d., p.353 ff.
2 Identifications and comments by Dr A. Wetmore, Smithsonian Institution, Washington. Mr R.J. Scarlett, Canterbury Museum, Christchurch, helped with the preliminary sorting.
3 Division of Wild Life, Commonwealth Scientific and Industrial Research Organisation, Canberra. Verbal communication.
2. Passeriformes - perching birds
   Three species are represented.

3. Puffinus sp.
   The bird present is a shearwater of medium size.

4. Tyto alba lulu - barn owl
   This small form is peculiar to the Central Pacific Islands.

5. Unidentifiable.

Site distribution is shown in text table X.7 which records numbers of bones.

<table>
<thead>
<tr>
<th>Text table X.7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distribution of Bird Bones by Site and Horizon</td>
</tr>
<tr>
<td>type</td>
</tr>
<tr>
<td>site</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>To.1</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>To.2</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>To.3</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>total</td>
</tr>
</tbody>
</table>
2. Domesticated

1. *Chicken* (*Gallus gallus*)

Some of the unidentified bird bone may, of course, belong to chicken. Forty-eight bones were positively identified, on a basis of the preserved ends of long bones and, in a few cases, spurcores of cocks.

Site distribution is set out in text table X.8 which records numbers of identified bones.

**Text table X.8**

<table>
<thead>
<tr>
<th>horizon</th>
<th>To.1</th>
<th>To.2</th>
<th>To.5</th>
<th>To.6</th>
</tr>
</thead>
<tbody>
<tr>
<td>III</td>
<td>-</td>
<td>1</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>II</td>
<td>6</td>
<td>2</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>I</td>
<td>17</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>subsoil</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>other</td>
<td>4</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>total</td>
<td>29</td>
<td>6</td>
<td>1</td>
<td>12</td>
</tr>
</tbody>
</table>

Domestic fowl was thus known early (To.1 horizon I, To.2, To.5 horizon I) and late (To.1 horizon II, To.6 horizons II and III).

2. *Pig* (*Sus scrofa*)

Very few identifiable bones were found. They were mainly fragments of cranium, mandible, teeth, limbs, ribs

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1 Identifications by Dr Wetmore.

2 Identifications at To.6 by Professor C.A. Reed, who gave valuable help and advice on faunal identifications in general. The identifications at To.1 were made by R.J. Scarlett.
and pelvis. Site distribution is given in text table X.9 with numbers of identified bones recorded.

**Text table X.9**

**Distribution of Pig Bones by Site and Horizon**

<table>
<thead>
<tr>
<th>site</th>
<th>To.1</th>
<th>To.6</th>
</tr>
</thead>
<tbody>
<tr>
<td>horizon</td>
<td></td>
<td></td>
</tr>
<tr>
<td>III</td>
<td></td>
<td>several</td>
</tr>
<tr>
<td>II</td>
<td>3(5)</td>
<td>0</td>
</tr>
<tr>
<td>I</td>
<td>2(6)</td>
<td>0</td>
</tr>
<tr>
<td>other</td>
<td>2(2)</td>
<td>0</td>
</tr>
<tr>
<td>total</td>
<td>7(13)</td>
<td>several</td>
</tr>
</tbody>
</table>

() = determination uncertain.

As with chicken, pig was known early (To.1 horizon I) and late (To.1 horizon II and To.6 horizon III).

Professor Reed concluded that the pig bones from To.6 (all from pit AJ, horizon III) represent at least five individuals, all extremely young: new born, 1-1½ months, 7 weeks, 3 months, and 5-6 months.¹

3. **Dog (Canis familiaris)**

There is no indisputable evidence for dog. The determination of two limb fragments (one rat-gnawed) from To.1 is uncertain:² one is from horizon I, the provenance of the other is uncertain. One fragment of vertebra from horizon I, To.6, is either pig or dog, and a limb fragment

¹ Pers. comm.
² Information from R.J. Scarlett.
from horizon II, To.6, is with reservation attributed to dog, both on the identification of Mr C.L. Cram.¹

The archaeological evidence is thus as unclear as the historical on the presence of dog in Tonga before European contact.²

4. Rat³

Though not a domesticated form, rat presumably was not present in Tonga before man. Of the determinable bones recovered by the excavations, all but three are of Polynesian rat, Rattus exulans. The exceptions are from the recently introduced species R. rattus and/or R. norvegicus: they represent two individuals and come from To.1, one from horizon II, the provenance of the other being uncertain.

R. exulans was identified on femur, tibia, humerus, mandibular ramus, teeth and innominate bone. The femur was the bone most commonly represented. Minimum numbers in text table X.10 have been calculated from the highest representation of any one particular identifiable bone in any one horizon.

¹ Then of Department of Anthropology and Sociology, Australian National University.
³ Identified by Mr J.A. Mahoney, Department of Geology and Geophysics, University of Sydney.
In a few cases a pit contained a fair concentration of rat bones: a minimum number of 11 individuals was present in pit AC at To.1, horizon I, for example. The use of rats for food is reported by Mariner, who, however, says that they were eaten only by the lower orders.¹

5. Man²

Fragments of human bone occurred scattered in all horizons of all middens, though in very small numbers. Various parts of the skeleton are represented, including skull fragments and teeth. Among the human bones from To.1, Scarlett noted that a fair amount consisted of cranial fragments, almost all from the roof of the skull.

Four particular occurrences of human bone need mention.

² For preliminary identifications I thank C.L. Cram. Some of the human bones from To.1 were identified by R.J. Scarlett.
1. The burial in trench II of To.1, belonging to horizon II (fig. 18. 1,2; also figs. 7.6, 9). The pit (AF) which formed the grave had been dug for another purpose and was partly infilled before burial was made. The body lay 20 cm above the bottom of the pit, on approximately the same level as the subsoil, and was placed directly on soil burnt red. It was in a very contracted position, back on the ground, head towards the west, elbows close to the body, hands at the shoulders, left leg close to the body with the knee at the left hand. No trace was found of the right leg and most of the right part of the pelvis was missing. There was a shell adze (To.1: 2293, SE 1 of fig. 114, no. 2 of fig. 122) at the right elbow.

The grave fill was ordinary shell midden, which contrasts with the normal Tongan custom of filling a specially dug grave with clean coral sand, such as was encountered on To.2. Perhaps Schofield's tentative conclusion from his study of the femur that the remains are probably not those of a Polynesian is relevant to these circumstances of burial. However, Taylor sees nothing in the jaws and teeth in disaccord with other Tongan material examined by him. He suspects that teeth

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1 All bones from this burial were examined by Professor G.C. Schofield, Department of Anatomy, Monash University, Melbourne, whose report on the left femur appears as Appendix VI. The jaws and teeth, together with all other excavated jaws and teeth, were studied by Dr R.M.S. Taylor, Department of Anthropology, University of Auckland, see Appendix VII.

from more than one individual are present in the grave or its fill, though neither he nor Schofield identified duplicate parts.

The body was that of an adult male, from the teeth probably middle-aged. Some of the teeth had been destroyed by excessive dental caries or wear or both and traces of periodontal disease are evident. For some time the individual had been chewing only on the right side of his mouth. Furthermore, there was evidence that he had received a severe blow on the front of the face.

2. Excavation at To.2 showed that some time after occupation at the old shell midden had ceased, it was remodelled into a grave mound. Because of local sentiment, no detailed investigation of the graves uncovered during excavation of the site was possible and the bones had to be reburied almost immediately. However a few general observations can be made.

The graves were of normal Tongan type, pits of semicircular or trapezoid cross section being filled with coral sand after burial had taken place (cf. figs. 25.2, 27.1, 2; also figs. 22 and 23). In three square metres of the excavated trench eight to ten graves were identified. All skeletons lay on the back; the head pointed ESE or ENE or almost north, but never west, suggesting that the burials were made before Christian influence began.

3. In trench II of To.5 a grave of semicircular cross section was excavated (feature AM in fig. 37). Only a somewhat fragmentary skull, that of a child of about six or seven, was found and there was no evidence that other bones had ever existed in the grave. The fill consisted
of a layer of sticky earth at the bottom of the pit, followed by a thick deposit of concentrated shell.

4. A concentration of about $2\frac{1}{2}$ kg of fragmentary bones was found in trench I at To.6, mainly in squares 26-8/20 and in or near the soft horizon (horizon II). Excavation of this accumulation was too hurried, because of shortage of time, for precise observations to be made, but there was no apparent order in the disposition of the bones suggesting burial. From Taylor's and Cram's study of the remains, more than one individual is present. Though the surrounding earth is heavily intermixed with ash, the bones are not burnt. Perhaps they, and the scattered occurrences of human bone fragments elsewhere in the middens, testify to the practice of cannibalism. Ethnographic evidence of this is supplied by Mariner and was collected by McKern.

Some interesting comments are offered by Taylor as a result of his examination of jaws and teeth from all the middens and other Tongan material. Dental decay is present in slight to moderate degree in Tongans, but absent in Chatham Is. Moriori and New Zealand Maori. Tartar is often found on Tongan teeth, sometimes as a

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1 Jaws and teeth examined by Dr Taylor, see Appendix VII. C.L. Cram did preliminary sorting of the material.
4 Supplied by Miss Davidson, see Davidson, 1964, pp.9-10.
fairly heavy deposit. Tartar is seldom found on Moriori and Maori teeth, and only in slight amounts. There is evidence of chronic alveolar abscesses in Tongans, Morioris and Maoris, but in the former the predisposing cause appears to be death of the dental pulp from caries or periodontal disease, whereas in the latter the pulp was exposed by excessive wear. Wear on Tongan teeth is less, thus testifying to a softer diet requiring less masticatory effort and compatible with greater reliance on pulpy vegetable foods.

Botanical Materials

The only plant remains to be identified were contained in burnt layers in the fill of pit A in the main trench of To.1. They comprised charred fragments of coconut husk, some of which provided part of the radiocarbon samples NZ-597 (AD 1486 ± 82) and K-961 (AD 1530 ± 100) discussed in chapter VII.

Summary

Pig and chicken, found in early contexts during excavation, probably accompanied the first settlers to Tonga. The presence of dog there before European contact is uncertain on both historical and archaeological grounds. Rat is in evidence throughout the sequence.

Of the cultivated plants that were traditional in Tonga there is direct evidence only for coconut, and that only for the late period. There is a sparse representation of scraping and paring tools generally thought of as being used for the preparation of cultivated tubers and tree fruits for food. These were fully
discussed in chapter IX (artifact class 2): only the Strombus (class 2C) and possibly the Anadara (class 2B) paring knives were found in an early location. The state of the teeth examined, all from late contexts, is consistent with a soft vegetable diet.

Bird bone is rare in the middens, but the scattered occurrence at all sites and in all horizons of human bone, together with the concentration at To.6, may be evidence of cannibalism. The vast quantities of shell comprise two main types, to'o (Gafrarium spp.) and kaloa'a (Anadara antiquata), the former dominant at the lagoonal sites, the latter at the lagoon entrance site of To.2. An increased ratio of kaloa'a to to'o beneath the main middens at To.1 and To.5 and in the lower midden at To.3 may mean that some changes took place in the lagoon environment on Tongatapu during human occupation, involving in part the growing isolation of the lagoon from the influence of the open sea.

Some support might be lent to this hypothesis by the better representation of certain reef and shallow water fish in the earlier than in the later levels of lagoonal sites. There are other possible explanations of this circumstance, however, involving the regulation of rights to offshore fishing, tempered by exchange between coastal and inland inhabitants.¹

The only fishing gear well represented archaeologically are the caps of octopus lures and net sinkers of Anadara. An individual fishhook, gorge and sinker make up the rest

(ch. IX, artifact class 3). Nevertheless, though fishbone is not common in the investigated middens, the range of fish caught is very wide. The explanation is to be found in McKern's survey of traditional Tongan fishing methods. The most popular and productive devices were the fish drives and fish traps used in shallow water on coral reefs or sandy off-shore benches. Nets were much in use, again mainly in shallow water, while spears were employed on the reef and from boats and fish poisons in reef pools and in the lagoon. These methods would leave little archaeological evidence, but the types of fish they would secure are those best represented in the middens.

Deep water fishing, requiring the use of hook and line, was largely under chiefly control. Such a circumstance might account for the scarcity of both the gear and its produce in the investigated sites.

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1 Ibid., p.275 ff.
2 Ibid., pp.275, 301.
3 Ibid., pp.292-6.
4 Ibid., p.337.
5 Ibid., p.344 ff.
6 Ibid., pp.275, 325.
CHAPTER XI

INTERPRETATION OF SITES

Preceding chapters have been concerned with the description and interpretation of data on various aspects of prehistoric Tongan life and culture contained within shell middens: pottery, artifacts of stone, bone and shell, and faunal and botanical remains. These middens resulted from human occupation and the finds within them were items lost or broken by the occupants or discarded by them for other reasons.

Each midden site, as we have seen, is a complex structure, being made up of larger or smaller units of varying composition. For purposes of artifact analysis these units were organised into horizons representing, by the evidence of their excavation, major phases in the development of a site. The different elements within an horizon, however, have information to give about the nature of occupation. At the same time the interfaces between horizons are important in that they represent periods in the history of a site when shell midden was not accumulating at that particular spot.

We shall proceed by reviewing site by site the relevant evidence about site composition and developments.

To.1 (figs. 3-19)

Subsoil

This site has been described in chapter III as resting on an insignificant elevation in the terrain,
about two metres above present water level in the lagoon, which is 400-500 m away to the northeast. The elevated terrain continues south and southeast of the site, but west, north and east of it, the ground is low-lying and ill-drained.

As already mentioned in chapter IV, the subsoil at the site consists of a range of clays. The relationship between these is very complex and was only seriously studied in the principal trench (I). The top 40 cm of the subsoil are composed of two main formations. A is a somewhat soft deposit, light to dark yellow in colour, consisting of clay intermixed with coral sand. Broken shells and smaller fragments, sometimes cemented as lumps, and little pieces of pumice and coral are present. The sand and shells gave the clay a spotty appearance. Potsherds and fragments of bone were found in this deposit, as well as three of the four pearl shell pendants (ch. IX, artifact class 5I) found by excavation, one (To.1: 3507, fig. 130.9) in the top 10 cm, two (To.1: 3501 and 3502, fig. 130.10) between 20 and 30 cm deep, in the formation at the northern end of trench I.

Formation B is a strongly reddish-yellow clay, much more compact than A and with a more sporadic appearance of coral sand and small fragments of shell, the two sometimes conglomerated. Hard egg-sized lumps of dark reddish-brown or bluish-black material occur. There is a sparse representation of potsherds and bone fragments. Formation A is characteristic of the northern end of trench I, formation B of the southern end, the gradual transition between them taking place about -/60 to -/62 (cf. figs. 4,
5), though typical pockets of each occur somewhat beyond this range.

Embedded in A and B at 10-30 cm depth below the subsoil surface is an intermittent zone composed of distinct pockets made up of large and complete shells loosely packed and sometimes containing potsherds. These pockets have only been drawn, as an illustration, over a four metre stretch of profile 84/- on fig. 5.

Below formations A and B is formation C, an extremely hard and homogeneous deposit of almost pure clay, brownish-yellow in colour, whose contact with the formations above is sharp but turbulent. There are frequent wedge-like intrusions of formation B into C.

These various characteristics of the subsoil, the shell pockets, formation C below, the intrusions into this, are all visible on fig. 15.1 at a point in trench I where the lateral transition from formation A to B is taking place. Fig. 16.1, immediately adjacent, may also be consulted.

Dr Crook's analysis of samples from the three formations indicates for A an accumulation in a shallow salt-water environment. Though B has many of the characteristics of a deeply weathered soil, there are evidences of some movement of it by water. Crook suggests its development on low-lying land immediately adjacent to a lagoonal embayment. The underlying formation C is a soil with some of the characteristics of formation B, but no content undeniably derived from salt water.

Appendix III.
All this is evidence for an extension of the lagoon to the area of To.1 which is now 400-500 m distant from it. On the materials deposited by this former lagoon extension part of the To.1 midden accumulated. Whether some unexcavated part of the To.1 site was being occupied at the time the area was coastal is unclear. However, the archaeological finds made in the subsoil, though not numerous, would seem to indicate a phase of occupation appreciably earlier than the midden accumulation immediately above. This might have been either at the time when the deposits were accumulating in or at the margins of the lagoon or sufficiently soon after the retreat of the lagoon that movement down through the deposits could be effected by some agency, such perhaps as mangrove crabs.

In connection with all this the early and otherwise unexplainable early date on to'o shell, K-904, 820 BC ± 100, comes to mind. Pit A, from the filling of which the relevant shells were collected, cuts deeply into the subsoil at the northern end of trench I where formation A with its considerable shell content (cf. table 54) is present (cf. figs. 8 and 11.1). Old shells from this level may well have been cast up in the digging of pit A and later incorporated in its infilling. These shells had in all probability died and been originally deposited quite naturally. But they may have done so at or shortly before a time when artifacts found their way into the same deposits.

The shell analysis of samples taken from the subsoil at the northern end of trench I (82/57-9, 83/57-9) may be interpreted as adding something about the environment when
formation A was being laid down. As a comparison of tables 54 and 53 shows and as chapter X has already discussed, kaloa'a is much more abundantly represented in the subsoil than in the midden samples. Their presence perhaps testifies to conditions at this far point of the lagoon more tidally influenced than at present. This interpretation is not at variance with Crook's comments in Appendix III on the conditions of accumulation of formation A.

Midden

In the midden proper two main horizons were recognised, separated, by the evidence of the pottery analysis, by a break in accumulation of some significance. The earlier midden was visibly more shelly than the later (cf. figs. 15.1, 16.1, 2). This was confirmed by calculations of the proportion of shell by weight in each of the samples taken as part of the midden sampling programme described in chapter X. In the two columns taken through undisturbed midden, sample 8 (82/58 in the coordinate system of the site, fig. 3) and sample 11 (50/94), the proportions of shell in horizon I were respectively of 21% and 10%, in horizon II 6% and 1%. Both horizons grew primarily in the horizontal dimension, horizon II being the more extensive, at least to the east (fig. 15.2), the total midden not being a very conspicuous feature of the landscape.

There were structures associated with each of the two main phases of midden formation at the site. These will be described under the headings of fireplaces, pits and post holes and with reference to the plans and profiles that illustrate them.
Fireplaces

This designation is given to places in the midden where fires were lit, for whatever purpose. It covers two types: fires lit on flat ground and fires lit in round, basin-shaped depressions dug into the ground. The latter is the typical Tongan umu or earth oven used to the present day. In the excavations at To.1 these two types were found only with horizon I. Evidence for fires in more complex pits belonging to horizon II will be discussed in the section on pits below.

(a) fires on flat ground

In the main trench at the site (section I) there were discovered two examples. One was a roundish concentration of sooty black earth, 50-80 cm in diameter and 2-3 cm thick, with small crushed pieces of coral cooking stones. It was designated BL and located in 83/66 of the trench (cf. fig. 8). The second example, at the northern end of the trench, was a homogeneous and very compact deposit of small shell fragments, apparently burnt on the spot, over an area 2 m square and 5-10 cm thick. It is feature BW of fig. 5.

In section IV, in the centre of 53/75 (cf. fig. 9), feature BT was a concentration of sticky ash 30 cm across and 4 cm thick, while BN in 62/75 of section V (cf. fig. 9), was a similar deposit, 100 cm across and 10-5 cm in depth, but containing coral cooking stones.

(b) umu

There are two examples to be noted: one, BS, situated in the top of the fill of pit AL in section IV (cf. fig. 6), 100 cm across and with a maximum depth of 15 cm; the
other, BV, 75 cm across and 8 cm deep, situated in 60/75 of section V (cf. fig. 9) towards the bottom of the horizon and containing ash and cooking stones.

Pits

There are eight early pits to note, and 16 late ones.

(a) early pits

These are restricted to excavated sections I, pits E, W, Y, AC (figs. 5 and 8) and IV, pits AL, AM, AP, AQ (figs. 6 and 9). AL was definitely dug from the level of the subsoil, the rest apparently so, except for E which definitely and AC which apparently were dug from within horizon I. All of them as excavated are somewhat irregular. The outline tends to rounded rectangular or elongated oval, except for Y (cf. fig. 17.1, middle of left wall) which is more regularly rectangular and W which is so irregular that it may be two pits. The sides tend to slope steeply, except for AQ where the one excavated is vertical and AP where they range from slightly through steeply sloping to undercut. The bottoms are rounded (E, AC), slightly rounded (AM, AP), or flat (W, Y, AL, AQ). Where measurable the longest dimension falls between 120 and 150 cm, except for W where because of irregularity the correct measurement is difficult to make and for AC which seems to have been cut from a higher level than the subsoil where alone its presence has been recorded. Depths vary between 30 and 50 cm, except again for W which is only 20 cm deep. The fill of all pits was fairly concentrated shell midden. In AC a noticeable quantity of potsherds was discovered, as well as bones from at least 11 rats.
These pits have been described together because there is a certain similarity between them. This is perhaps most marked between pits AL, AM and AP (? also AQ) of section IV.

(b) **late pits**

All 16 pits seem to have been cut from the surface of horizon I into the early midden horizon. Two radiocarbon dates from one of them, pit A in the main trench, are late (NZ-597, AD 1486 ± 82, and K-961, AD 1530 ± 100, see fig. 7.2). According to the analysis on pp.143-6, however, the pottery they contain seems in the main to be early. The suggestion is that they represent a phase of activity at the site when the surface of the early midden was being used for pit digging, with dumping taking place at some other part of the site. The early shell midden material dug out in the course of such pit digging was used to fill in adjacent pits that had gone out of use. Subsequently the late midden of horizon II was deposited and sealed in these pits and their infilling.

The pits in question are distributed in section I (A, M, N, P, S, X, AA, AB, AD and CJ, figs. 4, 5, 7 and 8), section II (BO and CL, fig. 6) and section III (AE, AF, AG and AH, figs. 7 and 9; cf. fig. 18.1). Of the eight early period pits, four were found in section I, four in section IV. Apart from P which appears as though it might have been irregularly rectangular, AE which may have been rectangular, CJ, BO and CL which are irregular, and AB (cf. fig. 17.1, second from foreground left wall) and possibly AG which bear some resemblance to the early pits in plan, the late pits range from circular (e.g. A, figs. 13, 14), though more irregularly round (e.g. M) to rounded quadrangular (e.g. AA, fig. 17.1, middle of right wall) in
plan. These rounded pits are deeper than the early pits, ranging from 50 cm (X, AF), through 60 cm (AD), 70 cm (S), 80 cm (AA), and 90 cm (AH) to 110 cm (A), 120 cm (M) and 130 cm (N). The two deepest pits, M and N, are amongst the smallest in diameter, the former measuring 80 cm, the latter 100 cm. The pits with the largest diameter tend to be shallow, as X (cf. fig. 17.1, far end right wall) 180 cm diameter, 50 cm depth, AF 130 cm diameter, 50 cm depth and AD 120+ cm diameter and 60 cm depth. But pit A of 130 cm diameter is 110 cm deep, and there are some small pits with moderate depth, for example S with 100 cm diameter and 70 cm depth and AH with 100 cm diameter and 90 cm depth. The sides range from steep (A, figs. 11-4) to vertical (e.g. M, fig. 16.1, N) and some are undercut (AA, fig. 16.2, AF). Bottoms are almost invariably flat.

Some of these features of depth, steep and undercut sides and flat bottoms are characteristic of other late pits, withheld from the above discussion because of their different shape in plan. This is true of AB, CJ, and CL, less so of BO, AG (depth only 40 cm) and AE which was very incompletely excavated. By all the evidence, however, pit P, 280 cm in one dimension and only 40 cm depth, is definitely in a completely different category.

Five pits showed evidence of firing in their fill. Interpreted as the secondary use of pits for cooking, this might account for the lack of flat and basin-shaped fireplaces with the later deposits. The pits in question are: deep and circular pit A (fig. 7.2) where two separate sloping fire layers were characterised by a lining of charred coconut shell and husk and three large cooking stones of coral rock were found at the bottom of the pit.
(cf. fig. 11.1, 13.1 and 14); pit P, large, shallow and perhaps rectangular in outline, with a 5-10 cm thick layer on the base of concentrated shell with ash and powdery charcoal; pit S, a round pit of moderate size and depth, in the fill of which were embedded undisturbed lenses of ash and some cooking stones of coral rock; pit AD, a large, apparently round pit of moderate depth, where in the middle of the fill was a layer of earth mixed with ash and powdery charcoal; and round pit AF (fig. 7.6), with a layer of reddish burnt soil with ash on top of the pit fill at the level of the subsoil into which the pit had been dug. Directly adjacent to pit AF to the south was a hole DM with many coral rock cooking stones.

Pit AF was subsequently used as a grave (cf. figs. 9 and 18), described in chapter X. Pit AH cut into its fill without disturbing the skeleton. Pit AG is separated from AF by a 10 cm high 'threshhold' but the relationship of the two is obscure.

Post holes

Small holes into the subsoil were met with in all trenches (figs. 8, 9). They were extraordinarily numerous in the southern half of trench I (fig. 17.1). Only those visible in profiles can be attributed to horizons. Thus for the early period only BA and BF of section V (fig. 6) can be proposed as post hole features, though without doubt more exist amongst the holes not present in profile. The same is true of the late horizon, where, however, the situation is confused by the additional presence of planting holes from recent gardening. For the late horizon only CB, CD and CA for section I (figs. 4, 5, 8),
CP for section IV (fig. 9) and AR and CV for section V (figs. 6, 9) are acceptable as post holes.

One of the difficulties throughout was that no pattern of post holes ever emerged, no doubt because excavation proceeded by trenches rather than areas. At one stage during the excavation of section V (fig. 9) the two series of holes, AU, AV and AT on the one hand and BD, BE and BF on the other, with the intermediate line AX, AZ and BB, looked as though they might define an early period structure in association with flat fireplace BN in \(62/75\), but in the event the evidence did not seem convincing enough to extend the excavation. It is interesting to note that the triple grouping of holes evidenced in section V seems to have parallels in section I (fig. 8) in features DZ (82/60) and EC (82/70).

To.2 (figs. 20-7)

The midden here built up on coral sand. It was of very restricted horizontal extension (fig. 20). The pottery analysis suggests that occupation was restricted to a single archaeological phase. Right at the beginning a few post holes seem to have been dug on the spot (e.g. Q of fig. 22, middle of fig. 26.1, and AG and AJ of fig. 23) and a large, basin-shaped depression was made to hold umu U (figs. 22, 23). But no traces of pits proper were found. People dumped shells amongst other rubbish during the ensuing occupation: samples taken in \(50/55\) from the three zones of the midden horizon registered \(6\%\) by weight of shell in the top and bottom zones, \(7\frac{1}{2}\%\) in the middle zone. As the midden grew, fires were lit at various levels, some on a flat surface, others in umu pits (fig.
Most remarkable is the big example M in the centre of the midden where three successive usages are to be observed (figs. 22, 23 and 27.2).

At a later stage a mound was built over the shell midden, which itself had assumed a mounded form. An analysis of the pottery in the lower midden and upper mound horizons (pp.142-3) showed no detectable differences in the features represented and confirmed what had been suspected from the evidence of excavation, that material from the margins of the old midden was used in the making of the mound. In addition coral sand, *sio* shells and fragments of branch coral were brought from the beach (figs. 22, 23, 25.2 and 26). Overall was deposited a layer of earth with some shells and sherds, which gave the structure its present circular ground plan, sloping sides and flattened summit (figs. 21 and 25.1).

It is arguable whether this last deposit of earth belonged to the second stage in the history of the site, that is the mound building stage, or a third stage. Certainly there were, after the use of the site as a midden, two later stages in its use. The first of these is represented by the formal burials in pits infilled with coral sand described in chapter X (figs. 22, 23, 25.2, 27). The second is the known use of the flattened top for habitation in recent times, archaeologically reflected in the pattern of depressions visible in the top of the mound before excavation and in post holes X and AC (the latter still with rotted wooden post, fig. 27.1) recorded in profile on figs. 22 and 23. It is perhaps more likely that the final layer of earth which certainly seals in all the excavated graves, was in fact an integral part of the
grave mound intended to protect the graves, than that it was a later addition transforming the grave mound into a habitation mound. On this argument habitation would have either taken advantage of a previously built mound with conveniently flattened top or necessitated the flattening of a rounded summit. Some support is lent to this interpretation by the circumstances of grave D on fig. 23, which is wholly in the top layer, and of graves Z and AA on fig. 22, which are partly so.

To.3 (figs. 28-32)

Because of the restricted investigations at this site, no large conclusions can be drawn about it. The formation of a shell midden took place on coral sand (fig. 32.2) and there is evidence of post hole digging and digging of umu in connection with or immediately prior to this. Overall in this original midden shell proved to constitute 33% by weight. As we saw in the last chapter (cf. table 56), an interesting difference emerged between the top four and the bottom three spits of the sample taken in 21/21 of excavated section I (cf. figs. 28, 29), with the latter showing a significantly higher representation of kaloa'a to to'o. Together with the presence of presumed early motifs on some of the pottery from this site, this evidence might be interpreted to mean that the earliest midden formation at To.3 belonged to an early period in the settlement of Tongatapu as a whole, when lagoon conditions were somewhat different from what they are today.

At a later stage a wide and deep ditch was dug into the shell midden mound near its foot (fig. 32.1), probably
surrounding the mound, though with precisely what purpose is unknown. The third step was to refill the ditch and continue using the surface of the old midden. Pit N was dug into this near the former ditch in trench I (fig. 29). It had steep sides and flat bottom. In the last stage this pit was itself filled in and build-up took place with materials from the edges of the midden and from the beach, producing the mound of to-day (fig. 31.1), quite a massive one with flattened top, which, from the apparent absence of graves, was probably meant to serve for habitation only.

To.4 (figs. 33-4)

No original midden was ever present under the so-called house mound at this site, and no traces of graves were seen or reported in it. It may have been constructed therefore as a house mound. The fill consisted of old midden material, probably taken from the northern quarter of the To.3 mound, and beach materials, also available at the spot. These fills were dumped on top of each other load by load (fig. 33). To judge from the orientation of the dumping units the mound began with a number of small heaps of alternating fills, deposited next to and partly over-lapping each other (fig. 34). Increased height was obtained by using midden fill only. The top of the mound was left flat. The grave mound or fa'itoka at the site overlaps not only this house mound but also the midden and the later ditch at To.3 (fig. 30), but its relationship to the final stage at To.3 is unknown. The fa'itoka was also built of alternating deposits of beach sand and midden material, the latter probably taken from To.3 also.
More extensive digging in the To.3 midden would have placed it in the sequence of excavated sites and thus have given a terminus post quem for the various structures not only at To.3 itself, but also at To.4.

To.5 (figs. 35-9)

The earliest occupation at To.5, as at To.1 and possibly at To.3, took place in an environment somewhat different from the present. At that time the lagoon, now 150 m from the site in a northerly direction, must have been adjacent to it. Two thin occupation lenses are separated by 10-20 cm of coral sand: the lower layer has 20-30 cm of coral sand between it and coral rock, the upper 5-10 cm of coral sand between it and the main midden above (see horizon 0 on fig. 36, also fig. 38). This coral sand, which contrasts with the muddiness of the present lagoon near the site, suggests, instead of the protected environment of to-day, more open beach conditions. In this connection note how the coral sand begins part way along the profiles of the main trench and shows an even slope up of 30 cm in the course of the next 3 m (fig. 36). Note too that the analysis of the shell samples from the coral sand shows an increased representation of kaloa'a against to'o when compared with the midden above (table 57). It is possible that the shells in these coral sand samples reflect to some extent the natural population of the neighbouring environment, especially those from the sand beneath the lower of the two cultural lenses, where human evidence was totally absent. If this is true, the differing proportion of to'o and kaloa'a in the cultural lenses compared to that in the coral sand in which they lie (table 57) must be due to human selectivity.
Besides the cultural materials described in previous chapters, we may note the presence in the cultural lenses of horizon 0 of two small umu, S and T (figs. 35, 36), 40 cm in diameter, 6 and 12 cm deep respectively. Shell constituted 28% by weight in the sample taken from the lower cultural lense, compared with 30% in the enclosing coral sand.

The brief and intermittent occupation seemingly represented by horizon 0 was followed by extensive midden deposition resting on bare coral rock towards the lagoon and on coral sand further inland (figs. 38, 39). Little digging belonging to the earliest horizon (I) of the main midden took place in the area of the excavated trench, since coral rock was immediately beneath in most places. The sole exception is the not fully excavated pit F at the southern end of excavated section I, dug into coral sand and cutting through the cultural lenses of horizon 0 (figs. 35, 35 and 38.1). Pit F is shallow (20-5 cm) and has gently sloping sides and flat bottom. Its outline shape cannot be guessed.

Also at the south end of trench I two features bring to an end the formation of horizon I. Firstly there is a layer of shells crushed more thoroughly than usual, which has been interpreted as a walking level. Secondly a layer of brown clay was laid down on top of this walking level. This layer, which appeared to belong to horizon I rather than to horizon II, was perhaps intended to give an even surface to the site for some reason.

From the analysis of the sample taken from horizon I, shell constituted 29% by weight. Its matrix in horizon I was discoloured sand.
Horizon II differs somewhat from horizon I, in that the matrix is a dark grey earth, stickier than that of the horizon below. In the sample analysed, shell constituted 16% by weight. No digging connected with this horizon took place in the excavated area, apart from a few small holes, but three fireplaces belong here, one (AK) of flat type, two (B and K) of umu type.

AK, at the bottom of horizon II in trench II (fig. 37), was represented by a small concentration of ash. B and K, dug into the top of horizon I in trench I, are 100 cm in diameter, 20 cm deep, and were filled with ash and charcoal (figs. 35, 36). From the fill of B and immediately around it were collected 50 kg of coral stone cooking stones. Umu B provided sample NZ-637 dated AD 350 ± 87.

Horizon III, the topmost horizon of the site, is characterised by a smaller density of shell (though no proportion by weight is available), while the accompanying earth is a sticky and homogeneous garden soil dark brown to black in colour (figs. 38, 39). It is possible that some of this soil has come from the slope above the site, washed down during heavy rains at periods perhaps when the ground was cleared for gardening. As at To.1, where also the late horizon is characterised by less dense shell, most pit and post hole digging belongs to the latest horizon. There are also three fireplaces, all umu, which will be described first.

Fireplaces

AF is in section II, where it was made in the top of the fill of pit A (fig. 37). It is 70 cm in diameter and
about 30 cm deep. The bottom 10 cm of its fill consisted of light grey ash, powdery charcoal and coral rock cooking stones.

D and E were found in trench I (figs. 35, 36). Both were dug, not from the surface of horizon II but from a level 10 cm or so higher into horizon III. Both are 100 cm in diameter and 20 cm deep in the middle and have the same fill as umu AF in excavated section II. Fireplace D, which cuts across E and is therefore later than it, gave sample ANU-23 (/l) dating AD 1620 + 100 (confirmed by the rerun ANU-23/2 dating AD 1610 + 63).

Pits

Few of the pits dating later than horizon II penetrated to the subsoil where their outlines might have been clearly seen. Also the small size of the excavation meant that almost all remained not fully excavated. For these reasons it is difficult to say anything definite about pits like AD and AE (fig. 36) and pit W, all in excavated section I.

Pit AL in section I (fig. 36) and pits A and AG in section II (fig. 37) appear to represent a type with roundish outline, gently sloping sides and rounded bottom: AL is upwards of 90 cm in diameter and 35-40 cm deep, A 120 cm across and 50 cm deep, AG, with irregular base, 100 cm across and 30-40 cm deep. Pit G, of which little was excavated (figs. 35, 36), appears also to have been of roundish outline, but with fairly steep sides and flat base: it is upwards of 90 cm across and 40 cm deep. There was also little exposed of pit V (fig. 36), with its fairly steep sides and flat base 30 cm deep.
Pit C and possibly pit J (both on figs. 35 and 36) bear the closest resemblance to pit types already described for To.1. Pit C, with rounded quadrangular outline, 100 cm across at the top narrowing to 70 cm at the flattish base which is 90 cm deep, bears comparison with the deep roundish pits of To.1, like pit A (fig. 7.2). Feature J at To.5, 80 cm across the top and 70 cm deep, with rounded outline and steep sides falling into a pointed base, may rather be a post hole than an equivalent of the deep, narrow pits of To.1, like M (fig. 7.3).

All the above features seem to have been dug from the surface of horizon II, except for pit C, which began about 10 cm higher in the lower part of horizon III.

Post holes

In addition to J, a possible post hole, there is only one other to report, AH (fig. 37), 70 cm deep, 40 cm across the top, and like J in shape.

As at To.1 there was a period between the formation of two midden horizons when the older midden surface was used for pit construction. No data were obtained on the relationship between midden formation and the neighbouring field monuments described in chapter III. We may draw attention, however, to the grave without coral sand infilling found in trench II horizon III (AM of fig. 37) and dealt with in chapter X.

To.6 (figs. 40-5)

With the available data it is unfortunately not possible to give more than a very incomplete reconstruction of this important and interesting site. One of the
biggest problems is to sort out the features that belong to the very early occupation of the site evidenced by the radiocarbon dates and some artifacts. None of the shell deposits deepest in horizon I at To.6 can be isolated convincingly from the rest of the horizon, while on the basis of the rim evidence horizon I in its entirety cannot be attributed to the early occupation. The only possible conclusion is that within the excavated area this occupation is not represented by any genuine shell midden formation. However, there are a number of fireplaces dug into the subsoil of the site, about which it was specifically noted during excavation that they were sealed in by the horizon I midden. At the time of excavation it was concluded that in the excavated part of To.6 settlement started with a cooking area and that whatever midden accumulated contemporaneously did so in unexcavated ground. But it was not thought that there was any great lapse of time before midden began to accumulate over the cooking area. In view of later evidence, however, particularly that of the radiocarbon dates which were run on samples collected from the subsoil fireplaces (NZ-636, 430 BC Æ 51 from fireplace K, profile B, and ANU-24, 400 BC Æ 200, profile A, both profiles on fig. 41), it may be that all such features sealed in by the shell of horizon I, whether dug into the subsoil or lying on its surface, belong to the earliest settlement and form the only stratigraphic representation of it.

The fireplaces in this category are all umu except for M (profile D, fig. 42), one of the flat type of fireplace, 100 cm in diameter, 3-4 cm thick, consisting of ash and powdery charcoal resting on subsoil that was burned red. The list of umu, all shown in plan on fig. 43,
is DN, 140 cm across and 15 cm thick (profile A, fig. 41); K, 200 by 130 cm in dimensions and 20 cm thick, with subsoil burned red beneath it and 80 kg of coral rock cooking stones included in the grey ash and powdery charcoal fill (profile B, fig. 41); P, 140 cm across, 14 cm thick, subsoil burned red at the base and the fill consisting of sticky grey ash (profile B, fig. 41); N, 100 cm across and 25 cm thick, subsoil burned red beneath it and many coral rock cooking stones in the fill (profile C, fig. 42); DM, 90 cm in diameter and 15 cm thick, which cuts across umu P to the west (profile C, fig. 42); V, a distributed feature, 160 cm across and 15 cm thick, with subsoil burned red and coral cooking stones in the fill (profile E, fig. 40 and bottom right corner, fig. 45); O, which marginally cuts across V and is almost 200 cm across and 20 cm thick, with burned subsoil (foreground, fig. 45 and profiles D and E, figs. 42, 40); and F, a partly excavated feature in the NE corner of the excavation, included here by analogy, which is at least 150 cm across and 15 cm thick and has the subsoil burned red beneath it. Somewhat unusual is feature CW (profile A, fig. 41). This seems to have started life as a small umu, 100 cm across, beneath which the soil was burned red. During subsequent use a relatively shell-free deposit of earth with powdery charcoal and alternating layers of ash accumulated over a distance of 300 cm. At one stage umu DA (profile A, fig. 41) was cut across CW. This feature, 200 cm across, accumulated fill of earth, coral cooking stones, ash and powdery charcoal 30 cm thick and beneath it the subsoil was burned red.
Horizon I

We attribute the main shell midden formation to people who took up residence on the site at least a thousand years later than the initial occupation. The first stage of this later occupation is represented by horizon I (cf. fig. 44), a typical midden deposit that seems to have grown primarily in the horizontal dimension. In the samples from the four spits attributed to this horizon at co-ordinate 24/19.5, shell accounted for 18-22% by weight. No pits can be securely attributed to this stage of occupation: pit W (profile B, fig. 41) is a possibility but is here allocated to horizon II. There are no fireplaces to be described for horizon I, though it is possible that some of those described for the earliest settlement may in reality belong here.

Fig. 43 shows a number of post holes assigned to horizon I: DO, CL and CO (profile A, fig. 41), AO (profile B, fig. 41) and BW (profile C, fig. 42). It is possible, of course, that some at least of these belong to the very early occupation. As is the case on To.1, only those post holes found in the profiles can be safely attributed to horizon. It was noted during excavation, however, both by study of the trench profiles and by careful excavation of the surface of horizon II in trench V, that very few post holes penetrated this horizon. It is possible that some of the unattributed post holes on fig. 43 are earlier than the major deposition which is characteristic of horizon II, and belong therefore either to horizon I proper or to the very early occupation of the site.
Horizon II

The characteristic deposit of horizon II is a soft earth with few shells, called the 'soft horizon', laid down on top of the previous midden (cf. fig. 44.1). As the profiles (figs. 40-2) show, this was restricted to the centre and south of the excavated area: beyond this horizon II consisted of a more heterogeneous brown earth with shell and scattered patches of 'soft horizon' material.

There seem to have been two deliberate aims with the soft horizon proper: to fill in small concavities in the surface of the previous midden and to make an even surface to the new formation. At the time of excavation the general impression gained about the soft horizon was that it was the floor of an actual dwelling area, but unfortunately no pattern of post holes can be pointed out as representing a structure that might have stood there. We may again note here the presence of large quantities of human bone in and adjacent to the soft horizon in trench I and the admixture of ash with the soft horizon in the area in which the bones were found. This occurrence has been dealt with in chapter X.

Fireplaces

Fireplace L, an umu, 120 cm across and 20 cm deep, is the only one that can be attributed to this horizon: though dug into the previous midden it was partly embedded in the soft horizon (profile E, fig. 40, and figs. 43, 44.1). The earth beneath it was burned, its fill contained sticky ash and powdery charcoal, and on its western margin was a concentration of coral cooking stones.
Pits

Pit W (profile B, fig. 41, and fig. 43) is attributed to this horizon rather than to horizon I. Of rectangular outline, it is 290 cm long, 190 cm wide and 50 cm deep (fig. 45). The sides are vertically cut and the bottom is flat. It is uncertain whether the two adjacent features BM and J were associated with the functioning of the pit. Pit W bears some resemblance to pit P of To.1 (figs. 4, 8) in shape and dimensions, and like pit P there it is the only definitely rectangular structure on the site.

Post holes

Fig. 43 shows five post holes attributed to horizon II, one of which, BH (profile E, fig. 40), could belong to horizon III and another, CE (profile B, fig. 41), to horizon I. The three that belong with more certainty to horizon II are CQ (profile A, fig. 41), DP (profile B, fig. 41), and AY (profile C, fig. 42).

Horizon III

This final phase in the history of the site saw the accretion of a shell midden. Samples taken from the five spits forming this horizon in 24/19.5 show between 6% and 10% of shell by weight. Shells continue right up to present ground surface, at which the relatively shell-free humus found at other sites is missing (fig. 44). The midden grew more quickly at the middle of the site than at its margins, leading to a mounded aspect in this phase.
Fireplaces

Two small ones only seem to belong to this horizon. DL, a flat type 70 cm in diameter and 5 cm thick, rests partly on subsoil, which is burned red, partly over the fill of pit W (fig. 43). DS is an umu, 50 cm across and 10 cm deep, whose presence was only recognised in profile C (fig. 42, also fig. 43).

Pits

Of the five attributed to horizon III on fig. 43, only AJ was fully excavated and it alone appears in cross section on a drawn profile (profile B, fig. 41). Circular in outline, 130 cm in diameter and 120 cm deep, with steep sides and flat base, pit AJ (fig. 45) is the equivalent of the late circular pits of To.1, especially pit A (figs. 7.2 and 14), which it resembles in both shape and dimensions. AJ was cut from near the surface of the site, so that it belongs to a late stage of horizon III. It was in this pit that were found bones from at least five young pigs, discussed in chapter X.

Pits AN and U, both of them rounded in outline and undercut at the base, can be compared with other of the late round pits of To.1, for example pit AF (figs. 7.6, 9 and 18) and AA (figs. 4, 8 and 16.2). It is uncertain whether AN (fig. 45 extreme right) was cut from the surface of horizon II or within horizon III, so that its depth may fall from 100 cm to 140 cm. From 140 cm diameter at the top the sides slope in to a diameter of 100 cm, fall vertically and then are slightly undercut at the flat base. With pit U there is also some uncertainty as to where in horizon III the feature starts, but it is
at least 80 cm deep and 160 cm across. Its sides are partly sloping, partly vertical and are undercut at the north side of the flat base.

Pit T, of rounded quadrangular outline, 120 cm across at the top and at least 65 cm deep, has a semi-circular cross section, which makes it resemble pit AH of To.1 (figs. 7.7 and 9). As with the two previous features, there is uncertainty as to the level within horizon III that the pit was dug from.

Pit AM, of which only a very small part was excavated, must have been a very large structure, substantially in excess of 200 cm in one dimension. The exposed sides slope gently. Only a low threshold separates it from pit AN (fig. 45, corner of excavation).

Post holes

Apart from BH (profile E, fig. 40) which may belong to horizon II, there is only one post hole definitely to report for horizon III (fig. 43). This is BV (profile B, fig. 41). Feature DR (profile A, fig. 41) is more likely to be a planting than a post hole.

Unattributed to horizon

Pits

Pit C, of rounded outline (figs. 43, 44.1), was not recognised until the subsoil was reached. Here it measured 100 cm by 80 cm and was 30 cm deep. The remaining sides were vertical and the bottom flat. It thus appears similar to some of the other roundish pits described above.
Post holes

There are six features fairly confidently to be interpreted as post holes which cannot be attributed to horizon (fig. 43). They are D, S and Z, which do not appear in any of the drawn profiles, J and BM on profile C (fig. 42), both in unknown relationship to pit W (cf. fig. 45), and B of profile E (fig. 40).

Because of the uncertainty regarding the chronology of some of the structural features, and especially the post holes, it is very difficult to interpret the rich structural information from To.6. We may note, however, that all the pits of horizon III are located on the northern and western margins of the excavation (fig. 43). This is precisely the area where the soft horizon properly so called does not exist, being barely visible in profiles F and G and completely absent from the connecting profile between them at the north. On the other hand most dug holes of any kind, excluding definite planting holes, and whether datable or not, are distributed differently from the pits and concentrated in the area of the soft horizon.

Now it is true that from the evidence of the profiles very few holes recognisably penetrate the soft horizon, an observation confirmed by the deliberate and careful examination of the surface of the soft horizon in trench V. This suggests that a majority of the holes belong before horizon II, whereas a majority of the pits belong after. This would seem to make the difference of distribution between pits and holes a coincidence. However pit W which belongs at latest to horizon II is situated in the same quarter of the site as the later pits. Since by all the artifactual evidence the second occupation of To.6 must
have been short and intensive, it may well be that the same pattern of occupation and activity was maintained throughout.

On the other hand there is little to refute the argument that the pre-horizon II holes may belong in fact to the very early primary occupation of the site.

**Summary and Conclusions**

The most conspicuous feature of the excavated sites was their use as dumps for the refuse of habitation, a varying but considerable proportion of this consisting of marine food shells. It is clear from the above review of structural evidence, however, that such sites were not exclusively refuse dumps but from time to time were the focus of other aspects of a community's activities.

This is particularly true of cooking, the fires for which seem not uncommonly to have been made within the middens themselves, either on a level surface or held in a scooped depression of circular outline, the typical Tongan *umu*. Both types were known from the earliest into the latest times. The making of cooking fires in features of other kinds on To.1 horizon II is thought to be a secondary use. Cooking stones were common in all horizons, associated with actual fireplaces and not so associated. These were predominantly of the *makalahe* variety, of coral rock, the better volcanic *makahunu* cooking stones being rare. Many cooking fires must have been built outside the area of the midden and the remains dumped there. We should note in this connection that the matrix of the middens contained much powdery ash and charcoal.
Of special interest are the pits dug within the midden area, especially at sites To.1 and To.6. Some of those investigated belong to the early period, but the majority are late and amongst these two forms call for comment. One is the large and shallow rectangular pit represented by P at To.1 and W at To.6. Somewhat similar pits are reported from Samoa. The other is the deeper pit with flat base and roundish outline, which includes steep sided examples like A at To.1 and AJ at To.6 and ones with undercut bases like AF at To.1 and AN at To.6. Similar structures are on record for Tonga. Golson encountered a deep pit on the offshore islet of 'Onevao, and on Velitoa a circular pit, three to four feet across and three and a half feet deep, of a rather special type which, being clay lined, was probably dug for water catchment and storage, as McKern reports. On a habitation site at Atele College Davidson found pits of circular form and undercut sides and others of rounded rectangular plan. Undercut pits were also met with at the Manga'ia mound, Nuku'alofa.

The most plausible explanation given by my informants for the pits is that they were meant for the storage and fermentation of food. McKern describes as prevalent the use of covered pits both for the fermentation of vegetables

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1 Green, 1964, fig. 6 and p.29.
4 Davidson, 1964, p.10.
5 Ibid.
and fruits in the interests of preservation and for the storage of sea food.\footnote{McKern, n.d., pp.400-5.}

It would appear that the investigated pits were dug and used at times when midden formation resulting from activity at a site was going on elsewhere. This is particularly clear at To.1, where pits were filled in with midden material from the early horizon I into which they were dug and sealed in by the midden formation of late horizon II.

In these circumstances it was disappointing that no information about houses or other above ground structures was obtained, despite the numbers of holes found and excavated, some of them certainly post holes. The possibility is that amongst the holes at sites like To.1 and 6 part of the living structures was present but remained unrecognised largely because of the insufficient size of the excavations. The occurrence, as we have seen in chapter IX (cf. text tables IX.2 and 10), of complete and unbroken artifacts at sites, as well as of unfinished and broken ones, increases this possibility. It is not at all unlikely that a suitable midden surface would have been used as a site for actual dwelling, as the soft horizon at To.6 was first interpreted. Some modern houses belonging to people living by the lagoon and much engaged in shell fishing are actually built on a midden in process of accumulation. It is also quite a common practice to-day for houses to take advantage of the elevation afforded by prehistoric sites standing above ground level. We have a
not very old example of this at site To.2 where a burial mound was used for habitation and McKern records a similar instance from Pangaimotu, an islet off Tongatapu.¹

These observations have relevance to the question of the relationship of Tongan houses to those of Samoa and parts of Eastern Polynesia where stone or earth platforms for houses were common. McKern says that the better type of Tongan dwelling house was always built on a low, flat-topped mound of earth called tu'unga fale, about 12-8 ins high and the same shape as but slightly larger than the house floor. The margins of some of these house mounds were retained by a low retaining wall of coconut logs or loosely piled coral rocks. In the best mounds the retaining wall consisted of cut and dressed slabs of coral limestone placed on edge end to end and sunk partly into the ground.²

As to more general problems about Tongan settlement no light is cast by the present work. To answer questions about the number of households contributing to the formation of a midden and about the continuity of occupation at a site needs a different kind of investigation than that described here.

Two late period burials were excavated at To.1 and To.5. Both were unusual in that the graves were not accompanied by coral sand: the To.5 burial was that of a fragmentary child's skull only, while that at To.1 was made in a pit dug for another purpose. The middle stage

¹ McKern, 1929, pp.104-6.
of use of the To.2 site is an example of the normal type of Tongan burial practice, with formal graves infilled with coral sand. Similar burial mounds, but surrounded by a ditch, have been excavated by Davidson near Atele College. There is a ditch belonging to a phase in the history of the To.3 site, but its significance is unknown because of the limited excavations.

We have noted the higher representation of kaloa'a to to'o (in possibly natural assemblages) in the subsoil at To.1 and To.5, as compared with the middens there, and argued that this represents evidence for a change in the lagoon environment from more open, tidally influenced to more enclosed conditions. Some support has been sought for this interpretation in geomorphological conditions at To.1 and To.5 at the time when these assemblages were laid down. At site To.2, at the mouth of the lagoon where tidal influence is marked, kaloa'a is predominant.

Whatever the nature of the change, it was going on in the early stages of human settlement. At To.3 kaloa'a is significantly more abundant in the lower than in the upper part of the original midden. At To.5 there are definite signs of human occupation in the coral sand subsoil from which the evidence for a different lagoonal regime has been drawn, and it appears that the same may have been the case at To.1.

The change was accompanied by a retreat of the lagoon from sites To.1 and To.5 to which it had been adjacent but from which it is now 400-500 m and 150 m distant.

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1 Davidson, 1964, p.11.
respectively. To judge from the radiocarbon date for horizon II at To.5 (NZ-637, AD 350 ± 87) and from the ceramic correspondences between horizon I at To.1 and horizons I and II at To.5, this retreat was well advanced by the fourth century AD. We may conclude with an additional piece of evidence for a similar situation from McKern.¹ This concerns the ditch and bank defence around the residential area, Lapaha, at Mu'a, the seat of former Tongan kings. This ditch and bank ties in with an old shore line, 70-200 m inland from the present lagoon shore. On a genealogical basis the defences are dated to the fourteenth century AD. It should be mentioned in this connection, however, that one tradition exists that explains the difference between the old and the present shore as the result of deliberate reclamation.

¹ McKern, 1929, pp.92-101 and fig. 46.
CHAPTER XII

CONCLUSIONS

The data provided by the excavations have been reviewed, class by class, and their implications separately discussed. It now remains to draw the various conclusions together and to focus them on the major problems in view when the Tongan project was planned. It must be appreciated, however, that in the course of the project itself these problems were reformulated as a result of archaeological discoveries elsewhere in the region and of reappraisals of the general evidence on South Pacific culture history.¹

Tonga

Excavations at four main sites have contributed, through stratigraphy, seriation and radiocarbon dates, to a framework for the prehistory of Tongatapu. There are two better illuminated phases of this prehistory as a result of the evidence recovered: they have been called for the sake of convenience the 'early period' and the 'late period', without any attempt strictly to delimit them or to define phases within them.

1. **Early period**

This is represented by horizon I at To.1, the midden horizon at To.2, horizons O-II at To.5 and a very early occupation in horizon I at To.6. Very similar radiocarbon dates were obtained for an early stage of horizon II at To.5 (NZ-637, AD 350 ± 87) and the lower half of zone III of the midden at To.2 (NZ-635, AD 330 ± 60). By seriation of rim features and analysis of features of decoration, horizon I at To.1 tends to be equivalent to the later, the To.2 midden to the earlier, part of the time bracket represented by horizons I and II at To.5. Below these at To.5 there is horizon 0, which goes some way towards filling the gap to the two very early radiocarbon dates for To.6 (NZ-636, 430 BC ± 51, and ANU-24, 400 BC ± 200). It is impossible to decide whether the very early date on shell from To.1, K-904, 820 BC ± 100, which seems to be reliable, refers to human occupation.

From analyses of shell samples taken from natural subsoil formations beneath the main middens at To.1 and To.5, from soil analyses of these formations at the former and observations of them at the latter, it is certain that at the time of first human settlement the lagoon was of somewhat greater extent than it is at present and possible that it was less enclosed and more tidally affected.

The settlers seem to have brought with them pigs, chickens and rats. There is no direct evidence for the presence of cultivated plants and little indirect evidence in the form of food preparation implements, only the *Strombus* paring knife being definitely early, the *Anadara*
equivalent possibly so. But it is probably safe to attribute the introduction of food plants to the original colonists. Cooking was done in part in earth ovens of the type called umu to-day.

The pottery was a low- to medium-fired earthenware, with abundant filler. We have no precise knowledge of the types of vessel in use. The vast majority of vessels must have had round bases, to judge by the few definite flat base sherds found, some perhaps belonging to a type of shallow dish with outward flaring rim decorated inside and out and with a plastic band on the inside below the lip. A significant proportion of the vessels was provided with collar rims (20-25% of total rims), the more complex B collar being equally popular with or more popular than the simpler A collar. Equally in evidence were pots with vertical or near vertical rims and ones with distinctly everted rims. The bodies of the vessels beneath these various rim types were not markedly convex. A small class of vessels was of simple bowl form with slightly inwardly oriented rim. Excluding the collar rims, where in the nature of the case the walls of the rim converged towards the lip, the rim walls on the other vessels were in the main parallel, rather less commonly convergent and uncommonly divergent. Lips were mostly flat and round, in almost equal proportions, and less commonly 'hybrid' (centrally flat with rounded margins to the wall).

Decoration is an important feature of the pottery in the early period. It is only possible to judge how important by the somewhat imprecise measure of the proportion of decorated to non-decorated rims. In the early period levels under discussion decorated rims range
from about 20%-40% of the total and belong in the main to
the pots with everted rim, the shallow dishes and the
bowls. Surface decoration with dentate stamp is the
predominant technique and is based on fairly simple
curvilinear and rectilinear elements, alone or in various
combinations, including some complex ones.

A varied pottery technology is in evidence with slab-
building, paddle and anvil and possibly coiling. Some
complex rims and perhaps all collar and flange rims were
made by prefabrication. Various devices for handling
pots, including loop handles, were known, as well as
thick-walled pottery of uncertain use. There is evidence
for hollow ceramic pot rests and perhaps for pottery ring
stands. A deliberate greyish-white coating of calcium
phosphate or calcium carbonate occurs on some sherds.
Burnishing and slipping of vessels were practised but have
not been quantified.

Stone adzes of quadrangular, oval and semicircular
cross section belong to the early period, together with
shell adzes of rectilinear and curvilinear cross section
made from the hinge part of the Tridacna and retaining
evidence of the shell's natural corrugations on the back.
Small gouge-like tools of Conus were also known. Under
fishing gear we have possibly early evidence for a simple
one-piece hook, definitely early evidence for a slightly
bent gorge, and ample evidence for Anadara shell net
sinkers and cowrie shell caps for octopus lures,
unperforated and unnotched. Under industrial tools there
are, besides the normal hammerstones and grinders and
polishers of coral and stone, stone cutters, branch coral
files and combined hammers and files of coral definitely
and stone and sea urchin files possibly.
Ornaments are quite varied. They are predominantly of shell, mainly *Conus* and *Tridacna*, and include narrow bracelets, the much less common broad bracelet and various forms of unit, long, squat, rectangular (this presumably early), circular and annular, meant for stringing in necklaces, armlets, wristlets and the like. Of these the most common was the long unit. Shell pendants were known, including pearl shell valves perforated for suspension. The practice of tattooing is evidenced by the discovery of a group of tattooing chisels. Bone awls were found in early period horizons. Finally bowling stones were part of the early period repertoire.

We have no knowledge of the house types of the early period and the pits found in early period contexts do not admit of a ready explanation in functional terms. We can only note the close spatial association of the middens with their content of dumped shell, ash and cooking stones, and other activities of the community, as seen in the discovery of unbroken and completely finished artifacts like adzes and ornaments by the midden excavations.

2. *Late period*

This is represented in the top horizons at To.1 (II) and To.5 (III) and by virtually the whole of site To.6 with its three stratified horizons. Two radiocarbon dates for the same event in pit A of To.1, AD 1486 ± 82 (NZ-597) and AD 1530 ± 100 (K-961) antedate the formation of horizon II at that spot. Two others, on the same sample from fireplace D at To.5, AD 1620 ± 100 (ANU-23/1) and AD 1610 ± 63 (ANU-23/2), date an early stage in the formation of horizon III at the site. In terms of pottery
the two horizons are equivalent to each other, as they are by radiocarbon dating, and to horizons I and in part II at To.6. The latest horizon at that site, III, as well as in part II, have a distinctive character by comparison and constitute a good case for the subdivision of the late period into an earlier and a later phase.

The pottery in terms of technique is the same as in the early period, with evidence of prefabrication, slab-building, paddle and anvil and whitish coating on some sherds. Handling devices seem to be much less prominent than in the early period, though one loop handle was found. Hollow ceramic pot rests were employed, besides what have been interpreted as solid vessel legs, not on record for the early period. Thick-walled pottery occurs as in the early period.

Flat bases are virtually non-existent and with them has disappeared the distinctive decorated shallow dish of the early period. Collar-rimmed pots are still present, though with only half the frequency of the early period (10%-15%) and at the top of To.6 even less than this (6%). The simple A collar is now twice as prominent as the more complex B collar. Vessels with everted rims have declined equally in importance, amounting only to 8%-10% of rim totals and at the top of To.6 to even less (2%). Strongly everted rims seem to be virtually absent. Replacing these rim types in importance is the vertical or near vertical rim, which accounts for 40%-45% of rims at To.1 horizon II and To.5 horizon III and 76%-80% in horizons II and III at To.6. Bodies below these rims are not markedly convex. Simple bowls with inwardly oriented rims are still present in small numbers.
Excluding the collar rims where the walls of the rim converge in the nature of the case to the lip, rim walls are in the main parallel or divergent, as against the early period pattern of parallel or convergent. In the upper levels of To.6 divergent rims become dominant. Flat lips are now more prominent than round (45% and 58% at To.1 and To.5 respectively as against 15% and 20%) but in horizons II and III at To.6 they become absolutely dominant (72% and 83% respectively as against 9% and 5%).

Decorated rims now account for only about 7%-12% of the total (at To.5 and To.1), but at To.6 the figures fall to 2% (horizon I and II) and 1% (horizon III). This seems truly to reflect a decline in the incidence of decoration, to the extent that in the upper levels of To.6 hardly any decorated pieces at all occur. The decorated pottery of the top horizons of To.1 and To.5 nevertheless closely resembles that of the early period in decorative technique and motifs, though some of the motifs of the early period, including the more complex ones, recur seldom if at all (motifs of classes B, K, L, M, N, O and P).

Stone adzes of rectilinear and curvilinear cross section belong to the late period. Because of uncertainty as to what period to attribute adzes in the bottommost spit of To.6, the presence in the late period of adzes of decisively quadrangular cross section such as are well established for the early period depends on the slender evidence of a fragment in horizon I, but not the bottom spit, at To.6. Adzes of the well known West Polynesian type of trapezoid cross section with front narrower than back are present in the late period but not yet in evidence for the early period. The same is true of the type with
trapezoid cross section, back narrower than front. But oval-sectioned and semicircular-sectioned adzes are known in both periods. Shell adzes, made in the way described for the early period, are present also in the late period, but only ones of rectilinear cross section have been definitely established for it. Terebra shell chisels, not yet established for the early period, occur in the late period, but the early Conus gouges have not been found late.

Under fishing gear a shell fishhook blank testifies to the presence of a simple type of one-piece bait hook in the late period. Octopus lure caps of cowrie shell, unnotched and unperforated, are known, as well as Anadara shell and stone net sinkers. Under industrial tools, besides possible hammer stones and grinders and polishers of coral, stone and pumice, we have branch coral files and possibly sea urchin files, combined hammers and files of coral, and perhaps stone cutters.

Ornaments appear to be less varied in type, though fulfilling the same functions as in the early period and made in the same materials. Narrow bracelets are present but rare; broad bracelets are known. Amongst the ornamental units the long and the circular varieties are definitely present, the annular type possibly so. Of the types of shell pendant, one of trumpet shell was found in an apparently late context. Beads of bone and stone are known, as are needles and awls of bone.

Finally bowling stones are part of the late period, as they were of the early period, repertoire.

No house plans were recognised amongst the structural evidence of the late period uncovered by excavation, but
the presence of shallow rectangular and deeper circular pits, these sometimes with undercut sides, was firmly established, as well as earth ovens. This structural evidence, together with the discovery of finished and unbroken implements, suggests as close a physical association of the shell middens with other activities of the community as in the early period.

With the shells that formed an important part of the diet in the late as in the early period were a few bones of pig and chicken but not unequivocally of dog. Coconut is the only plant for which direct evidence was recovered, but a range of food preparation tools was found, including Strombus and Anadara paring knives and possibly Tonna scrapers.

3. European period

All the evidence suggests that the upper levels of To.6 must approach closely the period of continuous and intense European contact from the late eighteenth century, even though no European materials were found there or indeed at the other excavated sites.

This being so, one might on the one hand expect to find correspondences between the archaeological evidence of the late period and the ethnographic record, on the other be entitled to read back from the ethnographic situation to the late prehistoric one. As regards the latter, information on specific points has been used to supplement the archaeological record, as with the discussion of fishing gear and techniques and the suggested interpretation of some at least of the late pits as for the storage and fermentation of vegetable foods.
As regards correspondences between the archaeological and ethnographic record, the difficulty is that the latter is very imperfect until the systematic study by McKern, who, however, did not work until well over a century after the period of regular European contact began. In the interval much of the technology in stone and shell which is important in the archaeological record had disappeared, and the craft of pottery so thoroughly that all memory of it was lost. As a result there are few detailed correspondences between what McKern and other ethnographic sources record and what archaeology reveals. One of the few concerns the use of circular ornamental units of shell in composite ornaments. In addition items like pule shell pendants and tattooing chisels, which occur in the early period but were not established for the late period, are seen to be late period forms also by virtue of their appearance in the ethnographic record.

4. Evolution of Tongan culture

The main weight of argument in this respect must fall on the pottery, which alone of the artifacts exists in sufficient quantities to give positive indications. These indications are unequivocal, in type of ware, techniques of manufacture and ornamentation and details of vessel form and decorative style, that from first settlement to the eve of European contact we are dealing with the same ceramic tradition and its internal evolution over more than 2000 years.

We have chosen above to describe the major features of the pottery in terms of two different chronological stages, an early period and a late period. The
description given of the late period pottery set against that of the early period pottery shows plainly that we are dealing with changing emphases within a given set of formal and decorative elements. The process over time is one of simplification and standardisation. Decoration becomes less complex and less common. Elaborate forms of rim, the class of so-called unique rims, perhaps never very common, disappear. Collar rims decrease in importance and increase in simplicity. The rather ornate and distinctive shallow dish is lost. The pot type with vertical or near vertical rim, divergent rim walls and flat lip becomes dominant. It appears that nothing new is created: all the elements in the late pottery are there in smaller numbers in a more varied context in the early pottery.

To speak purely in terms of early and late periods obscures the fact, however, that within each the trends that distinguish between the two can be seen. This is possible by virtue of the stratigraphic sequence at To.5 of horizons I and II within the early period and III representing the late period, and at To.6 of three superimposed horizons within the late period. The differences between the pottery in To.5 I and To.5 III are partly developed in To.5 II and carried to their logical conclusion in To.6 I-III. Judging by the indications of absolute chronology, the pace of change represented by the sequence from To.1 II/To.5 III to To.6 III is considerable since it must have taken place within a few centuries. By contrast a much longer period is needed to accomplish equivalent or smaller change from To.5 I to To.5 III.
If we try to use the evidence of other artifacts as a check on the broad conclusions reached above, we are at once hindered by the small numbers in which most of them are present, whereby absences may and in some cases demonstrably are not significant. Positive indications of continuity are afforded, however, by ornament forms like narrow and broad bracelets, shell pendants like the *pule* pendant, ornamental units such as the long and circular and possibly the annular types; by the practice of tattooing and the presence of bone awls; by fishing equipment like simple one-piece hooks, \(^1\) octopus lures of the same special type, and net sinkers of shell; by food preparation tools like *Strombus* paring knives and possibly the *Anadara* equivalent; by industrial tools like branch coral files, combined hammers and files of coral, and perhaps sea urchin files and stone cutters; by stone adzes of oval and semi-circular cross section and possibly the type with decisively quadrangular cross section; by shell adzes of rectilinear cross section made in the same way from the hinge part of *Tridacna*; by bowling stones; and by the similar formation and use of shell middens.

We have here the answer to one of the main questions asked in the introduction. By all the evidence, ceramic mainly but by no means exclusively, the prehistory of Tongatapu comprises the settlement and development of a single culture. Whatever external influences came to bear on it, and the evidence of exotic elements in the form of odd pieces of pottery is set out in chapter VIII, they played no decisive role as far as the excavated evidence can show. All in all Tongatapu prehistory exemplifies the principles of the 'founder' culture and the insularity of

\(^1\) Possibly.
its cultural evolution as argued by Vayda and Rappaport for oceanic societies.¹

The Origins of Tongan Culture

There is no doubt that Tongan pottery belongs to the Lapita tradition of the SW Pacific, best known in the literature from New Caledonia and New Britain. The technique and style of the decoration affords the clearest evidence: the use of dentate stamp and plastic bands, the notching of plastic bands and lips and the infilling of decoration with whitish material may be mentioned in addition to the similarity of the motifs used. Certain formal aspects of Tongan pottery are also matched at the Lapita sites: the importance of flat lips and everted rims, the presence of loop handles and flat bases, the apparent occurrence of collar and flange rims, and the distinctive shallow dish decorated inside and out and provided with a plastic band on the inside just below the rim.

There are very obvious differences between the Tongan and overseas Lapita styles, however, which suggest that its relationship to them is at some remove. The differences are to be seen partly in the greater complexity and elaboration of the New Caledonian and New Britain decoration, which receives only faint echo, as we saw in chapter VII, in the Tongan material and that exclusively on early sites, partly in the much looser execution of the decoration on the Tongan sherds, few of

¹ A.P. Vayda and R.A. Rappaport, 'Island Cultures', in Fosberg, 1963.
which (cf. fig. 80.4) approach the tightness and regularity typical of the overseas material.

Besides pottery there are other artifacts in Tonga which link with the overseas Lapita sites. From the Watom site in New Britain there are adzes of curvilinear cross section, a Conus gouge and a rectangular ornamental unit; from site 13 in New Caledonia rectangular and circular ornamental units, broad and narrow bracelets, cowrie octopus lure caps without perforation or notching and Anadara net sinkers.

However, in New Caledonia all these forms, except the two ornamental units, occur on later sites of non-Lapita ceramic tradition. Moreover the rich shell technology of Tonga and some of its forms are, as chapter IX explored in detail, paralleled in other parts of the Western Pacific, of which Yap and the southern New Hebrides are the two most conspicuous examples. Perhaps the broad geographical and chronological spread characterising this technology reflects an ancient and widely diffused adaptation to oceanic conditions rather than any specific cultural connections. On the other hand the number and detailed similarity of the New Hebrides parallels suggest the possibility of such connections in this case. These parallels include, besides items like Tonna/Turbo scrapers, Anadara net sinkers, narrow bracelets and circular units present elsewhere, a number of more restricted items, Conus gouges (also Watom Island), small rings, bowling stones and branch coral and sea urchin files. But as yet we lack well-defined contexts for this material in the New Hebrides and so can do no more than note the similarities.
Another of the questions asked in the introduction is now answered. The founder culture of Tonga is closely linked with sites in the Western Pacific characterised by the Lapita tradition of pottery. Tongan prehistory is concerned with the development of the variant of Lapita culture established there in the middle of the first millennium BC into the society that was made known to the outside world at the end of the eighteenth century.

Tonga and Samoa

If Tongan culture of AD 1800 derives mainly, as we have argued, from the Lapita founding culture, it would be logical to call that founding culture proto-Tongan and thus in some sense proto-Polynesian.

Unfortunately the matter is not so simple, in part due to the normal difficulties of equating archaeological evidence restricted to a few items of material culture with total societies defined in linguistic and sociological terms. These difficulties become very real and practical when few of the expectations from the hypothesis that Lapita in some sense equals proto-Polynesian seem to be fulfilled.

The first surprise is the small number of similarities in archaeological terms between Tonga and its neighbour in the West Polynesian culture area, Samoa, for which we have some evidence back to the beginnings of our era.¹ It is true that pottery is part of the Samoan cultural repertoire at this stage, but if this pottery

¹ For a discussion of this see Davidson, 1965, pp.67-9.
belongs to the Lapita tradition at all, it is far removed from the Lapita we have been discussing, lacking all decoration and being formally restricted. Some of the adzes described for the early Samoan levels have their parallels in Tonga, those with quadrangular, oval and semicircular cross section. But the very close similarities that we have seen to exist between Tongan and Samoan adzes, so that Buck's typology for the latter could be applied in chapter IX to the former, are to be found in the main amongst the Tongan surface adzes and in four adzes of trapezoidal cross section as yet only from late period contexts in Tonga, two with front narrower than back, two with back narrower than front. Other parallels include Turbo scrapers (the equivalent of the Tongan Tonna type with circular perforation in the shell wall), sea urchin files, simple one-piece fishhooks of shell and octopus lures with, however, formalised stone sinkers (not recovered in Tonga) and cowrie shell caps but whether perforated or not is unknown. A possible similarity in rectangular pit type between Tonga and Samoa has been mentioned in chapter XI.

Samoan archaeology has a different look, however, from the Tongan. The latter is characterised by the accumulation of shell middens reflecting a heavy exploitation of shell fish. This type of site is almost unknown in Samoa. No doubt these are geographical factors at work here, Samoa providing larger land masses than Tonga. Also the Tongan programme concentrated specifically on shell middens and may have tended to overemphasise them. However, the basic distinction remains and is paralleled, on present evidence, by another - the absence in Samoa of the rich shell industry
characteristic of Tonga. Not one of the Tongan ornament types in shell has been reported from Samoan sites. Yet the similarities between Tongan and Samoan culture at the time of European contact were so great and the differences between both and the cultures of Eastern Polynesia so marked that Burrows devoted an entire monograph to their description and explanation.¹

Green has recently put forward reasons as to how this situation could have come about.² Using the results of Pawley's demonstration of the closer linguistic relationship of Samoan with the Eastern Polynesian languages than with Tongan,³ he suggests that the archaeological differences visible at an early stage of prehistory between Tonga and Samoa reflect the remote separation of Tonga from the main Polynesian stream established on linguistic grounds. The cultural similarities that mark Tonga and Samoa off as Western Polynesia from Eastern Polynesia at European discovery would result from prolonged and intimate contact between the two neighbouring groups in more recent prehistoric times, of the type possible in terms of Polynesian navigational capacities and claimed, as we saw in chapter II, by the local traditions.

¹ Burrows, 1938.
Western and Eastern Polynesia

As chapter IX showed, however, there are archaeological parallels between Tonga and Eastern Polynesia, some of which are quite detailed. From the stone adzes, amongst which a number of similarities have been shown to exist, we may select the type with semicircular cross section and flattened base (our 2b) which is on record for the Society Islands and the Marquesas besides Samoa and note the presence of a single genuinely Tongan adze with East Polynesian-type grip. The Terebra chisel, with working edge fabricated at the pointed end, is known in the Society Islands and the Marquesas. The Tongan Tonna scraper has Marquesan parallels as well as Samoan ones. Stone cutters and files of stone, branch coral and sea urchin spines are all found in Eastern Polynesia. The toothed tattooing chisel is well known there and awls and needles are on more restricted record. The bowling stone or its equivalent in vegetable material is widespread. Apart from the Tonna/Turbo scraper, none of these artifacts is part of the widely diffused technology of the Western Pacific to which reference has been made and in which Tonga shares. A number of them do, as we have seen, turn up in the New Hebrides, but a specific cultural explanation is possible here on grounds of geographical position alone.

The major differences between Tonga and Eastern Polynesia in terms of the type of material we have been discussing concern pottery, ornaments and fishing gear.

Besides Samoa, pottery has been found in early levels of the Marquesas, though in small amounts only. Like the Samoan pottery, the Marquesan ware, undecorated, is not
obviously related to the Lapita tradition. Some general similarities have been mentioned in chapter VII between the ten sherds put on record by Suggs for Nuku Hiva and Tongan pottery: flat and slightly grooved lips, outward rim orientation and surface striation.

In the sphere of ornaments there is a complete absence from East Polynesia, as from Samoa, of the shell bracelets so typical of at least the early period in Tonga and well known in the Western Pacific at large. Nor is there close similarity in the detail of other ornament forms between Tonga and the rest of Polynesia, though the ornamental fashions are similar. Thus the pendant is an item common to Tonga and Eastern Polynesia. Similarly the stringing of units for use in composite ornaments like necklaces is known in both areas. As discussed in chapter IX, the whale tooth and reel units of Eastern Polynesia are not known from the Tongan excavations, while the various types of Tongan shell unit are not precisely matched in form in Eastern Polynesia. Yet the transverse perforations of units for stringing and the back to front perforation for attachment testify to the same ornamental aims in the two areas. In Tonga some of the characteristic features of the shell technology are the result of the forms of ornament produced, particularly out of Conus, so that the absence of these forms elsewhere in Polynesia gives a different look to the shell technology present there.

The Tongan archaeological record seems to lack, as the Tongan ethnographic record certainly does, the well developed bait hook fishing gear characteristic, as we have indicated in chapter IX, of early levels in Eastern
Polynesia. The negative archaeological evidence is hard to evaluate, since the lure hook gear that was highly evolved in Tonga at European contact is likewise not represented in the archaeological record. From the excavated fish remains discussed in chapter X it appears that fish traps and nets were probably the most important fishing devices and in the archaeological record Anadara shell net sinkers are common. The fishgorge was known: a close parallel has been cited for the Tongan example from Hawaii. The rather complex octopus lure is a prominent item amongst the excavated fishing gear but its cowrie shell caps lack the perforations characteristic of at least some examples on archaeological record for Eastern Polynesia, while there is no evidence for the formalised stone sinkers of Samoa and Eastern Polynesia.

The lack of archaeological evidence for bait and lure hook fishing gear is as characteristic of Samoan as of Tongan prehistory. For both island groups only a single example of the simplest of one-piece bait hooks is yet on record. The elaboration of bait hook tackle seems to be a specifically Eastern Polynesian development, the origins of which are as yet unknown.

The contribution that the Tongan project makes to these wider questions of South Pacific culture history cannot be fully evaluated until the ceramic data presented here can be compared in detail to those particularly of Samoa. Leaving this branch of evidence aside, the conclusions we can propose on the basis of adzes, Terebra chisels, Tonna scrapers, sea urchin and coral files, Anell, 1955, pp.161-2, 167-9.
tattooing chisels and bowling stones are in support of those of Suggs from his Marquesan work, of Emory and Sinoto from the Maupiti burial complex, and of Green from his Samoan excavations. These are that Eastern and Western Polynesian cultures developed from an ancestral stock. This ancestral culture was established early in the SW Pacific, spanning the boundary between Melanesia and Polynesia and antedating its appearance. This circumstance accounts in part at least for some of the shared aspects of Melanesian and Polynesian cultures.

At the same time there are significant differences from the beginning between Tonga and all other Polynesian groups. This is to be seen particularly in the sphere of ornaments. Tongan bracelets of shell have no counterparts elsewhere in Polynesia and though composite ornaments were common to both areas, there is little formal similarity in the units employed. The Tongan octopus lure is different in detail from that used in the rest of Polynesia, most strikingly perhaps in the lack of a formalised sinker. A number of Tongan shell implements, like the Strombus and Anadara paring knives and the Anadara net sinkers, have no precise Polynesian analogues. Such differences could well be viewed, as Green has suggested, as the cultural reflection of the linguistic distance between Tongan and all other Polynesian languages. With the extended time scale now established by radiocarbon dating for the settlement of the SW Pacific, involving that of Tonga by 500 BC, adequate time becomes available for the changes involved. But it does not seem that time alone is sufficient to account for the differences. Whether the decisive factor is the settlement of Tonga from a different part of the ancestral culture area than for
example that of Samoa, or whether it is a greater complexity in the archaeological manifestations of proto-Polynesian culture than we realise must remain for future research to determine.

These wide speculations have been offered on the basis of excavations at a few specialised sites in a small area round the lagoon of one island in the Tongan group. As the information assembled in chapter III showed, there are areas of Tongatapu not characterised by shell middens and the prehistoric settlement and exploitation of these has not been illuminated. There are in addition other types of site than shell middens whose relationship to the shell middens and place in the overall pattern of Tongan settlement is unknown.

We have no knowledge of the archaeological situation in other parts of the Tongan group, for which indeed no pottery finds are at present on record. We might expect considerable differences between Tongatapu in prehistory and the atolls of the Ha'apai group, where fishing was traditionally of considerable significance. The important Vava'u group similarly should have an individual chapter to contribute to the overall story of Tonga in the past. For these reasons the present work is but a contribution to the prehistory of the Tongan islands.
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APPENDIX I

PETROGRAPHY OF SOME STONE ADZES FROM TONGATAPU, TONGA GROUP

Dr A.J.R. White

Stone adzes collected by Mr J. Poulsen from excavations on Tongatapu are chiefly basaltic types. Since three main associations of volcanic rocks are recognized viz., alkaline, tholeiitic and calc-alkaline, a study has been made on several selected adzes in an attempt to determine from petrographic characteristics the association from which each has been derived. From the known occurrence of each association in the region some limitations on the source of each are made.

Rocks of the Tholeiitic Association

Adzes Two have been examined in thin section. A fine grained type (To.6: 158) and a coarser grained type (To.5: 38) are both pale grey typical tholeiitic basalts. To.5: 38 contains phenocrysts of plagioclase (labradorite), augite and rare hypersthene (rimmed by augite) in a fine groundmass made up of plagioclase laths, granular pyroxene, magnetite and interstitial brown glass. To.6: 158 is an even grained aggregate of tiny plagioclase laths, granular clino-pyroxene and magnetite with an abundance of interstitial brown glass.

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Broken Pebble  A broken pebble (To.6: 3177)\(^1\) found in the excavations along with the adzes is also a typical tholeiitic basalt. It is pale grey in colour, slightly coarser in grain size than the adzes described above, and consists of plagioclase, granular clinopyroxene, magnetite and again patches of interstitial brown glass. This rock is coarse enough to allow the positive optical identification of the characteristic clinopyroxene pigeonite.

Pebbles from the Ha'apai Group  Three pebbles, one fine grained and pale grey (1), another slightly coarser in grain size and greyish brown because of iron staining (2), and a third very dark grey in colour (3), were collected from gravel used as aggregate in the Ha'apai Group. These are believed to have been brought from either Kao or Tofua which are volcanic islands on the western side of the Group. All of these are typical tholeiitic basalts with features that perfectly match those of the excavations. Specimen (1) for instance contains microphenocrysts of plagioclase, clinopyroxene and rare hypersthene, again rimmed with clinopyroxene, set in a groundmass of plagioclase magnetite and granular clinopyroxene which includes pigeonite. There is no doubt that the tholeiitic adzes and pebbles of the excavations are derived from the volcanic islands of the Ha'apai Group.

\(^1\) Of the type called makahunu, horizon provenance uncertain (J.I.P.).
Rocks of the Calc-alkaline Series and Related Types

Altered 'Andesite or Trachyandesite' (To.l: 1914)
This specimen is typical of a group of fine grained massive adzes common in the excavations of Tongatapu. They are almost black when polished. The rock contains micro-phenocrysts of partly altered augite set in a groundmass of feldspar, secondary green-brown phyllosilicates, pale green uralitic hornblende, epidote. Xenocrysts of quartz surrounded by aggregates of clinopyroxene were also found. Some of the feldspar could be alkaline. This rock is very similar to the dykes which cut the older highly altered tuffs, ash beds and altered andesites, dacites and rhyolites of 'Eua island (Alling, 1932). Alling referred to these dyke rocks as 'fine grained porphyritic andesite or trachyandesite' and said that they contained secondary alteration products such as uralitic hornblende, sericite, epidote chlorite and carbonates. He also mentions that one dyke rock contains corroded quartz xenoliths.

It is suggested that the most logical source for the dark coloured adzes is the dykes of 'Eua.

Uralitized Gabbro

The only specimen available from 'Eua is a gabbro consisting of plagioclase (labradorite) and uralitic amphibole aggregated obviously pseudomorphing pyroxene. Harker (1891) described uralitized gabbro and Alling (1932) described 'diabase morite' from 'Eua.
Alkaline Association

Two adzes from the excavations can be assigned to the alkaline rock association (To.6: 20 and To.6: 170). To.6: 20 is a fine, dark grey even-grained rock in which a prominent planar arrangement of feldspars gives a characteristic sheen on broken surfaces. Under the microscope it is seen to consist of plagioclase, clinopyroxene, olivine, magnetite, and rare hornblende.

Plagioclase appears as a matted aggregate of laths with a composition ranging from An_{45} in the cores to oligoclase (An_{20}) at the margins according to extinction angle measurements. Independent grains of alkali feldspar were not recognized. The pyroxene is pale green and occurs as stumpy crystals: it is all monoclinic with an optic axial angle close to 60°. Olivine is seen as tiny well-shaped crystals or as interstitial patches showing all stages of alteration to serpentine. Tiny black octahedra of magnetite are abundant but pale brown hornblende with ragged outlines is sparsely distributed throughout the rock.

This rock is a typical hawaiite (MacDonald, 1960) or mugearite (Harker, 1904) and is characteristic of oceanic alkaline rock associations. To.6: 70 is also a hawaiite. From the available literature on the volcanic rocks of Tonga these are obviously foreigners to the region. Rocks of the hawaiite-mugearite type have been described from Wallis Island (MacDonald, 1945) and from Samoa (MacDonald, 1944). The Fiji islands are essentially made up of calc-alkaline volcanic rocks which are conspicuous by their absence in the rocks from Tongatapu. It is therefore improbable that the source of the hawaiite adze is from
Fiji or even the Lau group which are petrographically unknown. Alkaline rocks are known from the New Hebrides and the Loyalty Islands (Maré) and hence it is possible that the hawaiite adzes have come from the west. Fig. 1 summarizes the known distribution of igneous rock associations in the region of Tonga and the most probable sources of hawaiites.

References


APPENDIX II

THE PETROLOGY OF SOME TONGATAPU POTTERY

C.A. Key

Nineteen potsherds from four different archaeological sites as well as two natural clays from Tongatapu and a mineral concentrate from 'Eua island were examined. Thin sections were prepared from the sherds and these were examined under the polarizing microscope to determine the amount and morphology of the various impurities in the clay body of the pottery. A visual estimate of these amounts was found to be grossly inaccurate and a 'Swift' point counter was used to determine the volume percentage of the inclusions in the clay.

To facilitate the point-counting and to differentiate between them, these inclusions are grouped under five headings. The first group includes all the pyroxenes, hypersthene, pigeonite and augite. The second group includes with feldspar the occasional fragments of quartz. The third group includes, under the heading basalt, 0.1-0.5 mm pellets of weathered basalt, pumice shreds and bits of devitrified volcanic glass. The fourth group includes pellets of limonite, angular lumps of unprocessed clay and in three specimens magnetite. In only one specimen, To.5: 738, is there more than a trace, and it amounts to

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approximately half of the 'limonite'. The heading shell includes all carbonate material, shell, coral and foraminifera.

The results of this mineralogical investigation are set out in the accompanying table where the volume percentage in the sherd is followed by volume percentage of the total mineral content. Figure 1 gives an overall view of the total volume percentage impurities in each specimen.

Descriptions of the Materials

To.1: 2969. The sherd is 11.5 mm thick, more oxidized on the outside than the inside, with a centre of unoxidized black clay. Shreds of clay are oriented parallel to the surface. The filler is made up of a coarse fraction of 0.1-0.5 mm fragments of all the constituents and a smaller amount of fines which are all feldspar fragments. The carbonates consist of fragments of both shell and coral.

To.2: 5237. A 4 mm thick decorated sherd fired red only on the outside half and brown, incompletely oxidized, inside. All filler constituents range from 0.1-0.4 mm in size. The clay shows no orientation. A few unidentified fragments of carbonate are present.

To.2: 5365. A 5 mm thick sherd evenly fired throughout. The only sherd which is not oxidized to a red terracotta but is a light buff colour. The filler too differs in that it contains large 0.75 mm pyroxenes and some similarly large fragments of green hornblende. The fines are feldspar.
To.5: 237. A 5 mm thick decorated sherd fired only on the outside and friable on the inside. The only sherd which has a noticeable self-slip on it and orientated clay as well as orientated feldspar fines.

To.5: 258. A decorated sherd well fired on the outside, with a coarse 0.1-0.5 mm filler which has very little limonite or clay pellets in it.

To.5: 314. A well-fired, 11 mm thick, decorated sherd with most of its clay oriented parallel to the surface. It contains a high proportion of shell and limonite as filler.

To.5: 377. A 13.5 mm thick, decorated sherd, oxidized both inside and outside, with a black centre. It contains the highest proportion of pyroxene, 35.8%, and little else.

To.5: 738. A decorated sherd, 11.5 mm thick, badly fired with only the outside 2 mm oxidized. It contains relatively little fresh pyroxene and feldspar but many other fragments of basalt, limonite, clay lumps, pumice and some shell. This sherd, though it would seem to have the same proportions of the various impurities in the clay as To.5: 314, contains, in fact, little limonite but a substantial amount of magnetite, the only one out of this collection.

To.5: 739. A 12.0 mm thick, decorated sherd, well fired on the outside. It has a coarse filler up to 0.75 mm in diameter, consisting mostly of pyroxene and feldspar.

To.6: 434. A well-fired 5 mm sherd. The filler consists of a large amount of basalt, pumice and limonite and less pyroxene and feldspar. The weathered basalt and limonite pellets range from 0.5-1.0 mm and there are few fines.
To.6: 1231. A sherd, 6 mm thick, evenly fired throughout and similar to sherd To.6: 434.

To.6: 2154. A 6 mm thick sherd with only its outside oxidized. It contains a relatively coarse filler, half of which is pyroxene.

To.6: 2257. A 15 mm thick sherd fired only on the inside. More than half the volume consists of mineral fragments. Of these less than half are angular fragments of feldspar and the rest is angular fragments of a medium-grained uralitized gabbro. The sherd contains no pyroxene or basalt fragments but some limonite. This sherd is the only one made of these entirely different materials.

To.6: 2924. A 6.5 mm thick sherd, well fired. This sherd contains the least filler of all those examined and has angular lumps of undisturbed clay set in a matrix of well orientated shreds of clay.

To.6: 2990. An evenly fired, 5 mm thick sherd. More than half the filler is fairly coarse, 0.5-0.8 mm fragments of pyroxene. There are no fines and the clay matrix is well orientated.

To.6: 3043. A 5 mm thick sherd, fired on the outside only. It contains a large proportion of basalt pellets.

To.6: 3363. A very thick, 19 mm sherd fired on the outside, containing very little pyroxene and no fines.

To.6: 3366. A 7 mm thick sherd which is evenly fired. It contains, in addition to the usual mineral fragments, small angular lumps of clay in a matrix of orientated clay. The clay from site To.6 was wet-sieved and found to contain 1% by weight mineral fragments, limonite and shell
greater than 0.125 mm and 1% greater than 0.177 but less
than 0.5 mm. The minerals represented were, in order of
importance, limonite nodules, fragments and complete
bipyramids of quartz, feldspar, carbonates, magnetite and
some pyroxene.

The clay from the Ma'ufanga quarry contained only 1%
of a similar suite of minerals.

The mineral concentrate from a stream bed on the
adjacent island of 'Eua contained the same minerals but
with a very much larger percentage of magnetite.

Conclusions

The sherds are coarse oxidized earthenware which was
unevenly fired in the open air. The hand specimens look
very much alike and to show up possible differences in the
filler a more accurate method had to be used to determine
the amount of inclusions in the clay.

The inclusions were grouped together to differentiate
between (a) the weathered basalt and limonite which may be
breakdown products of the same parent material as the clay
and (b) the filler added to the clay by the potter. This
is necessary since it cannot be established with certainty
that the basalt pellets are not related to the clay. The
examination of the two Tongatapu clays however showed them
to have about 2% inclusions in contrast to a minimum of
10.4% in the sherds.

Tongatapu has no igneous rock outcrops, no sandy
beaches with heavy mineral concentrations such as are
found on many islands in the Pacific nor are there streams
which might have produced placer deposits. The vague
descriptions of the island mention that its surface is covered with *in situ* weathered clay with small beaches made up of coarse coral fragments. This indicates that either mineral mixtures to be used as filler or finished pottery were imported.

The mineral filler is shown in the table to consist of a peculiar mixture of heavy and light fractions, in which the heavy pyroxenes are fresh and the light basalt is weathered. This seems to indicate that the potter used clay which contained natural inclusions of basalt and limonite, to which he added a filler of pyroxene and probably feldspar. If this is the case, the pottery must have been imported.

The sherd To.6: 2267 was almost certainly part of an imported pot, because of the gabbro inclusions. Some sherds from site Tonga 5 seem to differ from those in site 6 in that they carry a higher proportion of pyroxene. If these high pyroxene sherds are contemporaneous with those, low in pyroxene, of site 6, then the two settlements must have had different sources of supply.

Other features were examined such as the relationship between the amount of filler and a) the thickness of the wall of the vessels, and b) the porosity and strength after firing. Until a much greater corpus of material has been examined these other features have no diagnostic value. Research into these aspects will continue.
## TONGAN SHERDS

### Point Count Analysis of Impurities in the Clay Body

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<th>Total %</th>
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<th>Feldspar Quartz</th>
<th>Basalt Pumice</th>
<th>Limonite</th>
<th>Shell</th>
<th>P</th>
<th>F</th>
<th>B</th>
<th>L</th>
<th>P</th>
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* Indicates the presence of some magnetite as well as limonite
** Indicates the presence of a few grains of hornblende
*** Indicates the presence of gabbro fragments
APPENDIX III

ANALYSIS OF SOIL SAMPLES FROM TO.1

Dr K.A.W. Crook

Samples of formations A, B and C taken from the subsoil at 83/56 in excavated section I at To.1 were submitted. My interpretation of them is based on size analyses, composition of the sand fractions and petrographic features of two of the samples (B and C) examined in thin section.

Formation A contains 40% sand, the remainder being gravel (10%), silt (15%) and clay (35%). It is rich in organic carbonate, principally shell fragments of marine invertebrates.

The poor sorting of the gravel-sand fraction and the overall very poor sorting of the material, together with the abundance of marine organic remains, suggest accumulation in a shallow protected salt-water environment with an abundant epifauna (to give shell material) and an abundant infauna (to comminute it). These conditions would be met in a shallow tidal lagoon.

Formation B contains 1% gravel, 16% sand, 13% silt and 70% clay. Rare marine invertebrate shell fragments are present.

1 Department of Geology, School of General Studies, Australian National University, Canberra.
2 See section on To.1, chapter XI (J.I.P.).
The predominantly clayey nature of the material is a reflection of its deeply weathered state: the material has many characteristics of a sedentary soil. There are some rounded volcanic rock fragments and scattered angular grains of pyroxene and feldspar. The former suggest that part, at least, of the material has been moved by water, and the rare organic remains support this. However a true marine environment appears unlikely, for the evidences of current action are slight. Probably this material represents a weathering profile (soil) developed in low-lying land immediately adjacent to a bay of lagoon, from which occasional transported fragments could be derived by wind action or organic transporting agents.

The nature of the material in which the soil has developed is problematical. It may have been a marine mud - in which case almost all the calcium carbonate originally present has disappeared (the shell fragments present being little altered and probably younger than much of the weathering); or it may have been a volcanic ash.

Formation C contains 3% gravel, 22% sand, 20% silt and 55% clay. In many respects the finer fraction resembles that of formation B. However, silt-sized pyroxene opaques and feldspar are more abundant. Pumice fragments form most of the coarser fraction, with minor pyroxene and feldspar. Calcium carbonate is absent.

This too appears to be a soil, but it shows no sign of a marine-derived fraction. The pumice fragments may indicate water transport, but this could be overland. Alternatively they could be aeolian (volcanic ash fragments), as could the finer fraction, in situ weathering having occurred subsequently.
APPENDIX IV

CHI-SQUARE TEST OF TONGAN POTTERY DATA

B. Isaksen

The underlying statistical problem in this dissertation is to decide whether or not two given frequencies are statistically different. The standard method for deciding this is the Chi-square test.

The results of an investigation are presented in the form

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<th>number in horizon I</th>
<th>number in horizon II</th>
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<tr>
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<td>n₂ = a₁₂ + a₂₂</td>
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</tr>
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1 Department of Mathematics, University of Aarhus.
\[
X^2 = \frac{(\frac{a_1}{n_1} - \frac{a_1}{n_2})^2}{(\frac{1}{n_1} + \frac{1}{n_2}) \frac{a_1}{n_2} (1 - \frac{a_1}{n_2})}
\]

\[
= \frac{n_0(a_{11}a_{22} - a_{12}a_{21})^2}{n_1n_2a_{10}a_{20}}
\]

The number \(X^2\) is approximately \(X^2\) - distributed with one degree of freedom. We only evaluate \(X^2\) upwards. We choose significance level 2.5%, i.e. the critical region extends from 97.5% fractile to infinity. The interval from 0 to the 92.5% fractile was chosen as the acceptance region. The remaining region could be called the region of doubt; \(X^2\) there leads neither to rejection or acceptance, but rather to a position of indecision.

A more detailed description of the test can be found in A. Hald: Statistical Theory with Engineering Applications, Wiley, 1960, chapter 23.
APPENDIX V

EXAMINATION BY X-RAY POWDER DIFFRACTION OF GREYISH-WHITE COATING ON POTSHERDS

Dr Meta Sterns

To.1 Samples

Since the coating was extremely thin, most of the samples examined contained a large proportion of clay from the sherds.

Where an almost pure sample of the coating could be isolated, as To.1: 1266, sample (ii), it was found to consist mainly of calcium phosphate, in the form of carbonate-apatite $\text{Ca}_{10}(\text{PO}_4,\text{CO}_3\text{OH})_6(\text{OH})_2$ or possibly hydroxyl apatite $\text{Ca}_5(\text{PO}_4)_3(\text{OH})$, together with some iron oxide (magnetite, $\text{Fe}_3\text{O}_4$) from the body of the sherd. The possible sources of the calcium phosphate could be phosphate rock, other phosphate deposits such as guano, or bones.

X-ray patterns of samples To.1: 1268, To.1: 1768 and To.1: 1266 sample (i), showed the presence of iron oxides ($\text{Fe}_3\text{O}_4$ and some $\text{Fe}_2\text{O}_3$), quartz ($\text{SiO}_2$) and feldspars, all presumably from the body of the sherds, and a small amount of calcium phosphate.

---

1 Department of Chemistry, School of General Studies, Australian National University, Canberra.
To.2 Sample

The white coating examined on sherd To.2: 2282 was considerably thicker and harder than the layer on the To.1 samples and was found to consist of calcite, CaCO$_3$ (limestone), without any detectable impurities.
APPENDIX VI

THE LEFT FEMUR (TO.1: 2256) FROM THE BURIAL AT TO.1

Prof. G.C. Schofield

Upper Shaft

- Anteroposterior diameter: 25 mm
- Transverse diameter: 31
- Platymeric index: 80.6

Mid Shaft

- Anteroposterior diameter: 30.5
- Transverse diameter: 25
- Pilastric index: 122

No marked platymeric protrusion. Linea aspera moderately developed.

The remains to which the above belongs appear to be those of one adult male (possibly showing Paget's disease although this would require histological confirmation). The remains are probably not Polynesian by reason of the high platymeric and pilastric indices.

1
Department of Anatomy, Monash University, Melbourne.
APPENDIX VII

SOME EXCAVATED JAWS AND TEETH FROM TONGA

Dr R.M.S. Taylor

I. The Burial at To.1

a. The material as received (in six packets)

2281 One small fragment; ? from parietal bone.

2286 One small fragment of bone and one tooth. The bone is ? from shaft of a long bone. The tooth is probably .

2287 One small bone fragment, not identified.

2292 Twenty-two small fragments of skull bones, labelled '3rd Group'.

" Thirty bone fragments, labelled '7th Group'.

" Seventeen teeth, or fragments of teeth, and two fragments of maxilla.

b. Fairly certain replacements

From the bone and tooth fragments and separate teeth it was possible to assemble portions of upper and lower jaws, replace a number of teeth and gather certain information about the dental condition of the individual, a fully mature adult, probably middle age.

1 Department of Anthropology, University of Auckland.
Of the upper jaw there was part of the bony palate, part of the floor of each maxillary antrum and the alveolar ridge from right second molar socket to a trace of the socket of the palatal root of left second molar. The graph for this part of the dentition may be set down as:

| R | X65X3XX | X2345X | Left |

where X signifies that the tooth was present at death, was lost post mortem, and has not been identified among the fragments recovered;

and X signifies that the tooth was probably present at time of death, but may have been lost through disease not long before death occurred.

The doubts concerning these particular teeth arise from the evidence of periodontal disease that is found in the remaining parts of their sockets. The bone had been modified and the teeth must have been so loose that they would have fallen away as soon as the soft tissue decayed. In any case these missing teeth must have been little more than roots or root fragments, the crowns having been destroyed by extensive dental caries, or wear, or both.

Of the teeth that do remain, all but 6| certainly (and this tooth probably as well) have been very extensively decayed and the root canals have been exposed.
Of the lower jaw, after assembling available fragments, there was almost all the body, the greater part of the right ramus, and part of each coronoid process (but unfortunately neither condyle). The dental graph is:

```
R - - 6543 - - | - - 345X - -
```

Left

where - signifies that the tooth appears to have been absent long before death, and the corresponding portion of the alveolus had evidently healed. Both third molar regions (8|8) were checked with X-ray.

c. Although much of the dental evidence appears 'certain' in that teeth fit their sockets precisely, and the condition of teeth and surrounding bone are consistent with one another and with that of adjacent teeth and bone, there are features which present conflicting evidence.

Thus 6 neatly fits the small remaining portion of root socket, but with such a small contact this may fit by chance. On the other hand the tooth might well belong with 654|345 judged by condition, but it is very different in this respect from 2345, and it does not seem to be consistent with the condition of 6.

Again 6| is now worn down right to the root, but the teeth below it are in good condition; the wear in lowers is usually greater than in their opposing teeth. The lower teeth still in situ are in good condition, but those of upper left present gross decay.
Inconsistencies are seen also in anterior teeth. The lowers evidently had been lost long before death. The 21 region presents the cavity of a large chronic alveolar abscess (as also in the region of 34) and the crowns of 2345 are hollow shells as a result of decay. But the upper incisor labelled 'R. lateral Incisor' (though it is more likely a central incisor) was apparently sound at the time of death. One cannot reconcile it with its reputed (?) associates.

With such carious upper left teeth (apart from 6 which is suspect) function could not have been effective on the left side for a considerable time, and the wear on teeth of right side indicates that function was effective there; effective anterior to the molars at time of death, but had long ceased to be effective between 6 and 7. The tooth 6 could have had its period of usefulness prolonged by bringing it forward out of normal occlusion through a conscious dislocation of the temporo-mandibular joint. The right temporal fragment bears evidence that such dislocation was indeed present. A similar case has been described and illustrated by the author. ¹

Suggestions to account for inconsistencies observed might include (i) the fragments may be from more than one individual, and (ii) survival of injury to the face may have led to unusual masticatory function and different conditions on the two sides of the mouth. Brief examination of these

¹ Taylor, 1963, p.141 and fig. 11.
possibilities shows that there is evidence both for and against. Thus:–

(i) in the jaw fragments I did not positively identify a duplicate of any part. The many small fragments of skull were not carefully checked in this respect. It is not known whether there was any other evidence to suggest that parts of more than one person were included in the same burial. The upper incisor labelled separately, and some fragments of teeth from another individual, might accidentally have been packed with the known pieces.

(ii) injury to the face may easily affect function. The condition of bone in the region of missing lower incisors is consistent with an injury having been received. Lack of function (where cariogenic factors are present) could lead to increased severity of tooth decay, and that in turn to toothache and further avoidance of function in that part of the mouth. This individual obviously was susceptible to tooth decay and must surely have had pain for periods in the anterior and left upper teeth.

As general comments it may be stated that the dental condition and evidence of decay, tartar or calculus, periodontal disease, and tooth wear are quite within my experience of other skeletal material from Tonga, though in this case the decay in some upper teeth is unusually severe. In this regard it has also been shown to be 'one-sided' and therefore likely to have been aggravated by some unusual circumstances; a possible explanation has been offered.
II. The Burial from To.5

a. Twenty-nine fragments of skull and jaws (some with teeth and some teeth separately). Three separate portions of jaw with teeth in place may be recorded graphically as:

   6 E D x x x
   x x C D E
   6 E D x x x
   x x D E x x

where C D E are the deciduous canine and first and second molars respectively,

   x represents a tooth that has fallen out of its socket or crypt post mortem,

and

   a circle around the tooth symbol indicates that the tooth had not emerged or erupted to occlusion.

Of the twenty-nine fragments, twenty-one were identified and included:-

Almost complete R maxilla, and part of L maxilla.

An incomplete mandible, broken through the socket of 6 and the crypt of the unerupted 7.

R malar bone, and R and L orbital processes of frontal bone.

Part of sphenoid bone with the great wing of R side and part of great wing of L side. On both sides the foramina ovale and rotunda were present. Temporal bone, part of R petrous portion with external and internal auditory meati; glenoid fossa and part of zygomatic and mastoid processes.
b. Where loose teeth were replaced, the graphic chart of the dentition was:

\[
\begin{array}{cccc}
5 & 4 & 3 & \\
? & 6 & E & D & C & x & x \\
\end{array}
\begin{array}{cccc}
3 & 4 & 5 & \\
? & 6 & E & D & C & 2 & 1 & 1 & 2 & C & D & E & 6 & 7 & 8 & \text{(Broken and missing)}
\end{array}
\]

(c) The state of development of the dentition shows that these fragments are part of the skeleton of a child aged about six to seven years at the time of death. The appearance of the material is normal and there is no evidence of pathology or trauma.

III. The Bone Accumulation from To.6

2047 Fragment of human mandible with only \( 51 \) present, and some tooth sockets. There are no loose teeth to be added to the fragment, and some teeth are not even represented by sockets. It seems likely that \( 41 \) had been missing congenitally and \( 51 \) had drifted to become anterior to the mental foramen. This tooth is much worn. Probably \( 71 \) with periodontal disease and partly exfoliated was present at the time of death, but \( 61 \) seems to have been lost a considerable time before this. The evidence suggests a relatively elderly individual with an unhealthy mouth. The fragment was X-rayed and the result was consistent with the visual findings.

2022 An incomplete human maxilla, Left side; at time of death \( 2456 \) had been present. The premolars present sinuses from long-standing chronic alveolar abscesses, and the socket of \( 61 \) presents clear evidence of periodontal disease, the affected area of bone apparently in communication with the sinus over \( 51 \).
In spite of this evidence of chronic bone disease in close proximity, it is interesting to note that the maxillary antrum was apparently healthy. Its clean base is easily seen through the broken-away nasal and orbital surfaces of the bone.

2023 Part of L temporal bone, including the whole of the glenoid fossa, which is of special interest because of the evidence of pathology and of functional disability. The eminentia is hollowed out and increased in area, and it is likely that the condyle would also have been flattened and 'lipped'.

2397- Fragment of mandible together with loose teeth which could be certainly replaced to give

\[ 3 \times \begin{array} {c}
-1 \\
2 \\
3 \\
4 \\
5 \\
\end{array} \]

Close examination of this fragment led to the following observations and conclusions:

Both lower centrals had either been congenitally absent, or lost some years before death. No trace of them could be seen in a radiograph. The sloping sockets of \( \overline{2\overline{2}} \) might well have followed loss of \( \overline{1\overline{1}} \) and the facet on \( \overline{2\overline{2}} \) mesial could have arisen from an adjacent \( \overline{1\overline{1}} \).

The missing portions of the cusp tip of \( \overline{3\overline{3}} \) and incisal edge of \( \overline{2\overline{2}} \) are not from wear but from fracture which could have taken place in life.

The teeth \( \overline{2\overline{3}} \) are elevated above the occlusal line of the other remaining teeth, which suggests that they had no antagonists in the upper jaw. Tooth \( \overline{3\overline{3}} \)

---

1 Taylor, 1963, p.141 and pl. 11.
is worn by function but the occlusal facets on \(5\) are not sharply defined and could indicate reduced vigour of mastication on that side of the mouth. The decay in \(5\) and associated pain might well have contributed to this. Salivary and subgingival tartar and alveolar recession indicate that gingivitis, gingival recession and probably septic periodontal pockets were present. The disposition of salivary tartar and stain, especially on \(23\), is further testimony to lost function. These observations collectively suggest that normal occlusion and normal function might well have preceded a severe blow in the face, as a result of which some teeth were knocked out and some broken, and normal function ceased. The local effects, immediate and in subsequent years, may be deduced in part from the observations that have been noted.

IV. **General**

This skeletal material from Tonga is in general very similar to that obtained at about the same time and now in the Department of Anthropology, University of Auckland. I have made a detailed study of jaws and teeth and a cursory study of other parts in the latter collection but have not yet completed a report.

I am familiar with similar material from Chatham Islands and pre-European Maori and have shown their very close similarity.\(^1\) The Polynesian material from

---

Tonga, however, is strikingly different as regards dental conditions. The contrasting features of the Tongan material in my experience are:

There is much less wear of teeth.

Salivary tartar particularly (and subgingival tartar to less degree) is very common, considerable in amount, and widespread throughout a dentition. Associated with this there is, of course, much loss of alveolar bone by absorption, and it is easy to imagine the unclean condition of the mouths. It is quite obvious that Tongan diet for these individuals was very different as regards its physical condition from that which so often demanded vigorous mastication in the case of Morioris and Maoris. But perhaps the most surprising difference in teeth between these groups of Polynesians is that decay of teeth was common, often severe and in many teeth in a mouth, in the jaws of these Tongans, and almost entirely absent from the others.

Evidence of chronic alveolar abscesses is common in the Tongan material, as it was also in the Moriori and Maori jaws, where the pulp cavities had been exposed by excessive wear. In the Tongans, by contrast, the predisposing causes appear to have been decay of teeth or periodontal disease leading to death of the dental pulp. Destruction of supporting bone was often so severe that teeth were exfoliated. There are many examples of this, with traces of the tooth socket, or with partly or completely healed bone, to tell the story. These stages were common also in the Maori and Moriori jaws.
Although Tongan teeth involved in these pathological processes were also subjected to displacement, there was none of the dislocation so characteristically found in the Moriori and Maori material, nor any evidence of the particular pattern of wear I have called 'fernroot planes'.

References

N.B. all R.M.S. Taylor


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   2A Tonna scrapers
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5J Pule shell pendants
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5M Small bone beads
5N Stone beads
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5P Incomplete pieces
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APPENDIX X

EXPLANATION OF CONVENTIONS USED IN TABLES

X.1 Total Rim Distribution by Square and Spit

These tables illustrate the procedure whereby the distribution of any required pottery feature (in these cases rim sherds) was obtained from the computer. The figures are set out by square meter units and spits, but also by the other classes of origin coded in the record code, categories 6, 9 and 12 of table 3.

The individual figures from a spit excavation were combined for analysis into totals for individual horizons in the site, as explained in chapter V, pp.102-4. These are numbered I-V for To.2 in table 4 (I-III being the zones of the midden horizon, IV-V the superimposed mound horizon) and I-III for To.5 in table 5. The boundaries of these horizons in the tables reflect the particular spits allocated to the individual horizons. As explained in chapter V, spit horizons are called B horizons and the B above the left-hand part of table 5 registers this fact for To.5.

The hatched areas represent material withheld from the analysis of spit horizons either as buffer zones between two major formations of a site where mixing of artifacts of different age might have occurred (between midden and mound at To.2, table 4) or because of the
disturbance of the deposit in specific square metre units (as at To.5, table 5).

At some sites analysis was also done in terms of average horizons, where within broad limits the lie of the layers allowed attribution of identically numbered spits to the same horizon. The average horizon is called the C horizon and the C above the right-hand part of table 5 registers this fact for To.5.

C in the top left corner of table 4 signifies the grave area of the site.

X.2 Categories of Horizon

This section has relevance to tables 7-13, 21-2, 24, 28-9, 31-2, 34, 43 and 49-50 (also to tables 4-5 of X.1 above, tables 14-7 and 25-7 of X.4 and tables 18-9 of X.5, below).

The letters A-D appended to horizon numbers specify the category of horizon according to which the analysis in question was carried out. These categories are explained in detail in chapter V, pp.102-4.

In tables 21-2 and 29, which deal with analyses by spit zones, the horizons used are C horizons, the so-called average horizon, with all identically numbered spits allocated to the same horizon. The buffer zone at To.1 in tables 21 and 29 was designed to avoid the mixture of horizon I and horizon II material, by withholding from analysis finds from the spit straddling the contact between them.
X.3 Unprovenanced Finds

In tables 43, 47, 49-50 and 52 the category 'other' relates to finds, other than surface finds, that cannot for one reason or another (e.g. disturbance of the deposit) be securely attributed to horizon.

X.4 Tables of Tendency

These tables, nos. 14-7 and 25-7, deal with the significance of the differences between the frequency of occurrence of specific pottery features in the different horizons of sites To.1-2 and 5-6. The different categories of horizon used in the analysis are distinguished by the letters A-D, which are explained in detail in chapter V, pp.102-4.

The tables record the results of statistical treatment of the raw data, as explained in Appendix IV.

The arrow-like symbol signifies greater frequency of occurrence in the higher horizon when the open end is up, smaller frequency when the point is up, of varying degrees of significance.

The + sign accompanying the thick arrows means that the difference between the two horizons is a significant one.

The ? sign means that the difference is possibly significant only.

A thin arrow means that the difference is not significant.
X.5 Graphs of Percentage Occurrence of Rim Features

There are two tables of these, 18 and 19. At the top of each graph there is a letter, A-D, signifying the type of horizon employed in the analysis in question, as explained in detail in chapter V, pp.102-4.

The vertical axis on the individual graphs represents time, the bottom early, the top late. The intercepts represent the percentage occurrence of a particular feature for each horizon at a particular site and are arranged stratigraphically, a higher horizon upper on the graph, a lower horizon lower. Thus at the same time the relative importance of a feature within any horizon can be judged from the size of the intercept belonging to it and the behaviour of that feature over time seen from the relative length of intercepts belonging to different horizons. This behaviour is symbolised in the arrows for each feature at the left of the graph, upward-pointing for decreasing occurrence over time, downward-pointing for increasing occurrence.

In cases where a particular stratigraphy is not consistent with the general trend of behaviour of a feature over time, the intercepts are arranged according to trend and the appended Roman numerals represent the stratigraphic order of the horizons.

Where values for two horizons are the same, the intercept is thickened and terminates in a cross line.
The origin of a graph (o) is at the top of the vertical axis where a feature becomes less common over time, at the bottom if it becomes more common. This arrangement means that similar values at different sites are graphed on the same line, higher values at one site nearer the top or bottom of the graph than lower values at another site, as appropriate. Such comparability allows the seriation in terms of particular features of the different horizons of different sites to be appreciated at a glance.

X.6 Shell Analyses by Count and Weight

The relevant tables, nos. 53-8, are set out as explained in text table X.1, p.295. For sampling procedures see chapter X, pp.293-5.
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mainly Tridacna

134 Files
branch coral and sea urchin, with one item of worked shell

135 Coral Sculpture (?)

136-7 Stone Implements

136 Grinders and polishers, file, cutters, hammerstone, net sinker, bowling stones

137 Grinding stone and hammerstone

138 Pumice Grinders and Polishers
APPENDIX XII

EXPLANATION OF CONVENTIONS USED IN LINE ILLUSTRATIONS OF POTTERY

1. The exterior of the vessel is always to the right.

2. A line of dots on a pottery profile marks a zone of decoration.

3. The following symbols above a rim refer to orientation:

   A. orientation certain to degree
      a horizontal line ———

   B. orientation certain within a range
      \[ \rightarrow = -1/-2 \]
      \[ \rightarrow = -1/0 \]
      \[ \rightarrow = -1/1 \]
      \[ \rightarrow = 0/1 \]
      \[ \rightarrow = +1/2 \]

   C. orientation certain to tendency only, inward or outward
      \[ \rightarrow = \text{inward} \]
      \[ \rightarrow = \text{outward} \]

   D. orientation completely uncertain
      ?