To H.M. King Taufa'ahau Tupou IV.

Your Majesty,

It is a great pleasure and honour for me to convey to your Majesty this record of my work in Tonga all too many years ago.

With deep respects,

[Signature]

Sohn other copy
29.3.85
His Majesty King Taufa‘ahau Tupou IV
C/- Palace Office
Nuku‘alofa
Kingdom of Tonga

Your Majesty:

It gives me great pleasure to send to you a book on the early history of your Kingdom, which has just been published in this Department. It is written by Dr Jens Poulsen and based on archaeological researches which he carried out on Tongatapu when a student of this University over 20 years ago. It is an expression of appreciation by Dr Poulsen and myself for all the help and kindesses received.

The story which Dr Poulsen tells is important for our understanding of the history of the peoples of the South Pacific. I hope you will find it makes a contribution to the Tongan People’s knowledge and appreciation of their own past.

With the highest respect

(Jack Golson)
Professor of Prehistory

Encs
The Chairman  
Tongan Traditions Committee  
The Prime Minister  
HRH Tu‘i Pelehake  
C/- Palace Office  
Nuku‘alofa  
Kingdom of Tonga

Your Royal Highness:

I am sending you the enclosed volumes on the early history of Tonga which have just been issued by this Department. They are the work of Dr Jens Poulsen and are based on archaeological researches which he carried out on Tongatapu more than 20 years ago, when a student at the University.

The gift is in appreciation of your Committee’s support for his work so many years ago and in the hope that we may continue to be associated in the same way in the study of the history of the Kingdom.

With the highest respect

(Jack Golson)  
Professor of Prehistory

Encs
Terra Australis reports the results of archaeological and related research within the region south and east of Asia, though mainly Australia, New Guinea and Island Melanesia - lands that have remained terra australis incognita to generations of prehistorians.

Its subject is the settlement of the diverse environments in this isolated quarter of the globe by peoples who have maintained their discrete and traditional ways of life into the recent recorded or remembered past and at times into the observable present.

Cover map ‘Hollandia Nova’, Thevenot 1663 by courtesy of the National Library of Australia
EARLY TONGAN PREHISTORY
the Lapita period on Tongatapu and its relationships

Jens Poulsen

Volume I - Text

Department of Prehistory, Research School of Pacific Studies
The Australian National University, Canberra
1987
FOREWORD

Jens Poulsen was born in Copenhagen in 1932 and graduated with an MA in Scandinavian archaeology and European prehistory from the University of Copenhagen in 1962. During his student years he had training in fieldwork and museology (at the Danish National Museum) and directed an archaeological survey in northernmost Norway for the Tromsø Museum. His MA thesis on necklaces of the pre-Roman Iron Age in Scandinavia was supervised by Professor C.-J. Becker.

In earlier years, from 1948-51, Poulsen sailed as a deckhand on small trading vessels in the Baltic and on the full-rigged training ship Danmark in the Atlantic. It was inevitable that as a sailor and a Scandinavian he should be inspired by Thor Heyerdahl and the Kon-Tiki voyage. It was thus logical that when as a student of prehistory he was attracted to work away from Europe, somewhere where archaeology was at its beginnings, his attention was drawn to the Pacific as a result of Heyerdahl’s researches there. He came to the Australian National University as our second research scholar in prehistory in early 1963. His topic was to follow up promising indications revealed by previous rather small-scale excavations in Tonga for the study of what is now well known as the Lapita Culture of the Southwest Pacific.

By the time he submitted his PhD dissertation on his Tongan researches in 1967, he had returned to Denmark to take up a post in the Institute of Prehistoric Archaeology and Ethnography at the University of Aarhus. Established by the late Professor P.C. Glob in 1949, this institution was at the time of Poulsen’s appointment under the leadership of the late Professor Ole Klindt-Jensen. Since 1972 Poulsen has been a senior lecturer there. His major responsibilities are concerned with teaching and research on the European Bronze Age. His involvement with Pacific archaeology has in the main centred on the preparation of the present monograph, to which he devoted, over the years, much time and energy. In addition, he did archaeological fieldwork in 1968 on the Polynesian outlier of Bellona in the Solomon Islands, which, with its sister island Rennell, has been a focus for Danish research since the days of K. Birket-Smith. He also continued for a time to contribute to conferences and publications on Pacific prehistory.

There have been tremendous advances in our knowledge of the prehistory of the South Pacific since Jens Poulsen wrote his doctoral dissertation and it is to his credit that, although now far removed from the Pacific scene in an academic as well as a geographical sense, he set out in his rewriting to take note of the more important of these. Some of the questions which were current when he began his work have been answered, with his help, and new ones have emerged. The revision of his dissertation which he presents in this monograph does not directly address these new questions, but the abundant data from his Tongan researches, here comprehensively treated and fully illustrated, provide important evidence in their consideration.

The appearance of the monograph is particularly appropriate in the light of current interest in the manifestations of the Lapita culture throughout the Western Pacific, since it gives us the details of one of the richest and most thoroughly investigated examples to date.

Jack Golson
I carried out the archaeological fieldwork on which this monograph is based between September 1963 and September 1964, when a research scholar in what was at the time the prehistory section of the Department of Anthropology and Sociology in the Research School of Pacific Studies at the Australian National University. The PhD dissertation in which the results were presented was submitted in December 1967, under the title *A Contribution to the Prehistory of the Tongan Islands* (2 vols).

Because of the richness of the excavated materials, I planned early publication of the dissertation as it was, unaltered, but financial circumstances were against it, especially because of the large amount of tabulated data. As a result I prepared the methodological sections of the dissertation as a separate publication, which appeared in 1972 (*On the Processing of Pottery Data*, Jysk Arkaeologisk Selskab, Haandbøger II, Aarhus). At the same time, in the light of the immense potential of computer manipulation of data of which I became aware when a doctoral student, I was encouraged to think in terms of a reorganised computer analysis of the site context of the ceramic information from my excavations. The purpose was to rework and refine the pottery sequence I had established and I prepared for this during 1970 and 1971. When the operation got under way during the early 1970s, I was able to take full note of the implications of a paper published by L.M. Groube in the *Journal of the Polynesian Society* for 1971, in which, in the light of his recent work in Tonga and new evidence from Fiji and Samoa, he made important criticisms of my original interpretations of my radiocarbon results. Indeed I was fortunate enough to be able to work with Groube himself for some weeks at the end of 1971 and the beginning of 1972 in Aarhus, reviewing the results of our independent fieldwork in Tonga.

The reassessment of my excavation records which I undertook came to provide a firm basis not only for the ceramic reanalysis on which I had embarked but also for the reinterpretation of the rich non-ceramic evidence, artifactual and non-artifactual, which became necessary. At the same time, with the help of the computer, I began to explore other aspects of the ceramic data than those related to sequence-building and Chapter IV of this monograph, on the nature of Tongan Lapita pottery, is the ultimate result.

Meanwhile, of course, research in Pacific prehistory relevant to my own specific work on the Tongan materials was taking place and being published. The end of the 1970s saw the the opening up, so to speak, of the world of South Pacific archaeology through the publication of works of synthesis and generalisation, Peter Bellwood's *Man's Conquest of the Pacific* (1978), Jesse Jennings' edited volume *The Prehistory of Polynesia* (1979) and Geoff Irwin's article on Oceania in the *Cambridge Encyclopaedia of Archaeology* (1980). However, I have made no attempt to deal with the hypotheses about the nature of the Lapita phenomenon in the Southwest Pacific first given extended treatment there. I have made use of publications later than 1978 only when they report relevant archaeological data from the Western Polynesian region which is my focus and for the purpose of external comparisons of Tongan artifacts. In all cases I have not carried this exercise essentially beyond 1980.

All the excavated material reported on in this monograph is stored in the Department of Prehistory, Research School of Pacific Studies, Australian National University, until such time as it can be transferred to the care of a museum in the Kingdom of Tonga itself. Likewise, copies of all the essential computer printouts relating to the ceramic analysis are on file with the Department.

Jens Poulsen
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   M. Sterns
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C.A. Key

Temper Sands in some Tongan Lapita Sherds
W.R. Dickinson

Petrology of some Stone Adzes from Tongatapu, Tonga Group
A.J.R. White

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R.M.S. Taylor

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ACKNOWLEDGEMENTS

The archaeological project now published has, like all archaeological work, made great demands upon the assistance and goodwill of many people, both during the year-long fieldwork in Tonga and the many years of analysis that followed. I should like to express my thanks to everyone who in one way or another has shared in whatever contribution the present work makes to our knowledge of the prehistory of Tonga and the South Pacific.

I have divided my acknowledgements into two sections. The first section relates to Stage 1 of my Tongan researches, the fieldwork and its analysis and presentation in thesis form. People are acknowledged in the positions they occupied when they helped me during those years (1963-67). The second section relates to Stage 2 of the work, the preparation of the revised and expanded version that I present here. Again people are thanked as they were when they provided me the help which I acknowledge. Where specific help was given, acknowledgements are repeated in appropriate places in the text.

In the field

Tonga, general

H.M. King Taufa'ahau Tupou IV
H.R.H. Tu'ipelehake
The Royal Family (for permission to investigate Site To.6)
Mrs Leafa'a, Tokomololo, widow of the late chief Tu'ih'a'ateiho; Hon. Lavaka, late chief of Pea; Hon. Ve'ehala, Keeper of the Palace Records
Mr M. Challons, Secretary to Government; Mr E.J. Coode, British Consul; Mr and Mrs K. Helu; Messrs H. and T. Helu; Mr P. Kaufman, alias Tavi; Mr Kilisimasi, Chief Dentist; Dr S. Latukefu; Dr H.A. Rehder, Smithsonian Institution, Washington; Mr J. Richelman; Mr H.N.H. Statham of Canberra
'Atele College
Mr H. Hopkins, headmaster
Ha'ateiho
Mrs S. Mafi; Mr T. Masima; Mr Sevelo
Havelu
Mr and Mrs Brown, Tonga Copra Board
Nukuleka
Mr A. Moala
Pea
Mr and Mrs H. Finau, Pea Middle School
Tupou College
Mr Manisela

Fiji, Suva

Mr J.B. Palmer, Director, Fiji Museum
Out of the field

Australia

Australian National University, Canberra

Department of Anthropology and Sociology: Professor J.A. Barnes, Miss L. Fuller, Mrs D. Gregory, Miss L. Howard, Mr C.A. Key, Mr D.J. Mulvaney, Mr H.N.H. Statham, Mrs L. White; in particular Mr W.R. Ambrose, who prepared the photographs, and Miss W.I. Mumford, who devoted much patience and skill to the line drawings; also Mr C.L. Cram for his help with the faunal remains.

Department of Chemistry: Mr G. Kolar; Dr M. Sterns

Department of Geography: Mr A. Maude

Department of Geology: Dr K.A.W. Crook; Dr A.J.R. White

Department of Geophysics and Geochemistry: Dr J.F. Lovering

Department of Statistics: Dr D. Vere-Jones

Central Store: Mrs E.C. Lynch

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Data Processing Unit: Mrs S. Darius; Mr P. Wilson

Radiocarbon Laboratory: Mr H.A. Polach

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Canberra

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Monash University, Melbourne

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Stage 2
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I have already mentioned in my Preface the importance of the 1971 article of Mr L.M. Groube (then Department of Prehistory, Research School of Pacific Studies, Australian National University) and my subsequent discussions with him in Aarhus. Mr and Mrs L. Birks of Auckland kindly provided me with information about their archaeological work in Tonga and Fiji. Mr J. Craib, at the time with the Department of Anthropology, University of Auckland, made valuable comments on and additions to my review, in Chapter VI, of Micronesian parallels to Tongan artifacts. I had the benefit of discussions with Dr J. Garanger, Centre National de la Recherche Scientifique, Paris.

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Jens Poulсен
NOTE ON CROSS-REFERENCING AND NOMENCLATURE

Cross-referencing

The structure of the monograph has meant the need for much cross-referencing. This is done by giving numbers to the subdivisions of each chapter listed by headings in the Table of Contents. A cross-reference to a chapter and section in the text can be traced by reference to this enumeration in the Contents. Cross-references which do not cite a chapter refer to sections of the same chapter in which they appear.

Geographical names

While the monograph was being prepared, some Pacific island groups became independent and adopted new names, which I have used throughout the text.

Kiribati = Gilbert Islands
Tuvalu = Ellice Islands
Vanuatu = New Hebrides
I THE RESEARCH AND ITS CONTEXTS

THE BACKGROUND

At the time I began my Tongan researches in 1963 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*, drawing its evidence mainly from the fields of material culture and Polynesian traditions, won acceptance as a classic statement (Buck 1938a, cf. Buck 1959).

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 (Elbert 1953; Emory 1963), while dirt archaeology made its belated entry on the South Pacific scene. Initially, archaeological efforts were confined to Melanesia (Gifford 1951; Gifford and Shutler 1956), though on the basis of archaeological studies in New Zealand, allowing some time depth to be given to the rich material culture of those islands, Duff (1950) attempted a reinterpretation of the Polynesian evidence in general. 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 (1959a). The results achieved by excavations in the Marquesas were so illuminating that in 1960, ahead of his excavation report from that group, Suggs (1960) was able to offer a new view of Polynesian culture history based on the archaeological findings and their attendant radiocarbon dates.

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 Western Polynesia, Tonga and Samoa, were the first to be settled and they constituted the point of departure for the earliest settlement of Eastern Polynesia. This itself was an important modification of the thesis put forward by Buck (1960: 65, 67-72, 150) that the Society Islands of Eastern Polynesia were the dispersal point, or Hawaiiki, for the settlement of all the Polynesian islands, including those of Western Polynesia. Indeed, in the light of his archaeological discoveries in the Marquesas, Suggs (1960: 104-6, 109-23) could claim that within Eastern 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 including pottery, the first to be discovered in Eastern Polynesia, to archaeological and ethnographic material recorded for Western Polynesia and Melanesia. This evidence for connections between the early Marquesas on the one hand and Western Polynesia and Melanesia on the other Suggs used also to support the argument that the distinctive cultures recorded for Western and Eastern Polynesia in modern times had developed, in geographical isolation, from an ancestral culture initially homogeneous and that this ancestral culture shared something in common with the Melanesian cultures to the west.

The cultural differences that exist between Western and Eastern Polynesia had been made the subject of an important study by Burrows (1938), who suggested that historical processes such as diffusion from contiguous culture areas of different character, local development and the abandonment and rejection of traits could convincingly account for the differentiation. Looking at this question again in the light of newly won archaeological data, Golson (1959a:17-19, 50-51) had suggested that the differences were more basic and stemmed from the impact of East Asian influences in Eastern Polynesia which failed to penetrate the west. These he saw reflected especially in the gripped adzes and sophisticated bait-hook fishing gear
of Eastern Polynesia, which appeared to be absent from Western Polynesia but were paralleled in the maritime regions of East Asia. Golson also suggested a possible prehistoric relationship between the areas now called Polynesia and Melanesia, particularly in terms of that apparently non-Polynesian item of material culture, pottery.

Pottery was described in use in Tonga alone of the Polynesian islands by early European visitors (cf. Groube 1971:293-95 for details) and during his archaeological survey of 1920-21 McKern found potsherds abundant in kitchen middens on Tongatapu and neighbouring islets (McKern 1929:106-19). Two circumstances, the absence of pottery 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 (McKern 1929:116-19), 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 18th century (Derrick 1950:120-25). The discovery of pottery in early levels in Samoa (Golson 1959a:28) and the Marquesas (Suggs 1961:95-97) prompted re-examination of the status of the Tongan ware.

Following his fieldwork in Tonga, Golson was able to suggest that Tongan pottery was of local manufacture and belonged to a single ceramic tradition which had little in common with the late pottery of Fiji (Golson 1961:174-76). 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 possible relationships for it, by virtue of the character and motifs of its pointillé decoration. These possible relationships were with McKern's Tongan pottery on the one hand and on the other with discoveries within the geographical Melanesian area, comprising surface sherds from a site on Viti Levu in Fiji and, in particular, material excavated in the early part of the century by Father Meyer on the island of Watom in New Britain (Gifford and Shutler 1956:94). Golson noted that a considerable antiquity (first millennium BC) and an apparent priority in the local sequence could be ascribed to Gifford's Site 13 pottery in New Caledonia on the basis of radiocarbon dates and, after his own excavations on the Ile des Pins, from archaeological indications also (Golson 1961:169-70, 176). He therefore suggested the existence of an ancient community of culture in the Southwest 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 Eastern 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 my project therefore was to recover pottery from as long a time range of Tongan prehistory as possible and to assess whether there was any phase of that prehistory when pottery was not in use. On the basis of adequate pottery collections it would be possible to judge whether the Tongan material in fact belonged to one ceramic tradition only and, if so, to judge its relationship to the material from New Caledonia, New Britain and Fiji with which it had been compared. If this hypothesis was not confirmed, the extra-Tongan affiliations and intra-Tongan relationships of the divergent pottery traditions could be investigated. 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 the 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 and mounds (McKern 1929:10-33, 80-89), came to be investigated.

**GEOGRAPHY AND HISTORY**

The brief account given here is minimally changed from that of my original dissertation (Poulsen 1967a:8-21). This was based on Gifford 1929, Naval Intelligence Division 1944, Kennedy 1959 and Tonga 1965, with specific references given only in special cases. Subsequent publications of relevance are Rutherford (1977) on history, Maude (1973) on human geography and Taylor and Bloom (1977) and Bloom (1980:510) on geological evolution.

**Geography: general**

The Tongan archipelago (Fig.1a; see the map in Appendix 7 for the wider setting) 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, Niutatputapu and 'Ata being beyond these limits. The total land area is about 700 km². Excluding the three outliers, 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 100-120 km of open sea from the other two.

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 western Pacific (see the map in Appendix 7) and is thus distinguished from the truly oceanic islands to the east of this line where basaltic lavas and reef limestones constitute the geology (Bryan 1963; Thomas 1963:9-10).

Within the archipelago there are three types of islands:

1. 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 up to 1030 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 (kiliki) for the decoration of chiefly graves (McKern 1929:31), something that was done with the grave of the late Queen Salote (Pacific Islands Monthly April 1966:12). Today the small pebbles are also collected for use as grouting in concrete.

2. 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 50 to 330 m and include the Nomuka group in Ha'apai and 'Eua near Tongatapu. The last island has been investigated geologically in greater detail than any other island in Tonga (Hoffmeister 1932). The geological sequence is made up of old volcanic rock at the base, of foraminiferal limestone next, 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, or dykes, have as a result been open to exploitation for raw materials by Tongans in the past (cf. Appendix 7).

3. 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 6 m high, and the raised coralline islands like Tongatapu and Vava'u, the latter with its 223 m elevation being the highest in this category.
The soils of Tonga are rich and fertile and cultivated land occupies a larger portion of the total area than is usual in 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 normally found on limestone islands owing to the greater mineral content of the volcanic element. This is, for example, the case on Tongatapu, the only island where the soils have been analysed in any 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. Their total depth 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 clays 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 (cf. Appendix 5).

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 increasing intensity from south to north (Naval Intelligence Division 1944: Figs 11-14). The average annual rainfall for Tongatapu and Ha'apai is 150-180 cm whereas in Niuafo'ou, northernmost in the group, it is almost twice as much. 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 21° and 27°C, the extreme high and low temperatures never exceeding 32° and 10°C respectively.

Natural supplies of fresh water are scarce in Tonga. There is one permanent stream on Niutatoputapu, 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. The normal way of obtaining water is to dig wells and to collect rainwater. In former times rainwater collecting was done in pits dug into clay soil or lined with clay (McKern n.d.: 411-12).

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 (Zimmerman 1963). Wild vegetation now occupies a relatively small proportion of the total land area, being mostly confined to hilly regions and being best seen on Vava'u and 'Eua. The latter island is the only one where rainforest 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 (e.g. Barraud 1961:18). 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 sugarcane and kava. But, like other groups, Tonga occupies a place in regional patterns of varying plant significance (Barraud 1961:19). Thus the sweet potato is of less and the yam of much greater popularity in Western Polynesia than in the east (Barraud 1961:44-46, 53). The kape tubers (Alocasia macrorrhiza) have a particular traditional importance in Tonga and Uvea (Barraud 1961:19). Important plants include 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 materials for a wide range of construction and handicraft purposes are 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 (Kennedy 1959:42-44).
As with other Pacific islands, the terrestrial fauna of Tonga is poor (e.g. Zimmerman 1963), 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 (McKern 1929:19-30). Traditionally, animal foods appear not 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 (Urban 1961:17-18).

The Polynesian rat (*Rattus exulans*) had, however, been introduced in prehistoric times. According to Mariner (Martin 1827a:225), 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.

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 (Gifford 1929:131).

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 (Vaea and Straatmans 1954). In addition the reefs in general offer good catching grounds for other important items of sea food, such as crab, crayfish, 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 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 coraline 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 18th and 19th centuries ventured far beyond their home waters to Fiji and Samoa, some 400 km and 800 km away respectively, to mention two major examples (Dening 1963:110). The record of the famous voyage of the Tongan Kau Moala at the beginning of the 19th century serves to illustrate the navigational skill and seamanship which make plausible the claims for long-distance contacts between Tonga and the external world in prehistoric times (Dening 1963:131; Parsonson 1963:29-30). 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 (Gifford 1929:46-47, 181). Since fieldwork was concentrated on this island, it will be useful to have a more detailed description of its geography.

**Geography: Tongatapu**

Tongatapu is a raised coraline island, about 260 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 low-lying and protected. made up of sand beaches and mangrove swamps. In a southerly direction the land gradually rises, attaining a maximum height of about 65 m in the area of the airport near Fua'amotu. This is the result of a complex geological history, rather than, as previously proposed, the simple consequence of tilting to the northwest (Taylor and Bloom 1977:278). 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 Hufangalupe beach from a height of perhaps 40 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 freshwater pools close to the entrance. The fringing reef is quite close to land on the liku coast, some 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 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, so that a person can touch bottom in most places. Shell fish can be collected in abundance everywhere, in the lagoon and at 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.

At the time of my work the population of Tongatapu was about 32,000, giving a density of about 123 persons per km². This represents a considerable increase by comparison with the figure of under 10,000 presented by Gifford (1929:4-5, Table I) for the period 1840-1921. Green (1973) reviews the considerable amount of work that has been done in recent years on Tongan demographic history. This suggests a decline of population in the first half of the 19th century as a result of war and disease following on regular European contact (Green 1973:62-64). Green's best estimate (1973:72) for the population of Tongatapu in the late 18th century, based on the requirements for arable land in a cultivation cycle involving bush fallowing, is 15,000-17,000.

History

The Tongan islands were discovered piecemeal by European voyagers: Niuatoputapu by Schouten and Lemaire in 1616; 'Ata, Tongatapu and Nomuka by Tasman in 1643; Vava'u by Maurelle in 1781; Niuafo'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 18th 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 centralised system of government and a stratified society made up of the royal family, chiefs and commoners (Gifford 1929:48, 108). From traditions and genealogies subsequently collected (Gifford 1929:49-51), this seems to have been the case for some centuries previously: on genealogical reckoning the king list can be carried back to the 10th 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 (Gifford 1929:12, 49). The traditions have also been interpreted to show that over many centuries a steady trickle of
immigration took place from Fiji, Samoa, Rotuma and Tokelau. More important additions are said to have been made from Fiji about AD 1200 and in the 16th and 17th centuries, and from Samoa in the 16th century (Gifford 1929:13-14). 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 purpose of tribute. Rotuma still had to pay tribute to Tonga as late as 1824 (Gifford 1929:12). Many Tongans are said to have married and settled in Samoa, and before AD 1250 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 (Derrick 1950:120-25).

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 (Gifford 1929:5-8, 45). The origin of the present pattern of village settlement is explained by reference to the highly unstable political conditions of the first half of the 19th century, characterised among other things by civil wars throughout the islands. Under these circumstances people gathered together to live in nucleated settlements for the sake of safety. It has been suggested that Tongan forts with ditch-and-bank defences (McKern 1929:80-89 describes 19 fortifications from all three island subgroups, 12 of them situated on Tongatapu) reflect this change in the settlement pattern (Golson 1961:173; Davidson 1965:63). If so, they should all be late in date. However, the defence at the former royal domain at Mu'a would on genealogical grounds be dated to the 14th century AD, an antiquity consistent with the fact that the defence works tie in with an old shoreline of the lagoon (McKern 1929:100-1). Of course, 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 19th 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 (Gifford 1924; Koch 1955). The sequel will show some of the areas in which change has occurred.

### SITE RECONNAISSANCE

Work was concentrated on Tongatapu for a number of reasons. It is the most fertile and largest of the Tongan islands and traditionally the most important. Archaeologically it appeared to be the most promising. Sites producing pottery, which was intended as the major analytical tool, were abundant here, to judge from the fieldwork of McKern (1929:102-12) and Golson (1957:7-11; 1961:173-74). Indeed, Tongatapu with its offshore islets and the neighbouring island of 'Eua was, at the time, the only part of Tonga for which pottery had been reported archaeologically. Although Cook had observed pottery on Nomuka in the southern part of the Ha'apai group, of the same sort as that on Tongatapu, which was supposed to be of local manufacture (Beaglehole 1961:451), and Mariner (Martin 1827b:117) had seen pottery, said to be imported from Fiji, in use on Vava'u, there were in 1963 no reports of potsherds from the northern islands.

A variety of archaeological field monuments had been described for Tongatapu by McKern and Golson, including royal tombs (langi), chiefly burial mounds (fa'itoka), royal and chiefly resting platforms ('esi), pigeon mounds (sihaheulupe), fortifications, 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 planned project were offered by this last category, which regularly associated easily recognisable shell with abundant potsherds and other cultural materials (Golson 1961:173). Such refuse middens ought also to record the continuity or discontinuity of pottery use in Tonga.

Site reconnaissance followed up leads given by members of the Cadastral Survey to Golson and
by Tongan and European residents to myself, and straightforward field survey was undertaken as well. It soon became apparent that the most numerous and productive midden sites were in the area of the lagoon, the region on which McKern and Golson had concentrated. Within this area two districts seemed, from the frequency and nature of the sites, to be promising: the village area of Pea, Ha'ateiho and Tokomololo, and the Nukuleka peninsula at the eastern side of the entrance to the lagoon (Fig.1b).

Evidence of the nature and intensity of habitation evidence in inland areas and along the south and east coasts (the liku coast) was less apparent. Members of the Cadastral Survey had reported a few sites with sherds near this coast north of Haveluliku, but these could not be relocated on the available information. A few surface sites were discovered in this area with a handful or so of tiny sherds (all undecorated) but with no shells. Some stretches along the southern liku coast were searched, but no pottery was found. At the farthest point of the Kolovai peninsula to the west a few sherds were found together with a few shells. Traversed also were 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 a hundred mounds are reported to have been destroyed and various artifacts, including pottery, found, but any such material had 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, a strategy I was fortunate to be able to discuss on the spot in 1963 with Roger Green of the Department of Anthropology, University of Auckland.

The area of investigation selected comprised the villages of Pea, Ha'ateiho and Tokomololo, situated within a convenient distance of headquarters in Nuku'alofa (Fig.1b). 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 fortification (McKern 1929:86-87) and a remnant in Ha'ateiho village apparently comprising more than one line of defensive work.

The district is a flat and low-lying area of about 10 km², the bed of a former extension of the lagoon, bounded 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 being remembered as occurring about 1912. Scattered occurrences of old raised shorelines are characteristic of the district. The present shoreline is an extensive mangrove swamp. The only two open-air freshwater 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 frequency of decorated sherds. Golson (1961:174) had reported the proportion of decorated to undecorated pottery in his sites to be very small (less than 1%), a ratio strikingly at variance with a 37% occurrence at the Lapita site (Site 13) in New Caledonia (Gifford and Shutler 1956:71) and apparently also with the situation at Meyer's site on Watom Island (Meyer 1909, 1910 and manuscript notes deposited by Meyer with his collections in the Département d'Océanie, Musée de l'Homme, Paris, subsequently described by Specht 1968). If, as Golson suggested, the Tongan pottery was in the same tradition, a higher proportion of decorated to undecorated sherds than that reported by Golson would
possibly identify a site as older than those investigated by him and others in Tonga. The complexity of decoration as well as its frequency was also carefully noted. Equal attention was paid to the possible occurrence of shell middens without pottery, but none was located.

The only excavation undertaken outside the district was at Nukuleka (To.2), situated at the eastern entrance to the lagoon and thus within easy access of both shallow-water lagoon and offshore fishing (Fig.1b). It was hoped that excavation here might provide evidence of fishing gear, absent at the preceding excavation at Site To.1 on the inner lagoon. In addition, since the midden at To.2 formed part of a circular mound with flattened top, there was here an opportunity to investigate a mound. The limited investigations of two other mound sites, To.3 and 4, in the centre of the main district, were also influenced by this consideration.

These mounds, one of the most characteristic archaeological remains on Tongatapu (McKern 1929:10-33), are very numerous: they may easily total between 1000 and 1500. They seem to be present everywhere, scattered or in groups of a few or many, of varying types and sizes. In Ha'ateiho village some 15 mounds were located. A few sherds were occasionally picked up from or near a mound, while, 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 their own right, demanding substantial resources and teamwork if the many and important problems attaching to them were to be attacked efficiently. The same consideration also applied to the third comprehensive group of field monuments in Tonga, the fortifications.

Summary

In order to obtain sufficient material for the construction of a pottery sequence, work was concentrated on shell middens. Early reconnaissance indicated that the lagoon shores constituted the most promising region. A small area was chosen for intensive work as being more likely to produce the required material than scattered investigations. The district selected, in and near the villages of Pea, Tokomololo and Ha'ateiho, is a flat and low-lying area bordered on three sides by uplifted terrain, on the fourth by the lagoon. The investigated sites cover the western and eastern 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 were situated in inhabited areas, Sites To.5 and 6 in gardens and/or bush. Site To.2, the only one 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 landscape. In contrast, Sites To.2 and 3 are elevated and the original middens have 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, while To.4 was included for the same purpose. To.2 was excavated also with the aim, unfortunately not realised, of recovering items of prehistoric fishing gear.
II THE EXCAVATIONS

FIELD TECHNIQUES

Excavation

Three methods of excavation of shell middens are theoretically possible: by original midden layers; in units of arbitrary, standard volume, so-called spits; by a combination of these two basically different methods.

Obviously excavation of the first kind could proceed normally on sites with a clear stratification but would be quite difficult with unclear stratigraphy. In the latter situation good results would depend on the time available and the skill of the archaeological personnel. The circumstances of the 1963-64 fieldwork 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 had to 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 sufficiently well. Any such method should allow 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 modification of the precise stratigraphic approach arose from the consideration that the trafficking of people, the digging of various kinds of holes and the displacement of midden material due to construction activities of all sorts would make it probable that some potsherds and other small objects had shifted position one or several times, both vertically and horizontally, through the lifetime 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 was judged to provide enough control for the elaboration of a sequence. The same argument about disturbance in fact applies also to clearly stratified middens unless the layers should prove to be separated by sterile zones, for example of beach sand or volcanic ash, providing protection.

The desired control was to be obtained by spit digging. 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 and recording the artifactual evidence by such units. The method of analysing the material from sites 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. An analysis of this type cannot give a completely true picture, but it will show trends of development and thus provide a satisfactory basis for the establishment of a sequence.

With wholly unstratified middens the only possible method of excavation 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 subsequent analysis to detect the details of a sequence in terms of the zonal distribution of evidence within a particular horizon, provided that sample size were satisfactory. So the idea of spit digging seemed to offer a good means of controlling the data from shell middens, whether stratified or not.

At the first excavated site, To.1, a combination of spit and stratigraphic digging was tried in the main trench, I, which was 2 x 19 m in area and with a midden thickness averaging 50 cm. Spits were 10 cm thick and dug in 1 m squares and the depth was regularly checked with a dumpy level. A separation was made at the interface between the two main midden deposits of the site wherever such occurred within a spit, so that finds were recorded both by spits and by original midden layers throughout this trench. Results were good, 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: topsoil, top horizon of midden, bottom horizon of midden, subsoil. It was clear that the artifactual evidence recovered in standard spits could be referred to its approximate distribution within the stratigraphy of the site simply by allocating the spits to the original midden layers recognised in the profiles.

In Trenches IV and V the method of excavation by standard spits exclusively, with profile drawing to record the original midden layers along both sides of the 1 m wide trench as a compensation for this less precise method, gave satisfactory results. The decision was therefore taken to apply this technique of excavation as a standard procedure on the midden sites subsequently excavated, 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 original layers should only take place in very exceptional cases, where circumstances were definitely in favour of this procedure and where layers could be recognised by the local labour without too much difficulty. In fact all the sites To.2-6 were dug mainly by spits and no doubt has subsequently arisen as to whether it was the correct principle to follow. 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.

Trowelling was used throughout the sites and all excavated ground was passed through sieves of 1/4 inch (6.35 mm) mesh. In all middens a distinction was made between special finds, whose positions were exactly measured in three-dimensions, and common finds, which were collected by spits. The exact position of a common find within a spit unit is thus unknown, whereas that of a special find is known. Special finds are all artifacts other than pottery but include exceptional pieces of pottery. Common finds comprise the bulk of the pottery and all unworked stone, bone and shell.

Cataloguing of finds

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 coordinate system of the excavation, the finds being numbered by m² units, the top spit (1) first. This concerns common finds of any kind. 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 the 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 manufacturing 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, combined for all sites.

Midden sampling

In order to gain some idea of the composition of sites, with particular reference to the representation of shell fish in the deposits, a sampling programme was instituted. Though this was not fully carried out as planned, samples were taken from all sites except To.4. The method was to remove spits in columns 50 cm square through deposits, but the depth of spits varied from site to site, as explained in the site reports which follow.

The exercise began at To.1, where 13 columns were taken, four of them 1 x 1 m, as well as
samples taken in a rather different fashion from the subsoil. At this stage the implications of systematic midden sampling began to be appreciated, in terms of the size of the middens, the number of samples required and the labour of processing. Since a project of this sort was not a main objective of the fieldwork, no more than two column samples were taken at subsequently excavated sites.

Following from the experience at To.1, where nine of the 13 columns were taken simultaneously with the excavation and it was subsequently discovered that all but one had been located in more or less disturbed midden, the location of the columns at other sites was selected only after careful study of the profiles, when excavation had indicated where undisturbed midden was present.

Pits and other disturbances

At all sites it was as a rule impossible to recognise the existence of pits, ovens and other disturbances in the horizontal plane of the dirty and shelly midden material. Before the excavation of each spit the surface of the excavation was always cleaned up to detect possible traces of differences in fill that would announce the appearance of disturbances, but without much success. This was true even in the main trench (I) at To.1, which was dug out by original layers as well as by spits and where an attempt was made to discover disturbances by detailed recording of the surface after the excavation of each level. All that this exercise showed was that the midden material of Horizon II always and continuously sealed in the material of Horizon I.

Everywhere, then, it was normally only at the surface of the subsoil that disturbances could be documented in plan. It was, of course, possible to recognise some of them in profile, but even when so recognised, it was in practice impossible to follow them in the horizontal downwards through the deposits. These difficulties are mainly explained by the fact that the material filling disturbances was as a rule identical with that of the surrounding midden horizons.

THE RADIOCARBON DATES

The reader will note in the sequel not only the small number of radiocarbon dates obtained during fieldwork which are relevant to the purpose of constructing a dated ceramic sequence, but also the uneven distribution of these within and between sites. This was because samples of proper charcoal were rare in the investigated middens and the charcoal samples dated all came from ovens, except for a pit containing burnt material in its fill. I wish to say something on both of these points: the nature of the samples and the structural context from which they were collected.

The problem of materials

Even though charcoal samples were collected for dating from ovens, these, as well as hearths built on flat ground, contained in the main only sticky, greyish ash and burnt soil, genuine charcoal being very rare. Powdered charcoal was often intermixed with shell-midden material, but it was impossible to separate adequate samples. At the time no techniques were readily available to deal with sooty soil samples (cf. Polach 1972).

Because of the preference for charcoal to other types of organic material for radiocarbon dating (cf. Polach and Golson 1966:27-32), the original submission of samples to date the Tongan sequence was limited by the factors just mentioned. In other words, dating choices were governed by the limited number of adequate charcoal samples that were available, rather than by strictly archaeological requirements.

The wisdom of this limitation seemed to be confirmed when two samples of different materials, shell and charcoal, from the same layer of the same structure of Site To.1, Trench I, were dated at the Copenhagen Laboratory as K-904 and K-961 and gave very discrepant results,
2770 ± 100 BP as against 420 ± 100 BP (Fig.6.2). As discussed later in the chapter (section 5.8), two samples of living shells from Tongatapu subsequently submitted to serve as a modern reference gave results which demonstrated the reliability of the prehistoric shell date. By the time this became apparent, however, the original Tongan dating programme was at an end.

The problem of context

The samples originally dated were collected from ovens and one pit and of such disturbances I have already said that their existence could not be picked up in plan in the midden layers and was normally only recognised when subsoil was reached.

Sometimes, however, their presence was registered in the temporary or permanent profiles of the excavation trenches, as can be seen in the profile drawings which illustrate the excavation reports. In no case did the evidence of the profiles give any clear indication that the structures in question had been dug from the ground surface above the sites. This conclusion was reached even though it was realised that activities of various kinds, particularly those associated with the gardening of sites, could have affected the stratigraphic evidence. As a result, radiocarbon samples from a number of structures were submitted in the full belief that they would date particular phases in the midden build-up and the associated pottery.

REWORKING THE CHRONOLOGY

Initial and revised interpretations

With radiocarbon dates of the type described, my original interpretation of the ceramic sequence revealed by the excavations was that it extended from the mid-first millennium BC almost to the time of the first European visit to Tonga in the 17th century AD (Poulsen 1967a:152-54; cf. Golson 1971:74-75).

In an important article a few years later Groube (1971) showed that this interpretation was untenable. Basing himself, amongst other things, on the results of his own excavations at Vuki’s Mound on Tongatapu and the logic of the total archaeological situation in the Southwest Pacific, which had itself become clearer with the availability of new data, he proposed a backdating of the Tongan ceramic sequence to, and essentially within, the first millennium BC. In his discussion he stressed the highly disturbed state of the pottery-rich sites in the vicinity of the Tongatapu lagoon, which meant that the digging of a pit or oven might have very little relationship to the infill and its artifactual contents (Groube 1971:295-97, 298-99, 301, 305-6). He therefore rejected a number of my dates from samples collected from such structures as validly dating pottery horizons, and reinterpreted some of the others.

Given the now demonstrated reliability of shells for radiocarbon dating in the Tongan context, he was able to select the best samples for testing his chronological propositions from the abundant shell materials from my Tongan excavations housed at the Australian National University. These best samples were of shell artifacts taken from secure cultural context at the base of To.2 and at an early stage of main midden formation at To.6, the former being the earliest, the latter the latest of my excavated sites by the evidence of the original ceramic analysis (Poulsen 1967a). Of these new radiocarbon results, which totally confirmed Groube’s hypothesis, the one from To.2, ANU-341, was published by Groube himself in the article referred to (1971:303), while the other, ANU-873 from To.6, is here published for the first time. They are discussed in detail in the appropriate sections of the excavation reports.
A new look at the structural evidence

The reworking of my data which I present in this volume has been done in the light of Groube's reinterpretation of the Tongan ceramic sequence. I have been particularly concerned to re-examine my field notes and drawings relating to structures, since it was evident that my initial allocation of pits to horizons was responsible for the misassociation of radiocarbon dates and cultural features which I have described above. More than this, however, pits in particular were of frequent occurrence at two sites and it was clearly important for proper interpretations of site use to reassess their stratigraphic relations at all sites where they occurred.

It was obvious that structures which on the evidence of radiocarbon dates were later than the formation of the midden into which they were dug had, for one reason or another, not left in the trench profiles clear stratigraphic evidence of the disturbance which they must have caused in the upper levels of sites. This being the case, I attempted to reassess the stratigraphic positioning of pits by a close inspection of my drawn cross-sections of the pits themselves. I compared the profile of the shaft of a pit with the profile of its observable top, which may of course be the real or only the apparent top. The assumption is that when the profile of the observable top is in direct continuation of the shaft, it is less certainly either the true top or close to it than when it is falling away from the line of the shaft profile and becoming rounded in shape. Furthermore, the profile of the observable top may give some indication as to the most likely construction level, when considered in relation to the amount of deposit above it to the ground surface. There is nothing, of course, to prevent observable tops which are in direct continuation of their shafts being as much true tops to pits as those which are rounded. In other words, it is only pits with observable rounded tops that can be safely allocated to an approximate construction level.

I have applied these principles to my analysis of structures in the excavation reports that follow.

INTRODUCING THE EXCAVATION REPORTS

These deal systematically with the location, outward appearance and observed stratification of the excavated sites. Since excavation was not primarily concerned with the study of midden formation in detail, the emphasis is on the isolation of the component horizons that 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, only the more important of which are described. When we come to the analysis of finds by horizon, the latter is sometimes called 'the investigation unit' or 'the analytical unit'.

Structures found within sites are discussed in some detail. At this stage the description of structures as early, late and the like is made in terms of the internal stratigraphy of a particular site. Some pits and many postholes cannot be allocated to horizon and are not normally therefore dealt with.

EXCAVATIONS AT TO.1

Site description (Figs 1b, 2; Plate 1)

This low-lying midden site is situated on the Middle School grounds in Pea village, about 400-500 m from the present lagoon shore. The shell midden was deposited on the surface of a barely visible natural elevation in a flat terrain 2 m above present water level in the lagoon. This 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 was probably part of the lagoon, as discussed in the section on stratigraphy below. 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 in the open, grass-covered school grounds. By the time of fieldwork school buildings and various houses and huts had been constructed on it and coconut palms grew here and there. From the evidence of some 200 test holes dug in the area there is a continuous cover of shell midden over at least 4300 m². Bulldozing to level the school playground had removed part of it to the north 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.

My introduction to this site was through an old man of Ha'ateiho village, called Sevelo, who kept some potsherds 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 now generally called dentate stamping. One of these belongs together with the sherds of Plate 44.3 whose union allows the reconstruction of the shallow bowl Figure 48.1, but because of damage to its edge it could not be physically joined to them. During a subsequent visit to the midden a considerable collection of sherds was picked up from the surface. Roughly 10-15% of these were decorated, also with dentate stamping. The high proportion of decorated sherds encouraged excavation.

**Excavation and sampling (Fig.2)**

Work started in December 1963 and lasted until April 1964. The working party consisted of four to six workmen, all Tongan, headed by the interpreter, Iteni Helu of Nuku'alofa. An Australian undergraduate, Nigel Statham of Canberra, was employed during December and January.

The investigation started with the opening of six test pits, each 1 m² in area. A total of 67.5 m² was finally excavated, i.e. about 1.6% of the total midden, in five trenches, I-V. Trench I was designed to allow the study of the formation of the shell midden in some detail and to experiment with various excavation methods. Trench II was located at the transition from the shell midden to the area outside. Trench III was dug to expose a burial located here. Trenches IV-V were dug partly because many fine decorated sherds were found in test holes here and partly to establish the excavation technique finally adopted.

Nine 50 x 50 cm column samples were taken from Trench I with the aim of characterising the composition of the midden, particularly as far as shell content was concerned. They were dug simultaneously with the excavation in spits 5 cm thick, but the distinction between the two main midden horizons was maintained. They were distributed quite arbitrarily, in Squares 82/57, 83/57, 82/58, 83/59, 83/65, 82/66, 83/67, 82/68 and 83/69. When the excavation of the trench was completed, it became apparent that only the sample from Square 82/58 (To.I/58) was representative of an undisturbed midden sequence at the site. The data from its analysis are spelt out in Table 1.

Four more columns of 50 x 50 cm were taken, in 5 cm spits, in 1 x 1 m test pits at the edge of the To.1 midden, outside the area of excavation: Squares 25/75, 50/94, 90/120, 115/95. Only one of these, Square 50/94, hit undisturbed midden of typical appearance and its analysis is set out in Table 2 (To.1/511).

Shell sampling in the subsoil was not carried out in the normal columns, as these were thought to be too small in size. Instead an area of 6 m² in Trench I, comprising Squares 82/57-59 and 83/57-59, was dug in three spits 10 cm thick.

Soil samples were collected from typical appearances of various kinds of subsoil in Square 83/56 of Trench I.
Stratigraphy (Figs 3-6; Plate 4)

Subsoil

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 1 m below the surface a pure hard clay begins.

The relationship between these clays is very complex and was only seriously studied in the principal trench (I). The top 40 cm of the subsoil is composed of two main formations, A and B.

Formation 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 give 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 found by excavation, one (To.1:3507, Plate 71.9) in the top 10 cm, two (including Plate 71.10) 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 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 in the centre of the trench (-/60 to -/62, Figs 3, 4), though typical pockets of each occur somewhat beyond this range.

Embedded in Formations A and B at 10-30 cm depth below the subsoil surface is an intermittent zone composed of distinct pockets 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. Some of these pockets also contained potsherds. These pockets have only been drawn, as an illustration, at two parts of the profile shown in Figure 4.

Formation C is below Formations A and B. It is 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 formations are visible in Plate 4.

K.A.W. Crook’s analysis of samples from them (Appendix 1) indicates for Formation A an accumulation in a shallow salt-water environment. Though Formation B has many of the characteristics of a deeply weathered soil, there is evidence of some movement of it by water. Crook suggests its development on low-lying land immediately adjacent to a lagoon bay. The underlying Formation C is a soil with some of the characteristics of Formation B, but no content undeniably derived from salt water.

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 site was being occupied at the time the area was lagoonal is unclear. However, the archaeological finds made in the subsoil, though not numerous, would seem to indicate a phase of occupation 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.

The analysis of shell samples from To.1, discussed in detail in Chapter VII, gives a useful clue
to the environment when Formation A was being laid down. *Anadara antiquata* (Tongan *kaloa'a*) is much more abundantly represented in the subsoil than in the midden samples. Its presence perhaps testifies to more tidally influenced conditions at that time in this inner region of the present lagoon area, a matter taken up more fully in Chapter VII (section 1.4). This interpretation is not at variance with Crook's comments in Appendix I on the conditions of accumulation of Formation A.

**Midden**

In the midden proper two main horizons were recognised. The earlier midden, Horizon I, was visibly more shelly than the later, Horizon II. The data from the shell-sampling columns S8 and S11 through undisturbed deposits show (Tables 1, 2) that the proportions of shell by weight in Horizon I were 20% and 12% respectively, in Horizon II 6% and 1% respectively.

**Horizon I** on the whole consists of one deposit only, a fairly compact and concentrated midden of shells, showing occasional layering. In general this 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 locally available coral rock (*Tongan makalohe*) are common but variable in occurrence (cf. the stone column of Tables 1 and 2). The deposit is also characterised 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 dark, rather compact and homogeneous, consisting of evenly distributed earth and small and large shell fragments. Complete shells are quite rare. Coral cooking stones are common, more so than appears from the 1.5% by weight calculated for shell-sampling column S8 (Table 1). The boundary between this deposit and Horizon I was quite readily recognisable. The upper deposit, the topsoil, is black soil with only scattered occurrences of complete and fragmentary shells plus crushed shells, and it is infiltrated with roots of grass, recent trees and shrubs. The border between these two deposits is diffuse.

This sequence was seen in all excavated trenches except Trench II, where only Horizon II was present and in fact fading out.

**Hearths and ovens**

Hearths are fires lit on flat ground and ovens consist of 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 later than Horizon I will be discussed in the section on pits below.

**Hearths**

In the main trench (I) at the site there were two examples of hearths, BL and BW of Figure 4. Hearth BL, visible in the profile around Square 54/67, 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 situated towards the bottom of Horizon I, partly covering the top fill of Pit Y. Only 3 m to the southeast of Hearth BL was found a concentration of 11.5 kg of closely packed coral cooking stones, on average 5 cm in diameter. This lay in the middle of undisturbed Horizon I midden in Square 82/69 and could belong either to Hearth BL or to some other feature in nearby unexcavated ground. The other hearth, BW, recognisable in all three profiles at the northern end of the main trench and thus not fully excavated, covered an area more than 2 m across. It rested on the surface of the subsoil at the bottom of Horizon I and was disturbed by the digging of Pit E and other holes. Five to 15 cm thick, it consisted at the bottom of partly sooty, grey-brown sand with coral and shell, at the top of a homogeneous
and very compact concentration of small crushed shell fragments, apparently burnt on the spot. This upper layer extended further than the lower and in the northeast corner of Square 82/55 surrounded a small but thick occurrence of finely crushed and burnt coral cooking stones.

Hearth BT, in the centre of Square 53/75 of Trench IV in Horizon I (Fig.5 for profile), was a small concentration of white sticky ash, 30 cm across and 4 cm thick, surrounded by a heavy concentration of Gafarium shells (Tongan to'o).

Hearth BN, in Square 62/75 of Trench V (Fig.5 for profile), was a similar but larger deposit, 100-150 cm across and 10-18 cm in depth. It was stratified, consisting at the top of finely crushed coral cooking stones, some light grey ash and also whole cooking stones. At the bottom was earthy shell midden with much powdered charcoal. A thick concentration of shell surrounded this hearth. It was situated towards the bottom of Horizon I and rested directly on the surface of an at least 3.5 m large, 10-20 cm thick and quite flat layer, DX, of typical Horizon I midden material containing much more charcoal than normal. DX was only recognised in the southern profile (-/76, see Fig.5) of the trench, so its extension into unexcavated area to the south was not established. It rested directly on the surface of the subsoil. These two contiguous and related structures, BN and DX, probably represent one and the same hearth in successive use within a short time.

Ovens

There were two oven depressions. Oven BV, in Square 60/75 of Trench V near to Hearth BN, was 75 cm across and 8 cm deep, situated towards the bottom of Horizon I. It contained white and sooty ash and cooking stones of coral. A small compact deposit of cooking stones was found just to the east of BV.

The other oven, BS, situated in Horizon I on top of the fill of Pit AL in Trench IV, was 100 cm across with a maximum depth of 15 cm. It was stratified, consisting at the top of light grey ash, at the bottom of very sooty midden earth, and lay to the west of a concentration of Tellina (Quidnipagus) palatam shells (Tongan mehingo).

Pits

A large number of pits was discovered during the excavations. Of those that could with certainty be attributed to horizon, there are eight belonging to Horizon I and 18 which were cut into Horizon I deposits. Only these 26 pits will be dealt with below.

Horizon I

These are restricted to Trench I, Pits E, W, Y, AC (Figs 4, 7), and Trench IV, Pits AL, AM, AP, AQ (Figs 5, 8). AL was definitely dug from the level of the subsoil, the rest apparently so, except for E, which was cut from the surface of the large hearth BW lying on the subsoil, and AC, which apparently was dug from within Horizon I. All of them as excavated are somewhat irregular. The outline tends to be rounded or elongated oval, except for Y (Plate 5, middle of left wall) which is somewhat rectangular, and W, which is so irregular that it may be two pits. The sides tend to be sloping to steep, except for AQ, where the excavated wall is vertical, and AP, where they range from sloping through steep to undercut. The bottoms are rounded or flat. 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 might have been cut from a higher level than the subsoil. Depths were measured from the surface of the subsoil unless a higher level of origin could be established. They vary between 30 and 50 cm, except again for W, which is only 20 cm deep. The fill of the pits was fairly concentrated shell midden as in Horizon I. 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, AP and AQ of Trench IV, which may represent some joint structure.

**Later than Horizon I**

Pit digging was much more pronounced in the later use of the site than during the formation of the first midden. The distribution of the later pits is somewhat different from that of the early pits in that the majority is situated in the area of the main trench (I) and the rest in that of Trenches II and III, while none was found in the intervening area of Trenches IV and V.

There are 18 later pits: A, M, N, P, S, M, X, AA, AB, AD and CJ in Trench I (Figs 3, 4, 6, 7; Plates 2, 3, 5); BO and CL in Trench II (Fig.5); and AE, AF, AG, DW and AH in Trench III (Figs 6, 8; Plate 6). They could not be recognised in the profiles above the surface of Horizon I. However, two radiocarbon dates from Pit A, discussed below, make sense only if that pit was dug through (and so is later than) Horizon II as well as Horizon I. In reworking my data, therefore, I paid particular attention to the nature of the contact between the later pits of the site and the Horizon I/Horizon II interface, where first they registered themselves in profile. Those pits whose walls had not begun to fall away as they approached that contact from below became candidates for having been dug from a higher level than the contact itself, in line with the reasoning set out in section 3.2 of this chapter. They include certainly (because of the radiocarbon dates as well as its profile) Pit A and possibly (because of their profiles) Pits M, P, S, AA and AD also in Trench I, BO and CL of Trench II and, as a bare possibility, AF of Trench III. It may be noted that the six pits in Trench I fall on a line, which might point to their having shared some localised function. Also four of them, as discussed in the next section, contain materials resulting from the use of fire.

There is some evidence against the wholesale allocation of these pits to a period after midden formation had ceased at the site. Thus, in the fill of Pit N (Fig.4 upper), a lens of midden material 30 cm long and 10 cm thick is likely to represent the slumping of Horizon I midden into the partly filled pit. Such an event is likely to have occurred from the rim of the pit, rather than from mid-way down its shaft, which suggests the pit was dug from the top of Horizon I, rather than the top of Horizon II. Also, according to the analysis of To. I described in section 10.1 of Chapter III, the pottery contained by the later pits of Trench I seems in the main to be early and the conclusion to be drawn from this is that it is unlikely that all the many later pits here could postdate the interface between Horizons I and II. The suggestion is that most of them represent a phase of activity at this specific part of the site when the old surface of the early midden was being used for pit digging, with dumping of midden material taking place at some other part of the site. The fact that the later pits in Trench I never overlap supports the idea that they represent some organised use of this particular part of the site. The early shell-midden material dug out in the course of this later pit digging was, it is proposed, 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.

A similar explanation is offered for Pits AF, AG and AH of Trench III (Fig.6.6, 7). The fill of Pit AF was much like Horizon I midden and it was the position of the included burial (AK) at the same level as the subsoil which suggested that in reality the pit had been dug through Horizon I, though this was not actually observed in the field. Pit AF is cut across by Pit AH, a very deep structure, whose rounded base is 80 cm below the subsoil and 90-95 cm below the surface of the Horizon I midden. Pit AH was recognised only at the subsoil, due to the fact that its fill, like that of Pit AF, resembled Horizon I midden material. Because it cuts across Pit AF, Pit AH must be later. The pottery from its basal fill (50 sherds, of which 24 are rims and five are decorated, four of these being rims) displays features which are midway between early and late in terms of the ceramic analyses described in the next chapter. Pit AG, of rounded form, was separated from Pit AH by a 10 cm-high ‘threshold’, but the relationship
between the two is obscure. Its shallow rounded bottom was at the same level as that of Pit AF. Since it was located away from the profiles of the trench, its relationship to the stratigraphy of the site could not be established. However, like Pits AF and AH, its fill was similar to Horizon I shell midden.

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 in ground plan, and AB and possibly AG, which bear some resemblance to the early pits, the later pits range from circular (e.g. A in Fig.7; Plate 3), through more irregularly round (e.g. M in Fig.7) to rounded quadrangular (e.g. AA in Fig.7) in ground plan. These rounded pits are deeper than the early pits, ranging from 50 to 130 cm as measured from the surface of the Horizon I midden. The two deepest pits, M and N, 120 cm and 130 cm respectively, are among the smallest in diameter, the former measuring 80 cm, the latter 100 cm. The pits largest in plan tend to be shallow, like P which is 280 cm across and 40 cm deep, X (Plate 5, the far end right wall) which is 180 cm across and 50 cm deep, AF which is 130 cm across and 50 cm deep, and AD and AE which, with minimum horizontal dimensions of 120 cm, are 60 cm deep. But Pit A, 130 cm in diameter, is 110 cm deep (in reality 135 cm, since dug from the top of Horizon II), while there are some small pits with moderate depth, for example S (100 cm across and 70 cm deep), AH (100 cm across and 90 cm deep) and DW (60 cm wide and 40 cm deep). The sides of the later pits range from steep to vertical, while some have undercut sides. Bottoms are almost invariably flat or flattish.

Some of these features of depth, steep and undercut sides and flat bottoms are characteristic of other later pits, withheld from the above description because of their different ground 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.

There are clear differences between early and later pits in terms of dimensions and form. Early pits are smaller and shallower than later pits. Early pits tend to be wide and shallow, later pits narrow and deeper, except for two pits, P and M, which are both very wide and quite shallow. Early pits are generally rounded in outline, later pits mainly also of this shape but they include some examples of angularity as well. Early pits tend to have sloping to steep sides, vertical or undercut sides being rare, while later pits have steep, vertical and sometimes also undercut sides. Early pits have rounded or flattish bottoms, later pits mostly flat, rarely rounded bottoms.

All early and most later pits contained as a rule similar fill material, ordinary shell midden. The fill of the later ones tended to be less homogeneously shelly than the matrix of Horizon I through which they were dug, which matrix occurs in the early pits. The difference would seem to reflect the practical circumstances of the digging, use and refilling of pits. Five of the later pits had fills of a different kind and composition, and to these we now turn.

Later pits with fire or cooking evidence

It is a characteristic of the habitation later than Horizon I in the excavated area that hearths and ovens are not present as they were in the earlier phase of occupation. That fires were used is shown by the occurrence of cooking stones and ash in Horizon II itself and by the fills of the five pits just mentioned.

Two sloping layers in the fill of the deep and circular Pit A (Fig.6.2) were composed of charred coconut shell and husk with red-burned soil at the base, while three large cooking stones of coral rock were found at the bottom of the pit. Pit P, large and shallow and perhaps rectangular in outline, had a 5-10 cm-thick layer at the base consisting of concentrated shell with ash and powdery charcoal, covered in the southern end of the pit by a 10 cm-thick and 60 cm-large concentration of mehingo shells (*Tellina (Quidnipagus) palatam*). In the fill of Pit S, round and of moderate size and depth, were embedded undisturbed lenses of ash and some cooking stones of coral rock. A layer of earth mixed with ash and powdery charcoal was found in the middle of the fill of AD, a round pit of moderate depth. A layer of reddish-burnt soil
with ash, at maximum 10-12 cm thick, thinning out towards the edges, was found near the bottom of round Pit AF, from about the level of the subsoil into which the pit penetrated and downwards (Fig.6.6). Directly adjacent to this pit to the south was a small pit, DW, with a great many coral-rock cooking stones in its upper fill, which could have come from Pit AF (Fig.8, Trench III).

A common feature of these five pits is thus the occurrence of fill material reflecting the use of fire. The question is, and this indeed applies to all sites, whether such use was made in the pits themselves or elsewhere, the pits having only served as a place for dumping the remnants. Pit A would seem to be an example of the former case, with evidence of two fires having been lit in it, though it is highly unlikely that the pit was dug for this purpose. Pits P, S and AD are more likely to illustrate the other alternative, while Pit AF, round and flat-based like Pit A, though different in other aspects, is more equivocal. It has red-burned soil in situ with ash, but since a skeleton from a proper burial (section 5.7 of this chapter) rested directly on the layer, the purpose of the fire is impossible to determine.

Postholes

Small holes into the subsoil were met with in all trenches. They were extraordinarily numerous in the southern half of Trench I (Plate 5). Only those visible in profiles can be considered for attribution to horizons. Thus only BA and BF of Trench V (Fig.5) can be proposed as posthole features of the early period, though without doubt more exist amongst the holes not present in profile. The same is true of Horizon II, where, however, the situation is confused by the additional presence of planting holes from subsequent gardening. Only CB, CD and CA for Trench I (Figs 3, 4, 7), CP for Trench IV (Fig.8) and AR and CV for Trench V (Figs 5, 8) are acceptable as postholes connected with Horizon II, largely because their profiles suggest they were dug from the top of Horizon I or not much higher.

Hole shape is cylindrical with base flat (BA) or rounded (CD, CP, RR) or conical with rounded base (BF, CB, CV and, slightly, CA). Depths fall between 50 cm and 70 cm, though BF is only 30 cm, while diameters at the top are 30 cm (BA, BF, AR), 40 cm (CD, CA, CP) and 50 cm (CB, CV).

One of the difficulties throughout was that no pattern of postholes ever emerged, no doubt because excavation proceeded by trenches rather than areas. At one stage during the excavation of Trench V (Fig.8) 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 of holes AM, AZ and BB, looked as though they might define an early-period structure in association with the large hearth Squares BN/DM in Squares 62-64/75, 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 Trench V (Fig.8) seems to be paralleled by features DZ (52/60) and EC (52/70) in Trench I (Fig.7).

Burial AK (Fig.8; Plates 6, 7)

For whatever purposes Pit AF, described in the section on pits later than Horizon I, above, was originally dug, it was at least in the end used as a grave, with a burial placed on the surface of the layer of red-burned soil in its lower part and covered by some 20-25 cm of shell-midden material, that is, up to about the level of the surface of the Horizon I midden outside. The body lay 20 cm above the bottom of the pit, on approximately the same level as the subsoil surface and the base of the Horizon I midden (Fig.8 bottom; Plates 6, 7). Though it was placed directly on top of the red-burned soil, none of the bones showed traces of having been burnt. At a later stage Pit AH was cut into the edge of the fill of Pit AF but without disturbing the skeleton.

It should be noted that 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 at Site To.2, the *langi* Folokamanu (McKern 1929:113-14) and the 'Atele burial mounds (Davidson 1969a). There was, however, a small shell adze placed, apparently as a grave gift, at the right elbow (To.1:2293, Fig.76, SE 1, and Plate 66.2).

All bones were initially examined by G.C. Schofield (1966, Department of Anatomy, Monash University, Melbourne) and all jaws and teeth by R.M.S. Taylor (1966, Department of Anthropology, University of Auckland) and their reports (Schofield's restricted to the left femur) appeared as appendices in the unpublished doctoral thesis (Poulsen 1967a:Appendices VI, VII). In early 1985 a reanalysis of all bones was made by D.H.R. Spennemann, when a graduate student of the Seminar for Pre- and Protohistory, Johann Wolfgang Goethe University, Frankfurt-on-Main, visiting Canberra in the course of a study tour ahead of archaeological fieldwork in Tonga. The reanalysis was able to show that skeletal remains of at least three individuals were present, though only one, a middle-aged male (Individual 1), was anything like complete and constitutes the main burial. The bones of the other individuals (one adult male and one juvenile or subadult individual of unknown sex) may either be intrusive or, as some bones were found at a lower level than Individual 1, belong to an earlier inhumation which was later removed. In the light of these findings an edited version of Spennemann's detailed report (1985) is substituted, as Appendix 9, for Schofield's appendix in the thesis and some of Taylor's (cf. Appendix 10 here).

From my field description and records Spennemann (1985:34) observes that the bones of the right foot were found mixed with those of the left, suggesting that the feet were placed close together and probably crossed. In addition, the right patella was found at the left shoulder. He thus makes the following reconstruction. The body was placed with back on the ground, head towards the west, elbows close to the body with the knees up by the left hand. This unnatural position would be possible only with breakage of the pelvic-femoral joint, for which there is no evidence, or from the corpse having been bound. If it had been bound, the reason was not the small size of the pit in which the body was disposed, since there was space between the skeleton and the pit walls. Only a few parts of the right leg were found and most of the right pelvis was missing. Since this is most certainly not due to their decay, some disturbance of the upper part of the pit must have taken place in later times. Since no visible evidence for this reopening was noted, it appears that the secondary disturbance took place within the boundaries of the original pit.

Biological and other information derived from the study of the skeletal remains from Pit AF at To.1 and elsewhere is discussed in Appendices 9 and 10 and taken up in Chapter VII.

**Radiocarbon dates**

Three dates are available, all from the same burnt layer in the fill of Pit A in Trench I (Fig.6.2). At the time of excavation Pit A was thought to belong to the interface between Horizons I and II (Plate 2). Two samples were submitted to the Copenhagen Radiocarbon Dating Laboratory to date this phase, one (K-904) of shells identified as *Gafrarium pectinatum* by J. Knudsen (Zoological Museum, Copenhagen), the other (K-961) of charcoal, composed partly of burnt fragments of coconut shell and husk. They gave wildly discrepant results:

1. K-904 2770 ± 100 BP (= BP*; see Appendix 3 for environmental correction)
2. K-961 420 ± 100 BP

Two samples of living shells of *G. pectinatum* and *Anadara antiquata*, being two of the types most commonly represented in the Tongan middens, were collected for me in Tongatapu in 1965 by Iteni Helu and submitted the same year to the Copenhagen Laboratory in order to see whether the shell date was the source of the discrepancy. In 1966 H. Tauber (pers. comm.) reported the results of his analysis of these samples as K-690 and K-691, being respectively 104.4 ± 0.7% and 102.4 ± 0.7% with reference to 95% of the Oxalic standard value. He commented that there was therefore no reason to doubt the validity of the shell date, K-904, based on considerations of C-14 distribution in the Tongan oceanic reservoir.
Meanwhile part of the same sample of charcoal which had provided the material for K-961 was submitted, in 1965, to the Radiocarbon Dating Laboratory in New Zealand and gave a result indistinguishable from that of the original:

3. NZ-597 464 ± 82 BP

The immediate conclusion to be drawn was that the shells must have been introduced into the pit from a much older primary location (Poulsen 1967a:150). The shell pockets of the subsoil into which Pit A deeply penetrates are now seen as a likely candidate.

The charcoal dates K-961 and NZ-597 can be accepted as validly dating a stage in the infilling of Pit A. In view of Groube's (1971) revision of the chronology of the Tongan ceramic sequence (see section 3.1 above), they do not date a stage of that sequence, as initially proposed (Poulsen 1967a:Chapter VII). Pit A, from whose infilling the samples were obtained, cannot belong to Horizon II, which was my original interpretation, but must have been dug from its surface long after its accumulation had been completed and pottery manufacture had been abandoned.

EXCAVATIONS AT TO.2

Site description (Figs 1b, 9, 10; Plate 10)

The site is a circular mound, with gently sloping sides and flattened top, about 25 m in diameter and 1.5 m high. It is situated at the southern end of the village of Nukuleka, about 200 m from the beach to the east. The surrounding ground is about 1.5 m above high-tide mark. The land was owned by Alungia Moala, whose house stood partly on the mound.

The village of Nukuleka is on a small peninsula about 100 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 narrow entrance accounts for the many fish traps observable at Nukuleka and further north. With good access to both sea and lagoon, Nukuleka seemed a good area to recover items of prehistoric fishing gear.

There are several midden sites in Nukuleka and quantities of potsherds were collected all over the peninsula and on the sand flats 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 was present, suggesting the presence of graves within the mound; the top area of the mound was flattened and depressions from former postholes were still visible there.

The problems posed by the site were clear. Was the mound built directly on the natural ground surface out of 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 any 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 had 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 there, though Moala himself was sceptical.

Excavation and sampling (Figs 9, 10)

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.

It was thought sufficient to open one big trench, Trench I, 1 x 15 m in dimensions, from the centre of the mound to its northern margin. A small trench (II) was opened south of the centre to investigate the extent of a particular element of the mound horizon, composed of the
shells known to Tongans as sio (Ostrea cf. sandvichensis) (Zone IV). In addition to this, 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, so that something like 5% was eventually excavated. The grave area of the main trench was not investigated under ideal conditions: out of respect for the wishes of the villagers, the bones were removed for reburial on the day of their exposure.

Shell samples were collected in 10 cm spits from two columns through undisturbed deposits in Squares 50/54 and 50/57, but only the former (To.2/S2) was fully processed (Table 3).

Stratigraphy (Figs 10-12; Plates 11-15)

Subsoil

The subsoil is a homogeneous deposit of coral sand, whose surface is 170 cm below ground surface at the centre of the mound and 90 cm below at its foot. Parallel with the present beach line to the west its surface is horizontal, but towards this it rises slightly.

Midden Horizon (Zones I-III)

At the bottom of the site proper is the midden horizon. The boundary between this and the subsoil is quite sharp. At the centre of the mounded site this horizon is 80-100 cm thick, at the foot only 30 cm. This thick horizon comprises on the whole one deposit only, a typical, dark-coloured shell midden, made up of earth mixed with much shell. The data from the shell-sampling column S2 (Table 3) show that the proportion of all shell by weight is actually just 6.6% in the midden horizon. Sometimes the shells occur in more or less compact lumps. Coral cooking stones are common, 7% by weight (Table 3) for the whole horizon but 6-12% in the bottom half. This bottom half of the deposit is blackish-grey in colour, whereas the top half is generally somewhat lighter in appearance and slightly browner. This could be particularly observed in the southern (inner) half of the trench.

For analytical purposes the midden horizon was arbitrarily divided into three zones, I-III.

Mound Horizon (Zones IV-VI)

The shell midden is sealed in by the mound horizon. The boundary between the two was easily distinguishable. At the centre of the site the mound horizon is 90 cm thick, at the edge 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.

Zone IV is the very heterogeneous lower zone, including real midden material, a mixture of sand and earth, earth including some shells, and compact deposits of Ostrea shells intermixed with a relatively small amount of earth and sand and with numerous fragments of broken branch coral. The prominence of Ostrea and coral in Spits 3-5 of the shell-sampling column S2 is evident in Table 3. There was a number of Ostrea shell deposits of varying dimensions, isolated from each other.

Zone V comprises graves containing coral sand, dug into the diversified layers of Zone IV in the central part of the mound.

Zone VI, uppermost, and probably a part of the mound horizon, is a compact and homogeneous deposit, consisting of earth with a few whole and fragmentary shells.

Interpretation of the site

The analysis of the pottery in the midden and mound horizons in Chapter III (section 6.1) showed no detectable differences, while joining pieces of the same broken artifacts were found appearing in the two horizons (section 12.6 of this chapter). This 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, together with an important component of materials taken from elsewhere, in the form specifically of *Ostrea* shells.

The *Ostrea* shells were visually prominent in the composition of the mound (Figs 10-12), but nowhere in the midden were they so, and they formed a very small component of the midden in the shell-sampling column (Table 3). At the same time, because the character of its content of pottery and other artifacts was like that of the midden (including at least two instances of decorated potsherds joining with pieces in the top zone of the midden), I do not think that the *Ostrea* shells are an accumulation of younger age than the midden, as Green (1972:83-84) supposes (cf. section 10.2 of Chapter III).

It is arguable whether the uppermost layer of earth, Zone VI, belonged to the second stage in the history of the site, that is the mound-building stage, or a third, separate stage. Certainly there were, after the deposition of the midden, two later stages of site use. The first of these is represented by the formal burials in pits infilled with coral sand in the main grave area in the centre of the mound. The second was the 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. It is perhaps more likely that the final layer of earth, Zone VI, which certainly seals in all the excavated graves, was in fact an integral part of the grave mound intended to protect the graves, than a later addition transforming the grave mound into a habitation mound. Some support is lent to this interpretation by the circumstances of Grave D of Figure 12, which is wholly in the top layer, and of Graves Z and AA of Figure 11, which are partly so. 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.

**Hearths and ovens**

**Pre-midden**

Three large and shallow depressions sealed in by the midden presumably all represent ovens. A/U, at the northern end of Trench I (Fig.13), must surely have been one, since its fill was coral sand mixed with plenty of light grey ash. Its full extent must have been rather large, at least 2 m. At maximum it is 25 cm deep. There are two stages of use, U at bottom and A at top (Fig.12), partly overlapping, both apparently of rounded outline, with sloping sides.

Adjacent to A/U is a similar shallow depression, P (Figs 11-13), largely unexcavated, with sloping sides and midden fill.

In the southern end of the trench, S (Figs 11, 13) is of angular shape with steep sides, 1 m in diameter and 20 cm deep, containing midden and to one side sand.

**Midden**

As the midden grew, fires were lit at various levels on its sloping surface, some in hearths, some in ovens, all of moderate dimensions (Fig.11).

**Post-midden**

The most remarkable of the oven features found at the site was the large structure M (Figs 11-13; cf. Plate 15), which was only partially excavated. It is situated centrally on the top of the midden and exhibits at least three successive stages of use. It consists of a central compact and stratified deposit of sooty and ashy earth, which fans out in several horizontal lenses alternating with stripes of either shelly midden material or rather shell-free sand, a pattern that could be followed over almost 2 m. The complete structure must have been very large, some 3-4 m in diameter.
In the field there was no obvious evidence to suggest that a pit had been dug from the surface of the midden to make this oven, thus disturbing the midden deposit. As a result, the radiocarbon sample from the oven, the only one originally submitted for To.2, was accepted as dating the latest stage of midden formation (NZ-635). When subsequently this interpretation became untenable for reasons discussed (section 6.8 on radiocarbon dates below), I returned to my original field notes and drawings. These showed that in the alternating sequence of oven layers and layers of other types of fill, which continues up to the general surface level of the midden, the other layers are limited horizontally to the extent of the oven layers themselves. This horizontal confinement of a complex stratified series surrounded by uniform midden material is plausible evidence for Oven M being a pit dug into the top of an existing midden.

Nevertheless, the stratigraphic evidence alone does not indicate that the oven was necessarily connected with the mound. Its size and clear central position might, however, support some ceremonial interpretation in connection with the construction of the burial mound above.

**Postholes**

**Pre-midden**

During the earliest use of the site there are three possible postholes of moderate dimensions: Q, AG and AJ (Figs 11, 12; Plate 12 middle of the right-hand wall). Their fill was shell midden, mixed with ash in the bottom half.

**Mound**

Posthole AB at the foot of the mound (Fig.11) was sealed in by Zone VI and may be thus somehow connected with the use of the site for burial purposes.

**Recent habitation**

The pattern of depressions visible in the top of the mound before excavation derive, as already mentioned, from the posts of a house that stood here until 1952. Postholes for this house appear as features X and AC in Figures 11 and 12, AC containing a rotted post (Plate 14).

**Burials**

The graves in the mound horizon are of the normal Tongan type (cf. Davidson 1969a), pits of semicircular or trapezoid cross-section, filled with coral sand after burial had taken place (Figs 11, 12; Plates 11-15). In the 3 m² of the excavated trench eight to ten graves were identified. All skeletons lay on their backs, heads pointing ESE, ENE and almost north, but never west, thus suggesting that the burials were made before Christian influence began.

The total continuous main grave area of the central part of the mound probably covered some 10 x 10 m, but isolated burials were made beyond this.

**Radiocarbon dates**

Two radiocarbon dates are available for To.2: ANU-541 and NZ-635.

1. ANU-541 3090 ± 95 BP (2680 ± 95 BP*; see Appendix 3 for environmental correction)

The sample consists of six *Anadara* shell net sinkers (catalogue numbers 1182, 1183, 1202, 1203, 5761, 5762) found securely at the very bottom of Zone I of the midden deposit in Spits 15 and 16 of Square 50/54. Their status as artifacts reduces the danger of them being redeposited from a very much older context, as was the case with the unmodified shells of radiocarbon sample K-904 at To.1.

They were submitted for dating in 1970 by L.M. Groube in the course of his chronological
revision of the Tongan sequence (Groube 1971:303), the implications of which for my original interpretations have already been discussed (section 3.1 above).

2. NZ-635 1620 ± 60 BP

This is a sample of charcoal scattered through the burnt layers of Oven M, which, as we have seen above (section 6.5 above), was originally thought to belong to the latest phase of midden formation at the site. It was submitted in 1965 to date that phase, which was characterised by an abundance of decorated pottery, and I accepted it as a valid result (Poulsen 1967a:149). In the light of Groube's (1971) general conclusions about the chronology of Tongan pottery and its decorated component (section 3.1 above), and of the particular implications of ANU-541 for the date of the To.2 midden with its homogeneous content of pottery (section 6.1 of Chapter III), NZ-635 and Oven M from which it was collected must postdate midden formation at the site.

It has been tentatively suggested before that the oven might be associated with the construction of the burial mound, which would thus be dated by NZ-635. In this connection we may note that excavations at a burial mound in the grounds of 'Atele College produced dates, on bone collagen, of 770 ± 200 BP (Burial 41, perhaps the earliest at the site) and 390 ± 110 BP (Burial 10, from a later level of inhumations) (Davidson 1969a:274).

**EXCAVATIONS AT TO.3**

**Site description (Figs 1b, 14; Plate 16)**

This mounded site is in the centre of the village of Ha'ateiho, adjacent to the main road and only 600 m distant from Site To.1, on land owned by Mrs Samoa Mafi, whose house was on top of the mound. The shortest distance to the lagoon is about 200 m in a northeasterly direction, but the mangrove swamp starts only 80 m away. The ground level around the mound is roughly 1.5 m higher than the water level of the lagoon.

The mound at the time of excavation covered an area of 43 x 50 m and was almost 2 m high. In some places the sides were gently sloping, in others steeper; sometimes they were straight, sometimes irregular. There was 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 materials seem to have been removed, probably to supply spoil for the construction of the nearby grave and house mound, Site To.4.

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 dwelling house on top of the mound could hardly have avoided revealing evidence of graves, had these existed. The mound appeared to be a large shell midden. This in itself was interesting in that shell middens normally do not assume a mounded form.

**Excavation and sampling (Fig.14)**

The investigation of this site took place during late June and early July 1964. The working party consisted of four workmen and the interpreter, Iteni Helu.

Only limited excavation was undertaken. The aims were to investigate the nature of the mounded form and to recover pottery for comparison with that from the not very distant site of To.1, but also to examine the potential at midden sites of excavations limited to a few square metres in area as regards sampling size. Trench 1 (2 x 2 m) was opened at the northern corner of the flattened summit area. Trench II (0.5 x 8 m) was dug to investigate the stratigraphic relationship between the mound of To.3 and the grave mound of the neighbouring mound complex of To.4.
A column sample for shells (To.3/S1) was taken in 10 cm spits in Square 21/21 of Trench I, through an undisturbed section of deposits elsewhere disturbed (Table 4).

Stratigraphy of Trench I (Fig.15; Plates 18, 19)

Subsoil

The subsoil is pure coral sand, with 20% shell by weight (Table 4). Its surface is about 125 cm below ground surface.

Horizon I

This is the largely disturbed remains of the original shell midden on the spot, about 80 cm thick, characterised by four different deposits of typical shell-midden material, including coral cooking stones. This original midden was, however, quite undisturbed in the southern square, 21/21. From the sampling data collected here right in the southern corner (Table 4) it appears that the proportions of shell are quite high, 26% for the whole horizon and up to 45% for the base of it.

The shell analysis of Chapter VII reveals an interesting difference between the top and bottom parts of Horizon I itself. The lower samples, as well as samples from the subsoil immediately beneath, show a significantly higher representation of Anadara than of Gafrarium shell fish. This suggests that the beginning of midden formation at To.3 took place at a time when lagoonal conditions were somewhat different from today, being more tidally influenced, a matter taken up in detail in Chapter VII (section 1.4). The same picture is presented by the subsoil evidence at To.1, as we have seen.

Horizon II

This is represented by the fill of the not fully excavated feature called A on Figure 15 (cf. Plate 18). The fill 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 cooking stones were seen.

Horizon III

In general this is made up of two components: at bottom some typical shell midden as in Horizon I, with 6-12% shell (Table 4), and at top a compact deposit of earth, sand and shell fragments in the main of very small size.

Stratigraphy of Trench II (Fig.16)

Subsoil

The subsoil here also is pure coral sand.

Horizon I

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

Horizon II

Horizon II comprises the fill of the feature called F on Figure 16, 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 contain two types of deposit 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 Trench I.

**Top horizon**

This is formed by the edge of the material of the make-up of the grave mound of the neighbouring 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 similar relationship in the profile exposed along the road cutting through the grave mound at To.4 (Plate 21).

**Structures**

**Oven**

The only oven discovered, G in Trench II (Fig.16), is 15 cm deep. Its diameter could not be determined. Filled with light grey ash, it was dug into the coral-sand subsoil beneath the midden, prior to or in connection with its formation.

**Postholes**

At least six postholes were found dug into the coral sand, prior to or in association with the early midden formation. There were four in Trench I, neatly rounded holes, 26-55 cm deep, with vertical sides (B-E in Fig.14; C appears in profile in Fig.15). In Trench II there were at least two similar postholes, 40 and 60 cm deep (H and M in Fig.16).

**Ditch**

The two features, A in Trench I (Fig.15; Plate 18) and F in Trench II (Fig.16), whose fills constitute Horizon II in both trenches, are interpreted as separate segments of a wide ditch more than 2 m deep, probably surrounding the site (cf. Fig.14). Not only are their fills similar, but the bottoms of both are at a similar level.

**Pit**

Pit N in Trench I (Fig.15; Plates 18, 19), 90 cm deep and some 100 cm in diameter, has steep sides and a flat bottom at the level of the subsoil surface. Dug from the surface of Horizon I, it was filled up with the midden material of Horizon III, suggesting that it postdated the ditch near which it was dug, whose fill was sealed by Horizon III.

**Interpretation of the site**

Because of the restricted investigations at this site, no major conclusions can be drawn about it. The formation of the shell midden took place on coral sand and there is evidence in the subsoil of posthole digging and digging of ovens in connection with or immediately prior to this. At a later stage, represented by Horizon II, a ditch was dug through the shell midden into the subsoil near the edge of the site and probably surrounding it, though with precisely what purpose is unknown; a similar ditch was found at Vuki’s Mound, also in Ha’aiteihou (L.M. Groube pers. comm.).

Subsequently this ditch was filled up and the old midden surface continued in use with the digging of Pit N. In the last stage this pit was itself filled in and a build-up took place with materials from the edges of the midden and from the beach, producing the mound of today, quite a massive one with flattened top, which, from the apparent absence of graves, was probably meant to serve for habitation only.
EXCAVATIONS AT TO.4

Site description (Figs 1b, 17; Plates 17, 20, 21)

This site, a mound complex on land belonging to Timoti Masima, is immediately adjacent to Site To.3, which lies southeast. It consists of two mounds, provisionally identified as a chiefly burial mound (Tongan fa'itatoka) and a house mound.

The burial mound is well formed, rectangular in plan with rounded corners and covering an area of 25 x 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 the mound of Site To.3 originally overlapped, a bulldozed road had exposed a cross-section (Plate 21). This revealed that the burial mound was built up of alternating deposits of coral sand and shell midden, the latter containing 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 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 burials, as is also maintained, is uncertain. As the burial mound is still respected, it could not be excavated.

The so-called house mound has quite a different appearance. Covering an area of about 30 x 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 dwelling house erected on wooden posts. The occupant reported that he had never seen any traces of human bones or graves there, not even when he built his house. Shells were visible on the surface of the mound, but sherds were rare.

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

Interest was stimulated in this complex because the house mound, only 30-40 m away from 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 this mound and its relationship to neighbouring features, as well as test the possibility that it concealed an undisturbed midden deposit.

Excavation and sampling (Fig.17)

Excavation lasted from early to middle July 1964. The work team was the same as at Site To.3.

Two trenches, each 1 x 2 m, were opened on the flattened area of the house mound: Trench I northwest of the house, close to the spot where Golson did his trial excavation in 1957, and Trench II on the opposite side of the house.

Shell sampling was given up when the stratigraphy of the site showed it to be of no value.

Stratigraphy (Fig.17; Plates 22, 23)

Trench I

A study of the profiles of Trench I showed a most complex picture of haphazard build-up with sandy earths, none of which evidently had anything to do with an original midden. The excavation of this trench was therefore not completed and the profiles were not drawn, but only photographed.
**Trench II**

Although this trench also did not reveal original shell midden, it was fully excavated and the profiles drawn, as a clearer picture emerged from their study.

The subsoil is pure coral sand as at nearby To.3. Above it various deposits are present, but they seem to belong to one and the same horizon, which thus contains the total evidence. The lower half consists of alternating bands of typical dark-coloured shell midden and loose, very light-coloured sand with some shells, in the main sharply distinguished from each other, as shown in Plates 22 and 23.

**Interpretation of the site**

With no original midden present and no traces of graves seen or reported in it, this mound may have been constructed as a house mound. The fill consisted of old midden material, probably taken from the northern quarter of the To.3 mound which was hollowed out here, and of beach materials, also available at the spot. These fills were dumped on top of each other load by load (Fig. 17; Plates 22, 23). To judge from the sloping orientation of the dumping units, the mound began with a number of small heaps of alternating fills, deposited next to and partly overlapping each other. Increased height was obtained by using midden fill only. The top of the mound was left flat.

The grave mound southwards at the site overlaps not only this house mound but also the original midden and the later ditch at To.3 (Fig.16), but its relationship to the final stage at To.3 is unknown. Like the house mound, the burial mound at To.4 was built of alternating deposits of beach sand and midden material (Plate 21), the latter probably taken from To.3 also.

**EXCAVATIONS AT TO.5**

**Site description (Figs 1b, 18)**

The To.5 midden was in 1964 situated in a bush garden belonging to Leafa’a, widow of the late chief Tu’iha’ateiho. The site lies about 150 m from the present lagoon shore and 400-500 m northwest 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, and making its photography difficult, was on sloping ground. The land rises gently from the lagoon but becomes considerably steeper some 50 m south of the midden, beyond which the surface is level. This situation obtains for about 500 m both east and west of the site. The steep slope evidently represents an old shoreline roughly parallel to the present lagoon shore, with a flatish area of varying width between it and the mangroves. The steep slope links up at its western end with the old shoreline that defines the nuclear area of my investigations. 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 sloping ground west of the site was under grass and scrub with 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 rank 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 m across and 3-4 m high and only 3 m apart. The inner faces of each of these rocks form small and narrow shelters. Situated in a garden on the flat area below the slope, about 100 m away northeastwards from the midden, 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 or fa'itoka. It is almost perfectly square in ground plan, with sides about 40 m in length. The corners are oriented to the cardinal points. The course of each side is quite straight. The corners themselves are fairly sharp. The sides slope up evenly at an angle of 30-45°. The top is relatively flat, being raised about 1.5 m above the surrounding ground. Situated in the centre of the western quarter of this summit area 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 at the northwest and southwest of it. At its northern end is a coral slab 50 x 40 x 10 cm, standing on edge, possibly in its original position parallel to the side of the mound. The grave in the centre had been disturbed, apparently recently.

Only a few shells and sherds were found on the surface of the big mound. From 20 test holes dug all over it, the mound fill appeared to be brown garden soil, sometimes with scattered shell and/or crushed coral limestone but without sherds. Coral sand, the normal indicator of graves, was absent from these holes as well as from the surface of the big mound, except for the small mound on its top. A few pits in this top area are most likely to refer to some secondary use of the mound.

The investigation of this mound strongly indicated that burial had taken place at one spot only, in the small mound on its top. Whether this happened once or several times is, however, uncertain as no excavation could be carried out here. All the evidence thus points to the fact that this large mound is indeed a fa'itoka. According to Hon. Ve'ehala, Keeper of the Palace Records at the time of my fieldwork, there is traditional reference to habitation in the area just around this fa'itoka and the midden site at To.5.

On the flat elevated land to the south behind To.5 were gardens and scrub. Near the edge of this elevated country above the site, and some 300 m away from it, is a circular burial mound, coral sand being visible on its surface. A few sherds and shells were found on top of and around this mound.

The indications of Site 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 x 35 m, beyond which was dense vegetation, but apparently the midden continued a little to the 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 be about 1000 m². In general this proved to be defined by the surface scatter of shell.

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 eastern margin of the investigation area at the centre of which lay sites To.1, 3 and 4.

**Excavation and sampling (Fig.18)**

Investigations proceeded during July 1964 with the same working party as at To.4.

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 Site To.5, therefore, a minimum of 10 m² was to be excavated, this being judged in the light of experience as a reasonable minimum size of excavation at this type of midden for the specific purpose in question.

The initial test holes showed the midden to be thickest towards the south, away from the lagoon, and two trenches were opened there: Trench I, 1 x 11 m, the northern part located where a test hole had revealed a thick hearth deposit with charcoal; and Trench II, 1 x 2 m, where a test pit had indicated a notable concentration of shell. Trench II was later extended a little to investigate a burial in the midden. In all, about 1.6% of the site was excavated.

A column sample for shells (To.5/S1) was collected by stratigraphic layers through undisturbed deposit in Square 19/20 of Trench I (Table 5).
Stratigraphy (Figs 19, 20; Plates 24, 25)

Subsoil

At the base in both trenches was coral rock, the level surface of which was 100-150 cm below modern ground surface. It was covered in part by coral sand containing quite a number of shells, 30% by weight (Table 5), mostly whole. This sand deposit, at maximum 60 cm thick, thins out towards the lagoon, disappearing in the northern half of Trench I and being almost absent from Trench II.

Horizon 0

Within the coral sand, in the southern four squares of Trench I only, are two 5-10 cm-thick discrete cultural layers, identical in composition, which were largely dug out as stratigraphic units. They consist of loose coral sand with numerous shells, 28% by weight (Table 5), light to medium brownish-grey in colour and easily distinguishable from the whitish coral sand in which they lie. These 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 the coral rock, the upper layer 5-10 cm of coral sand between it and the main midden above (Fig. 19; Plates 24, 25). These two layers are jointly designated Horizon 0 and artifactual material contained in the associated sand layers is also attributed to it.

The character of this formation suggests that the earliest occupation at To.5, as at To.1 and To.3, took place in a coastal 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. Furthermore, the coral sand, which contrasts with the muddiness of the present lagoon near the site, indicates, instead of the protected environment of today, more open-beach conditions.

This interpretation is supported by the analysis of shell samples performed in Chapter VII (section 1.4). Samples from the coral sand show an increased representation of Anadara as against Gafrium when compared not only with the midden above but also with the two cultural lenses of Horizon 0. 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, of course, the differing proportion of Gafrium and Anadara in the cultural lenses compared to that in the coral sand in which they lie must be due to human selectivity.

Midden

Horizon I is of very varying thickness, from 20 to 60 cm; its surface is 40-70 cm below the ground level. It comprises two deposits. The predominant one is a very compact concentration of shells with relatively limited intermitture of greyish-yellow coral sand. Shell makes up 32% by weight (Table 5). Most shells are whole. In the northern end of Trench I the intermitture of sand is more pronounced. The second component of Horizon I is present only in the southern 5 m of this trench. It lies directly 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 impression of a surface over which much trafficking had taken place and was called a walking level.

Horizon II on average is 20 cm thick, the surface being 40-50 cm below the ground surface. In general it consists of one deposit only, a heterogeneous mixture of dark grey earth, numerous shells (16% by weight, see Table 5), both complete and fragmentary, many coral cooking stones and powdery ash and charcoal. The horizon was clearly distinguishable from those below and above.

At the bottom of the Horizon II midden and restricted to the southern 5-6 m of Trench I, there
is a homogeneous layer of sticky brown clay mixed with shells, right on top of the so-called walking level of Horizon I. The occurrence is more or less continuous and of varying thickness, never exceeding 10-13 cm. It was dug out as a stratigraphic unit. It could not be established whether it represents a natural layer washed down from the slope to the west or a layer deliberately added to the previous surface to provide a smooth new surface, more adequate for occupation than the walking level beneath. In either case the brown clay layer could refer to any point in time between the formation of Horizons I and II.

**Horizon III**, extending to ground surface, is in the main about 50 cm thick, but occasionally less, down to 30 cm. Its surface slopes down slightly towards the north. It comprises two deposits. The lower is a homogeneous garden soil of sticky brownish clay, stickier than the upper, which is topsoil. Its shell content is generally lower than that of the topsoil and fragmentary shells predominate. The boundary between the two 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 element of Horizon III, the shells in it being scattered, never concentrated, and amounting to less than 1% by weight (Table 5). 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.

**General remarks on structures**

The digging of structures was not characteristic of Horizons 0 and I at To.5, presumably because of the presence of coral rock immediately below. However, there was also little digging connected with Horizon II. As at Site To.1, where also the top horizon is characterised by less dense shell, most digging is late here, in or after Horizon III.

**Hearth and ovens**

**Horizon 0**

The brief and intermittent occupation here was associated with two small ovens, S and T, 40 cm in diameter and 6 cm and 12 cm deep respectively (Fig.18). Their fill was sticky light grey ash with a little powdery charcoal.

**Horizon II**

One hearth (AK) and two ovens (B, K) belong here, all at the bottom of the horizon.

Hearth AK in Trench II (Fig.20) was represented by a small concentration of ash, 10 cm thick and 50 cm across.

Ovens B and K in Trench I (Figs 18, 19), both surrounded by the brown clay layer described in the section on stratigraphy above in connection with Horizon II, were dug into the top of Horizon I. They are 20 cm deep and measure some 100 cm across. They were recorded as being sealed in by the upper, midden, component of Horizon II and filled with ash and charcoal. From the fill of B were collected 50 kg of coral cooking stones.

As already mentioned, the brown clay layer which is interrupted by these ovens could belong to any point in time between the formation of Horizons I and II. A more difficult question is the relationship of the ovens themselves to this layer. Initially the preference was to see the brown clay as the deliberate provision of a working surface in association with the two ovens. However, radiocarbon date NZ-637 from Oven B, discussed below (section 9.9), raises problems for this interpretation, and indeed with their allocation to Horizon II at all.
Horizon III and later

There are three ovens to be discussed.

Oven AF in Trench II (Fig.20) was made in the top of the fill of Pit A. 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.

Ovens D and E of Trench I (Figs 18, 19) are each 100 cm in diameter and 20-25 cm deep in the midden and have the same fill as Oven AF of Trench II. Oven D cuts across E and is thus later. Both were allocated to Horizon III, since they seemed to have been dug from a level 10 cm or so above the surface of Horizon II, within the lower part of Horizon III, the earth of which apparently sealed both of them in. The results from a radiocarbon dating sample collected from Oven D, ANU-23, discussed below (section 9.9), are now seen as making it impossible to accept this interpretation, as was originally done (Poulsen 1967a:149). It seems necessary to conclude either that Oven D, and perhaps Oven E, were dug from a higher level, later gardening activities having destroyed the stratigraphic evidence for this, or that they were in fact made at the level where they were visible, which might have been an old ground surface subsequently buried by earth washed down from the slope above.

Pits

Horizon I

A single example is represented by the not fully exposed Pit F at the southern end of Trench I (Figs 18, 19), dug into coral sand and cutting through the cultural lenses of Horizon 0. It is 20-25 cm deep, with flat bottom and gently sloping sides, and had a fill of midden earth as in Horizon I. Its overall shape cannot be guessed.

Later than Horizon II (Figs 18-20)

Few of the pits dating later than Horizon II penetrated to the coral sand where their outlines might have been clearly seen. Also the small size of the excavation meant that most were not fully excavated. For these reasons it is difficult to say anything definite about pits like AD, AE and W, all in Trench I.

Pits AL in Trench I and A and AG in Trench II 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 is 120 cm across and 50 cm deep and AG, with irregular base, is 100 cm across and 30-40 cm deep. Pit G, of which little was excavated, 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 with its fairly steep sides and flat base 30 cm deep.

Pits C and possibly J 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 A (Fig.6.2; Plate 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 perhaps be a posthole rather than an equivalent of the deep, narrow pits of To.1, like M (Fig.6.3).

All the above structures seemed to have been dug from the surface of Horizon II and to be filled with material of the same kind as that defining Horizon III. It looks as though, 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.

Pit C (Fig.19) is a definite exception. Not only did its fill contain recognisable subsoil materials, its northern edge could be seen for 10 cm above the interface between Horizons II and III and to a point 30 cm below the present ground surface. A similar construction level
would make sense for Pit G, in the light of my concern, in reworking my data, to assess the nature of the contact between the tops of pit walls and the surfaces from which they appeared to have been dug (section 3.2 above). It so happens that Ovens D and E at the northern end of Trench I, described in section 9.5 above, were observed as being cut from a similar depth. It could be that all these structures are of a similar age, which would be provided by radiocarbon sample ANU-23 from Oven D (section 9.9, below) and that the 30 cm of soil that seals them all was washed in over time from the nearby slopes.

Postholes

Horizon II

There are a few small holes filled with Horizon II material, of which AA of Trench I (Fig.19) could be a posthole, 30 cm deep.

Later than Horizon II

In addition to J, a possible posthole mentioned in the section on pits above, there is only one other to report, AH in Trench II, 70 cm deep, 40 cm across the top and like J in shape (Fig.20).

Burial

In Horizon III of Trench II a grave of semicircular cross-section was excavated (AM in Fig.20). Only a somewhat fragmentary skull, that of a child of about six or seven, was found (see Appendix 10), situated in the northern end of the grave. There was no evidence that other bones had ever been present. The fill consisted of sticky earth at the bottom, followed by a thick layer of concentrated shell-midden material, much like that of Horizon I into which the grave pit had been dug. Apparently digging took place from a level in the upper part of Horizon III.

Radiocarbon dates

Three radiocarbon dates are available for To.5: NZ-637 and ANU-23/1 and 2, separate runs on the same sample.

1. NZ-637 1600 ± 87 BP

This is a charcoal sample collected from Oven B in Trench I (Figs 18, 19), described in section 9.5 above. The oven was dug into Horizon I and to all appearances sealed in by the upper, midden, component of Horizon II. The radiocarbon result was originally accepted with confidence as dating a phase of the Tongan ceramic sequence characterised by a marked frequency of decorated sherds, because it agreed so well with NZ-635 from Oven M at To.2, initially thought to belong to a deposit with a similar ceramic character (Poulsen 1967a:151; cf. section 6.8 on To.2 dates, above).

As with NZ-635 at To.2, NZ-637 as a date for a ceramic phase cannot be reconciled with Grube’s (1971) revised ceramic chronology (see section 3.1 above). Either, therefore, the association of the radiocarbon date with the event to be dated is unreliable or the available stratigraphic observations are not fully informative. As I have had occasion to stress, the latter is always a possibility with shell-midden stratigraphy. In the present instance, however, given the circumstances relating to Oven B discussed in section 9.5 above, which are duplicated for the similar Oven K which almost forms its continuation to the north, I find it hard to believe that either oven could have been dug from a higher level in the midden than that originally recorded. My only choice therefore is to reject NZ-637 as dating the structure in question.
2. ANU-23/1 330 ± 63 BP; ANU-23/2 340 ± 100 BP

These are results on the same sample of charcoal collected from Oven D of Trench I (Fig.19), discussed in section 9.5 above. The oven was dug into Horizon II from a level thought to be within Horizon III. ANU-23/1 was run in 1966 in the expectation that it would provide a date for a late stage of the Tongan ceramic sequence. ANU-23/2 was run as a check in 1967 when samples NZ-636 and ANU-24 from To.6, expected to give similar dates, in fact gave much earlier ones.

In the light of Grube's (1971) revised chronology for Tongan ceramics, these dates are not relevant to any part of the ceramic sequence. They date an oven which was dug into earlier pottery-bearing deposits.

**EXCAVATIONS AT TO.6**

Site description (Figs 1b, 21; Plates 26, 27)

This site is called Tufu Mahina and it is on land owned by the Royal Family.

The site 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 shortest distance from the site to the present lagoon shore is about 200 m in a southeastern direction. The surface of the site is 8-10 m above the level of the lagoon.

The midden is situated at the corner where the old shoreline forming the boundary of the main area of my investigations 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 found a concentration of shells and sherds on completely flat and somewhat swampy ground near the mangrove belt. The land west of the site could not be surveyed owing to dense vegetation. In the low area just below the site there was scrub and mangrove swamp. About 150 m south of the site is one of the very few freshwater pools on the island.

Most of the midden was situated in cleared garden. Its original extent was judged to have been about 1400-1500 m². 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 recognised 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 To.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 western boundary of which it is situated.

Excavation and sampling (Fig.35)

Investigations lasted from early August to early September 1964. The normal work force was supplemented by two new workmen.

Excavations were more extensive than elsewhere and produced important structural evidence, the nature of which the excavations, despite their extent, could not elucidate in detail.

An initial test pit of 3 m², located in what was to become Trench 1, produced no decorated
potsherds. The full Trench I, of 14 m², yielded three decorated sherds only, all from the bottom. The next trench, VI, gave one decorated sherd, 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 and excavated partly as a stratigraphic unit, producing evidence of a structure which was thought to continue to the northwest. In order to investigate this, two new trenches were opened, IV and II. The intervening trenches, V and III, were then excavated. A total of 73 m² was dug, including 4 m² at the eastern end of Trench I where no real midden existed. Most unfortunately further excavation could not be carried out due to lack of time. About 4.5% of the site was investigated.

A column sample for shells (To.6/S1) was collected in 10 cm spits through undisturbed deposits in Square 24/19 of Trench I, at the thickest part of the midden. It is analysed in Table 6.

**Stratigraphy (Figs 21-23; Plates 28, 29)**

Because of the rapid approach of the end of the fieldwork and the occurrence of much bad weather, only the profiles shown in Figures 21-23 were recorded and the drawing of these concentrated on distinguishing the three observable horizons rather than on detailed recording of units within them.

**Subsoil**

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. In the eastern five squares of Trench I the subsoil surface falls off in an easterly direction (Fig.22 upper). Subsoil consists of homogeneous and rather compact clay, medium to dark brown in colour.

**Midden**

*Horizon I* is in general 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. There is 20% shell by weight (Table 6) and coral cooking stones are common.

The horizon has an average thickness of 20 cm and a horizontal surface. It was not observed throughout the excavated area, being apparently absent to the north and east along the edges of the site. It was less developed or absent in the southernmost square of each of Trenches II-V (Figs 22 lower, 23), where Ovens K and N and Hearth M are situated. As it was well developed in the southernmost square of Trench VI (Fig.21 lower) and in most of Trench I (Fig.22 upper), it may be supposed that it fades out in the unexcavated baulk north of Trench I (Fig.21 upper). This means that the midden of Horizon I is not continuous but involves either two separate occurrences 1.5-2 m apart or a single one with a rounded or elongated gap within it.

The pottery analysis described in Chapter III (section 10.3) indicates that the stratigraphic homogeneity of the horizon stands in marked contrast to the heterogeneity of its ceramic content.

*Horizon II*, known from its most characteristic element as 'the soft horizon', is thereby easily distinguished from the horizons below and above. This element is composed of soft, medium grey to brown soil with few shells; the figure of 13% shell by weight in Table 6 is not at all representative of this horizon, which was not characteristically present in the shell-sampling column taken in Square 24/19. An important feature is that the surface of the soft horizon is fairly level, whereas its base is often uneven, filling small concavities in the surface of
Horizon I. At the time of excavation it was thought that Horizon II was a deliberate attempt to make an even surface, probably as the floor of an actual dwelling house. In Trench V a careful excavation of its surface showed two things: that only a few holes penetrated it, of which none seemed to correspond with holes recognised at subsoil level; and that only a few depressions were present in its surface. Because of the time factor, however, the original intention of digging the entire soft horizon out as a stratigraphic unit had most unfortunately to be abandoned apart from this one trench.

This middle horizon has an average thickness of 10 cm, in places up to 20 cm, from its horizontal surface. It seems to have a distribution similar to Horizon I, being absent at the northernmost and easternmost ends of the area examined (Fig.24). It was less developed, or was disturbed, in the southernmost square of each of Trenches II-IV, well developed in the equivalent square of Trench V, apparently absent from that of Trench VI and hardly visible in the north wall of the four squares at the west end of Trench I (Figs 21-23). Traces were very scant indeed in the west and east walls of the main excavation, but clear in the undrawn southern wall of Trench I from 26-31.5/20 (Fig.21 upper). The evidence therefore seems to favour two separate occurrences of Horizon II in terms of its most diagnostic element, the soft layer. It is to be noted (see Fig.24) that the northern one is contained wholly within the excavated area of Trenches II-VI, that the southern one continues into unexcavated ground to the south, probably getting wider there, and that the narrow gap between the two partly overlaps the previously mentioned interruption of Horizon I. It is difficult to decide whether this is coincidental or not. If the two occurrences of Horizon II represent the same constructional phenomenon, they were possibly both elongated, of oval shape, oriented N-S and located close to each other.

A concentration of human bone found in this horizon in Trench I is discussed as Area 4 in Chapter VII, section 10.2.

Horizon III is basically like Horizon I in composition, but generally speaking it is a dark grey, more heterogeneous mixture of earth with whole and fragmentary shells in abundance, the average shell content being 8% by weight (Table 6). There are many compact and isolated shell pockets of varying dimensions. Coral cooking stones are common. A concentration of human bones found in Trench I is discussed as Area 5 in Chapter VII, section 10.2.

The horizon varies in thickness between 50 cm in the central area of the midden and 20 cm at the edges, its surface sloping accordingly. In the eastern five squares of Trench I its surface falls markedly in an easterly direction (Fig.22 upper). Horizon III, which is present in all the excavated area, is thus both thicker and more extensive in distribution than the two lower horizons. Shells continue right up to the present ground surface, where the relatively shell-free humus found at other sites is missing (Plates 28, 29). Only in Trench I was the horizon followed right to the edge, the transition to pure brown garden soil being quite gradual.

Hearth and ovens

Early features: description

Prior to the earliest midden dumping of Horizon I or integrated with the beginning stages of its formation, a number of ovens and one hearth were built within the excavated area. There are no postholes in association to suggest the construction of cooking sheds. I shall describe the structures individually before discussing them as a whole.

Hearth are few in number: one certain example (M), with others less certain.

Hearth M (Figs 23 lower, 24) is a thin feature, 100 cm wide, on the flat subsoil surface, which is burned red underneath the 4 cm-thick layer of ash and powdery charcoal, whose surface is flat or slightly convex. The northern part of it was covered by the shell midden of Horizon I, the southern by Horizon II deposit. Stratigraphically it is thus older than these two horizons.
The possibility that the later stages of use of Oven K and Oven Complex CW/DA (Figs 22, 24) were as hearths is discussed below.

Ovens number nine, four of them in Trench I, with which I begin the descriptions.

Oven DN (Figs 22 upper, 24) is dug 10 cm into the subsoil. The surface of its 15 cm-thick fill is slightly convex and quite undisturbed by the overlying shell-midden deposit of Horizon I, which is less typical here than from a point 25 cm east of the oven onwards. Hole DQ cutting into Horizon I stops right on the surface of DN. Radiocarbon sample ANU-24, discussed in section 10.8 below, was collected from this oven.

CW/DA (Figs 22 upper, 24) represent together the largest oven complex at the site, being some 4 m wide, but it was not fully excavated. It seems to have started life as a small oven, CW, 100 cm across, dug 10 cm into the subsoil, whose surface is burned red here. During subsequent use CW developed into a relatively shell-free deposit of earth with powdery charcoal and alternating layers of ash accumulating on both sides of the smaller oven at the base, over a distance of 300 cm at least. This extension rested directly upon the surface of the subsoil, which was not burned red here. The appearance of this extended and heightened CW structure was that of a heaped deposit, 20 cm high, with flattish surface, whose observable edge to the west was rather steep (45°) and convex. Not much later, structure CW was disturbed in its eastern part by the construction of Oven DA, 120 cm across, which was cut 10 cm into the subsoil to form a flat-based basin burned red at the bottom. It then developed a 30 cm-thick fill of earth, ash, powdery charcoal and many coral cooking stones, 200 cm across, extending beyond the original oven at the base to the east, where an originally sloping edge was probably somewhat disturbed by later digging. Its surface was flattish and continuous with that of CW. A 2-6 cm-thick layer of ash, sealing in CW and DA, may in fact represent a final stage of use as a hearth. At its western end this was slightly dug into the top of CW, unless it just filled up a small oven-like depression here, at the bottom of which was found red-burned soil. The whole complex, CW/DA, was undisturbed by the formation of the overlying midden of Horizon I.

K (Figs 22 lower, 24) is an oven 200 x 130 cm, dug 10-15 cm into the subsoil, with red-burned soil at its base and a fill of shell-midden material, grey ash, powdery charcoal and 80 kg of coral-rock cooking stones. Its northern edge seems to rest on a tiny wedge of badly developed Horizon I shell midden. At this specific point, too, the fill of the oven is adjacent to a small occurrence of material like the soft horizon (II). The original character of the surface of the oven fill cannot be determined owing to very difficult midden stratigraphy above and north of it, but also because it had been subjected to disturbances involving refilling of small concavities in it with shell midden and shell-free material. Its surface seems at two points to be intact up to the level of the general surface of Horizon I to the north, so in principle a convexity of its original surface of some 15 cm is observable. Its stratigraphic status is, however, complex as far as its relation to Horizon I midden is concerned.

The fact that K was one of the radiocarbon-dated ovens (NZ-636, section 10.8 below) has prompted me to look closely in my field notebooks at the observations made during its excavation. In the recorded cross-section of the east wall of Trench II (Fig.22 lower) the oven has a northern limit 23 cm into Square 24/23, apparently resting on a small occurrence of Horizon I midden. The oven extended 30 cm eastwards into Trench III (Fig.24) and when this trench was excavated, the northern limit was found to extend 67 cm further north and was recorded as being below the base of the Horizon I midden. The explanation for this seems to be that the oven was in multiple use at the time that the first components of the Horizon I midden were being deposited hereabouts and that during the course of its life some of those components were deposited in it, stratigraphically separating earlier from later uses of it. Those later uses led in time to the formation of a large deposit some 15 cm above the surrounding ground level, which was subsequently subject to various disturbances. This development of K is reminiscent of CW/DA of Trench I and, like the latter, it might have finished life as a hearth.
Oven N (Figs 23 upper, 24) is 100 cm wide and dug 15 cm into the subsoil, whose surface is burned red. Its northern edge is undercut. The surface of its fill was partially disturbed, especially to the south, but its original convex character (giving a total thickness of 25 cm) could just be recognised to the north, where it was overlain by Horizon I shell midden. The preserved fill included many cooking stones. Oven N is stratigraphically earlier than Horizon I.

Ovens K and N thus have many elements in common and the fact that they virtually touch each other may indicate that they were in use about the same time.

P (Figs 22 lower, 24) is an oven 140 cm wide, cut 10 cm into the subsoil, with red-burned soil at its base. The surface of the preserved fill appears to be slightly concave or flat, but the oven was probably disturbed before the shell midden of Horizon I was deposited above it.

Oven DM (Figs 23 upper, 24) is 90 cm wide and cut 10 cm into the subsoil. The surface of the fill is slightly convex, giving a total thickness of 15 cm. It was completely covered by the shell midden of Horizon I.

Ovens P and DM may in fact be part of the same structural complex.

O (Figs 21 lower, 23 lower, 24) is an oven with a minimum width of 200 cm, dug 15 cm into subsoil and with red-burned soil at its base. The surface of the fill was convex (giving a total thickness of 20 cm) and apparently little disturbed. The oven was partly sealed in by Horizon I midden, mainly in its southern segment, and elsewhere by the soft material of Horizon II. It is thus stratigraphically older than these deposits.

Oven V (Figs 21 lower, 24; Plate 31) is 160 cm wide and dug 20 cm into the subsoil, with red-burned soil at its bottom. The fill was very disturbed, preserved only at the bottom where patches of ash mixed with crushed shell were observed, of which some were situated below the fill of Oven O. Its stratigraphic status is thus clear, though the midden stratigraphy above it is disturbed and confused.

It would seem that the two ovens, O and V, which are adjacent and slightly overlapping, relate practically to the same phase of use, the latter being given up as the other took over, as with CW and DA.

Early features: relationship to Horizon I

The ovens described above are generally quite large, 100-200 cm across, mostly 10-15 cm deep. In plan they are rounded, the cross-section involving sloping sides and rounded bottom; a combination of sloping and undercut sides is noted in one case only, Oven N.

Other common features of the ovens involve a zone of red-burned soil at the base, sometimes mixed with reddish ash, and a fill consisting of white, grey or reddish ash, generally of a sticky character, earth and varying amounts of shell, whole or crushed and burned grey, powdery charcoal and cooking stones of coral rock. A larger quantity of cooking stones was found in Ovens DA, K and N. Stratification of the fill elements did not normally occur.

The outstanding question with these structures found at the base of the site is their stratigraphic relationship to the midden of Horizon I. Are they earlier or are they, practically speaking, contemporary with it? The matter has importance in view of the fact that two of these ovens, K and DN, are radiocarbon-dated, as reported in section 10.8 below.

We are dealing with ten features, one hearth and nine ovens, including Oven K and the two ovens in complex CW/DA which seem to have finished life as hearths. The stratigraphic relationship of these various structures to the bottom midden is not always equally clear. Wholly sealed in are DN, CW, DA, P, DM, O and V; partially sealed in are N and Hearth M. In the case of the final oven, K, the evidence suggests that it was in use during the initial stages of midden formation.

The midden of Horizon I appears then to be superimposed on the distribution of these
structures: some are covered completely, a few partially. Some of the ovens occur in pairs, K/N, CW/DA, P/DM and O/V, which lends support to the interpreted status of K. Four ovens are very close together, K, N, M, DN, which are situated just where the Horizon I midden is thought to be interrupted, as if to make room perhaps for a specific cooking area. This would suggest practical contemporaneity between midden and ovens. A strong similar indication that no long time can have elapsed between the use of the structures in question and the beginnings of midden formation is afforded by the observed convexity of the surface of the fill in Ovens DN, K, N, DM and O and by moundedness, coupled with large extension, in the case of CW and DA. Another observation to the same effect is the strong occurrence of cooking stones and powdery charcoal in the Horizon I midden between Ovens K/N and P/DM, 4 m apart in Trench III (Fig.24). This would realistically reflect the use of these ovens at the same time as shell midden accumulated between them and became the dumping ground for materials thrown out of them.

On balance, though stratigraphically speaking the ovens are earlier than the bottom midden at To.6, we are most probably dealing with two contemporaneous, perhaps even interdependent, functions on the site: an extensive use of cooking fires and the formation of shell midden in between them and gradually also on top of them as they were given up. Four fires, K, N, DN and M (Fig.24), were probably in operation at the very same time in a narrow area especially kept free of refuse, while in the course of events the foot of the midden in process of formation gradually encroached upon them. This interpretation makes it understandable why in a few cases it was difficult to be certain about the stratigraphic relationship between structures and midden.

**Horizon II**

One oven certainly (L) and another possibly (DS) belong to this horizon.

Oven L (Figs 21 lower, 24) is partly embedded in the soft horizon, though also dug into the previous midden. The earth beneath it was burned, its fill consisted of sticky ash and powdery charcoal and on its western margin was a concentration of coral-rock cooking stones. It is of rounded shape, 120 cm across and 20 cm deep.

Oven DS (Figs 23 upper, 24) is embedded in the top of an extension of Horizon II which here is hard clay and ash. Because of its relationship to the surface of Horizon II, it is referred to this rather than to a subsequent phase.

**Horizon III**

Two similar small hearths are allocated here.

Hearth DL in Trench II (Fig.24) is 70 cm in diameter and 5 cm thick with ash resting partly on subsoil, which is burnt red, partly over the fill of Pit W.

Hearth DY (Figs 23 lower, 24) is 90 cm across and 4 cm thick, with ash and burnt soil underneath. It lies on the surface of the soft horizon (II).

**Uncertain horizon**

There are two structures in this category.

Oven F (Fig.24) is a possible candidate for early status. This is by virtue of its size, 150 cm minimum width and dug 15 cm into the subsoil, and its possession of a mixture of reddish ash and red-burned soil at the base. However, it was situated in an area where Horizon I shell midden was absent and it could not be satisfactorily tied into the stratigraphy that was present.

Oven A (Fig.24) was an only partially recognised feature. Dug 15 cm into the subsoil, it apparently had a squarish outline, with minimum dimensions of 50 cm. Its relationship with the stratigraphy of the site is uncertain.
Pits (Plates 30-33)

Horizon I

No pits can be securely attributed here.

Pit CG in the southwest corner of Trench I (Fig.24) is a strong possibility, since it is located where the midden deposits appeared undisturbed. It is a shallow, flat-based structure, minimum dimensions 150 x 75 x 23 cm deep, irregularly rounded in outline and with steep sides.

Pit W is a candidate for Horizon I but is allocated to Horizon II as the more likely case.

? Horizon I

Pit C (Fig.24) is rounded in plan, with vertical sides and flat bottom and minimum dimensions of 100 x 80 x 30 cm deep. It is similar in size and shape to Pit CG described under Horizon I and may be equally early, though the profile of Figure 21 lower just missed registering its western margin.

Horizon II

Pit W (Figs 22 lower, 23 upper, 24; Plates 31, 32) is attributed to this horizon rather than to Horizon I, because its fill to some degree is identifiable with the less homogeneous extension of the soft horizon. Its use in terms of a Horizon II occupation of the site would thus have fallen in the first stage of this. The other possibility is that it was used during the last stage of the Horizon I occupation and still stood open at the time of the subsequent occupation, in which case the two occupations can hardly have been far removed in time. Its situation at the northern end of the soft horizon, which seems just to overlap it here (Fig.24), makes it attractive to think that their functions were interrelated: a pit right outside a house. It is uncertain whether the two adjacent postholes, J and BM, were associated with the functioning of the pit.

Pit W is rectangular in shape with vertical walls and flat bottom. It is 290 x 190 cm and 60 cm deep. It thus bears some relationship to Pit P of To. I (Figs 3 upper, 7) in shape and dimensions and, like Pit P there, it is the only definitely rectangular structure discovered on the site.

Later than Horizon II

Five pits belong here (Fig.24), but only one, AJ, was fully excavated and it alone appears in cross-section on a drawn profile (Fig.22 lower). As regards the other four pits, it was uncertain at the time of excavation at what level above Horizon II they originated. None of them was recorded in sufficient detail for me to be able at this stage to reinspect their profiles at the point they first became visible, in order to decide the likelihood of their having been dug from further above (cf. section 3.2 above).

Pit AJ (Figs 22 lower, 24; Plates 31-33) is a circular structure, 130 cm in diameter and at least 120 cm deep. It has near-vertical sides and a flat bottom. It is the equivalent of the late circular pits of To. I, especially Pit A (Fig.6.2; Plates 2, 3) which it resembles in both shape and size. It was cut (Fig.22 lower) either from near the surface of the site, in which case it belongs to a late stage of Horizon III, or more likely, judging from its upper profile, from the surface itself, thus postdating the horizon. An accumulation of pig bone in the fill of this pit lends support to this latter interpretation, as discussed in Chapter VII (section 7.3 on pig).

Pits AN and U (Fig.24), both of them rounded in outline and undercut at the base, can be compared with late round pits of To. I, like Pit AF (Figs 6.6, 8 bottom; cf. Plate 6) and Pit AA (Figs 3, 7). Since it is uncertain whether AN was cut from the surface of Horizon II or
within Horizon III, its depth may fall between 100 and 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. Pit U 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 (Fig.24), 120 cm across at the top and at least 65 cm deep, has a semicircular cross-section with steep sides and rounded bottom, which makes it resemble Pit AH of To.1 (Figs 6,7, 8 bottom).

Pit AM, of which only a small part was excavated (Fig.24), must have been a very large structure, more than 300 x 200 cm in dimensions and over 79 cm deep. The exposed sides slope gently. Only a low threshold separates it from Pit AN.

Postholes (Plate 30)

Horizon I

By the stratigraphic evidence of the site profiles, a small number of postholes is assigned in a general way to Horizon I on Figure 24. They are features DO, CL, CO and DU, all in Trench I and shown in Figure 22 upper; AO and CE of Figure 22 lower, the latter noted as possibly belonging with Horizon II; AE and BW of Figure 23 upper and possibly B of Figure 21 lower. Most of them were filled with ordinary shell-midden material.

Their dimensions in cm are respectively: width 25, 25, 20, 15, 40, 60, 30, 10 and 40; depth 25, 35, 30, 45, 50, 130, 52, 20 and 70; distance of base below datum (level 100 on the profiles) 30, 53, 51, 65, 63, 148, 79, 39 and 99. The shafts of AO, CE, BW and B are cylindrical, those of the others conical. CL, CO and CE have flattish bases, DU a pointed one and the rest are rounded at the bottom. Holes CE and B have special features which will be described in detail for CE below.

Whether we look at these dated holes alone or together with similar but undated holes, it is impossible to detect a reliable pattern predating Horizon II which would indicate a house construction.

The special features of Posthole CE concern the eastern extension shown on Figure 24. Its western wall is near-vertical throughout the 130 cm depth of the cylindrical shaft below the surface of the subsoil. Down to 60 cm depth on the east side of the shaft there is a steep-sided extension of 30 cm, which leads up to a further feature 40 x 60 cm in area, 40 cm deep below the subsoil surface, with flat base and vertical sides.

Besides B, attributed tentatively to Horizon I, there are a number of undated postholes with lateral extensions at the top, to one or two sides or all round (Fig.24). They are: in Trench I CP, CR, CV, CY, DG and DK; in Trench III AK and S; in Trench IV AT, BQ, CD, J and BM; in Trench V AB/1 and AB/2; and in Trench VI Z. Most of them are very deep: their base levels in respect to datum (level 100 on the profiles) are less than the maximum recorded for the 'normal' postholes attributed to Horizon I (Posthole AE, base 79 cm below datum) in only four out of the 16 examples spelt out above (CR 59 cm, BQ 55 cm, CD 75 cm, AB/2 63 cm).

In this they resemble CE and B, the former probably and the latter possibly belonging to Horizon I on stratigraphic grounds. Their depth may argue their belonging to this horizon rather than any later one. Moreover, more than half of them are found within the area of the soft component of Horizon II (Fig.24), regarding which it was concluded from careful study of the profiles and careful excavation of its surface in Trench V that very few holes of any type penetrated it.

The indications are then that the soft horizon sealed in postholes of this special type, the general explanation for which may be simply the provision of extra working space for the digging stick at the top to give extra depth. Unfortunately these particular holes do not form any pattern. Only four holes fall on a straight line and have similar bottom levels: Z and B,
1.5 m apart in the southeast corner of the main excavation area, and J and BM, the same
distance apart in the northwest corner. The distance between the two pairs is 6 m minimum
and 9.5 m maximum. Hole BM is slightly off the line of the others.

A final point is that at the bottom of CE there was a concentration of ash. Undated holes of
the same type, S and J, held varying amounts of ash, while a great many cooking stones were
found in S, as well as in a posthole of normal type, CD. These similarities may serve further
to link these holes together.

**Horizon II**

Only three postholes are confidently attributed to Horizon II on Figure 24 by the evidence of
profiles, CQ (Fig.22 upper) (40 cm diameter, 65 cm deep, base 57 cm below datum, i.e. level
100 on the profile), DP (Fig.22 lower) (40, 50, 70) and AY (Fig.23 upper)(20, 60, 45). A
possible fourth, BH, is more likely to be later than Horizon II. Grouping them with other
comparable holes not similarly provenanced stratigraphically produces no logical pattern to
represent a house that might have stood where the soft horizon is present.

**Later than Horizon II**

Postholes referred here are BV (Fig.22 lower), 25 cm in diameter and 35 cm deep, with base 43
cm below the datum (level 100 on the profile); DR (Fig.22 upper), 100 cm wide and 60 cm
deep, with base 50 cm below datum, which does not reach the subsoil and may be better
interpreted as a hole from planting or indeed as a small pit; and BH (Fig.21 lower), 30 cm
wide and 60 cm deep, with base 74 cm below datum, which could as an outside possibility
belong with Horizon II.

It might be expected that late postholes would include those with the shallowest bottoms in
respect of datum, leading to confusion with planting holes dug from the surface in the course
of gardening, especially since in some parts of the site they need not have reached the subsoil.
Looking at the distribution of all possible postholes of moderate base level, I was unable to
discover any sort of patterning.

**Conclusion**

It may be stated in conclusion that an examination of the total available data on dimensions,
form and position of all possible postholes from To.6, referable to horizon or not, has
consistently failed to reveal whole and/or fragmentary patterns of house constructions. The
most important part of this analysis was based on a grouping of holes by base level below
datum (level 100 on the profiles) in 10 cm intervals, e.g. 40-49 cm, 50-59 cm, etc., the
assumption being that holes with deep bottom levels would predominantly be early and that
holes with more moderate bottom levels would generally be later. The distribution of the
resulting groupings over the site, singly and in combination, was tried out systematically but
without positive result.

**The structural evidence overall**

Because of the uncertainty regarding the stratigraphy and hence the chronology of some of the
structural features and especially of the postholes, it is very difficult to interpret satisfactorily
the rich structural information from To.6. We may note, however, that all the later pits are
located on the northern and western margins of the excavation (Fig.24; Plate 30). This is
precisely the area where the soft horizon properly so called does not exist. 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.

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 this 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 the latest to Horizon II is situated in the same quarter of the site as the later pits. It could be that the same pattern of occupation and activity was maintained on the site throughout.

**Radiocarbon dates**

Three radiocarbon dates are available, NZ-636, ANU-24 and ANU-873.

1. **NZ-636 2380 ± 51 BP**

   This is a sample of charcoal from Oven K dug into the subsoil at the base of Horizon I (Fig.22 lower). It was submitted in 1965 to date the earliest occupation of the site.

2. **ANU-24 2350 ± 200 BP**

   This charcoal sample comes from Oven DN, only 1.5 m away from Oven K where the previous sample was collected and, like Oven K, dug into the subsoil at the base of Horizon I (Fig.22 upper). It was submitted for dating in 1966 as a check on NZ-636, when sample ANU-23/1 from Site To.5, which was expected to give a similar date for a late stage of the Tongan ceramic sequence, in fact gave a much later one (see section 9.9 above).

   In 1967 (Poulsen 1967a:153-54) I resolved this perceived difficulty by proposing an early occupation at To.6, for which there was some evidence in the ceramics. The existence of such an early occupation has been confirmed by my subsequent reanalysis of the pottery (Chapter III, section 10.3). The difficulty does not lie there, but in the allocation of the two radiocarbon-dated ovens to it.

   In the light of Groube's (1971) revision of the Tongan ceramic sequence (see section 3.1 above), I was at particular pains to review the field evidence relating to these ovens and others associated with them. As a result of this review (see section 10.4 above), there is no doubt that the ovens belong to the main Horizon I midden at the site and date an early stage in its formation.

3. **ANU-873 2730 ± 60 BP (2320 ± 60 BP*; see Appendix 3 for environmental correction)**

   This sample of shell artifacts comes from the middle levels of the Horizon I midden where this was quite well developed and securely sealed by the soft component of Horizon II (Fig.22 upper). It was submitted by L.M. Groube in 1970 in the course of his Tongan reanalysis. With correction for oceanic environment, the value of the BP* is in complete agreement with the charcoal ages from the two ovens and confirms the interpretation that they date the beginning of the main occupation at To.6 (cf. Groube 1971:301).

**SUMMARY AND INTERPRETATION OF SITES**

I have now described and discussed the stratigraphic and structural data produced by excavations at six sites. The most important sites are middens resulting from human occupation and the finds of artifacts made within them, dealt with later, were items lost or broken by the occupants or discarded by them for other reasons.

Each midden site is a complex whole, being made up of larger or smaller units of varying composition. These units were organised into horizons representing, by the evidence of their excavation, major phases in the development of a site and they are subsequently employed for purposes of artifact analysis. The different structural features assigned as far as possible to the horizons reflect 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.
Interpretation of the available structural evidence may sometimes suffer from the problematic relationship between stratigraphy and chronology. Does a structural feature located at the interface between the two horizons belong chronologically to the upper or to the lower of the two? If sometimes the evidence favours the latter alternative, then it may be concluded that no great time gap can separate the formation of the two horizons concerned. A pit, posthole or oven could hardly remain open and intact for any length of time without material accumulating inside or without the collapse of edges and sides. Much of the judgement then depends on the nature of the contained fill and its artifacts and I shall take up this question in particular instances later (Chapter III, section 10).

The most conspicuous feature of most of the excavated sites was their use as dumps for the refuse of habitation, an appreciable proportion of which consisted of marine shells. This proportion is, however, characterised by a great deal of variation from site to site and through the horizons, as documented by the weights of shell from the shell-sampling columns set out in Tables 1-6. They show two things. One is that the field observation ‘much or abundant’ shell for the proportion of shell in a specific horizon is a very general and relative statement which, when quantified, may cover a wide range of actual content. It was surprising, for example, to see that the midden at To.2 holds just 6% shell. The second point is that generally there is a clear trend towards smaller proportions of shell in upper horizons of sites. Whether this can be interpreted as indicating decreasing use of shell fish over time will be discussed in Chapter VII (section 12.3).

It is equally clear, however, that the midden sites were not exclusively refuse dumps but from time to time were the focus of other aspects of a community’s activities. Chapter VI (section 1) considers the circumstances of occurrence of the excavated artifacts, which tend to the same conclusion. On the evidence so far reviewed, cooking activities are prominent, the fires for which seem not uncommonly to have been made within the middens themselves, either as a flat hearth or contained in a scooped depression of rounded outline, the typical Tongan earth oven or ‘umu. Both types appear from the earliest to the latest levels. Cooking stones were common in all horizons, associated with actual fire-structures and not. 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 ash and powdery charcoal.

Of special interest are the pits dug within the midden area, especially at Sites To.1 and To.6. The most plausible explanation for at least some of these, given by informants and documentary sources (e.g. McKern n.d.:400-5), is that they were meant for the storage and/or fermentation of food, a topic to which I return in Chapter VII. Some of those investigated belong to early horizons, but the majority is later, some indeed after the ceramic period. Among the later pits as a whole, two forms call for comment. One is the large and shallow rectangular pit represented by P at To.1 and W at To.6. 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 those with undercut sides, like AF at To.1 and AN at To.6.

It would appear that some pits were dug and used at times when midden formation resulting from activity at a site was going on elsewhere on it. This is how I have interpreted the evidence of the main trench (I) at To.1, where pits were evidently filled in with midden material from Horizon I into which they were dug and sealed in by the midden formation of Horizon II (Chapter III, section 10.1). While these pits were in use, midden formation would have taken place elsewhere, for example in the nearby area of Trenches IV and V where no pits later than Horizon I were discovered.

In excavations at 'Atele Davidson (1969a:275-79) found a complex of pits, the plan of which (1969a:276) gives the site a striking resemblance to Trenches I and III at To.1 (Figs 7, 8) and to the main excavation at To.6 (Fig.24). Moreover, the two pit types at To.1 and 6 isolated for special comment above are both represented at 'Atele, though the rectangular pits there
are deeper than mine. The later pits of the 'Atele complex appear to have filled in naturally, at least in part, while the earlier ones were seemingly deliberately infilled. Davidson's (1969a:279) evidence suggests that the pit complex falls after the end of pottery production and before the first of the burials found nearby, which gave a date of 770 ± 200 BP (GaK-1204) on bone collagen (Davidson 1969a:274).

It was disappointing that no information about houses or other above-ground structures was obtained at my sites, despite the numbers of holes found and excavated, some of them certainly postholes. The possibility is that amongst the holes at sites like To.1 and To.6 parts of living structures were present but remained unrecognised largely because of the size of the excavations undertaken. The occurrence of finished and unbroken artifacts in the middens (cf. Chapter VI, section 1.7 and Table 84), 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, and for industrial activities. Some modern houses belonging to people living by the lagoon and much engaged in shell-fish collecting are actually built on a midden in process of accumulation. It is also quite a common practice today 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 (1929:104-6) records a similar instance from Pangaimotu, an islet off Tongatapu.

Burials sometimes took place in midden areas. Two such 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 and here the dead was provided with a grave gift. The later reuse 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 (1969a) near 'Atele College adjacent to the present investigation district.

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.

Finally, we have noted the higher representation of Anadara than of Gafarium shells in (possibly natural assemblages in) the subsoil at Sites To.1, 3 and 5, as compared with the middens there, and suggested that this reflects a change in the lagoonal environment from more open, tidally influenced to more enclosed conditions. This argument is set out in detail in Chapter VII (section 1.4) and has been anticipated here to support the compatible geomorphological evidence from To.1 and To.5 at the time the shell assemblages were laid down.

Whatever the nature of the lagoonal change, the evidence, especially from To.5, shows that it was going on at an early stage of human settlement. I shall consider the implications of this in Chapter VII.

**THE PROBLEM OF MIDDEN DISTURBANCE**

The descriptions of the excavations which I have presented provide much evidence of the disruption of stratigraphy by pit and posthole digging. As a result of such disturbance not only earth and shell but also objects of material culture may shift position. Such objects will have a primary position where they first landed and in cases have remained ever since, but they may have a secondary position which they subsequently occupy due to disturbance once or several times.

Added to this is the use of abandoned sites for agriculture, during which the digging of planting holes has without doubt resulted in the vertical and horizontal displacement of soil, shell and artifacts (cf. the observation of Rogers 1974:312 and Kirch 1978:8 on Niuatoputapu). The dimensions of planting holes seem from the enquiries I made to have varied considerably
depending on the variety of root or tree crop to be grown in them. The smallest holes would be 10-20 cm deep, the biggest 200 cm or in rare cases 250 cm deep. These very deep holes, for early yams, would be 40-50 cm across the top. The holes for late yams would be 35-130 cm deep.

No specific effort was made to discover and isolate planting holes during the actual excavations, since the excavation techniques employed were in part adopted with the aim of circumventing the problems they posed (section 1.1 above). Few such holes were recognised and these exclusively in trench profiles on sites recently used as gardens (To.1, To.5 and To.6). These no doubt represent a minority of the total planting holes ever dug within the excavated area. Despite this it was impossible to believe that gardening activities could literally have turned the middens upside down. Excavation proceeded therefore on the assumption that such activities would not have altered the original distribution of the artifactual evidence to the extent of making it quite futile to try to derive meaningful results from its statistical analysis.

The results surely justified this hope and thus require moderation of the criticism of ‘rapid’ and ‘arbitrary’ excavation methods employed in my examination of Sites To.1-To.6 (Groube 1971:295-96, 298, 306). It is nevertheless felt necessary to attempt to substantiate my basic assumption by a tentative study of midden disturbance relating to the excavated sites.

**The measurement of disturbance through joining fragments**

One way of measuring the degree of midden disturbance is to study the distribution of joining fragments of once-whole objects based on the positions in which they were found by excavation. This is a matter of investigating which fragments belong together and of relating the recorded positions of all such fragments to the stratigraphy of the site. The degree of disturbance is reflected by the degree of horizontal and/or vertical scatter of related fragments: the more pronounced the scatter, the more disturbance has taken place. If for each individual site it is possible to establish a scale of disturbance, this may be of help in deciding whether or not the total artifactual material lends itself to reliable quantified analysis oriented towards a sequence.

Success is dependent on two things. The first concerns field methods. The three-dimensional recording of every single item of material culture found in a midden represents the ideal, since it makes it possible to investigate the exact distribution of all related fragments. Secondly, success is naturally also a matter of the proportion of related fragments that can actually be traced in a given body of material. Groube (1971:297-98) instituted the most rigorous procedures in both these respects during his excavation of Vuki's Mound.

**Limitations of the data**

The field methods used in my excavations had other aims and are far from being ideal in the specified terms. A systematic search for related fragments from neighbouring spits of these excavations would no doubt lead to results comparable to those possible by the ideal method described above. Even though this has not been done, it has been possible, from notes made during the original analyses, to list 122 cases of fragmentation, two involving shell bracelets, two stone adzes, the rest pottery. They represent 392 individual fragments plus their recorded positions.

These data were gathered during the original cataloguing of all finds and subsequently during the analytical handling of selected groups of pottery. Comparisons were arbitrary and incidental, in that only some fragments were compared with each other - those that looked conspicuously to be related - the size of the collections and the time available ruling out systematic comparisons of any pair of fragments. The pottery catalogue was restricted to rim sherds and decorated sherds plus any 'notable' sherd. As a simple function of the cataloguing procedure chosen (section 1.2 above), the comparisons made were with neighbouring squares.
and spits. Further comparisons were made during the analytical ordering of sherds, both when the codes were worked out and when the material was actually coded. Though unintentional, this allowed the matching of related fragments found further apart than was the case during cataloguing.

Though at this distance in time it is impossible to assess the representativeness of the result, it is considered that the joint effect of the two different procedures contributing to it make the 122 cases presented here a fairly reliable sample for a tentative investigation of the problem. The data are set out in Tables 7-12 and are discussed below.

**Nature of the data**

Table 7 sets out the distribution of the 122 cases of joining fragments by site and artifact class, irrespective of the number of fragments involved. Table 8 gives the numbers of fragments covered by these 122 cases, showing, as expected, that the greater the number of cases, the smaller the number of fragments involved. All but five of the matches concern rims and decorated sherds. The numbers of pieces participating in the 117 cases of joining fragments of rims and decorated sherds are set out by site in Table 9, where they are compared with the totals of rims and decorated sherds excavated at the individual sites. It is apparent that the matching pieces make up only 6% of the total of rims and decorated sherds handled in the ceramic analysis overall, with the figures for individual sites ranging from 2.3% to 10%. Obviously neither the individual samples nor the combined sample are of a size sufficient for detailed statistical study.

**Horizontal scatter of joining fragments**

Table 10 shows that related fragments have clearly been found close to each other. In the majority of cases (84%) they have been recorded from positions 1-4 m apart.

There are 12 cases involving positions more than 5 m apart, the details of which are set out below (section 12.7). At To.1 distances range from 6 to 37 m, at To.2 from 7 to 12 m, at To.5 from 7 to 9 m and at To.6 from 4 to 14 m. Site To.2 seems to deviate from the rest, with proportions of 23% and 18% respectively for fragments found 4-5 m and more than 5 m apart.

Considerable horizontal separation is perhaps most likely to refer to secondary displacement and thus to midden disturbance proper. On the other hand it is not impossible that related fragments were originally dumped in widely scattered primary positions on a midden and have remained there ever since.

**Vertical scatter of joining fragments**

Table 11 shows the extent of vertical scatter. Matches most often (32.1%) occur within the same spit of the same m² excavation unit or equivalent spits in other m² units, that is within the same 10 cm depth range, anywhere vertically in the midden, measuring from the ground surface. Matches are almost as common (26.4%) from actually or equivalently adjoining spits, i.e. within the same 20 cm depth range. The balance of 74 cases concerns matches occurring in different spits separated by one or more actually or equivalently intervening spits: 27 of them (15.2% of the overall total) represent a separation by one spit (i.e. the same depth range of more than 10 cm but no more than 30 cm) and 19 (10.7% of the overall total) a separation by two spits (i.e. the same depth range of more than 20 cm but no more than 40 cm). Given all this, the evidence is of light rather than heavy disturbance in the vertical dimension.

Site To.2 again forms a partial exception in that here there are quite a number of cases where related fragments were separated by up to nine spits, up to a possible 110 cm vertical distance from each other.

As for the overall distribution in terms of horizons, Table 12 shows that in the majority of cases, 60-75%, related fragments were recorded from the same horizon. Admittedly this
majority is not overwhelming, though still convincing. It is perhaps remarkable that with 25-40% of cases falling in different horizons, the main pottery analysis could result in a clear sequence, a result that may give an idea of the scale of disturbance permissible for such an analysis. We may therefore in all fairness say that the related fragments for the most part come from the same horizon but that there is clear evidence of midden disturbance.

What I did observe during this exercise was that related fragments were more likely to be identified the deeper they were found, with fewer cases of fragmentation recognised in material from top horizons. These horizons have probably been most exposed to midden disturbance, especially by gardening, subsequent to final cessation of midden formation on the spot. This will have tended to increase the rate of sherd breakage, to produce smaller and smaller fragments and consequently to make identification of related pieces more difficult (at least in terms of fitting them together). Therefore, from the scarcer occurrence of related fragments in top horizons, we are probably justified in suggesting that they have been more disturbed than the horizons they seal in.

Finally, it is worthwhile mentioning two cases from To.1 involving the joining of excavated with surface sherds. In both cases the excavated sherds were found in Horizon I, one of them in a pit. The two surface sherds were collected within a small area around the northern end of Trench 1, where the others were excavated. One of the cases involved has already been mentioned for Site To.1 above (section 5.1).

Site To.2

As we have seen, the data for To.2 indicate that the site as a whole is somewhat abnormal and must have been subject to heavy disturbance. Related fragments were in 41% of the cases found 4+ m apart (Table 10). In less than 50% of the cases were they within the same or equivalent spit, in adjoining spits or separated by no more than one spit (Table 11). In 70% of the cases they were found in different zones (Table 12), including Zones I and IV and Zones III and VI. These figures lend support to the conclusions drawn from the field observations discussed in the excavation section on To.2 above (section 6.4), as well as from analysis of the pottery in Chapter III (both sections 6.1 and 10.2), that the site consists of a midden from the edges of which materials were taken to build a mound on top, with the addition of other materials contemporary with the midden taken from elsewhere.

Does the present investigation have anything to say about the status of the midden itself, whether this might be a secondary formation of redeposited material and not the primary midden which was the conclusion from the field evidence?

Pronounced vertical scatter of matching pieces through Zones I-III would be strong indication of redeposition. From the ten cases of relevance to the question we have eight of related fragments found practically at the same level in the midden and for the most part quite close to each other as well, thus illustrating moderate scatter only. In one deviating case there is a 50 cm difference in depth but both fragments were found in the lower part of the midden, one of them in a shallow pit. The other exception refers to fragments found in the same square of Zones I, III and IV. The Zone IV fragment originates from above Oven M which, as we have discussed in section 6.5 above, represents a post-midden use of the site. The midden itself appears on the evidence to represent a primary deposit.

Conclusions

We have now seen how both the vertical and the horizontal scatters of related fragments show that while certainly the midden sites cannot be characterised as undisturbed, on the other hand they are far from having been turned wholly upside down in the course of time. All horizons/zones have been exposed to disturbance, especially, it would seem, the topmost. In general, the disturbance has been minor, involving displacement of artifact fragments a few metres in the horizontal dimension and 10-30 cm in the vertical, and more often within the
same horizon than from one into another. In the main, perhaps, this reflects displacement of things at the time of formation of the dumping horizon concerned or before a new one was added on its top. Disturbance of a more serious kind has been less frequent and may be best discussed by reference to the data on combined horizontal and vertical scatter for the total of 12 cases where at least some fragments were found more than 5 m apart. I set out these data below, omitting distances less than 5 m in the cases at issue, since these are recorded in Table 10.

To.1  a four potsherds including positions 10, 24 and 25 m apart and all in the same horizon (I)
       b two potsherds found 6 m apart, one in a pit, the other in the midden, but both in the same horizon (I)
       c seven potsherds including positions 33, 35 and 37 m apart, five in Horizon I, one in Horizon II and one in uncertain horizon

To.2  d two potsherds found 7 m apart, one in Zone I, the other in Zone IV (in spits nos 16 and 6 respectively)
       e five potsherds including positions 7 m apart, two in Zone III, three in the buffer zone between Zones III and IV
       f three potsherds including positions 8 m apart, one in Zone III, one in Zone IV and one in uncertain zone
       g two pieces of a stone adze found 12 m apart, one in Zone IV, the other in Zone VI

To.5  h three potsherds including positions 9 m apart, one in Horizon I, the other two in Horizon II
       i two potsherds found 7 m apart, one in Horizon II, the other in uncertain horizon

To.6  j two potsherds found 10 m apart, one in the bottom of Horizon I, the other in uncertain horizon
       k six potsherds including positions 9 and 12 m apart, four in Horizon I (three at the base of this, one further up), one in Horizon II, one in uncertain horizon
       l three potsherds including positions 9 m apart, one in Horizon I (at the top), one in Horizon III, one in uncertain horizon

What is very clear from the above is that in cases comprising many fragments the majority or all of them proved to derive from the same horizon, the 'founder' unit. This suggests that the displacement of the artifact fragments was confined to the horizon under formation, where they belonged culturally and chronologically and of whose formation their broken state was an integral part. Furthermore, it appears that the formation of a new horizon on top of the old one sealed it in and tended to reduce disturbance. There is a hint here that if we had statistically valid samples, we might be able to distinguish between primary and secondary scatter, between dumping and disturbance, primary position being due to the dumping of things on a midden and secondary position to the displacement of things already dumped as a result of midden disturbance.

In the present case, however, with the small amount of data available, it is difficult if not impossible to interpret the scatter of related fragments clearly in terms of dumping or disturbance. It is thus a matter of 'both/and' rather than of 'either/or'. Consequently I shall use the term 'disturbance' as a general expression for the different types of scatter discussed in the foregoing paragraphs.

In view of the tentative results obtained from this study of midden disturbance, how are we to judge the results of the main pottery analysis to which we shall shortly turn? Since the degree
of disturbance is generally slight and of only limited effect upon the homogeneity of the horizons/zones, then that analysis can surely be looked upon with a corresponding degree of confidence. Conversely, since the main pottery analysis gives sensible and internally consistent results, it can be argued that the degree of midden disturbance on Sites To.1-6 cannot be disabling. The original basic assumptions of the fieldwork and analysis thus hold up by various types of evidence. The only reservation is that we shall probably have to reckon with a slight increase in sherd totals for some top horizons at some sites, as a result of subsequent activities at the surface, especially gardening. This is a matter that could only be adequately addressed on the basis of a full study of sherd weights and counts of the total excavated material.

Finally, we should remind ourselves that the nature and degree of midden disturbance may vary a lot from site to site and will have to be specifically accounted for on every individual site. Vuki’s Mound, whose excavation occasioned the critical comments by Groube which stimulated the above discussion, seems to have been extraordinarily subject to disturbance (Groube 1971:298), but it may be fallacious to generalise from this one case.
III THE ANALYSIS OF THE POTTERY

At the time of first analysis of the pottery from the excavated sites in 1965-67, there was little written on archaeological pottery from the South Pacific and much of this was descriptive rather than analytical (Meyer 1909, 1910; Casey 1936; MacLachlan 1938, 1939; Lenormand 1948; Avias 1950; Gifford 1951; Gifford and Shutler 1956; Spoehr 1957; Gifford and Gifford 1959; Hébert 1963-65; Garanger 1966). In addition, not all the published material was closely related to the pottery from Tonga. In respect of related material there was not much evidence available for the types of vessel from which the sherds had originated. The analysis, therefore, could draw little on previous work within the general area of research, something which indeed also applied when the additional analyses presented in this volume were undertaken.

In 1972 I published a handbook on pottery analysis drawing on my experience with the Tongan ceramics. This handbook (Poulsen 1972) established the basis for the renewed investigations and is regularly referred to in the discussions below.

AIMS AND METHODOLOGY

If, with my own abundant materials, the ideal was a full characterisation of Tongan prehistoric ceramics, this was obviously limited by the time originally available and by the nature of the material under study. The excavated pottery was in a very fragmentary condition, comprising potsherds predominantly of small size, with only one whole pot, a small undecorated bowl (Fig.55.5; Plate 34.2), and a very few partially reconstructable vessels (Figs 44, 45.9-10, 46.1-2, 48-50, 53, 55.6, 56.17; Plate 34.1, 3). Of the great amount of sherds 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 extreme fragmentation of the pottery had a further consequence. It was necessary to do the analysis primarily in terms of individual pottery features and only secondarily in terms of combinations of features. In this way the fullest use could be made of the study material, in that where all features were not present on broken pieces, those that were could still be included in the investigation (cf. Green 1961:142).

In addition to such practical considerations, there are of course good theoretical reasons in support of such attribute analysis (cf. Rowe 1959; Spaulding 1960a, b). Artifacts, after all, are complex combinations of many individual traits, each of which may change at different rates and occur in different frequencies over time. It is possible to characterise a particular region at a particular time in terms of a combination of particular attributes in particular frequencies which we may call a particular pottery spectrum - and to contrast it with other regions and/or the periods characterised by other pottery spectra. This procedure makes much more complete and sophisticated use of the information locked up in the study material than operating in terms of pottery types, combinations of a limited number of specific features which are judged for one reason or another to be the important ones.

THE DATA AND ITS HANDLING

Table 13 spells out the material selected for analysis from the excavated and surface collections at the investigated sites. A total just in excess of 7000 rim and decorated sherds is involved. Sites To.3 and 4 were not originally included in the analysis. Not only was the sherd sample from both sites very small, but also at the former site the excavated midden deposits were much disturbed, while at the latter no real midden was present. The material
from the fairly undisturbed parts of To.3 was included in the reanalysis as an experiment. The other sites seemed all 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.

To facilitate analysis of the typological and contextual aspects of the voluminous collection, it was clear from the beginning that some mechanical facilities had to be explored. The information held by the material was therefore extracted by means of codes and recorded on punch cards of the ordinary type with 80 columns, allowing various kinds of machine and computer processing of the data (see Poulsen 1972:33-34 for discussion of alternative types of punch card considered).

At the outset it was decided that, whatever its size, a single sherd scored one, that is a punch card was made for every potsherd that was coded. A certain amount of caution is therefore required in the interpretation, especially with small samples. If a large sherd is broken into five, the occurrence of a trait is increased by five times in the individual case, but correspondingly less when included in a larger group of sherds.

The factors that caused breakage at any one level of a site might, within broad limits, be assumed to operate equally on discarded pottery of different types. The unknown circumstances of breakage should themselves 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. A partial exception to this would be a situation where gardening has increased the rate of sherd breakage in top horizons, as discussed in Chapter II (section 12.5). As mentioned there, evaluation of this factor would require a full study of sherd weights and counts in the total excavated material.

In the event, no evidence appeared from the study to challenge the assumptions underlying the decision to make every potsherd of equal value. Obviously, however, the statistical evaluation of frequencies of occurrences is in the circumstances the more reliable the larger the samples from which they are derived.

Two sets of punch cards were made: one for rim features and one for decoration features, based on the rim and decoration codes described below. The information on the provenance of the sherds in the investigated sites was translated into a so-called record code, also described below, and transferred onto the two sets of punch cards. All decorated rim sherds had to be coded twice, once for the rim features and once for the decoration features, and their site record duplicated. There were 836 sherds of this kind included both in the rim sherd total of 4633 and the decorated sherd total of 3318. This gave a total number of 7951 punch cards recording the full information on the material initially selected for analysis.

Though most of the pottery analysis was performed by computer, there is reason to mention two other practical advantages connected with using the punch cards concerned. Every potsherd is represented by an individual punch card (the decorated rims by two cards), whose punches stand for the attributes that characterise it. The numbers of the punches are printed out along the upper edge of the card. This enables easy decoding of the information and so readily allows manual sorting of cards in limited test analyses. Manually operable sorting machines may be required if there are too many cards. In other words use of the computer is not always necessary in handling the data held by this type of punch card. The other thing is that the cards may be sorted into any order and the information contained by them thus be printed out on lists. To list items in catalogue number order by sites is, for example, an obvious requirement for archival purposes (cf. Poulsen 1972:35).
THE POTTERY CODES
(Figs 25-41)

To systematise the description and analysis of the abundant rim and decoration features characterising the pottery corpus, the relevant observations, as well as those relating to the provenance of the individual sherds, were ordered in codes (cf. Poulsen 1972:9).

Since at the time of working out the pottery codes none of the related Lapita pottery of the Southwest Pacific had been subjected to detailed analysis, it was uncertain which features might provide the evidence hoped for. Some impressions had been gained in the field and during the cataloguing of the material, while subsequent trials on samples of sherds suggested the potentiality of other features. Detailed study of the principles of pottery coding resulting from the work of J.-C. Gardin and colleagues (e.g. Centre d'Analyse Documentaire pour l'Archéologie 1962) helped in the construction of workable codes for the Tongan pottery.

The completed codes are explained in detail elsewhere (Poulsen 1972:9-32) and will here be described in outline only. The results of the analysis being largely unpredictable, the codes were relatively comprehensive in the categories to be included. This decision was made not only in the light of the principles of coding seen against the specific research situation concerned, but also of the mechanical handling of the data that was planned: after all, many observations could be included without too much extra effort at the point of coding. The idea of the codes thus was to provide an efficient starting point for the successive selection of features during analysis with the aims that have been specified.

The Rim Code (Figs 25-31)

Definition of a rim (Fig. 25.1)

If the vessel wall changes direction and it is possible to observe a transition, i.e. a specific point or zone where the change of direction takes place, then the rim is looked upon as complete and comprises that part of the vessel wall situated on the lip side of, or above, the transition. Conversely, the body is that part of the vessel wall situated below the transition. Practically all complete rims in the collections come under this definition (the so-called A rim).

According to the condition of the rim sherds, the collection comprises three main groups of rims. Common to which is only the fact that the lip is preserved: complete rims, sherds where part of the body below the rim is present; incomplete rims, sherds which definitely contain the upper part of the once complete rim but no trace whatsoever either of the body wall beneath or even of the transition between body and rim; and uncertain rims, sherds on which it is uncertain whether the body below the rim is present or not and consequently how much of the rim is preserved.

Any rim has a basic rim form. Simple rims are those which have no extra rim features added; complex rims are those which have such extra features. Incorporated in the concept of a basic rim form is the central axis of a rim, an imaginary line through the middle of a rim and following the general straight or curved course of this. The central axis is used in determining the orientation of a rim, the body-rim inclination and flat lip inclination.

Rim features

The main categories of rim features accounted for in the code may briefly be described as follows (for the full explanation see Poulsen 1972:10-25).

Rim orientation (Fig. 29) is the angle between the perpendicular centre line of the original pot standing upright and the central axis of the rim as it sat on the pot (on curved rims the straight line that continues the direction of the central axis at the lip). Orientation may be inward, outward or vertical and expressed in degrees or within a range of degrees. Orientation may be uncertain if the state of preservation of the sherd, especially along the lip, is poor.
**Body-rim inclination** (Fig.30) is the angle by which the course of the rim deviates from the course of the body immediately below it. Inclination may be inward or outward and could normally be measured with precision.

**Body rim joints** (Fig.25.6) on the outside and inside of the sherd may be marked or not marked.

**Basic rim form** (Fig.26.12) is the behaviour of the inner and outer rim walls in relation to each other as they approach the lip. In most cases observed the rim form is parallel, convergent or divergent.

**Extra rim features** (Fig.27.13-27) are thickenings of various forms and reductions of two types, any of which may be present inside and/or outside the sherd. The regularity or irregularity of extra rim features was coded, as well as their length and width relative to the maximum width of the thickened or reduced rim sherd.

**Lip** (Figs 27.29-30; 28.30-32, 34; 31) is the generally narrow end element that connects the inside and outside walls of the rim. A range of classes and subclasses of lip form was defined, with flat and round lip forms dominating. Flat lips may or may not be horizontally oriented, but the observation depends upon the certainty with which rim orientation can be established. Lip form may be symmetrical or asymmetrical (inward or outward) around the central axis of the rim. The degree of asymmetry of flat lips is called flat lip inclination, which is the angle between the lip and the central axis of the rim expressed in degrees or a range of degrees. Transitions of flat lips are the corners between the lip and the rim sides. They may be marked or not marked.

**Collar and flange rims** (Figs 25.7, 8; 26.9-11) made up some 900 sherds of the collection. They are characterised by the outer wall of the rim being offset at an angle from the outer wall of the body, with the inner wall either reflecting the offset course of the outer profile or not. The short link between the bottom of the outer wall of the rim and the top of the outer wall of the body is called the overhang and probably served to provide the pots with a ready grip. The main difference between the two types is the profile of the outer wall from lip to overhang, which in flanges is concave, in collars straight or convex. Because the collar variety is predominant in this group of special rims, all of them are often referred to jointly as collar rims or just collars. Their special features of form and dimensions were described by specific categories, while their normal rim features were coded by means of the ordinary code categories.

**Measurements** of various dimensions on the rims were taken in mm and coded directly as such (Fig.28.35-38). They comprise the categories of maximum width of rim, wall thickness relating to the body wall just beneath the rim, and, for collar and flange rims only, width of overhang.

**The Decoration Code** (Figs 32-41)

This code aims at a general characterisation of the nature of the decoration and a practical grouping of its observed features (for a full account see Poulsen 1972:26-29). Given the nature of the material, there could be no satisfactory answer to questions relating to the total decoration: whether particular pot forms were characterised by particular decoration features, which combinations of motifs were preferred, whether motifs occurred in specific sequence from lip to base and the like.

The introductory categories are concerned with the **kinds of sherds** that carry decoration; the **type of decoration**, surface (impressed), applied or notched; the **position of decoration**, inside or outside of the sherd; and the **distribution of decoration** on sherds (Fig.32.5, 6).

A number of categories deal with aspects of the surface decoration: its **nature**, whether rectilinear or curvilinear in style of motif; its **technique**, whether made by dentate stamp, shell edge, incision or perforation; **number and position of motif zones**: one or more zones in total,
inside or outside of the sherd, presence on lip, applied band or flange; filling of zones, whether
with different or similar motifs; and types of zone border, horizontal lines (Fig.32.15) or vessel
features such as lips or carinations.

The large range of motifs of surface decoration is grouped into a number of motif categories,
each including variations. They comprise vertical A arcs (Fig.33); horizontal B arcs (Fig.34);
grouped C arcs, often producing circular figures (Fig.34); horizontal D zigzags or triangles
(Figs 34, 35); vertical E chevrons and zigzags (Fig.35); vertical F bars (Figs 35, 36); oblique G
bars (Fig.36); horizontal H lines as independent motifs (Fig.36); vertical or oblique J bundles
of close-spaced lines in rows or groups (Fig.36); composite K and L motifs built up of
combinations of the foregoing motifs (Fig.37); labyrinth-like M motifs (Figs 37, 38); house-
net- and labyrinth-like N motifs (Fig.38); column-like O motifs (Fig.38); and the P motifs
consisting of variously filled-in panels (Figs 39, 40). Lastly come the unique Q motifs,
distinguished only by being different from the foregoing motifs (Figs 40, 41) and a final group
of fragmentary decoration, R, that defies identification with any motifs whatsoever.

There are also categories to describe various kinds of applied decoration, such as vertical and
horizontal bands, knobs and unusual figures, as well as perforations of the vessel wall, and to
note their position and distribution on the sherds. In addition, the nature and distribution of
notched decoration is dealt with.

The Record Code

This provides information on the provenance of the sherds in the midden sites (for details see
Poulsen 1972:30-32). The opening categories record the type of sherd coded, the
identification of the site and the catalogue number of the individual sherd. The next eight
entries spell out the position in which a sherd was found: which square and spit, if in a
structure like a pit or posthole and which one. Another category is employed when a sherd
was found on the surface of a site. In my reanalysis of the material two new categories were
added to the code and the punch cards to record the horizon or zone to which a sherd
belonged. These were introduced to make analysis easier than before.

DIVISION OF THE MATERIAL FOR ANALYSIS

General considerations

Analysis of the coded pottery was done according to its distribution in terms of the
stratigraphic horizons of the investigated sites. Consideration of the subject of site
disturbance at the end of the last chapter has established the broad integrity of the midden
horizons for analytical purposes.

The conversion of midden horizons into analytical units was accomplished by allocating the
excavation units - the spits - as well as possible to the stratigraphy of the sites by reference to
the profiles drawn at 1 m intervals during excavation. Where the stratigraphy comprised level
interfaces between horizons, the allocation of spits was straightforward. However, where the
interfaces were uneven or sloping, buffer zones between horizons were defined and the material
from these withdrawn from the analysis. A buffer zone may involve one or more spits within
one or more squares.

Analytical units constructed by the allocation of spits to horizons in this way are called spit
horizons, in contrast to true horizons, which were excavated stratigraphically.

By far the greater part of the material in the various analytical units was found in the
horizons themselves; a small part only comes from postholes and pits that could be allocated
to horizon. Most squares excavated provided material, but some squares had to be excluded
from analysis because they appeared to be too much disturbed by activities on the site, both
contemporary and subsequent. However, a special analysis was made of the material from the
main trench at To.1 to investigate the distinction between disturbed and undisturbed squares (section 10.1 below).

As a preparation for the reanalysis of the material which I have undertaken, I sought wherever possible to increase sample size. This was achieved mainly by including material from structural features like pits, postholes and fireplaces, withheld from the initial analyses, according to their stratigraphic relationship with the midden horizons. In the event this was of benefit mostly to bottom horizons because structural features belonging stratigraphically to later horizons are likely to contain mixed artifactual material originating from more than one horizon and are thus best not included in the analysis.

Analytical units site by site

The procedure of establishing the analytical units for the renewed analysis varied slightly from site to site.

To.1 Here they were established on the basis of two types of horizon: the True Horizons I and II of the main trench (I) which were stratigraphically dug and the Spit Horizons I and II of Trenches II, IV and V (plus Square 50/94). In the analysis the total data from these two kinds of horizon were summed and appear jointly for the whole site under the headings Horizons I and II or Analytical Units I and II.

To.2 Here there are two spit horizons, the Midden Horizon and the Mound Horizon. The material from these was analysed by horizon, ignoring subdivisions, and was identified as originating from the midden and the mound. In addition, each of these two major units was divided into zones, also by spit allocation, the mound according to the stratigraphy into Zones IV, V and VI and the midden arbitrarily into Zones I, II and III, where Zone II acts as a buffer zone for the purpose of detecting possible differences within the otherwise uniform midden horizon. Zones I-VI were analysed as individual analytical units as though they were separate horizons. Material from Trench II (Fig.9) was included as most probably deriving from Zone IV.

To.3 Wherever possible in view of disturbances, spits were allocated to Horizons I, II and III in Trenches I and II of this site. It appeared then that some 130 rim sherds and 105 decorated sherds could be referred to horizons and it was decided to include this material in the resumed analysis.

To.5 As analytical units, Horizon I-III are spit horizons, Horizon 0 a true horizon. In the analysis Horizons 0 and I have been treated both separately and together; the pottery from Horizon 0 is quite limited and seems to be identical to that in Horizon I.

To.6 The analytical units at this site are spit horizons, I-III. Because the earlier analysis had indicated that the artifactual evidence in Horizon I was not uniform within the stratigraphically uniform deposit (Poulsen 1967:139-40, 141, 153-54), a subdivision was made for purposes of the reanalysis whereby the bottommost spit of the horizon in any square was allocated to a Zone IB (= bottom), to be contrasted with the remainder of the horizon above, called Zone IT (= top). This somewhat arbitrary procedure meant that in general the structures at the base of the site were included in Zone IB. Of the total of 26 decorated sherds referred to IB, one came from these structures, as did 22 of the 118 rims. Some material was also recovered here and there from the subsoil below Horizon I and the numbered spits where such finds were made were also allocated to IB.

For all sites the number of analytical units was enlarged for the reanalysis by the inclusion of 'whole site, surface collection' and 'whole site, excavated collection total'. This was stimulated by the concept of pottery spectra as a measure of ceramic development and relative chronology (see section 1 above), not only for the existing material but also for the future.

A final grouping, 'whole site, excavated stray finds' (covering, for example, material taken out of trench walls before backfilling) was added simply to make the tally of excavated finds balance.
ANALYTICAL PROCEDURES

The first step in analysis was to spell out the frequency of occurrence of the coded pottery attributes in the various horizons and/or zones selected as units of analysis. The raw data were incorporated in a series of tables, one per unit of analysis, collectively known as (Computer) Table IA-D, A and B the rim features, C and D the decoration features. The next step was to express selected aspects of these data in terms of percentages and to submit them to statistical testing to discover the degree of significance attaching to differences between the established frequencies in different analytical units. The results of these operations were incorporated in a series of tables collectively known as (Computer) Table II. Copies of Computer Tables I and II are held in the Department of Prehistory, Research School of Pacific Studies, Australian National University, Canberra, and in the Institute of Prehistoric Archaeology, University of Aarhus.

Computer Table IA-D: frequency distribution of attributes

These tables were arranged with the numbered categories of the rim code (Figs 25-31) in the case of A and B and of the decoration code (Figs 32-41) in the case of C and D along one axis and along the other the numbered classes which represent the subdivisions of the major categories in the rim and decoration codes (Figs 25-41). It was thus a simple matter to read off the number of sherds representing any class of any category for any unit of investigation.

Because of the increase in some samples at the time of reanalysis, the totals per horizon or zone were sometimes higher in Table I than in the equivalent Table 24 of Poulсен 1967b.

Computer Table II: the analysis of attribute distributions

With the data set out in the way described, it was possible to select features for analysis by their adequacy of occurrence for statistical testing. Other factors entered into the selection process, of course: earlier experience, sheer intuition and the very simplicity of the procedures once the second code had been improved, as mentioned, by the addition of two new categories relating to the horizon or zone of origin of a sherd.

Table 14 lists the features and feature combinations selected for analysis. The object of the analysis was to compare the frequency of occurrence of the selected pottery attributes in the different horizons constituting the units of analysis. Horizons more like each other should have similar frequencies of occurrence of particular attributes and those less alike should show differences of greater or lesser significance. The larger the sample, the more reliable the indications provided by such differences or their absence. Since some of the different horizons in question were in stratigraphic relationship, it should be possible to discover trends in pottery development over time based on the statistical behaviour of the pottery attributes. A few observations, not real pottery features, were selected for reasons of site interpretation. These are nos 4, 15 and 29 of Table 14. They concern uncertainties in classification due to the fragmentation of sherds. As already mentioned, it is possible that site disturbance in upper horizons has increased the frequency of rim sherds on which some observations were impossible. Clearly we have here to do with the effects of non-cultural factors.

The results of the analysis constitute Computer Table II, where it takes just one sheet to provide the data relating to one pottery feature for the five sites To.1-3, 5 and 6. The computations performed involved two things.

First was the calculation of percentages reflecting the frequency with which the feature occurs in the population of any analytical unit, the frequency figure being supplied by Computer Table I. The base used for the percentage calculations, called the relevant total, is of two kinds, general and specific. A specific total is one that results from summing up the occurrences of alternative positively observed features in a unit and excluding cases where positive observation is impossible: thus, in respect of lip form, it would include ‘flat lip’, ‘round lip’ and ‘hybrid lip’ and exclude ‘lip form uncertain’, due perhaps to damage. The
corresponding general total would not only include 'lip form uncertain', but be constituted by all rims in the unit under analysis, since by definition all rims have a lip. General totals dominated operations during the 1967 analysis and was tried initially also in the resumed analysis. But it was found that specific totals, though perhaps a more severe test of the material, yielded finer and more realistic results. Table 14 specifies the kind of total used in the analysis of each feature/combination of features.

The next step was the test of the statistical significance of difference between frequencies of features from pairs of analytical units (or sometimes groups of such units as at To.2) using the Chi-Square formula with significance level 2.5% and one degree of freedom (see Appendix 2). The degrees of significance were symbolised by '+' for a case of definite or primary significance, '0' for one of possible or secondary significance and '-' for 'not significant', while '/' signalled that calculation of the degree of significance had not been performed. This was used in comparisons where all or some of the figures involved were too small to make calculation relevant, where n was 2 or less (see Appendix 2). This is not to deny that near or total absence of a specific feature is a specific horizon (zone) may not be important information, but such cases are better judged intuitively.

The earlier and the later analyses

The 1967 analysis had already shown the rim aspect of the Tongan pottery to be sensitive enough to allow the construction of a sequence. This prompted inclusion of all 1967 individual and combined features (Poulsen 1967b:Table 6) in the new analysis as a check. It also encouraged inclusion of quite a number of additional individual and combined features in the hope of increasing the amount of evidence for statistical analysis. Many possibilities incorporated in the rim code have thus been systematically exhausted without practical difficulties, thanks to the new categories in the record code on horizon/zone provenance, which allowed simplified data retrieval.

All rim features were run once only: they included all rim sherds, whether decorated or not.

The idea with the decoration reanalysis was to concentrate on general features and to ignore specific ones, as indicated by the experience of 1967. The earlier enquiry showed decoration to represent a very stable aspect of the Tongan ware through time, almost without evidence of development that could help in establishing a sequence.

Study of Computer Table I made it clear that it would not be worthwhile to redo all the 1967 decoration features (set out in Poulsen 1967b:Table 23): for some the numbers were too small; others made little sense (e.g. no. 58 of 1967); yet others did not contribute to positive results, though the figures were big enough (i.e. those testifying to the stability mentioned above); finally some could be included more economically (e.g. nos 61-63 of 1967 which are in fact adequately covered by no. 68, which is the same as no. 139 of the new list). The new list, set out in Table 14, includes features, therefore, that were almost all on the old list, but only 31 of the total of 71 features of the old list were rerun in the new analysis.

All decoration features were run three times for different categories of sherds: all sherds with decoration, whether rim or body sherds (A); decorated rim sherds only (B); and decorated body sherds only (C).

The relevant totals used in the calculations were not always identical for the earlier and later investigations. However, the old and the new results are generally in good accord: the trends disclosed are almost invariably the same, increasing or decreasing, and in the main of the same significance. The later analysis not only confirms the chronological results of the earlier one, it also improves on it.
THE ANALYSIS OF RIMS: INDIVIDUAL RIM FEATURES

Trends in development

Information on IOI rim features was analysed in Computer Table II in the way described above; they are nos 1-62, 65-101 and 141-142 of Table 14 and their frequencies of occurrence by site and horizon are spelt out in Table 15. Fifty-four of them gave positive indications of trends of development in intra-site comparisons, increasing or decreasing in frequency over time, and it is with these 54 features that I am concerned in this section. Their analysis is dealt with in Tables 16 and 17, where the additional entries marked * should be for the moment ignored. Table 16 sets out the percentage values used in the intra-site comparisons, calculated from the raw data in the manner described above (section 5.2). Table 17 gives the results of pairwise comparisons of these occurrences in terms of the direction of the trend (‘V’ indicating increase, ‘∧’ decrease, over time and ‘O’ absence of trend) and the degree of their statistical significance (‘1’ primary, ‘2’ secondary, ‘O’ lack of significance). All cases of primary and secondary significance are considered positive and have been represented by thickened lines in the table. As in Computer Table II, ‘/’ means that calculation of the degree of significance has not been performed (section 5.2 above).

Several things are evident from a glance at Table 17.

At Sites To.1, 5 and 6 rim development is represented within sites. One is struck by the consistency of the positive trends, either decreasing or increasing, as followed through their stratigraphy. This may be called a one-way trend. There is hardly any evidence of a two-way type of trend, for example trends for a feature occurring with increasing frequencies through some units followed by decreasing frequencies through others. The occurrence of the relatively many positive trends may be due to the fact that the majority of the features examined is of a general nature, for example flat lip. Features of more specific character, for example flattish lip, are less well represented.

In contrast to the above are Sites To.2, where the material is of striking homogeneity, with virtually not a single case of significant difference, and To.3, where the situation is somewhat the same, though here a great many cases are withheld from analysis, the numbers being too small. At To.2 homogeneity is a feature not only of the midden horizon, illustrated by the comparison between the bottom and the top zones (I and III), but also of Zones IV and VI of the mound and of the midden and the mound taken as aggregates (Table 17). The ceramic evidence thus confirms the conclusions from the evidence of excavation (Chapter II), that while there are two major periods of distinct use of the site, the materials used in the later one, the mound, were in large part those laid down in the earlier one, the midden. As a result, as we shall see, To.2 contributes significantly to the early phase of the Tongan ceramic sequence and the total sample from the site can serve as a unit in comparisons with the total sample from To.6.

It should be noted that some of the analysed features set out in Table 14 appear redundant. However, if different relevant totals are employed, they need not give identical results. Compare, for example, entries 26 and 68 where the totals used are general and specific respectively. The results are not quite the same in this case because the general total of 346 rims in To.1/II contains, besides 65 rims with inward body-rim inclination, 78 rims with outward inclination and 13 direct rims, no less than 190 where body-rim inclination could not be established but which must be distributed through the three named classes. Entry 68 looks at the behaviour of rims with inward inclination more narrowly by measuring them against rims with outward inclination, using a specific total of 143 (= 65 inward + 78 outward) and omitting both the unimportant class of direct rims and the large class where no positive observation was possible. Differences of this character have been held in mind when considering the general statistical structure of patterns of trends and degrees of significance of the 54 individual rim features involved in the intra-site comparisons of Table 17.

When we come to judge the significance of any given set of positive trends in these
comparisons in Table 17, that is, excluding the disturbed mound horizon at To.2 (the comparisons of Zones IV and VI of the Mound Horizon and of the Midden and Mound Horizons as a whole), as well, of course, as the entries marked *, it is obvious that we can make a distinction between pottery features where those trends are exclusively of primary significance (e.g. no. 1, all four cases); where some are of primary, others of secondary significance (e.g. no. 6, with four of the former, three of the latter kind); and where they are all of secondary significance (e.g. no. 62, both instances).

We can measure the strength of the pattern of significance formed by all the pottery features considered together by contrasting the number of features characterised by trends of primary significance, either exclusively or in combination with cases of secondary significance, with the number of features characterised only by trends of secondary significance. The more features fall into the first group, the stronger the pattern.

The overall structure of this pattern of significance may be further characterised by stating the total numbers of the trends of primary and secondary significance involved.

If we consider the data of Table 17 in these terms, we see that in the 54 features of the intra-site comparisons there are 34 cases with trends of primary significance as against 20 cases with trends of secondary significance only. One third, 34, of the total 101 features analysed thus yielded significant evidence of change, while in the remaining two-thirds trends were either absent or less strongly in evidence. The overall structure of the pattern formed by these 54 features throughout the intra-site comparisons set out in Table 17 involves a total of 115 trends of primary and 54 of secondary significance. The pattern of significance studied is thus a good one.

Excluding two features with inconsistent trends (nos 41 and 81), the pattern is made up of 30 features showing decreasing and 22 showing increasing trends. In the group with decreasing trends, features with trends of primary significance outnumber those with trends of only secondary significance 18 against 12, while the overall structure of this pattern is made up of 54 instances of primary and 34 of secondary significance. In the group with increasing trends, features showing trends of primary significance outnumber those showing trends of only secondary significance 14 against eight, while the overall structure consists of 58 instances of primary and 20 of secondary significance. The actual features involved are:

decreasing trends, some primary 1, 3, 6, 7, 8, 15, 26, 27, 42, 61, 65, 66, 71, 85, 88, 95, 97, 100 = 18
secondary only 9, 60, 62, 68, 73, 80, 82, 86, 90, 92, 96, 99 = 12
increasing trends, some primary 4, 12, 13, 14, 23, 29, 39, 67, 72, 77, 84, 87, 94, 98 = 14
secondary only 2, 18, 59, 69, 70, 83, 93, 101 = 8

These figures suggest that, though some features became more important, others less so over time, there is a tendency towards simplification of rim manufacture in the course of time.

Though a case has been counted as positive where only one instance of primary or secondary significance occurs in all units compared, half the 54 positive cases are represented at more than one site and they always number one or more instances of primary significance. Trends are remarkably consistent from site to site and it is often possible to follow them through more than two horizons at sites where such exist. Inconsistency is observable in two cases only (nos 41 and 81), both from To.6, involving minor rim features only. Positive trends are thus relatively many in number, of homogeneous and convincing character and well represented in the sites and horizons studied.

Regarding the state of the middle horizon (II) at Sites To.5 and 6, both with three horizons, each seems to be different from the horizons above and below. But the indications are that at To.5 Horizon II is more similar to the horizon below than to that above, while at To.6 it is
more similar to the top than to the bottom horizon. These observations are based on the number of cases of primary significance characterising the relationships. The internal trends of these two sites are consistent with those observed at all sites.

Earlier indications (Poulsen 1967a:139-40, 141, 153-54) that the base of Horizon I at To.6 was somewhat different from the upper part are confirmed by the data set out in Table 17, where there are no less than 14 differences of primary significance between IB and IT. Further, all positive trends observable within Horizon I are consistent with the trends at other sites.

This raises the question of the relationship of upper Horizon I to the two overlying horizons, II and III, at To.6. It is more often similar to or identical with these than different from them, but the general impression is nevertheless that it marks an intermediate stage in the internal pottery development of the site as a whole. The relationships between Horizon I as a unit and Horizons II and III are then determined to a large extent by the internal nature of Horizon I itself.

**Deriving a sequence of horizons**

Almost without exception all the rim features coded and analysed are present in all horizons of all sites. Some occur with proportionally the same frequencies everywhere, whereas others occur with varying frequencies from unit to unit. Where these variations follow the stratigraphy of the excavated sites, we can talk of certain trends of 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 in groups of mutually exclusive features within horizons. Some features begin as less important and become more important over time, with others the development is the reverse. Other changes over time not involving such reversals may be noted.

The high degree of agreement between consistent trends observed in the different sites therefore encourages the belief that they reflect general processes of ceramic change over time. The different percentage representations of individual ceramic features in the various horizons constitute different pottery spectra and can be used to set horizons and sites into a relative time sequence.

A good starting point for working out a relative chronology being to isolate the lower and upper extremes of the sequence, the potentiality in this respect of Sites To.2 and 6 taken as a whole was first examined. Comparing the trends between them in the last column of Table 17 with those exhibited by the intra-site comparisons, we note that they are only rarely inconsistent (nos 2, 3, 9, 41, 59, 60), while trends which are only of secondary significance are more often strengthened into trends of primary significance between the two sites (nos 18, 68, 69, 82, 90, 96, 99, 101) than otherwise (nos 2, 9, 59, 60). For the 54 features analysed at the intra-site level the two sites display 41 significant trends, half decreasing, half increasing, of which 38 are of primary significance. The 13 features which do not score positively are marked # in Table 17.

Moreover, an additional 23 positive trends appear, half decreasing, half increasing and all but one of primary significance, when To.2 and To.6 alone are compared in terms of the 101 features of Table 14. These 23 features are those marked * in Table 16, which gives the percentage frequencies at the two sites, and Table 17, which indicates the trends and their statistical significance.

Combining the above information, we thus have as many as 64 positive trends revealed by the comparison of Sites To.2 and To.6, comprising 60 examples of primary and only 4 of secondary significance. This leaves 37 cases of absence of trends out of the original list of 101 features in Table 14, of which lack of statistical significance was noted in 26 cases, the remainder not being calculated because of inadequate data. Thus no less than two-thirds of the total of 101 individual rim features analysed came out with positive results in the comparison of these two key sites.
Finally, the magnitude of the pottery trends between the two sites as quantified in percentage terms in Table 16 (which percentages make up the pottery spectra for each site) supports the case for the possibility of seriating all horizons/zones using these two sites as a standard.

This was done by systematically comparing all horizons pairwise in terms of the relationship of their percentage values for individual rim features to the values for the two key sites, To.2 and To.6, thus establishing their position in respect to these sites. For this exercise 41 of the 64 individual rim features were used for which positive trends are registered between the two key sites in Table 17. The remaining 23, those marked * in the table, could not be used, since they produced significant results only in comparisons between To.2 and To.6. Table 16 lists the percentage values for the 41 features used in the comparisons: they are those not marked * or #. It was decided to use all 41 features regardless of their actual nature, of the variations in their real numerical occurrences, of the differing ways in which percentages had been calculated for repeated questions and of the actual percentage differences between their frequencies in the various units. This was thought to give the most neutral average picture of the order of the excavated units.

As an example we may take the relationship between To.6 Horizon IB and To.5 Horizon III. In Table 17, of the total of 41 features concerned, there are 21 examples of decreasing trends from To.2 to To.6 and 20 examples of increasing trends. The magnitude of these trends is expressed in percentage terms in Table 16. From the same table it can be seen that for 13 of the decreasing trends (nos 6, 8, 26, 61, 62, 68, 71, 82, 86, 88, 90, 95, 97) and 15 of the increasing ones (nos 4, 12, 13, 14, 18, 29, 39, 41, 67, 69, 84, 87, 94, 98, 101), the numerical values of To.6/IB are nearer to those of To.2 and further away from those of To.6 than the corresponding values for To.5/III, that is, in 28 cases To.6/IB is 'earlier' than is To.5/III. On the other hand, in seven decreasing (nos 1, 2, 15, 59, 73, 96, 99) and four increasing (nos 3, 60, 72, 77) trends, it is To.5/III which is closer to To.2 values and more distant from To.6 values than To.6/IB, that is, in 11 cases To.5/III is 'earlier' than To.6/IB. The difference between the two estimations is 28-11 = 17 in favour of To.6/IB being earlier than To.5/III. This figure (17 in this case) is called the Priority Value (PV). Note that in this example there are two features, nos 9 and 85, scoring equally in Horizon IB of To.6 and Horizon III of To.5 and they are therefore withheld from the calculations.

Priority Values were calculated in this way for all horizons in terms of each other, except that at To.2 the total excavated sample was employed, without division into horizons/zones, and To.3 Horizon III was entirely withheld because of the small numbers of sherds involved. The resulting figures are set out in Table 18, where the small figures to the right above the Priority Values record the numbers of cases of equal percentage occurrences. The table is a matrix sorted in terms of the values which it records and establishes the sequence of sites and horizons in terms of individual rim features.

The procedure for ordering the matrix was first to look amongst lower horizons of sites for the smallest Priority Values from the point of view of To.2. This site is thus ahead of To.5/0-I by PV 10, To.5/0-I is ahead of To.1/1 by PV 9. As a check, To.2 is ahead of To.1/1 by PV 17, which means that the order between these three units cannot but be To.2, To.5/0-I and To.1/1. Further, To.1/1 is ahead of To.5/II by PV 9 and, as a further check, To.5/0-I is ahead of To.5/II by PV 16, while To.2 is ahead of To.5/II by PV 26. This procedure establishes a firm and logical relationship between units in terms of priority.

The matrix of Table 18 is largely self-explanatory. It will suffice to note just two things. Firstly, and this is very important of course, there is not a single case where the priority of units within sites is in conflict with their stratigraphic order. This is a confirmation of previous conclusions about the consistency of trends and about the independent analytical status of the units. Secondly, earlier conclusions about the ceramic heterogeneity obtaining within Horizon I of To.6 are given substantial support from the evidence of the matrix, where the relationships of Horizons IB and IT to each other and to Horizons II and III are quantified.

It is difficult to believe that the matrix order could be interpreted in terms other than
chronology. Precisely because of the consistency and stratigraphic harmony, other dimensions that can cause differentiation of the archaeological record are not thought likely to have much relevance to the interpretation of the data under discussion. Explanations such as function of sites, geographical separation between them and the like may well apply to other parts of the excavated collections in question, but the only other dimension that may influence the conclusions arrived at here is that pertaining to sampling problems. The minor anomalies observable in the various tables could no doubt be largely explained from this point of view.

**Measuring the differences between horizons**

What has been done so far is to establish the relative order of horizons but not yet to measure their distances from each other. The aim now is to use the data of the seriation matrix and the percentage spectra of the selected rim features to try to do this.

There are a number of considerations to be borne in mind. Two stratified midden horizons at the same site represent two different segments of time, with or without an intervening hiatus in occupation. Such horizons might, of course, have been laid down within the same phase of pottery development, as was the case with Zones I-III of the midden at To.2. Even though the previous analysis has shown evidence of positive trends in pottery development between horizons at other sites, it must be remembered that the pottery spectrum defining each horizon is only a generalised statement about the character of the ceramic content of the horizon as a whole and gives no information about the degree of change taking place within the time segment over which the midden horizon built up. Nevertheless, it appears reasonable to conclude that the smaller the Priority Value between any two units, the closer they stand to each other in the relative time sequence, the higher the PV, the further away they stand.

The best way of estimating these distances seems to be to take the stratigraphy of the sites into account, looking first at the PVs for adjoining units of the same site, as set out in Table 18. At To.1 the PV is 29 between Horizons I and II; at To.5 it is 16 between 0-I and II, 29 between II and III; and at To.6 it is 37 between IB and IT, 11 between IT and II and 12 between II and III. PV is thus very variable, ranging from 11-16 at one end of the scale to 29-37 at the other. In the light of the considerations discussed above, these figures make it most reasonable to suggest that a PV of about 10 indicates either lack of contemporaneity between any two horizons or, more probably, slight overlapping in pottery development and time of occupation.

I have therefore performed a correlation of all horizons as a function of two factors: the distance between each pair of adjoining units in the sequence as established by the PVs given in the matrix of Table 18; and the 'length' of the average phase of pottery production for each unit assumed to be roughly expressible as PV 10 (from which, of course, nothing can be concluded as regards the absolute length of time involved). The result is shown in Text Figure A. The 11 units are ordered along the established sequence, while all units at sites with more than one horizon have been additionally plotted by site, in terms of the internal PVs of their constituent units.

In general terms Text Figure A is an illustration of a gradual pottery development whose phases are represented in units strung along the time scale as beads on a string. Only two units represent the same phase, To.3/1-II and To.6/1B. Some slight irregularity is found at the upper end, at To.6/IT-III, representing possibly an acceleration of development, unless the bridging phase as between To.5/III and To.6/IT is represented by horizons as yet unexcavated.

In the light of the actual percentage spectra for the rim features in question (Table 16), it is tempting to suggest that a point of change occurs around the almost identical units To.3/1-II and To.6/1B, including to some extent also their respective neighbouring units To.5/II and To.1/II. Overall the material under analysis may be considered as falling into an early period with three units consisting, besides the homogeneous site To.2 in its totality, of the bottom horizons at two other sites, To.5/0-I and To.1/1; a late period with three units To.6, Horizons
IT-III; and a more vaguely defined middle period with the remaining five units, To.5/II, To.3/I-II, To.6/IB, To.1/II and To.5/III. This periodisation has been entered on Text Figure A.

In conclusion, it is appropriate to state that the analyses have confirmed the original proposition to treat To.2 and To.6 as key sites, since taken as a whole each is so uniform in rim features. Thus they can with a high degree of confidence be used in further analyses to represent the early and late periods respectively.

A confirmatory operation

The essentials of the analytical procedures described above were presented at a conference in 1976 (Poulsen 1976), and my contribution was eventually published, with supporting data, some years later (Poulsen 1983). In the interim, as a result of discussions about the methodology I had adopted, I tried a modification of the strategy. This strategy has determined the relative chronological position of the different horizons by the number of times they score ‘earlier’ and ‘later’ than each other (the Priority Value), using Site To.2 as the early standard and the percentage frequencies of the individual rim features under analysis as the vehicle. It has ignored the size of the difference between percentage frequencies in the individual comparisons undertaken, since whatever the margin, each score is only 1. In the modified procedure, equivalent in a sense to replacing a first-past-the-post by a preferential voting system, the percentage frequencies are allowed to speak for themselves, in that the actual differences between them enter into the calculation, which then proceeds as for Priority Values. I exemplify the process below, but need to describe another modification first. I confined the analysis to nine rim features representing real and independent attributes of the pottery, all showing trends of primary significance in comparisons between To.2 and To.6 in Table 17. The features chosen are nos 1, 6, 59, 66, 67, 71, 72, 77 and 87 of Table 14. In the example given below decreasing and increasing trends are established in terms of the comparisons between To.2 and To.6 in Table 17. The figure entered into the cell below each feature number is the difference in the percentage representations of the particular feature in the horizons being compared, as they are recorded in Table 16. These values are entered against one or other of the horizons under comparison according to the trend established for the particular feature in the comparisons between To.2 and To.6.

<table>
<thead>
<tr>
<th>Site/horizon</th>
<th>Decreasing trends</th>
<th>Increasing trends</th>
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<tr>
<td>To.1/II</td>
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<td>6</td>
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<td>59</td>
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<td></td>
<td>87</td>
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<td></td>
<td>1</td>
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<tr>
<td>To.5/III</td>
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<td>3</td>
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<td>24</td>
<td></td>
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<tr>
<td>Difference</td>
<td>5</td>
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</table>

These comparisons were performed for every pair of horizons, including some not included in the original analysis, these being each of the three Zones of the To.2 midden and Horizons 0 and I of To.5 separately (note, however, that in Table 16 here the percentage values for To.5/0 and I are not entered individually but only combined). Because of sample size, Horizons I and II at To.3 had to be combined, as in the previous analysis, and Horizon III withheld. The values obtained were entered into a matrix, which is reproduced here in its ordered form as Table 19.

Table 19 is actually a tidier matrix than Table 18. its equivalent in the original analysis, which it essentially confirms; the only real discrepancy is the fact that it puts Horizon II at To.5 earlier than Horizon I at To.1. However, it provides some interesting new information about the early levels of the sequence, as a result of not treating the To.2 midden and Horizons 0 and I at To.5 as single units. The three midden zones at To.1 show a satisfactory trend in development over time, while To.5/0 emerges as the earliest unit in the sequence and To.5/I slots in between Zones I and II at To.2.
The distances between chronologically adjacent units, and also between stratigraphically adjacent ones at the four sites for which this information exists, are plotted in Text Figure B in terms of the values in the matrix of Table 19. In general terms the picture is very similar to that given by the original analysis in Text Figure A, except that, as noted, To.1/1 and To.5/II switch places. This affects the previous allocation of horizons to early and middle periods, where To.1/1 is the latest unit in the former and To.5/II the earliest in the latter (Text Fig.A). By the present plot (Text Fig.B) both could be included at the end of the early period or the beginning of the middle. The picture is confused by the fact that the relationship of To.5/II and To.1/1 to the next earlier unit, To.2/III, in Table 19 is one of the very few cases of disconformity in the matrix, which is presumably responsible for the lack of agreement between the plots of frequency differences for To.5/II by stratigraphy and by relative chronology (vertically as against diagonally) in Text Figure B.

As a result, I choose the plot of Text Figure A as the basis of my periodisation.

THE ANALYSIS OF RIMS: COMBINED RIM FEATURES

Trends in development

The aim with the analysis of combined features was to see how the main categories and classes of rim features would behave in systematic, pairwise combinations, not only in terms of the ceramic sequence but also from the point of view of a better characterisation of the pottery than was possible using individual features only.

The 48 combinations involved, nos 144-191 of Table 14, concern features already analysed individually. This might be thought to run the risk of being spuriously confirmatory of previous conclusions, but such is not necessarily the case, since two independent features behaving individually with significance need not in combination do the same. The possibility of duplication may also be outweighed by the factor of lesser statistical probability of getting significant results with combinations as compared with individual features. As a result, therefore, positive indications on combined features may be looked upon with the same degree of confidence.

The frequencies of occurrence of the 48 feature combinations under analysis are set out, by site and horizon/zone in Table 20. These data are expressed in percentage terms in Table 21 for the 41 feature combinations which registered at least one significant trend in one of the comparisons displayed in Table 22. In this table there are 12 combinations (marked *) which show significant trends only in comparisons between To.2 and To.6 as whole sites and not in any of the intra-site comparisons. I shall deal first with the 29 combinations scoring significantly in these intra-site comparisons.

Of these 29 combined features, 18 show trends of primary significance as against 11 (nos 145, 150, 151, 153, 156, 162, 171, 173, 181, 183, 189) showing trends of secondary significance only. The overall structure of this pattern of significance has almost equal numbers of instances of primary and of secondary significance, 36 and 35 respectively.

The pattern consists of 17 combinations showing decreasing and 12 increasing trends. The group with decreasing trends is made up of nine feature combinations showing trends of primary significance (nos 146, 147, 165, 169, 172, 175, 184, 187, 190) against eight with trends of secondary significance only (nos 145, 151, 153, 162, 171, 173, 181, 189), the overall structure involving 15 instances of primary and 22 of secondary significance. The group with increasing trends includes nine combined features characterised by trends of primary significance (nos 148, 152, 167, 174, 176, 180, 182, 186, 188) and three feature combinations with trends of secondary significance only (nos 150, 156, 183), while the overall structure includes 21 instances of primary and 13 of secondary significance.

The trends are always consistent and in 12 of the 29 combinations in question they are represented at more than one site, almost always with at least one instance of primary
significance. At the same time it is often possible to follow trends through more than two horizons at sites where such occur.

The tendency towards simplification in rim manufacture is not as clear with these features as with the individual features, but it would seem nonetheless most reasonable to accept its reality.

The independent state of the middle horizon (II) at To.5 and 6 is not quite as well defined as with the individual features. At To.5 it seems to be almost identical with the lower horizon (0-I), while being different from the top horizon. At To.6 it is different from both neighbours, but perhaps more related to the bottom than to the top horizon. The internal trends at these sites are nevertheless consistent with those observed at all sites. This also applies to the trends separating the bottom and top parts of Horizon I at To.6, a pattern, however, which is not as well documented with combined as with individual rim features.

The dissimilarity between Sites To.2 and 6 which came out clearly in the analysis of individual rim features is, surprisingly, sharper in the present data (Table 22, last column). Four of the 29 feature combinations we have been dealing with in the intra-site comparisons do not score significantly in comparisons between To.2 and To.6 as whole sites. They are marked # in Table 22. However, there are an additional 12 features, marked * in Table 22, which show significant trends between To.2 and To.6, but not in the other comparisons. We are dealing then with 37 combinations yielding positive results, virtually all of primary significance. There are 25 cases of decreasing trends and 12 of increasing trends and all but one (no. 150) are consistent with those observed on all sites. Of the 11 feature combinations listed above, where trends are of secondary significance only in intra-site comparisons, nine are confirmed by cases of primary significance in the To.2-To.6 comparison in the last column of Table 22, nos 145 and 162 being the two exceptions. We thus arrive at the same conclusions as before, that the extremes of the pottery sequence are well established by the material from these sites, while the intermediate stages of the pottery development are represented at To.6 internally and at the other sites, especially To.1 and To.5.

**Deriving a sequence of horizons**

It was therefore obvious to apply to the present data the same methods of seriation and correlation of units as was used with the individual rim features. Priority Values were calculated from the data in Table 21 and ordered in the matrix shown in Table 23. The results are not quite identical, but the degree of similarity is acceptable, not the least in view of the more severe test conditions to which the data have been exposed: the likelihood of independent rim features occurring on the same pot is not to be assumed.

The only disagreement between the two matrices of Tables 18 and 23 relates to the order of the units To.6/IB and To.1/II, which is reversed in the present matrix. However, interchanging the two units would not alter the overall pattern significantly; there is only a minute difference in PV involved, just 2 for the two units in question. We may note in addition that the difference between To.5/II and To.1/1 is much less by the combined exercise than by the previous one.

The results from the analysis of combined rim features, as displayed in Text Figure C, are therefore considered to be in reasonably good accord with, and of important support to, those obtained on individual rim features. The different order of To.1/II and To.6/IB in the matrix table (Table 23) is, of course, carried over into the distance graph of Text Figure C. Also, To.5/II moves much closer to To.1/I, which leads to some difficulty in setting a boundary between early and middle periods, something I commented on in connection with Text Figure B in the last section. There is, however, good agreement between this graph and the corresponding graph of Text Figure A for individual rim features in placement by intra-site and inter-site comparisons. In addition, the overall look of the two graphs, constructed the one by individual, the other by combined rim features, is similar to a satisfactory degree.
THE ANALYSIS OF DECORATION

Trends in development

Thirty-nine features of decoration were analysed, mostly of a fairly general nature: they are spelt out in Table 14, nos 102-115, 117-140, 143. It is remarkable that Computer Table II, where the results of the analysis were first produced, shows virtually no trends of significance for Sites To.2, 3 and 6. The small samples from To.3 and 6 may explain the situation here, but the satisfactory number of sherds from To.2 surely makes this sample reliable (Table 13). Sites To.1 and 5 alone must therefore bear the burden of any positive evidence on the development of decoration within sites. Raw and percentage data on the occurrence of decoration at all sites, though not for every horizon/zone, appear in Tables 24 and 25 respectively, but only for those features showing positive trends.

Results from the run with rim sherds only (B) and with body sherds only (C) were less positive than those from the run involving all decorated sherds (A) (cf. section 5.3 above). There are only three features from the B run (nos 113, 121, 123) that came out with positive results not duplicated in the A run, although feature no. 109 produced different information in the two runs. All positive observations from the C run are duplicated in the A and B runs.

Table 26 lists the 22 decoration features, out of the 39 analysed, which display positive trends. Of these 22 features there are 13 showing trends of primary significance and nine (nos 104, 107, 109, 112, 113, 114, 121, 122, 123) showing trends of secondary significance only. The overall structure of this pattern of significance is a modest total of 16 instances of primary and 20 of secondary significance.

Excluding feature no. 139 because it shows conflicting trends, the pattern is made up of 13 features showing decreasing and eight showing increasing trends. The group with decreasing trends is characterised by ten features showing trends of primary significance (nos 102, 105, 106, 108, 110, 111, 125, 130, 136, 143) and three showing trends of secondary significance only (nos 104, 107, 113), while the overall structure involves 13 instances of primary and eight of secondary significance. The group with increasing trends is made up of six features showing only trends of secondary significance (nos 109, 112, 114, 121, 122, 123) and a mere two with trends of primary significance (nos 103, 117). The overall structure consists of only two cases of primary and 11 of secondary significance.

Only six features showing positive trends in frequencies are represented at more than one site (nos 109, 111, 117, 122, 139, 143). They are all consistent, except for one (no. 139). At To.5 nos 102 and 103 show consistent trends throughout all horizons.

We can conclude that positive differences are few and rather heterogeneously represented through the sites and horizons involved.

It is, in other words, noteworthy how generally uniform the decorated pottery is throughout the period represented by the excavated material. The majority of the coded and analysed features is found in all horizons of all sites where decorated pottery occurs. Their relative frequency of occurrence does not change at all or, where it does, the consistent or conflicting trends are mostly of no statistical significance. Trends of significance are predominantly of decreasing rather than of increasing nature. Consistent trends from more than one site are present in just five cases (nos 109, 111, 117, 122, 143). The indications of development of pottery decoration within sites and between sites are thus very few indeed and proved wholly inadequate for any exercise in seriation.

Perhaps the reason is to be sought in the smaller numbers involved, particularly since, as we shall see in the next section, decoration on pottery was undergoing a numerical decline throughout the period under review. At the same time, some indications exist that certain decorative motifs are largely confined to the earlier part of the sequence. This matter is looked at in Chapter IV (section 12.6), which takes up again the question of the nature of decorative development throughout the sequence.
The proportion of decorated to plain pottery

Table 17 shows that the proportions of decorated to total rims decline over time (entry I). 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 plain sherds leave questions unresolved: is, for example, a decline in the amount of decorated sherds due to fewer vessels being decorated or to a smaller decorated surface area on the same number of vessels? In any case information on complete counts and weights is not available. This being so, I intend to approach the question by calculating an index of decorated sherds to rim sherds for each horizon. The index is:

\[
\frac{\text{total number of decorated sherds} \times 10^2}{\text{total number of rim sherds}}
\]

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

The exercise gives some interesting results, as shown in Table 27. Excluding for a start To.2, there is a consistently declining tendency throughout the horizons, from an index of about 100 at the bottom of To.5 to one of 2-3 at the top of To.6. In the light of correlations established in terms of rim evidence (Text Figs A-C), the correspondence is good between Horizons II at To.1 and III at To.5 and fair between Horizon I at To.1 and II at To.5. To.3/1-II is identical with To.5/II, while To.3/III is better not considered. The indices from Horizons 0 and I at To.5 bridge the gap to the extraordinary indices from To.2 which, by the way, surely confirm the archaeological unity of the midden horizon of this site. Whatever the explanation of the To.2 figures, the older extreme of the pottery sequence is illustrated by this site. The younger extreme is clearly demonstrated by the near-absence of decorated ware from To.6 Horizons IT-III. The index for Horizon IB, 22, links it, as expected from the rim evidence, with the top horizons at To.1 and 5 and separates it from the late period horizons at To.6.

Indeed, the sequence and periodisation suggested by this rather gross analysis, displayed in Text Figure D, is in fair agreement overall with that established on the rim evidence in Text Figures A-C. The only unit out of order is To.1/1, as it is by the supplementary exercise on individual rim features summarised in Table 19 and Text Figure B. In order to investigate this problem, an analysis was made in terms of the spits making up the horizons (see section 4.1 above), not only of the material from the main trench (I) at To.1 but also of that from To.5, the site most similar to it. Table 28 gives the results.

At To.1, Spit 2 is a buffer zone between Horizons I and II. a buffer zone being a zone of contact between two horizons normally withheld from analysis because of the likely mixture of materials from two strata. In this analysis the material from Spit 2 was used and is entered in Table 28. At To.5, in order to give satisfactory samples, spits were allocated to horizons by an ‘averaging’ procedure (Poulsen 1967:103, 104, 108). Thus while Spits 1-3 belong unequivocally to Horizon III and Spits 8-10 to Horizon I, the situation is less straightforward with the intervening spits. Spit 4 actually belongs to Horizon III in nine out of the 12 excavated squares analysed (Poulsen 1972:Fig.9) but for this exercise is allocated totally to Horizon III in Table 28. Similarly, Spits 5-7 are allocated to Horizon II, though they really belong to that horizon in ten, nine and four squares respectively out of 12.

The results show a break in Horizon I at To.1 and also in Horizon II at To.5, whereby the index drops from about 100 to about half of that. The new values are plotted as crosses on Text Figure D. In terms of the question relating to the anomalous position of To.1 Horizon I which the analysis was designed to investigate, we may note that the new figures for the lowest two spits of To.1 Horizon I (Table 28) come closer to the old horizon value for To.5
Horizon I (Table 27), while the latter is very much in agreement with the indices for the three lowest spits of that site (Table 28), though these, as explained above, have been calculated on a different basis. At the same time the indices for Spits 4 and 5 at To.1 and Spits 6 and 7 at To.5 give a new relationship between Horizon I at the former site and Horizon II at the latter more in accord with the rim evidence. All these relationships are set out in Text Figure D, which also shows how, as a result of the analysis, Spit 3 at To.1 comes close to the values for Horizon II at that site and Spit 5 at To.5 does somewhat less so in relation to Horizon III there.

To conclude this section, reference may be made to some totals for decorated and undecorated pottery at different sites drawn up for other purposes (Poulsen 1967b: Table 30). The figures in question are totals of weight and they refer to whole sites: they are the sum of all horizons. For this reason it is worth considering only the totals for decorated and undecorated pottery at To.2, a wholly early site, and To.6, an almost completely late one. There is just one-twelfth the decorated pottery by weight at To.6 that there is at To.2, with some of this undoubtedly belonging to a separate early occupation of To.6. This is thought to reflect an absolute decline in the number of decorated vessels over time, not simply a decrease in the area of the vessel surface decorated (cf. Chapter IV, section 13.8).

**SUMMARY OF RESULTS**

The analytical potential of the material under study is relatively high and it may be said that the objectives for the investigation set out at the beginning of this chapter have been fairly successfully fulfilled. Large numbers of the questions asked of the material yield results characterised by statistical significance and consistency and in harmony with the stratigraphy of the sites. 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 investigations a ceramic sequence can be offered based on observations of gradually increasing or decreasing frequencies not only of individual but also of pairwise combined features, followed consistently through a number of stratigraphic horizons on various sites, showing these horizons to represent periods of archaeological time. The results of analysis by different methods and on different data sets are set out in Tables 18, 19 and 23 and displayed in Text Figures A-D.

There seem to be more decreasing than increasing frequencies. Very few rim and decoration features disappear midway in the sequence, though decoration as a whole has all but disappeared at its upper end. No new features for certain appear. It should be noted, however, that many features occur with fairly unchanged frequencies throughout the sequence. The cultural implications of these conclusions will be taken up in Chapter IV.

The pottery development is most clearly demonstrated by the extremes of the sequence, represented by Sites To.2 and 6, with the intermediate stages well illustrated by material from the other sites, as well as also internally at To.6 itself. To.2, on the other hand, is a remarkably uniform site and the pottery investigations have shown that the mound and midden horizons here are ceramically identical, all material originating from the same archaeological period. As for To.6, it is worth noting that the stratigraphically homogeneous Horizon I is not an equally uniform analytical unit from the point of view of the ceramic evidence. Therefore it has been treated in two zones for analysis, Horizon IB = bottom and Horizon IT = top.

The fact that trends are almost absolutely consistent in nature lends a high degree of credibility to the results obtained. But the immediate practical point is that generally speaking it will be impossible to give a chronological attribution to a single piece of pottery collected from the surface or a few pieces from a small excavation trench. It is vital as far as possible to collect samples big enough for statistical investigation, this being the only way to
reveal the position of a site or a horizon in the chronological sequence. The concept of pottery spectra touched upon above (section 1) is highly relevant in this connection. The percentage values making up the rim feature spectra for the seriated sites and horizons are presented in Tables 16 and 21. The indices on the proportional occurrence of decorated pottery presented in Table 27 will also be of some aid in dating future collections. However, elaboration of this facet of Tongan ceramics is perhaps best done when more material has been collected and analysed than is included in this work.

Text Figures A-D, summarising the chronological implications of the rim and the decoration evidence, suggest that some subdivision of the periods into phases is possible. Since the indications from the different operations are not absolutely identical on this score, no attempt has been made to introduce in practice the concept of phases. Only the chronological concepts of early, middle and late periods, founded on the rim evidence, will be used in the sequel, and in the form established by the analysis summarised in Table 18 and set out in Text Figure A.

SPECIFIC ANALYSES

Disturbance by pit digging at To.1

At this stage of the pottery analysis it is relevant to deal with some special problems concerning To.1. These have implications not only for the inclusion of this material in the main analysis but also for the understanding of the stratigraphy of structures dug into already existing midden horizons on all sites. The exercise concerns some of the rim evidence from Trench I of the site.

In the initial analysis no distinction was made between excavation squares where the early horizon, I, had been disturbed by stratigraphically later pit digging and excavation squares not so disturbed. Despite this the results of analysis were consistent with those from other sites. At first this was thought to be due to the fact that the statistically satisfactory size of the sample from Trench I had levelled out the effects of the disturbances. However, it is possible to conceive that the structures that had caused the disturbances of Horizon I had been dug from its surface at a stage when little or no Horizon II midden had accumulated at that particular part of the site, so that when the pits were filled in, this was done predominantly with older Horizon I midden material present on the spot. When at a later stage, therefore, Horizon II midden material came to be deposited here, it effected the sealing in of these structures and their earlier fill.

As I have discussed above in Chapter II (section 1.4), it proved impossible with pits and other features to determine in the field the level from which they had been originally dug. Theoretically, therefore, the structures cutting through Horizon I and into the subsoil at To.1 could have been dug from any one of a number of levels: from the surface of Horizon I, from the top of Horizon II, that is, the ground surface, or from some intermediate level between the two, that is, within Horizon II. A further complication is that pits originating at the surface of Horizon I could have been dug at the very end of the Horizon I occupation or at the very beginning of the Horizon II occupation.

It is to the investigation of these problems that a comparative analysis of the ceramic contents of pits and of the undisturbed parts of the midden through which they were dug was undertaken. Analysis proceeded on the basis of a distinction between early pits assigned to Horizon I, having their origin at the subsoil or within Horizon I and not therefore cutting through Horizon I as a whole; and later pits, having their origin at the top of Horizon I or above and therefore cutting through Horizon I as a whole and possibly through part or the whole of the overlying Horizon II as well.

There were severe constraints on the analysis due to the fact that the pits in question could normally only be recognised as such at the level of the subsoil. As a result only the contents of the 'bottom fill' of pits, that is, the fill below the level of the surrounding subsoil, could be
unequivocally assigned to the structures to which they belong. This allowed at least for a comparison of the contents of the bottom fill of early and later pits. Above the subsoil, however, we can only deal in terms of the excavation squares which pit digging will have disturbed, so that the 'upper fill' of pits inevitably contains material from the parts of those excavation squares which in fact were not disturbed during the course of pit digging.

Granted the imprecision of the procedure, a distinction was made between 'disturbed' and 'undisturbed' squares in the following way. With the class of later pits, defined as above, the excavation squares in which they occur were called disturbed and the whole of the deposit in those squares, from the subsoil where the pit became visible right up to the surface, considered pro forma as the upper fill. The contents of these upper fills were then to be compared with the contents of the squares judged undisturbed, made up of truly undisturbed squares and of squares containing only pits assigned to Horizon I ('early' by the definition given above) or not assigned to horizon at all. Since the deposit in these undisturbed squares is divided into two horizons, Horizons I and II, between which significant differences in the character of the contained ceramics have been revealed by the main analysis, the upper fill in the disturbed squares was similarly subdivided, by the allocation of the relevant spits, for purposes of the comparative analysis. The assumption is of course that the ceramic content of pits whose digging has disturbed deposits of Horizon II as well as of Horizon I should be different from that of undisturbed squares as defined, including, that is, pits which have only disturbed Horizon I.

The squares treated as disturbed are 82/56-57, 59-64, 66-68, 73 and 83/60-61, 68-71, a total of 18 m² (Fig.7). The undisturbed squares are 82/55, 58, 65, 69, 70-72 and 83/55-59, 62-67, 72-73, a total of 20 m². Analysing the contents of Horizons I and II separately in terms of this division is statistically a disadvantage because of the lower totals involved. In order to achieve more precise results, the analysis operates in the main with specific rather than general totals (for the distinction see section 5.2 above).

The comparison of disturbed and undisturbed squares

The material from the disturbed squares that are taken to represent the upper fills of pits and that from the undisturbed squares are submitted to an analysis by horizon in Tables 29 and 31 in terms of a shortened list of 13 features selected for the major pottery features they represent and the strong trends they exhibit in the rim analysis. Table 29 sets out the data and Table 31 sums up the trends and degrees of significance. In both tables information from the main pottery analysis of Tables 16 and 17 is included for purposes of comparison.

As for the relationships between the horizons of the disturbed and undisturbed groups, the trends they display are identical, while the degrees of significance are in good agreement in ten cases, disagreeing in the last three. The fact that entry 77 came out with secondary significance in the main analysis may explain this difference. As for entries 87-88, the discrepancy is best explained by reference to the small samples involved in the undisturbed group. In sum, the two groups are in generally good accord.

Comparing these data with those obtained in the main pottery analysis, we see that trends are again identical. The degrees of significance agree well in eight cases for the undisturbed group and in 11 cases for the other group, the remainder being in disagreement. The most important result here is the almost total agreement for the disturbed group, which is the real subject of the analysis. On a percentage basis it is remarkable how close the two groups both come to the total material of the trench. The disagreement is rarely more than 5%, the maximum 9-14% being noted for six out of the total of 52 cases concerned. It seems therefore that the so-called upper fill of the post-Horizon I pits consisted largely of early material up to the surface of Horizon I and that this was sealed in by late material up to the ground surface during the formation of the Horizon II midden. It thus appears that the early midden was physically disturbed by the later pit digging but remained uncontaminated by later material. All this being so, we should expect an analysis of the contents of the bottom fills of the post-Horizon I pits to contain the same early pottery as their higher fills.
The comparison of bottom fills

Because the pottery sample from the bottom fill of individual pits was generally less than ten sherds, it was necessary to pool the bottom fill contents on the one hand of the early pits (i.e. assigned to Horizon I) and on the other of the later pits (i.e. post-Horizon I) of Trench I in order to undertake a comparative analysis between them. In addition, in order to increase the sample size, the evidence of Trench I was augmented by that from the other and less disturbed trenches at the site. The data are set out in Table 30 and analysed in Table 31. In both tables information from the main pottery analysis of Tables 16 and 17 is included for purposes of comparison.

If we compare in Table 31 the Trench I evidence with that obtained in the main pottery analysis of the entire excavated material from the site, it will be noted that on the whole the same tendencies exist between early and later pits here as between Horizons I and II there. But the significance of these tendencies in the present case is very different and much less definite because of the small numbers involved. In fact there are only two positive cases, both of secondary significance only (nos 1 and 72). Looking at the equivalent data from all pits excavated at the site reveals almost the same equivocal picture, in spite of the somewhat bigger figures involved. We may, however, note a slight intensification of frequency trends in the ‘right’ direction in terms of the results of the main pottery analysis. In this list there is one case of primary significance, entry 72, and the only case of secondary significance from the other list, entry 1, is duplicated.

Whether this really expresses a situation where the pottery material of the fill of the two kinds of pits is not significantly different and is mostly of early nature, or one where indeed the late pits contain also late pottery but the overall totals are too small for this to be reflected statistically, cannot be decided. It is interesting that the three pits where samples in excess of 20 sherds were recorded in the bottom fills, Pits A, M and AH, tend to display late ceramic spectra, including vertical orientation of rim and flat lip. However, if the later pits had predominantly held late pottery, the lists should have been characterised by more cases of positive trends than is actually the case.

The trouble doubtless lies with the small samples involved, which makes it impossible unequivocally to recognise early or late pottery spectra because these are defined by differing proportional representation of the same features. The pooling of samples resorted to in the present instance is not a satisfactory answer to this problem because pottery of different ages may be involved. In these circumstances, we should be inclined to give more weight to the top fill material, though it should be recalled in this connection that the disturbed squares on the basis of which the top fill analysis was made contain greater or lesser proportions of undisturbed material stratified in midden horizons.

Conclusion

To conclude this discussion, the later pits were dug, by the stratigraphic evidence, after Horizon I had been laid down in the area of the excavations but, by the absence of decisive indicators of late ceramic spectra in their bottom fills or immediately above these, before Horizon II started accumulating in the immediate area. Indeed the analysis shows that Horizon II pottery spectra (= middle period of ceramic development) is characteristic of the top stratigraphic zone above the pits. The point is that the pits cannot generally belong to the post-ceramic period, when their digging would have disturbed Horizon II as well as Horizon I. The positive stratigraphic observations in profiles and plans (cf. the discussion on later pits at To.1, section 5.5 of Chapter II) argues against such a conclusion, as it would appear strange that so many pits could all have been dug from or from near the present ground surface without leaving recognisable stratigraphic and/or artifactual evidence to tell of this. This is not to deny that some pits do not in fact belong to the post-ceramic period: indeed the radiocarbon evidence shows this to be the case for Pit A. This general question is taken up below (section 11.4).
Another and no less important conclusion is that the disturbance produced by pit digging, especially in Trench I, did not involve the intrusion of later artifactual materials in sufficient quantity (if at all) to distort the picture given by the original analysis, which did not make the distinction between disturbed and undisturbed parts of the midden. On the contrary, the sample is statistically large enough to diminish the effects of any intermixture that might have taken place and yields a reasonable reflection of the original situation, supported as this is by the consistent evidence from the other sites. Thus the general interpretation of the stratigraphy and structures at Site To.1 advanced in the excavation report in Chapter II can be maintained.

**Zone IV of the Mound Horizon at To.2**

This discussion is prompted by Green’s (1972:83-84) use of Ostrea (Tongan sio) shell accumulation in this zone as evidence for the practice of concentrated shell dumping, and therefore of significant shell-fish exploitation, in the post-ceramic period, a matter taken up in Chapter VII (section 12.2).

Zone IV is made up of two main components, a blackish-grey earth layer with shells, and the Ostrea shell (Figs 11, 12). Generally the blackish-grey earth was sandwiched between layers of Ostrea shell, but in some places (e.g. in Squares 50/51-52 of Fig.11) it met directly with the surface of the early shell midden below. A third component, coral sand and grey ashy sand, was found in a short, wavy formation between the two major components (e.g. Squares 50/53-54 of Fig.11). Ostrea shell was also present in thin lenses towards the centre of the site, including right above Oven M, as well as in a 16 cm-thick occurrence in Trench II further south around Square 50/45. The stratigraphy of Zone IV is thus characterised by widely different components in clear-cut but integrated succession, reminiscent of the situation in Trench II at To.4 (Fig.17; Plates 22, 23). The pattern suggests rapid formation by dumping and stands in contrast to the homogeneous nature of the Midden Horizon below.

The pottery content of Zone IV as a whole consisted of around 100 rim and 180 decorated sherds and there is no doubt about the early period nature of the collection, the pottery spectra represented being identical with those of the early Midden Horizon as a whole and with its three arbitrary zones individually (Table 16). Due to the limitations of spit digging, 120 of the decorated sherd cannot be precisely attributed to their original component layer of Zone IV, but 34 were recorded from spits definitely relating to Ostrea shell contexts and 32 from spits definitely not.

The decoration of the 34 sherds from Ostrea shell contexts displays typical early period features: two or three zones of decoration; combination of surface, applied and notched decoration; inside decoration; motifs L2, L4, 01, P1, P13; horizontal and/or vertical applied bands; and applied knobs and perforations. Seven sherds are carinated and two came from flat-based vessels.

Despite the early-period character of its pottery, Zone IV was definitely put in place in post-ceramic times, by the evidence of its sitting above Oven M, dated to 1620 ± 60 BP (see discussion in section 11.2 below). All this strongly suggests that the materials forming Zone IV were derived from early-period deposits, a conclusion arrived at previously by different routes (excavation, Chapter II, section 6.4; the evidence of matching sherds, Chapter II, section 12.6; and this chapter, section 6.1 above). That some of these deposits were obtained from the early midden on the spot is indicated by the fact that in five cases decorated sherds from Zone IV (including at least two from Ostrea shell contexts) were found to join with sherds in the midden zones. That at least some of the Ostrea component of Zone IV was derived from early-period deposits elsewhere is suggested by the poor representation of Ostrea shells in the early midden itself.

This interpretation of Zone IV, and indeed of the mound as a whole, is important for the interpretation of stone and shell artifacts found there. We may anticipate their full discussion
in Chapter VI by saying that in the main they are of types represented in the midden horizon below, so that their early period derivation is supported.

The base of the midden at To.6

It has been said a number of times in foregoing pages that while Horizon I at To.6 was stratigraphically homogeneous, artistically it was not. That there was intermingling there of pottery of earlier and later character had been appreciated when the initial analysis of the excavations was done (Poulsen 1967a:139-40, 141, 153-54). Because of the way the radiocarbon dates from all sites were interpreted at that time, it was concluded (Poulsen 1967a:153) that the radiocarbon results for the oven structures at the base of the Horizon I midden (NZ-636 and ANU-24) put these at an early stage of the Tongan ceramic sequence and gave a date for the component of early pottery in the Horizon I midden.

As we have seen in Chapter II (section 3.1), this interpretation became untenable in the light of Groube's (1971) review of the Tongan ceramic sequence. The detailed restudy of the structures at the base of To.6 which has been described in Chapter II concluded that on stratigraphic grounds they are much more likely to relate to the occupation which laid down the Horizon I midden than to predate it. This left unresolved, however, the question of the heterogeneous character of the ceramic contents of Horizon I.

In the ceramic analysis described above, I approached this question by allocating the lowermost spit to a Zone IB (= bottom), to be contrasted with the remainder of the horizon above, called Zone IT (= top) (cf. section 4.2 above). The results show significant differences between the two units (Tables 17, 22, 27) and place them at some remove from each other in the seriation matrices (Tables 17, 18, 23). In the chronological ordering of sites and horizons displayed in Text Figures A-D, Horizon IB comes before Horizon II at To.1 and is attributed to the middle period, while Horizon IT is placed after Horizon III at To.5 and is attributed to the late period. I have already mentioned in connection with the interpretation of Text Figure A, that there is an indication there of a slight hiatus or displacement in the curve between units To.5/III and To.6/IT. The study of the decoration evidence suggests something similar (Text Fig. D; cf. Chapter IV, section 13.8). It is difficult to decide whether this reflects an acceleration in pottery development, a phase of the pottery development being as yet unrecorded by excavation, or is quite coincidental. Nevertheless, the indications are that some time must have passed between the occupations at To.6 identified by units IB and IT in ceramic terms. The question is why there is no corresponding stratigraphic evidence of this passage of time at the base of the site.

Given the homogeneity of the shelly midden which constitutes Horizon I at To.6 and the conclusion that the structures at the base of the site belong to that horizon and do not predate it, the only possible conclusion is that the earlier pottery of Horizon I is not in situ. Lying about on the ground surface unprotected by cultural deposits, it very easily became incorporated, during the first stage of the late period occupation, partly into the fill of the structures now being dug into the subsoil, but predominantly into the shelly matrix of the first midden at the site, and mainly its bottommost zone. Once this midden formation was completed, the earlier pottery had become sealed in there. Later pottery was deposited together with this first midden, mixed with the earlier potsherds in the lower part and occurring unmixed in the upper part. Hole digging from successively higher surfaces during the subsequent stages of site use then occasionally brought some of the earliest artifactual material out of Horizon I into yet other secondary positions. It may be noted that this explanation is in accord with the conclusion to be drawn from the discussion in Chapter II on midden disturbance (cf. section 12.7), that migration of sherds happened largely in the horizontal dimension.

If this interpretation is correct, it means of course that Horizon IB is a mixed horizon with both earlier and later pottery. The placement of the horizon in the middle period of the chronological sequence is thus an artifact of this intermixture. The true position of the older pottery component must be earlier than the analysis indicates.
Finally, it is worth pointing out that ceramic discrepancies within horizons such as this at To.6 Horizon I are not unknown at other sites. Thus within Horizons I at To.1 and II at To.5, which are adjoining units of the sequence, a clear and comparable drop in the indices for decorated ware is in evidence (see Table 28 and the discussion in section 8.2 above). However, in these cases the same trend is not apparent in the rim development (see Poulsen 1967b:Table 21). The explanation here must therefore be different from that proposed for Horizon I at To.6. The To.2 and To.5 evidence suggests that, though both were heading towards simplification, the rim and decoration developments were undergoing change at different rates. The lesson is that discrepancies noted in the internal character of a single analytical unit are worthy of consideration rather than being dismissed as, for example, due to sampling error or sample size.

THE CERAMIC SEQUENCE AND THE RADIOCARBON DATES

The task is now to review the evidence of the radiocarbon dates in the light of the established ceramic sequence. Table 32 sets out not only the data for my sites but also relevant dates from other Tongan sites. Appendix 3 by H.A. Polach deals with the correction factor for ages on marine shells (marked * in the table when so corrected) and other issues relating to the validity of radiocarbon determinations, as well as with the conversion of the radiocarbon ages into calendrical dates. I have in fact few dates which are relevant to the ceramic sequence. The reasons for this have been discussed in Chapter II (section 2). As mentioned there (section 3.1), the arguments advanced by Groube (1971) against the notion of pottery manufacture having continued on Tonga much into the Christian era make it certain that a number of the dates which I obtained from my excavations relate to post-ceramic activities at the excavated sites. Relevant details of all my samples are given in the appropriate excavation sections of Chapter II.

The early ceramic period

In my excavations the early period is constituted, in seriated order, by the To.2 midden, Horizons 0 and I together at To.5, and To.1/I.

There are two dates to be considered initially. They are ANU-541 from To.2 (no. 3 of Table 32) and K-904 from To.1 (no. 2 in the table), giving ages respectively of 3090 ± 95 BP (2680 ± 95 BP*) and 2770 ± 100 BP (= BP*). Only the former is in a position of primary association with materials of the early ceramic period. The sample derives from the very bottom of Zone I of the To.2 midden, in a square where no evidence of disturbance was found, and consists of artifacts (shell net weights), which avoids the problem with unworked shells of natural specimens being secondarily incorporated from an older context.

This is precisely the difficulty with the shells of sample K-904, from Pit A at To.1, whose radiocarbon age is more than 2000 years older than that of charcoal from the same pit, dated as NZ-597 and K-961. Since there is no doubt that these two charcoal samples validly date the pit, the only conclusion is that the shells were incorporated into the fill of the pit from a much earlier context. Pit A was dug deeply into the subsoil, whose top 40 cm, as I have described in the To.1 excavation section in Chapter II, consists at the northern end of Trench I of mixed clay and coral sand, containing some shell, bone and artifacts. It is possible, therefore, that the shells of sample K-961 derive from this earliest occupation on the site, which would then be closer to the occupation of To.2 than appears from the previous analyses (Tables 18, 19, 23; Text Figs A-D) of Horizon I at To.1 as a single unit. Some support for this possibility is provided by the evidence of the decoration indices by spits within Horizon I at the site (Table 28) and by the relatively high frequencies of so-called 'possibly early motifs' in Horizon I (see Chapter IV, section 12.6 on these motifs). The insignificant difference between the radiocarbon dates ANU-541 from To.2 and K-904 from To.1 is further evidence for the proposed interpretation.
It is necessary to make brief mention of the earliest Tongan radiocarbon date so far known, from the Mangaia Mound near Nuku'alofa. This is no. 1 of Table 32, NZ-726, 3130 ± 70 BP (= BP*), on a sample of shells from Pit C at the site. As Groube (1971:302) points out, however, Pit C was cut from near the surface, so that it cannot be accepted as reliably dating the excavated pottery. As with Pit A at Site To.1, we are dealing with a sample of shells in secondary position, where the possibility exists that they are old natural specimens accidentally incorporated in much younger cultural contexts. I have argued in the case of To.1 that an appropriately old cultural context exists from which the shells of sample K-904 could have been derived. In the case of Mangaia, where details of the site stratigraphy are unknown to me, the age is so far beyond the acceptable archaeological dates for Tongan settlement that it would seem best to regard the shells of sample NZ-726 as natural specimens. As we shall see in Chapter V (section 7.1), however, pottery comparable to the early ceramic period in Tonga occurs in Fiji at a date of 3240 ± 100 BP (GaK-1218) at Natunuku, which overlaps with the Mangaia shell date from Pit C.

The late ceramic period and the end of pottery production

In my excavations the late period is made up of Horizons IT, II and III at To.6.

I begin with the three dates from To.6 (nos 7-9 of Table 32). They are NZ-636 from Oven K, 2380 ± 51 BP; ANU-24 on charcoal from Oven DN, 2350 ± 200 BP; and ANU-873 on shell artifacts from the middle levels of the Horizon I midden, 2730 ± 60 BP (2320 ± 60 BP*).

The conclusion from the analysis of the excavation data (see Chapter II, section 10.4) was that the ovens belong to the main Horizon I midden, and not to the earlier, ephemeral occupation at the site, recognisable only in the middle-period character of some of the pottery in the bottommost spit of Horizon I at the site (see section 10.3 above). The main Horizon I midden belongs to the late ceramic period and the samples from the two ovens date an early phase of it. They are confirmed by the shell-artifact sample, ANU-873.

There are a number of dates from Vuki's Mound, of which Groube (1971:301) says that they point to a short occupation contemporary with To.6, with which the material remains are also exactly comparable. In Table 32 I have entered only three of the five dates which Groube describes as coming from clearly stratified sealed layers (nos 5, 6 and 10 of the table), omitting two with very large errors (ANU-433 and 436, Groube 1971:301). The three dates are 2540 ± 160 BP (ANU-424) and 2440 ± 110 BP (ANU-441), both on charcoal from Layer 14 near the base of the mound, and 2210 ± 145 BP (ANU-429), on charcoal from Layer 4 near its top.

ANU-429 at 2210 ± 145 BP is indeed the latest date unambiguously associated with pottery on Tongatatapu. The two next younger dates (nos 11-12 of Table 32) are equivocal on this question. They come from the Mangaia Mound: NZ-725, a shell sample with an age of 2100 ± 50 BP (= BP*), from a pit apparently cut from near the present ground surface (Groube 1971:302), and NZ-728, a shell sample dating 1765 ± 45 BP (= BP*), from Layer 2, a context of apparent redeposition (Groube 1971:302, fn.73).

With the next younger date (no. 13 of Table 32) we are on somewhat firmer ground. This is NZ-635, 1620 ± 60 BP, on charcoal from Oven M at To.2. As discussed in the relevant excavation report in Chapter II (section 6.5), the stratigraphic evidence is that the oven was dug into an existing midden and sealed in by a burial mound. The analyses performed earlier in the present chapter (sections 6.1 and 10.2 above; also Chapter II, section 12.6) show that the midden into which the oven was dug is early period and that the pottery in the burial mound is derived from this early midden and probably also from some other equally early source. There appears to be no pottery therefore at To.2 other than of the early period, for which there is a date at the site of 2680 ± 100 BP* (ANU-541, no. 3 of Table 32). Thus the date for Oven M at To.2, 1620 ± 60 BP, is highly likely to fall in the post-ceramic period.

To conclude this section, let us take the three next younger dates in Table 32, nos 14-16.
NZ-637 from Oven B at To.5 is, as explained in the excavation report in Chapter II (section 9.9), an enigma. ANU-442, 1150 ± 90 BP, from Vuki’s Mound, is said by Groube (1971:301, 304) to date a fireplace cut into the mound after its abandonment. GaK-1204, 770 ± 200 BP, on collagen from what Davidson (1969a:274) suggests is the earliest burial in a mound at ’Atele College, is seen by Green (1972:82) as postdating the period of pottery use. Any attempt to achieve greater precision in dating the end of pottery manufacture must come to terms with the problems posed by the digging of structures into earlier pottery-rich layers (cf. Groube 1971:295, 304-5).

The middle ceramic period

At my sites this period is represented by Horizon II at To.5 at the earlier end and Horizon III at the same site at the later end, with To.1/II, To.3/II and To.6/IB variously ordered between. I have, however, no relevant dates from my own excavations. It is possible that a date from the Mangaia Mound, NZ-727 (no. 4 of Table 32), relates to the middle, rather than to the late ceramic period.

NZ-727 is a shell sample from Layer 3 and has an age of 2630 ± 50 BP (= BP*), which shows some statistical difference (following Polach and Golson 1966:19-20) from the To.6 dates for the late ceramic period and, with one exception (ANU-424), from those from Vuki’s Mound. Layer 3 was the only layer of the Mangaia site to produce decorated pottery and Groube (1971:299, 300) says that it occurred there in slightly higher proportions than at Vuki’s Mound and To.6.

Now Groube indicates (1971:299, 300) that the decorated sherds at Vuki’s Mound came from a soil layer at the base of the site which not only predated but had nothing to do with the main site formation. Also the main representation of decorated pottery at To.6 came in the bottommost spit, which was analytically separated as To.6/IB (Table 27). This zone has been interpreted as including material from an ephemeral occupation preceding the main site formation at To.6 and belonging to the middle ceramic phase. These considerations make it reasonable to think that Mangaia Layer 3 represents a middle ceramic period occupation, even though, its pottery being unpublished, it is impossible to assess its relationship to other, especially middle ceramic period, horizons.

In addition Golson (1961:174) says that 25% of the decorated sherds from Mangaia Layer 3 are very similar to decorated Lapita ware from New Caledonia. As such, they may well include some of the so-called ‘possibly early motifs’ (on these motifs Chapter IV, section 12.6) known from the early, but also the middle ceramic period in Tonga, including in the latter the ephemeral occupation at the base of To.6.

Radiocarbon dates and the post-ceramic period

There are six dates from my excavations now to be dealt with.

Oven M at To.2

I have argued above (section 11.2) that the date for Oven M at To.2, 1620 ± 60 BP (NZ-635, no. 13 of Table 32), not only falls in the post-ceramic period, but is the earliest reliable date for that period. The oven was dug something like a thousand years after midden formation at the site, dated by ANU-541 (no. 3 of Table 32) to 2680 ± 100 BP*, and could relate, as suggested in the excavation report in Chapter II (section 6.5), to the building of the burial mound. Burials of a similar kind have been investigated by Davidson (1969a) at two mounds at ’Atele College, for which the earliest date is 770 ± 200 (GaK-1204, no. 16 of Table 32). Mound burial then would seem on present evidence to be a feature of Tongan prehistory only appearing after the pottery phase of the sequence.
Oven D at To.5

ANU 23/1 and 2 (nos 22 and 21 of Table 32) are parts of the same sample of charcoal from Oven D at Site To.5, which has been discussed in detail in the excavation report for the site in Chapter II (section 9.5). The samples date to $330 \pm 63$ BP and $340 \pm 100$ BP respectively, that is, to the very recent past, just prior to the time of European discovery.

Oven D is a very simple feature, of a type attested from the very early stages of Tongan settlement, since it occurs at the base of To.2.

Pits at To.1, 5 and 6

More interest attaches to the chronology of deep pits like Pit A at To.1, for which there are available two recent dates from the same layer of charcoal in the fill, $420 \pm 100$ BP (K-961) and $464 \pm 82$ BP (NZ-597), respectively nos 19 and 18 of Table 32.

The pits described as stratigraphically later in the sections dealing with site excavations in Chapter II all looked to have been dug, not from the present ground surface, but from the surface of midden horizons lower down, though it was realised that disturbance of the surface of sites, for example by gardening, might have destroyed the stratigraphic evidence of their true level of origin. However, if such pits had been dug at or near the present ground surface of an old midden and deeply into the yellow subsoil by people not themselves dumping shell-midden refuse on the site, one would have expected the fill to show some stratification of old dark shell midden and light, yellow subsoil materials. The fact that the latter were never observed in the fills of these pits, except for Pit C at To.5 (cf. also the build-up of the mound at To.4), suggests that the use of the pits is more likely to be related to activities accompanying midden formation, the inhabitants having deliberately and as a matter of normal practice dumped midden refuse in such holes. A special analysis undertaken to investigate this question at To.1 (section 10.1 above) seems to favour such pits there in general having been constructed from the surface of Horizon I rather than from any higher level.

The possibility that some of these pits were post-ceramic had, however, to be considered, since Pit A at To.1 is so dated on the radiocarbon evidence. The question therefore was to identify such pits when independent dating evidence was not available. Since this appeared to be impossible in terms of type of fill, dimensions, ground plan, cross-section or distribution on sites, I adopted the criterion of the character of the preserved rim of a pit, as described in Chapter II (section 3.2).

Applying this criterion, I have selected out below the pits which could possibly represent activity later than the formation of the uppermost midden horizon at my sites, that is, might date to the post-ceramic period. The details are given in the descriptions of excavations at the three relevant sites, To.1, To.5 and To.6, in Chapter II (sections 5.5, 9.6 and 10.5).

To.1 Pits A, P, S, X, AA, AD, BO and CL. Pit N would also have been considered, were it not that other evidence argues against it, as discussed in the excavation report in Chapter II (section 5.5). Moreover, as we have seen, the special analysis of the rim evidence from To.1 (section 10.1 above) makes it unlikely that the many stratigraphically later pits here could all be from the post-ceramic period. This has been specifically argued for Pit AH in Chapter II (section 5.5), in the light of the special interest that attaches to Pit AF and its burial, which on stratigraphic grounds is earlier than Pit AH. An argument solely in terms of the profile of Pit AF might make it a candidate for a post-ceramic date.

To.5 Pits C and G

To.6 Pit AJ. Four other pits, T, U, AM and AN, allocated to Horizon III, could not be considered because detailed profiles for them were unavailable.
Thus a maximum of 12 pits from three sites can be listed. The majority of them is from To.1, but, as we have seen, most of these are not really likely to be post-ceramic. Pits C and G at To.5 and Pit AJ at To.6 are better examples, Pit C being also the only one observed at any site whose fill contained recognisable subsoil materials. These three pits are all rather deep with straight shaft and flat base, but the ground plan could only be established for AJ, where it is circular. Their similarity with Pit A at To.1 is good. However, as the same features are recorded also for pits considered by the evidence of the To.1 ceramic analysis to belong to the middle ceramic period, we are probably dealing with a type of pit that has been in use during most of Tongan prehistory. In other words, there is no reason for defining a specific type of post-ceramic pit. Pits from other Tongatapu excavations fit well into the pattern; they include some examples dating possibly or certainly to earlier and later parts of the post-ceramic period (Davidson 1969a:258, 275, 284; Groube 1971:299, 302; Green 1972:82).

If we assume that pits were somehow connected with agricultural food production, the question may be asked whether the appearance of these deep pits by the middle ceramic period reflects some kind of change or intensification in economic activities around this point in time. Discussion of this subject is taken up in Chapter VII (sections 11.4 and 12.3).

Oven B at To.5

NZ-637 (no. 14 of Table 32), on charcoal from Oven B at To.5, is the most problematical sample in the dating series. Its date of 1600 ± 87 BP is entirely irreconcilable with the ceramic sequence as now interpreted. Horizon II, to which Oven B was originally allocated, is either early middle ceramic period or even late early period by the pottery analysis (cf. Text Figs A-D) and thus much earlier than the date obtained for the sample from Oven B. At the same time, for reasons discussed in detail in Chapter II (sections 9.5 and 9.9), it is hard to believe that the oven could have been dug from a higher level in the midden than originally recorded. I have therefore rejected NZ-637 as dating the structure in question.

Summary of chronology

Overall the radiocarbon dates for the ceramic period are consistent with the stratigraphy of the sites and, if plotted against a time scale, they describe a gradual curve very similar to that produced by the distance analysis of horizons in terms of rim features (Text Figs A-C). However, the large errors associated with the radiocarbon determinations make it very difficult to be precise about the actual age differences between the seriated units. In addition, there are very few of my own dates which are relevant to the ceramic sequence, while the ones I have used from the excavations of others relate to pottery which has not been described in detail.

It is possible as a result to attach dates to the ceramic sequence in only the most general way. All the data are set out in Table 32, including conversions to Christian calendar ages, for which see Appendix 3.

1. Early ceramic period

ANU-541 on shell artifacts from To.2 dates possibly the earliest stage of the period as at present known to 2650 ± 95 BP*. This converts to 800-920 BC.

K-904 on shells from Pit A at To.1 is plausibly interpreted as relating to the earliest traces of occupation at the site, in the subsoil below the main midden. Its date of 2770 ± 100 BP (= BP*) or 820-1050 BC is statistically indistinguishable from the preceding result.

NZ-726 from Pit C at the Mangaia Mound cannot be related to any archaeological feature and the redeposited shells which provided the sample may have been natural in origin. Their date of 3130 ± 70 BP* = 1370-1495 BC is similar to that for Lapita pottery in Fiji.
2. **Middle ceramic period**

I have no dates for horizons which the ceramic analysis has allocated to this period. I have argued that Layer 3 at the Mangaia Mound may belong to this period because of the representation of decorated pottery there. The radiocarbon date for Layer 3 is on shell (NZ-727) and gives an age of 2630 ± 50 BP* = 800-830 BC. This is statistically indistinguishable from ANU-541 from To.2 for the early ceramic period and ANU-424 from early in the main site formation at Vuki's Mound, which belongs to the late ceramic period. I argue that Burial AK in Pit AF at To.1 falls in the middle period (section 11.4, the discussion on pits, above; Chapter II, section 5.5).

3. **Late ceramic period**

Main site formation at Vuki's Mound as well as at To.6 belongs to the late ceramic period. An early stage at the former is dated by ANU-424 and ANU-441 on charcoal from Layer 14 while, on stratigraphic grounds, perhaps the very beginning of the main occupation at To.6 is marked by NZ-636 and ANU-24 on charcoal from Ovens K and DN respectively. In order, the four dates are 2540 ± 160 BP = 400-840 BC; 2440 ± 110 BP = 400-790 BC; 2380 ± 51 BP = 550-640 BC; and 2350 ± 200 BP = 195-790 BC. These dates are not significantly different from each other.

Other late dates, ANU-873 on shell artifacts from Horizon I at To.6 and ANU-429 on charcoal from Layer 4 at Vuki's Mound, fall within the late ceramic period. They are respectively 2320 ± 60 BP* and 2210 ± 145 BP. The value for ANU-873 cuts the calibration curve at two places, allowing dates of 375-405 BC and 250-290 BC. ANU-429 converts to 385 BC-AD 50.

4. **Post-ceramic period**

The end of pottery manufacture falls after the date on charcoal from Layer 4 at Vuki's Mound, ANU-429, 2210 ± 145 BP = 385 BC-AD 50. I have argued above (section 11.2) that NZ-635 for Oven M at To.2 is the earliest reliable date for the post-ceramic period. Its age is 1620 ± 60 BP, which converts to AD 380-530.

A series of radiocarbon dates, besides NZ-635, is available for structures dug into pottery-bearing sites in the post-ceramic period: a fireplace at Vuki's Mound (ANU-442); at least one oven at To.5 (ANU-23/1 and 2), NZ-637 being problematical; and Pit A at To.1 (NZ-597 and K-961). NZ-725 from Pit J at the Mangaia Mound is less securely associated.

There are two points of interest here. NZ-635, the charcoal sample from Oven M at To.2, may give a date of 1620 ± 60 BP = AD 380-530 for burial mound construction. NZ-597 and K-961, dating charcoal from the same layer of fill in Pit A at To.1 at 464 ± 82 BP = AD 1400-1470 and 420 ± 100 BP = AD 1410-1520 respectively, show the late persistence of a type of deep, circular pit thought to make its appearance during the middle ceramic period at To.1.
Text Figure A  The chronological distribution and periodisation of horizons, according to the individual rim feature evidence of Table 18

Text Figure B  The chronological distribution and periodisation of horizons, according to the individual rim feature evidence of Table 19
Text Figure C  The chronological distribution and periodisation of horizons, according to the combined rim feature evidence of Table 23

Text Figure D  The chronological distribution and periodisation of horizons, according to the decoration evidence of Tables 27 and 28
IV THE NATURE OF TONGAN POTTERY

THE EVIDENCE FOR VESSEL SHAPE

In this section I shall attempt to reconstruct the original vessel shapes of the Tongan Lapita ceramic tradition. Owing to the fragmentary state of the excavated material a lot of difficulty attaches to this undertaking. Nevertheless it is felt that it must be tried in order that we may advance to the level of a cultural understanding of the material. The results are to be looked upon with due caution, and it is to be hoped that future excavations in Tonga and elsewhere may help in testing their probability.

Methodological considerations

The basic difficulty, of course, consists in the almost total lack of whole or physically reconstructable pots and the smallness of the vast majority of the sherds, something that, as we have seen in Chapter III, prompted analysis primarily in terms of individual features. It seems, however, that a combined consideration of the following aspects may lead to reasonable results: base sherds, body sherds, ordinary rim sherds and their information on rim orientation and body-rim inclination, angled sherds and collar and flange rims. A basic assumption is that individual features occurring in fair numbers or proportions in the same horizon will tend to be combined in the same sherds in a pattern relevant to attempts at analytical reconstruction of vessel shape.

I shall make use of the material from all excavated sites but in particular from To.2 and To.6. A distinction is made between undecorated and decorated pottery simply in terms of the presence or absence of decoration on the specific sherds considered. 'All' includes them both.

Vessel base

It is easiest to begin at the bottom. We start with the definition of three types of pot base, the first two of which are characterised by an angle between vessel wall and base, which has to be distinguished from the angle on shouldered or carinated vessels, dealt with below. The principle with all these angled sherds is to establish their orientation on the walls of the original pots, just as in the case of rim sherds, and this is done by achieving horizontality of the corner angle.

1. A flat base is really flat from the centre to a clearly recognisable base-body corner, regardless of the degree of this angle (Fig.57; Plate 39.7-13).

2. A so-called rocking base is slightly curved from the centre to a recognisable base-body corner, at which point the angle between the adjacent part of the base and the horizontal by convention is $\leq 22^\circ$. It is my impression from the material that pots with such a base cannot readily be tipped over; they may be rocked from side to side but will soon come to rest again.

3. A round base is characterised by its curve continuing smoothly into the curve of the body wall, up to the point of the first break in profile whether this be a shoulder or the body-rim junction. Such pots may be tipped over more easily. Round-base pots were probably meant to sit on three or four stones or on ceramic pot rests, while flat- and rocking-base pots presumably were meant to rest on some even, horizontal surface.

Only 42 flat-base sherds have been identified, five from the surface and 37 excavated, of which eight are possibilities only. From Table 33 it is clear that pots with flat bases, while being very seldom made, represent an almost exclusively early feature of the craft. Decorated pieces are in the great majority and it is possible that the undecorated pieces actually derive from pots whose decoration is higher up. On all the decorated pieces the decoration is placed on the body adjacent the base-body angle.
Rocking bases are discussed more fully below, in the context of carination in general. They are also very rare.

The conclusion is that the overwhelming majority of the Tongan pots had round bases, whether decorated or not. In the section on The Reconstruction of Carinated Vessel Shapes (section 5 below) I shall discuss which pot shapes are most likely to have had flat and rocking bases.

**Vessel body**

In discussing the course of the pot wall as reflected on body sherds, this is in terms of the vertical plane. Many sherds were so small that no observation as to profile course could be made. At the time of inspection, no distinction was made between sherds with and without decoration, and no counts were performed.

It is, however, my impression that the prevailing kind of body sherds has a gently curving profile, convex outside and concave inside (Fig.55.1-6; Plate 34). This means that the pottery was typically marked by a convex profile below the body-rim transition in both simple and composite forms, i.e. those lacking or possessing an angle in the profile (Shepard 1963:232). Concave body sherds are uncommon and thought more likely to derive from the upper than the lower vessel part, either from the rim itself (the lip itself having been knocked off) or from the body below it, i.e. the neck or shoulder. Flat or straight body sherds are very rare, too, as are those giving evidence of inflected profiles, i.e. the curvature changing from concave to convex or vice versa (Shepard 1963:226).

This general information on body profile is quite important for the reconstruction of vessel shape, as will be seen.

**Vessel rim**

The most precise and at the same time variable information about vessel shape with the present material is to be gained from a study of the rim sherds, with their information on orientation and body-rim inclination. Since, however, body-rim inclination is a measure of the deviation of the course of the body from that of the rim, inward and outward (Fig.30), the shape of the vessel below the rim is only secondarily a function of this value, the primary factor being the orientation of the rim (Fig.29). Sherds of interest are therefore only those whose rim orientation can be established. We shall in the following sections consider various series of vessel shapes that are based on the combination of known rim orientation with known body-rim inclination.

Uncertainty relates, of course, to how the vessel wall continues below the rim and its immediately attached body part, but it is felt that the potential alternatives can be specified. From our knowledge of the sherds in general (sections 1.2 and 1.3 above), it is most realistic to draw a rather evenly convex line to represent a continuously rounded body-base shape.

There is, however, as already indicated, an important category of carinated pottery, which will be dealt with separately below (sections 4-6).

**THE RECONSTRUCTION OF UNCARINATED VESSEL SHAPES**

**(Fig.42)**

**Methodology**

Table 34 lays the basis for the definition of vessel shapes on the basis of the combination of three categories of rim inclination, inward, outward and vertical/near-vertical (= combined vertical) with two categories of body-rim inclination, inward and outward. It gives the statistics for each category alone and in combination. It does so in terms of plain and
decorated rims and of both together. Finally, it deals only with the excavated data from To.2 and To.6, in order to see what comparisons and contrasts exist between the early and the late ends of the ceramic sequence.

Several things are immediately clear from Table 34. Inward orientation of the rim was always a rare feature and, when used, such pots almost exclusively had inward inclination of the rim in respect of the body. Outward rim orientation was common early and rare late. It was almost never combined with inward body-rim inclination, but as a rule with outward inclination. This signifies a rather logical feature of the pottery tradition: orientation and inclination of the rim section were both to be similar, either inward or outward. Vertical orientation of the rim, on the other hand, common early and later dominant, was combined more freely with inclination: in the early period it was used more often on pots with inward inclination of the rim in respect of the body, while the preference was just the opposite in the late period. There are of course less constraints on a vertical rim being inwardly or outwardly inverted in respect of the vessel body than is the case with inwardly and outwardly oriented rims, so that the shift over time in inclination preference with vertical rims is an expression of cultural selection.

It was also evident from the picture displayed in Table 34 that four combinations were sufficiently well represented at both ends of the ceramic sequence to warrant attention being concentrated on them: inward orientation + inward inclination, outward orientation + outward inclination, combined vertical orientation + inward inclination and combined vertical orientation + outward inclination. In order to define groupings within these broad categories, only those complete excavated rim sherds were used on which it was possible to take exact measurements of rim orientation and body-rim inclination. This means that measurements in terms of ranges are excluded, with the result that the number of sherds available for some of the suggested shapes is small. It is possible in some cases, however, to introduce a distinction between specified and unspecified sherd allocation to the shape categories, according to whether the body-rim inclination is determinable - can be specified - to degree or only within a range, respectively.

It is moreover clear from Table 34 that some orientation-inclination combinations were preferred to others in the manufacture of decorated ware, and this will be a focus of interest in considering the various classes of vessel shape which combinations of precisely measured orientation and inclination produced. As with Table 34, the relevant tables are set out in such a way as to indicate the incidence of decoration both within and between categories and classes. In this way they display the range of choices open to the Tongan potter - which categories of shape to make and whether to decorate or not - and record the pattern of choices made. Again like Table 34, only the excavated data from To.2 and To.6 are taken into account, in order to produce the clearest possible picture of the early and late periods in respect of vessel shape and its decoration.

Eight Ceramic Series, A-H are proposed, with another group, Series J, being somewhat exceptional. They are the result partly of analysis, the upper vessel part, based on measurements of rim orientation and body-rim inclination, and partly of interpretation, the lower vessel part, the character of which is not readily observable and has been inferred. In spite of these shortcomings, it is felt that by supplementing these data with the rare information from whole or physically reconstructed vessels, the deductions made regarding shape variation are reasonably acceptable.

Analysis and results

The raw rim data are given in Table 35 and the resultant series A-H illustrated in Figure 42, where all shape possibilities are spelled out and identified individually. It will be seen that each series corresponds to a specific degree of rim orientation (A-H), while the degree of body-rim inclination varies (0/1-9). Collar rim vessels are included but will be discussed separately below. A great deal of uncertainty exists about the actual dimensions of the original pots, on
which score observations could only exceptionally be made (section 15.1 below). I have therefore chosen to be quite schematic in the presentation of the various suggested vessel forms, the diameter of the body-rim transition being always exactly the same, while all other dimensions vary arbitrarily.

The proposed vessel shapes can be described in terms of four groupings, all assumed to reflect function in one way or another:

1. **Bowls**, fairly deep pots of hemispherical outline below the rim
2.3. **Dishes** and **plates**, both shallow, but plates more so than dishes, and both of less than hemispherical outline below the rim
4. **Jars**, deep pots of more than hemispherical outline, that is more or less globular

Vessels of these basic body shapes may in addition be called constricted, open or flaring according to whether their rim orientation is inward, vertical or outward respectively.

Leaving for later discussion the problem of carinated ware, I assume that any shape occurs uncarinated, but some may also occur carinated; in other words, that no single shape was exclusively meant to be carinated.

In these terms the A series includes constricted bowls or jars (0/1-3) and dishes (4-5); the B series constricted jars (0/1-3); the C series flaring dishes (0/1), bowls (2) and jars (3-4); the D series flaring dishes (1-2) and bowls (3-4); the E series flaring dishes (2, 4), bowls (6) and jars (7); the F series flaring plates (1-3), dishes (4-6) and bowls (7-9); the G series open bowls (0/1-1), dishes (2-4) and plates (5-6); the H series open jars (0/1-6). The J series, treated separately, includes flaring dishes only.

It is necessarily assumed in what follows that the sherd frequencies reflect the general trend in frequencies of the pots from which they derive.

**Minor pottery series**

*The A series*

The constricted bowls or jars (0/1-3) and dishes (4-5) of this series were always rarely made. In the late period they were as a rule not provided with decoration but rather with a collar rim, especially on shapes with slight body-rim inclination. In the early period decoration was freely applied, mostly on shapes with moderate body-rim inclination (3-5), which are very similar in concept to some of the shapes of the G series. This indicates that shallower vessels were preferred for decorated ware.

The A series is represented by two reconstructed pots and one whole pot, all three from early levels of sites other than the two, To.2 and To.6, in terms of which these analyses are being done. Two of them exemplify a dish form with more pronounced body-rim inclination (degree 6) and therefore shallower shape than any identified in the analysed sherdage of To.2 and To.6. These A6 dishes are an undecorated example from Horizon I at To.1 (Fig.45.10; Plate 37.13) and a decorated example from Horizon II at To.5 (Fig.46.1; Plate 51.1). The whole pot is a decorated example of A4 (Fig.46.3), excavated in about 1970 by my former field assistant and interpreter, Iteni Helu, from To.1, where it was found securely sealed in the thick shell concentration of Horizon I. It was transferred to the Fiji Museum, Suva, where it is now temporarily lodged.

We may note that the two decorated pots are of fairly shallow depth, representing the preferred combination indicated by the sherd data.
The B series

The constricted jars of this series seem to represent a unique concept of pottery making in Tonga. They were made early and late, sometimes decorated. In the late period the concept was applied also to pots with collar rims.

The series is represented by one reconstructed decorated pot, shape B2, found in Horizon I at To.1 (Fig.45.9; Plates 37.15, 44.11). In addition, reference may be made to a reconstructed decorated pot found in Horizon II at To.6 (Fig.46.2). This is unclassified in the present system owing to its unique inward rim orientation of degree 3, but it is obviously related to the ideal of the B pots.

The C series

The flaring dishes (0/1), bowls (2) and jars (3-4) of the C series were always rarely made. Nevertheless they seem to represent a late preference, in much the same way as the very similar H shapes. The series was of no importance in the manufacture of decorated ware, the one exception recorded being from a late level.

The D series

The flaring dishes (1-2) and bowls (3-4) of this series also represent something unusual in the repertoire of both early and late Tongan pottery production. They were but rarely decorated, the sole exceptions all being late, involving late decoration features and notably shallow shapes (D2).

The E series

This is the last series of infrequent occurrence and comprises flaring dishes (2, 4) and bowls (6), which are all recorded for the early period only, where shallow examples occur decorated.

The series is represented by one reconstructed pot from Horizon I at To.1, an undecorated example of E7 (Fig.48.3).

Summary of minor series

The shape categories in the A-E series were not extensively used in Tongan pottery manufacture. They were most popular as undecorated ware, the A pots forming the sole noteworthy exception. This should be seen in the context of the close typological relationship of the latter with the decorated G shapes to be discussed below. In terms of decorated pottery, shape E2 comes close to shapes of the related series of F pots, much preferred for decoration.

Major pottery series

The F series

This represents one of the standard wares of early Tongan pottery and had virtually gone out of production by the late period. It comprises flaring plates (1-3), dishes (4-6) and bowls (7-9), according to the degree of outward body-rim inclination. They all appear with and without decoration. As Table 36 shows, however, the popularity of decoration varies significantly between plates, dishes and bowls. The lower the degree of body-rim inclination, that is the shallower the form, the more frequent is the occurrence of decoration. This greater incidence of decoration with, for example, plates than with bowls does not seem to be due to chance, as all three forms, bowls, dishes and plates, were roughly equally popular. The association of decoration with shallowness is thus a cultural preference, apparently expressed also in the rarely occurring related shallow E2 and A forms discussed earlier.
The tendency for F vessels with moderate outward body-rim inclination to be decorated twice as frequently as those with pronounced inclination is not only true for To.2 but for all early period levels taken as a whole (Table 37). There are 65 F sherds of moderate body-rim inclination from the pooled early levels (To.2 all excavated material, To.5/0-1, To.1/1) and 73 of pronounced inclination. Of the former 44 (68%) are decorated, of the latter only 26 (36%).

It seems possible to raise this number (44) of decorated rim sherds. There is a group of rim sherds with pronounced outward orientation of the rim, whose body-rim inclination cannot be specified much beyond the fact that it is outward. These unspecified rim sherds (see section 2.1 above) number 133 sherds, of which 82 are decorated. Of these 133 rim sherds, 127 are F sherds and 77 of these are decorated, or 61%. The closeness of this percentage with that for decorated rims within the total class of specified F sherds of moderate body-rim inclination (Table 37) makes it attractive to identify the 77 unspecified F sherds with this class of shallow F pots, rather than with the deeper F pots where incidence of decorated rims is half as much. On this interpretation we have a total of 121 decorated F rim sherds, specified and unspecified (44 + 77), to evidence the shallow type of decorated vessel that represents an early standard decorated ware on Tongatapu.

Further details on this matter are provided in Tables 38-40, with reference to the position of decoration (and see Tables 49, 50, discussed below in section 5.2). There is interesting evidence here that, from the point of view of decoration, some pots were specifically intended to be seen from the inside, though commonly they were decorated on the outside also. Indeed, inside decoration was almost absolutely confined to pots with pronounced outward rim orientation, notably all of the F category (Table 38). The very same pots appear from the evidence of body-rim inclination to be of rather shallow shapes (Tables 39, 40).

It is difficult to give an explanation of this clear-cut division of the material. Presumably it is related to the function of decorated pottery and points to the existence of a category of vessel, plates and dishes, meant to be served and eaten from, so that decoration was appropriately put on the inside.

F shapes were very seldom used in the late period, though the range is still there, with plates predominating (Table 35). Could this be a reminiscence of the earlier tradition, the same shapes still being made for similar purposes but no longer decorated because this practice had virtually died out?

The series is represented by one vessel reconstruction, an undecorated F9 bowl or jar from To.5/1 (Fig.50.2).

The G series

This represents another early standard Tongan ware, comprising, according to body-rim inclination, open bowls (0/1-1), dishes (2-4) and plates (5-6), in rapidly descending order of popularity (Table 41). Though the series was less frequent in the pottery of the late period, the same pattern of production was maintained.

In the late period G vessels were never decorated, in contrast to the early period when decoration was quite common. Of the four plates represented in the series at To.2, three are decorated, which is reminiscent of the association of decoration with shallow vessels in the F series. The G series, however, consists mainly of bowls and the data of Tables 36 and 41 show that there is a much greater likelihood of G bowls being decorated than F bowls.

In conclusion, we may note a small cup-like vessel (Fig.55.5; Plate 34.2) found in Horizon I of To.1. Although formally like the G bowls, it is only 8 cm in diameter at the orifice.
The H series

This includes open jars only (0/1-6) and constitutes a third standard Tongan ware, very typical of the late period, though the concept was present in the early manufacture of pottery, decorated ware included. The exceptional late occurrence of decoration in this series seems to involve late features only.

Table 35 reveals an overwhelming preference for shapes with moderate body-rim inclination, meaning proportionately small maximum diameter below the rim. Indeed, if the two lowest classes (0/1 and 1) are combined, there is an almost perfect decay curve through the higher values. Obviously the ideal with this series was to avoid globular body shape.

Summary of major series

The three series concerned, F, G and H, are quite likely to have comprised the bulk of Tongan pottery production, F and G being an early preference, H a late one.

The joint evidence of the F and G series is that shallow vessels with slight to moderate body-rim inclination tend to be decorated, because, though shallow G shapes are numerically few, they confirm the pattern of the more numerous shallow F shapes in this respect. Correspondingly, the undecorated vessels of both series tend to be deeper pots.

These results seem to make most sense if viewed in the terms of the function of pottery in the community: undecorated pottery was meant for storage, cooking and the like, with deep shapes needed from the practical point of view, while decorated pottery was meant for serving and eating for whatever specific purposes, profane or ceremonial, where shallow shapes were more appropriate.

In support of this view, attention may be drawn to the evidence for the late period, as at To.6, where G vessels do not occur decorated at all and where shallow shapes are absent or very infrequent. They have presumably become superfluous as a result of a change in the function of pottery: the finer, shallow and often decorated ware has lost its importance, regardless of the original purpose of its use. What remained were the deeper bowls, which continued for a while to serve their practical functions until the role of pottery was entirely played out and possibly taken over by vessels made in other materials.

The shallow vessels of the F and G series are thus to be considered as typical of early Tongan Lapita, whether decorated or not. They only exceptionally lived on into the late period, and then undecorated. Their fall-out contributes to the simplification of pottery manufacture in the course of time. Of the nine F shapes and seven G shapes outlined, all are made early and only four of each late (Table 44).

Corresponding to the decline in F and G shapes, and contributing also to the simplification of the pottery array, is the rise to overwhelming importance of the H jars, amongst which decoration is virtually absent (Tables 35, 45).

Miscellaneous series

This refers to the J series, which is somewhat heterogeneous, referring to a very restricted number of flaring dishes whose definition is not clear-cut. This is the reason why the data have been withheld from normal tabulation and analysis. It is established on the basis of some 30 rim sherds, seven of them decorated, recorded for all three periods, but especially for the early one: 20 early, three middle, two late, six uncertain.

The fundamental feature of these dishes is outwardly oriented rim and inward body-rim inclination, a highly unusual combination in the Tongan ceramics. The main rim details are given in Table 42. The general pattern revealed here is very slight inward body-rim inclination and moderate outward rim orientation. Assuming the body to continue this slight convexity to the centre of a round base, the resulting shape is a simple dish with flaring rim.
Two almost completely reconstructable pots illustrate what this category of vessel looked like: Figure 55.6, a J2 form from the mound horizon at To.2; and Figure 48.2, Plate 34.1, also J2, from Horizon I at To.1. Both therefore allocated to the early period, they are plain pots, the former 8.5 cm, the latter 17 cm across at the lip. A third representative, from the surface at To.3, is of uncertain date. It is a much larger pot, 45 cm in diameter at the lip, which is decorated (Fig.50.1).

Though there was a marked rareness of these rather simple dishes mainly of the early period, it was suspected that the class of straight uncertain rims, Category 1/4 of the rim code (Fig.25), could be affiliated. Some 55 such sherds, including four with decoration, display outward orientation, a kind of orientation that is highly exceptional in this class of rim. There are 21 from the early period, six from the middle and 16 from the late, while the status of 12 is uncertain. Their pattern of orientation is set out in Table 43 in comparison with that of the J pot rims. Unfortunately, however, their early period representation predominantly concerns examples where the degree of orientation is uncertain.

The overall conclusion seems to be that the simple dishes of the J category represent an unusual production of the Tongan industry, being practically confined to the early period, and that the straight uncertain rims dating to the late period derive more likely from pots of Series C and D by the evidence of their degree of orientation.

**UNCARINATED WARE OVER TIME**

**The two ends of the sequence**

Table 44 shows that all the pottery series A-H were present early, that is, at To.2, and all but one (E) late, that is, at To.6. The rather difficult J series, which stands somewhat apart from the others, was particularly known early. The occurrence of the various shapes within the A-H series, however, varies significantly over time (Table 44). Of the total of 43 shapes present, 86% were used early and 53% late, with 58% of them represented in decorated form and 74% in undecorated form in the early period, 14% and 53% respectively in the late period. The more frequently a particular vessel series was produced, the better represented is its range of variation, whether the pots were to be decorated or not, as can be seen by a comparison of Tables 44 and 45. Variation of shape within each series is gradual and the same can sometimes be said for shape variation between series: compare, for example, Series C to Series F and Shapes A 3-5 with G 3-5, C 2-3 with H 2-3, E2 with F3 (Fig.42). All this serves to emphasise the integrity of the ceramic tradition.

The evidence thus convincingly defines Tongan pottery manufacture as homogeneous in its full time perspective. The development of shape over time is characterised by coherent simplification leading to concentration on a limited range of shape alternatives without decoration, especially within the H category of utilitarian jars. It is important that there is nothing in the late period that is absent in the early period.

The rich early elaboration and variation in the combination of body-rim inclination and rim orientation, which affects the contour of the remaining part of the vessel body, between the extremes of plates and jars, gives way to a more stereotyped conception of vessel shape. This early variation in uncarinated shapes is perhaps in principle related to the idea of carination itself as another manifestation of the practice of a vital craft wanting to vary its products according to function and taste. The decoration of pottery is probably also to be connected with this early dynamism of the craft. There is no category of shape used exclusively in the manufacture of decorated ware, but those involving shallow pots were clearly preferred. Decorated pots were generally shallower than undecorated pots and it is natural to see this as a functional distinction. The specific functions of decorated pottery had practically died out by the late period, but there are echoes of the former situation in the rare occurrence of shapes of Series F and G, originally very popular amongst early decorated ware but now appearing without decoration.
Developments through the sequence

The foregoing analysis has been based on the study of the materials from To.2 at the beginning of the Tongan ceramic sequence and from To.6 at its end. The purpose of this section is to assess the conclusions that have been reached by looking at the behaviour of the pottery over the entire sequence.

The data are set out in Table 46 and are organised in terms of the information from all sites pooled according to the three time periods established in Chapter III. Thus the pooled early period is made up of To.2 (all excavated rims), To.5 Horizons 0 + 1 and To.1 Horizon I; the pooled middle period of To.5/II, To.3/1 + II, To.6/IB, To.1/II and To.5/III; the pooled late period of To.6/IT, II and III. Part A of the table gives the numbers of rim sherds represented within each ceramic series, plain, decorated and totalled, for each of the three periods and these are expressed as percentages of the relevant total (A-H). Part B of the table expresses the numbers of Part A as the percentage of plain and of decorated rims for each of the ceramic series, and all together (A-H), in each of the three periods. It should be noted that for To.6 the figures in this table may not tally with those in others. This is due to a number of reasons, mainly because here Horizon IB is treated with the middle period, whereas in other tables the site is dealt with as a whole, and because only sherds attributable to horizon are analysed, whereas in other tables all excavated sherds are included.

The table shows the real existence of the trends hypothesised on the basis of the two extreme sites of the sequence. This appears both from the total evidence and from that of the plain and decorated versions of each pottery series. Each series shows consistent changes over the sequence. It could be argued that this is to a large degree a function of the behaviour of the main categories of rim orientation, which enter both into the seriation of Chapter III and the shape classification now under consideration. However, the very fact of combining rim orientation with body-rim inclination might well have displayed patterns of another kind, especially the combinations involving vertical orientation which can be, and in fact are, combined with both outward and inward body-rim inclination. In addition, many other rim and decoration features contribute to making the types a ceramic reality rather than just an analytical fiction.

Further, it is of chronological interest to note that there is no convincing evidence of sharp breaks in the preferential popularity of the ceramic series between periods, though in this context it is necessary to recall that we are dealing with average patternings of the material. One point of interest is the behaviour of Series A and G, which makes one suspect that these are really one series rather than two separate ones; for this reason they are combined in an additional entry in Table 46. The difference between them is indeed at maximum one degree of orientation, often less in that the vertical orientation of the G pots involves cases where the orientation is only determinable as vertical-inward, range -1 to 0 (Fig.29). The similarity between A and G pots is also to be seen in their rim and decoration details (see sections 11.3 and 14.2 below).

ANGLED SHERDS

Only a small proportion of the excavated material consisted of angled or carinated sherds, inbent or outbent, the former category predominating. The inside and outside walls of outbent sherds are roughly parallel, while on the other category it is the outside wall that is angular, the inside being in the main curved, leaving the sherd thickened at the bend (Fig.56).

The majority of angled sherds is decorated and for the most part this is restricted to one side of the profile angle. The total number of excavated decorated angled sherds excavated is 634 (Table 47), with an additional 101 collected from the surface, especially on the Nukuleka peninsula around To.2. The sum, 735 sherds, makes up 22% of all decorated sherds recorded, which might mean that about one in every four or five decorated pots was carinated below the rim. The figures both for To.2 alone and for all early levels combined suggest the same conclusion.
The total number of undecorated angled sherds unfortunately cannot be given, but it is decisively smaller, in total about one or two hundred, so small indeed that undecorated pots with a carinated profile must have been an unusual feature of Tongan Lapita. This conclusion is reached on the basis of my inspection of the materials in 1965-66. When I began reanalysis some years later in Denmark, I was sent a collection of angled sherds on request, with the warning that it was probable that not all the relevant examples from the excavated sites had been located. This was certainly true for the decorated component, which I was able to check against my original coded data on decorated angled sherds: only one-third of the total was present. There were also 91 undecorated angled sherds in the collection sent to me. The analysis that follows is based on this sample of decorated and undecorated angled sherds.

Whether decorated or not, angled sherds represent but a fraction of the sherdage excavated from late levels, an indication that carinated pottery was practically speaking an exclusively early feature. Site disturbance indeed may account for the presence of some of the few angled sherds found in late levels. This preference is furthermore so closely connected with the use of decorated pottery that on the basis of decorated sherds found in proportion to total rims (Table 47), sites seriate in much the same way as with decorated rims (Text Fig.D). Similarly their proportion to total decorated sherds is fairly similar from level to level where decorated pottery is present, on average 20% (Table 47). Carinated vessel shape was thus a consistent, though not really frequent feature of decorated ware during the time of its manufacture.

On the face of it, it is impossible to say what is upper, what lower on an angled sherd. It is also uncertain to what part of the original pot it belongs. An inbent sherd might represent a base-body angle, a body-shoulder angle, a body-rim angle or (cf. Figs 25, 26) a collar base angle of a marked B type; an outbent sherd could be a foot-body corner, a shoulder-neck corner, a body-rim corner or (cf. Figs 25, 26) a body-collar base angle of a marked B type collar.

From a general knowledge of the material it is nevertheless my impression that the inbent category is most likely to represent shoulder sherds and to some degree perhaps also incomplete rim sherds, the outbent category incomplete rim sherds, i.e. from which the lip is missing. Measurement of the orientation and inclination of the sherds should help clarify the question. In view of the scarcity of outbent sherds, measurements have only been performed on inbent sherds.

Determination of their degree of body-rim inclination was easily done. Three classes were consistently observed. In the terminology of inclination (Fig.30) these are degrees 4, 6 and 8, but a different terminology has been chosen in the present context. Respectively they involve clusterings around the obtuse angle of 135°, the medium angle of 112° and the sharp angle of 90°.

As with rim sherds, it was more difficult to establish orientation, because of the generally small and fragmented nature of the material. But the principle was to achieve horizontality of the corner angle.

As a result, the orientation obtained, with a varying degree of accuracy, may be symmetrical or asymmetrical, i.e. both sides having a similar angle to the horizontal and similar curvatures, or the reverse. The difficulty in telling the upper side of an angled sherd now becomes relevant, except that flat base sherds are easily isolated. With sherds decorated to one side of the angle, it is the convention that the decorated side is upwards, regardless of the kind of orientation established. If they are decorated to both sides, this is of course impossible, as it also is with undecorated angled sherds. If, however, such sherds have an asymmetrical orientation, it is the convention that the side with the lesser angle to the horizontal is downwards (cf. Fig.48.4). The present material makes the alternative unlikely, as it does not seem to include pots where the part above the shoulder is close to horizontal, a so-called marked shoulder.

Using these criteria, it is possible to classify angled sherds on the one hand into flat-base
sherds and rocking-base sherds, both with asymmetrical orientation, on the other into shoulder sherds, with symmetrical orientation (cf. section 1.2 above). On the latter the angle between the lower part of the sherd and the horizontal is by convention >22°. The separation of flat-base sherds has already been done; they are very rare indeed and represent an almost exclusively early feature.

I now pass on to a consideration of the other inbent angled sherds.

From the material available for study, I have chosen to isolate the pooled data on 175 inbent angled sherds from early levels, comprising excavated sherds from To.1 Horizon I, To.5 Horizon 0/1 and, the majority, from To.2, the whole site. The conclusions are summarised in Table 48.

Inwardly angled profile was used more often in decorated than in undecorated ware. The sharp angle is almost exclusive to, and the medium angle dominant in, decorated ware, while the obtuse angle is equally often used in all pottery. Nevertheless, because medium angles were much more commonly produced than the other two categories, decorated sherds of medium angle are in the great majority. Thus obtuse and medium angles represent the bulk of the production of carinated ware as a whole, while the most pronounced variety of carination was reserved for the decorated ware.

Orientation is predominantly symmetrical in both decorated and undecorated pieces. There is a total of 16 definite cases of asymmetry. I suggest that such sherds are from pots, both decorated and plain, with a rocking base, though I am well aware with the undecorated examples that some at least may come from pots with the decoration placed elsewhere. The number of sherds whose orientation is uncertain, 74, is quite large and contributes to the reservations which we must have about the results of the analysis overall, especially with regard to relative frequencies. The consistency with which symmetrical orientation is dominant might suggest, however, that the majority of sherds with uncertain orientation is likely to belong to this class.

THE RECONSTRUCTION OF CARINATED VESSEL SHAPES
(Fig.43)

Methodology

In tackling the difficult problem of reconstructing the vessel shapes most likely to have been provided with a shouldered profile below the rim, I shall try to fit the data of orientation and body-rim inclination of rim sherds together with the corresponding data for angled sherds, in the light of the shape categories reconstructed for uncarinated vessels above. Angled sherds representing the base-body joints of truly flat-based pots have already been isolated (cf. section 1.2 above and see Table 33). They are therefore excluded from this investigation, except that I shall try to point out the vessel shapes most likely to have had such bases.

It is assumed that the angled sherds derive from a position on the original pots in fairly close continuation of the profile from the body-rim joint. Outwardly angled sherds being virtually non-existent, the body wall below the body-rim transition is thus bound to have been in the main gently convex and rarely concave, inflected or straight. Unfortunately we have neither qualitative nor quantitative information on such possibly crucial details. However, on such information as we do have, it is thought to be acceptable to operate with this assumption.

An important hint as to the kinds of vessels most likely to have been carinated is offered by the few recorded cases where larger vessel parts could be reconstructed from actual sherds: they have an everted rim of pronounced outward orientation and a rocking or rounded base and belong to the F category of shapes (Figs 48.1, 49).

In spite of the pitfalls possibly involved, I shall continue to use the simple distinction between decorated and undecorated pottery according to presence or absence of decoration on rim sherds and angled sherds.
Decorated vessel shapes with carination

It is logical to expect angled profile to be prominent amongst the vessel shapes that were preferred for decorated ware, i.e. various categories of Series F and G (Table 45). Trying to correlate these with the data on angled sherds of any kind, we run into difficulties straight away. We have seen that symmetrical orientation is predominant with all varieties of angle and yet with such orientation combinations are almost impossible to establish. Amongst the very few exceptions are H1 and 2 of Figure 43, but these shapes are rare in the early period, and rarely decorated, too.

We have more success in fitting the less common asymmetrically oriented angled sherds with the available shapes, as follows (cf. Fig. 43).

The shapes of Series A-E are all rare, B-D being entirely lacking in the repertoire of decorated pottery in the early period, while E2 just cannot be combined with any kind of carinated profile. All three kinds of angled sherd, sharp, medium and obtuse, combine with the decorated shapes of A series, resulting in various constricted dishes and bowls, perhaps even jars, with rocking or rounded base.

Combinations within the F series are only possible with shapes F5-9 which have pronounced outward body-rim inclination; these are the less commonly decorated shapes of this series. All three kinds of carination are involved, though to varying extent according to the subdivision of F5-9 by degree of body-rim inclination, and this produces flaring dishes and bowls, perhaps mostly with a rocking rather than with a rounded base.

This means that the more common decorated plates and shallow dishes, F1-4, with moderate body-rim inclination, must have had an evenly curved profile from the body-rim joint to the centre of a rocking or rounded base. Perhaps it is not very natural for such shallow vessels to have an angled profile, since the course of the body wall below the rim is generally oriented too near the horizontal to allow much room for carination at all (Fig. 42). However, flat-base sherds with an obtuse angle between base and body could well belong to this kind of vessel (Fig. 57.4, 8, 10, 20).

Combinations within the G series concentrate on those shapes with slight body-rim inclination which were fairly commonly decorated, especially G0/1. With medium and obtuse carination we thus get a range of open dishes and shallow bowls, all with rocking base.

All three kinds of angled sherd can be made to fit the few shapes of the H series that occur decorated, resulting in open, shouldered jars with rocking or mostly rounded base.

With asymmetrical orientation we should therefore note that all three kinds of angled sherd may be considered in most of the series and that rocking base shapes are fairly well represented. There are three reconstructed vessels with carination of asymmetrical orientation, two excavated from early levels. They are all decorated and two have a rocking base: a decorated example of C0/1 from To.1 Horizon 1 (Fig. 48.4); a decorated example of F6 from the same horizon (Fig. 48.1); and a decorated example of F6 from the surface near To.2 (Fig. 49.2).

The above is a strictly theoretical review of the combinations possible with the given data and has to be tested against the actual frequencies of occurrence of the various elements which have been combined. Almost all the combinations suggested are based on angled sherds oriented asymmetrically and yet such orientation is in a clear minority amongst angled sherds as a whole (Table 48). The awkward situation, then, is that combinations between rim sherds and the much more numerous symmetrically angled sherds, regardless of the kind of angle, are possible in two cases only, H1 and 2, shapes which themselves occur very rarely decorated. We are faced with the same problem in connection with undecorated pottery.

The explanation may have to do with the measurements performed. Absolutely accurate measurements of the body-rim inclination and in particular of the orientation of rim sherds and of the corresponding features of angled sherds are, as said a number of times, difficult to
achieve. The looked-for combinations, therefore, cannot be more accurate than the measurements taken individually on the constituent elements. We are therefore forced to make allowance for this in order to identify feasible combination profiles. The allowance I have adopted is a 20° orientation range for the angled sherds whose orientation is symmetrical (i.e. 10° on either side), thus overlapping them with the asymmetrical category. In view of my impression that sharply concave body sherds and sharply outbent angled sherds do not exist in the material, there is a natural limit set to the number of shapes that can with reason be suggested.

No fits seem possible with A and G shapes, producing as this would some bizarre zigzag vessel shapes not easily visualised in the material at hand. Combinations with H shapes have already been discussed. Efforts can therefore be confined to the F series of shapes, which indeed, in view of the rarity of B-E shapes, is the only choice left; moreover, vessel reconstruction from actual sherds with asymmetrical orientation of the carination indicates this to be quite a likely choice. With all degrees of carination in nearly symmetrical orientation we get an interesting series of variations of the same type (Fig.43): truly shouldered bowls or jars with a flaring rim of pronounced orientation and body-rim inclination, all with rounded base. The less pronounced the shoulder angle, the deeper the pot, while the more pronounced the body-rim inclination, the larger the diameter at the shoulder. There is only one reconstructed vessel to illustrate the existence of this style, a decorated example of F8, reconstructed from sherds found at the base of Horizon I at To.3, which belongs to the early period (Fig.49.1 and the front cover of Poulsen 1972).

It is puzzling perhaps that combinations are only possible with the less common, deep F shapes and not with the more common, shallow F shapes in terms of decorated ware. From a numerical point of view one should have expected the opposite to be the case. From a qualitative point of view the indication is that, in addition to other differences between decorated deep and shallow F pots, we can now suggest that carination dominated amongst the deeper pots of this category.

Confirmation of the hypothesis would ideally be afforded if it could be shown that the number of decorated angled sherds corresponded roughly with the number of decorated rim sherds representing the F5-9 shapes in question, on the assumption that both the rims and the shoulders of carinated pots of these deeper varieties have produced equally many sherds during breakage. From Table 47 it appears that the 358 excavated angled sherds with decoration from To.2 make up 22% of the total of decorated sherds excavated from this site, while Table 48 suggests that about 98% would be of symmetrical orientation, since of the 42 decorated angled sherds of determinable orientation examined from this site, 41 are of symmetrical orientation (cf. the final paragraph of section 4 above). From Table 35 it will be seen that the deeper F pots with pronounced outward body-rim inclination of the decorated rim are represented at To.2 by just 15 sherds, a mere 4% of the 358 decorated angled sherds in question. Even if we assume that any rim sherds, decorated or undecorated, of the F5-9 group at To.2 could derive from carinated ware with decoration, the 52 sherds concerned (Table 35) would represent but 15% of the total decorated angles at To.2.

The numerical evidence thus is not easily reconcilable with the formal evidence. The question is whether ways may be found to increase the number of F rim sherds required, the sherds that qualitatively provide the best candidates for the decorated pot shapes that were carinated.

The rim sherds with pronounced body-rim inclination that we have been considering in the above discussion have been specified F sherds, i.e. rim sherds whose orientation and body-rim inclination are both establishable to degree. The material at To.2 includes a series of other rim sherds whose orientation is similar but whose inclination is not determinable beyond the fact that it is outward. By definition they are F rim sherds, but finer classification is impossible, so they are unspecified F sherds. The excavated material from To.2 comprises a total of 94 such sherds, of which 54 are decorated.

We shall now look at the position of the decoration on the F rim sherds (Tables 49, 50). From
the evidence of the specified F rims it will be seen that outside rim decoration is much more common on shallow (F1-4) than on deep (F5-9) shapes and that exactly the same observation applies to inside rim decoration (Table 49). The striking thing is that inside rim decoration is present on 85% of all the specified shallow F shapes represented in the sherdage. The equivalent figure for unspecified F sherd is 74%. This seems to make it most reasonable to identify them with the shallow F pots, raising the maximum total figure for this ware at To.2 from 33 to 33 + 54 = 87 (see Table 49), a figure that confirms earlier impressions of the importance of shallow F shapes in the manufacture of decorated ware (see The F series in sections 2.5 and 2.6 above). On the other hand, we are left with the distressing result that the figure for deep F shapes remains very low indeed.

We have to explain this discrepancy if we are to maintain the view that the decorated ware with carinated shapes is most likely to belong to the deeper F shapes (5-9). It may be that one of the primary assumptions of the analysis, that both the rim and shoulder of carinated pots produced equal numbers of sherds during breakage, is wrong, though in this matter one would expect rims to be more fragile than shoulders and so to break more easily, which is the opposite of what we need. Another assumption that can be questioned, with more serious implications, is that decoration on angled sherds implies decoration on rim. In fact, we know very little with the present material about the distribution of decoration on the original pots. For To.2, for example, we have a total of 1629 excavated sherds with decoration (Table 13), of which 335 are rims (Table 13) and 358 other sherds are of the carinated category in question (Table 47), each group making up some 22% of the total. We just do not know whether these rims and angles belonged to the same pots. It may be that some pots decorated at the carination were not always decorated on the rim; for example, short rims of decorated pots may be left undecorated because of their very shortness. In these very complex circumstances it might be argued that the figures for decorated rims are not the best reflection of the quantity of decorated pottery as a whole.

In sum, therefore, the hypothesis I have been trying to test cannot be accepted with much confidence, considering the quantitative evidence involved. In spite of the fact that my excavations did not produce much material lending itself to physical reconstruction of vessels, I have tried, perhaps at too great length, to examine the qualitative evidence, because it seems impossible to ignore it. The suggestion thus is to maintain the hypothesis and rephrase it as follows.

As far as decorated pottery is concerned, shallow pot shapes prevail amongst uncarinated ware, deep shapes amongst carinated ware, both with rounded bases, depth being more variable on the rarer pots with rocking base (Fig.56.1, Plate 45.1 for a rocking base, whose full pot shape cannot unfortunately be determined, cf. Fig.44.13). About 22% of the decorated pottery involved carinated shapes and of predominantly symmetrical form (Tables 47, 48), i.e. one in every four or five decorated pots had a shouldered profile and is thus most likely to have been of rather deep shape, to make room for the true shoulder. Such deep shapes are suggested to be 5-9 of Series F. If other classes of Series F and other series included carinated pots, then the angle must have been of asymmetrical type and the vessels mostly characterised by a rocking base. This would particularly be likely with G and F 1-4 shapes. And if the frequency of the different carinated pots is a function of the varying frequency of symmetrically and asymmetrically oriented angles in the excavated sherdage, then the shouldered, round-based bowls and jars would be in a clear majority over the rocking-base dishes and shallow bowls.

The possibility that some of the angled sherds represent incomplete rims of inward orientation and body-rim inclination is easily disposed of. On the basis of the data in Table 35 on rims of inward body-rim inclination, which show that such rims are of degree 1 in rim orientation and slight to moderate inclination respectively, it is impossible to conceive of carinated sherds of sharp and medium angle coming from such rims, regardless of their orientation. Obtusely angled sherds could without difficulty represent the inward body-rim inclination of rims of A4 or even G4 pots, depending on the orientation, though both these shapes are seldom decorated.
These possibilities being outnumbered by the occurrence of angled sherds, it seems most likely that they do not represent rims but rather shoulders.

Conclusions about profile angles on decorated ware

We shall leave this problematic subject as it now stands. The angled sherds are all most likely to represent some kind of shoulder, either a true one on deeper pots with round base or the base-body corner of shallower pots with a rocking base, the former clearly dominant. This division roughly reflects the kind of orientation obtaining, the true shoulders defined mostly by angled sherds oriented symmetrically within the ±10° range established in previous discussion, the rocking-base corner sherds predominantly by asymmetrically oriented sherds. The analysis of rim and angled sherds seems to confirm the impression given by the few shouldered vessels reconstructable from sherds that they were terminated upwards by everted rims generally with pronounced orientation (F), very rarely with vertical orientation (H).

The allocation of flat base sherds to vessel form is not easy either. Obtuse angles are few, medium angles in the majority, closely followed by sharp angles (Fig.57.1-23). Most of the pot shapes that occur decorated could have a flat base. Because of their frequency the F and G series spring readily to mind. Tentatively, it may be said that obtusely angled base sherds would fit well with the presumed plate forms, F2-3, the medium angled base sherds with any shape of this series, the sharply angled base sherds best with pots whose body wall below the rim follows an almost vertical course, such as F7-9 and G0/1-1.

Undecorated vessel shapes with carination

Owing to the large degree of overlap in the possibilities of rim/angle combination between decorated and undecorated ware, the treatment of the angular profile of early undecorated ware can be kept quite brief. The infrequent occurrence of undecorated angles also makes it unnecessary to go more deeply.

Oriented within the ±10° range of symmetry, reasonable combinations with all three kinds of angle, sharp, medium and obtuse, can be pointed out in Ceramic Series B-F and H, but none at all in A and G, for the reasons discussed under decorated ware. As there, more correlations (Fig.33, decorated and undecorated; undecorated), now with the addition of Series A and G. The total range is wider than with the decorated pottery, possibly because the undecorated ware as such involves all categories of vessel form. The relative shape frequencies within the two classes, decorated and undecorated, are roughly the same, Series A-E and H being the least popular, F and G clearly in the majority (Table 45).

It would hardly be justified to go into detail on all possible combinations, rare as indeed they must have been, and because we have no way of telling which may have had priority. However, the most likely combinations may be isolated, as usual, by looking at the most frequent occurrences of categories of shape and types of angled sherd, here exclusively using the data of 51 undecorated angles from To.2 (Tables 47, 48).

In terms of frequencies in sherd representation Series F and G together occur three times as often as Series A-E and H, 102 as against 34 (Table 45). Even assuming that all the latter were carinated, there would still be 17 angled pots to isolate in Series F and G (51 undecorated angles to 34 A-E and H pots).

If we make the assumption, however, that carination of undecorated pottery is related to that of decorated, we should have to take the F and G shapes into account.

The sharp angle of carination is very rare, medium and obtuse angles are equally common and symmetrical orientation is preferred. I therefore propose that the round-based shouldered bowls and jars of the F series which dominated amongst the decorated carinated ware, involving carination of all three kinds of angle and symmetrical orientation, as illustrated in Fig.43 (ct'd) upper, dominated also amongst the undecorated carinated ware. We may note
here a correspondence between two observations: combinations are only possible with pronounced body-rim inclination, F5-9, and such inclination is more popular than is moderate, F1-4, as far as undecorated ware is concerned (Tables 35, 37). In other words, carination in undecorated ware concentrated on the most common amongst the most suitable shapes.

There is only one undecorated vessel with carination of symmetrical orientation reconstructed from the sherd evidence. From Horizon 0 at To.5, it is an example of F9 (Fig.50.3; cf. Fig.44.7).

Dominant amongst the angled sherds with asymmetrical orientation are those with an obtuse angle. Although they fit easily with many F forms, combinations are also quite feasible with many G shapes, especially the commonest of these, G0/1-2, which have a slight body-rim inclination, i.e. open bowls with rounded or rocking base (Table 41; Fig.43).

Allowing for some overlap, we may generalise by saying that angled sherds of symmetrical orientation correlate best with variations of the F series, those of asymmetrical orientation with variations of the G series. Whether any shapes of other series combine with carination is so difficult to determine, given their rarity of occurrence, that the question does not warrant consideration.

Conclusions about profile angles on undecorated ware

The conclusions about carination in decorated ware thus roughly apply to the undecorated. The only modification is that rocking-base pots were perhaps more common in the latter, as the proportion of asymetrically oriented angled sherds is greater here. Since, however, as noted at the beginning of the discussion on Angled Sherds (section 4 above), carination of undecorated pottery was generally an unusual, perhaps a most unusual feature, the angled sherds without decoration considered here may in fact derive from decorated pots with decoration distributed elsewhere on the vessel. The rarity of angled sherds in late levels of the excavated sites and the great variety in which features were combined in the early pottery, especially in evidence in the large To.2 collection, give rise to this suspicion.

I shall have to leave the question of carinated pottery with or without decoration in the late period entirely open. To judge from the available data, such pottery appears to have been virtually unknown then. If manufactured at all, it was presumably not different from that of the early period.

To turn finally to the matter of undecorated flat-base sherds, we may note that those with an obtuse angle are absolutely dominant (Fig.57.24-34). They are all early but one. As with the decorated examples, I suggest that they derive from plates like F2-3 (Fig.42).

GENERAL CONCLUSIONS ABOUT CARINATED WARE

For a number of reasons the details of carinated pottery present an extremely problematic aspect of Tongan ceramics as far as the present material is concerned. Carination is especially typical of the decorated pottery and it may in fact turn out to be exclusively so. Practically speaking, its manufacture was confined to the early and middle periods (cf. section 13.8 below on late-period decorated pottery). Most carinated sherds are vessel shoulders but angularity of the transition from a definable base to the vessel body has been isolated in the sherdage studied. There is an apparent dominance of angled profile on pots with a pronouncedly flaring rim and this combination is a typical feature of the mainstream of the Tongan Lapita tradition, whether decorated or possibly not. It comprises in the main shouldered pots with a round base, pots with a flat or rocking base being much less common, but their rim orientation and body-rim inclination is variable.
COLLAR AND FLANGE VESSELS
(Figs 52, 53; Plate 34.3)

Incidence over time

These special vessels were always less frequent than other pots overall, but they were significantly more popular early than late (Table 51). The general rules for pottery decoration seem to have been followed in the case of collar vessels, whose early representatives were decorated as often as other vessels, about one in every three. It is difficult to say whether collar-rim vessels were still decorated in the late period. The only sherds in question are from To.6 and they belong to the same pot: two were found in Horizon IB, two in II and one in III, so the age is uncertain (see, for details, Sherd Group II in section 13.2 below). In the later levels at other sites decorated collar-rim sherds are either absent or very few indeed: seven sherds from Horizon II at To.1 and one from Horizon III at To.5. They need not therefore be considered.

The flange type, with outer wall concave from lip to overhang, was essentially made only in the early period, but less frequently than the collar rim, where the outer wall is convex or straight. On the other hand, decoration was proportionately more often executed on flange than collar rims (Tables 51, 52). In respect of decoration, the flange proper bears a close similarity to applied bands.

Rim characteristics

Both collar and flange rims come in two varieties, called B, where the inner wall reflects the outside course of the outer (Fig.25, categories 7/2 and 8/2), and A, where the inner wall is like that of a normal rim (Fig.25, categories 7/1 and 8/1). With undecorated collars an early preference for the B collar gave way to one for the simple A collar in later times. Amongst the exclusively early flanges, the simpler A variety dominated in undecorated, the more elaborate B variety in decorated ware. The evidence, summarised in Table 52, underlines the greater vitality of the early pottery, as indicated already in the previous discussion of carinated and uncarinated vessel shapes.

The rim form of these pots is predominantly convergent and their lip, when observable, rounded, but thickening (cf. Fig.27, categories 15 and 16) never occur. Rim length varies a lot, from about 15 to 50 mm, but it is difficult to isolate any specific preferences. The width of the overhang of the collar base ranges between 2 and 15 mm, mostly between 4 and 10 mm (cf. Fig.25, category 11). So all in all collar rims are not very big, though in size the pots provided with them were not amongst the smallest produced in Tonga, the maximum width and height probably being about 30-40 cm.

Collar-rim sherds are in the main incomplete pieces in that the lip is missing. Orientation therefore could only be established for a limited number of sherds (Table 53). Such vessels never had rims oriented outwards. Inward orientation was rare early and common late and then almost exclusively of slight nature (degree 1), while vertical orientation was dominant early and common late. The early period pattern applies whether the pots were decorated or not.

Vessel shape

Regarding the general shape of collar-rim vessels, direct evidence is scant, actual reconstruction having been possible in only one case, fortunately almost completely (Fig.53.2; Plate 34.3). This pot is from Horizon I at To.1 and can be classified as Shape H2, having a gently convex contour right from the collar base to the centre of the pot base.

To judge from the indirect evidence, however, this shape does not appear to have been the standard for the manufacture of collared vessels in Tonga. As far as body-rim inclination could
be positively determined, this was generally inward or straight (Cat.4/3 of Rim Code), in both plain and decorated wares, outward cases being rarer (Table 54). This interpretation depends on the actual length of the preserved body wall just below the rim, which was rarely very long. However, the rareness of concave body sherds would support the generalisation. As is to be seen in Table 35 and Figure 42, the generally rounded shape of analytically reconstructed collar vessels involves for the most part deep bowls and jars of the A and G series, rarely of B and H, but possibly also a few shallow to medium-deep dishes and bowls of G3 and G5. From this evidence it appears that early collared vessels were predominantly of G shapes with only a few A and/or H pots. The same general picture applies also to the late period.

Regardless of how we look at the available material, the same conclusion is reached: collared jars with bulging body and constricted neck must have been far less common than those with only a slightly bulging body. In fact collar-rim pots were mostly deepish bowl shapes lacking necks and with a rounded body continuing right up to the base of the collar rim. This last feature is incidently illustrated in the only actually reconstructed collar-rim pot available (Fig.53.2; Plate 34.3), though this is a jar and not a bowl according to the present terminology.

RIMS AND THEIR DEVELOPMENT

Having arrived at a picture of the likely vessel shapes of the Tongan ceramics, we now turn to the details of their rims. We begin with a summary of the changes (or lack of them) which characterise rim development over time, as established in Chapter III. Since it was shown there that rim development can be followed consistently through a series of phases, it will suffice here for the sake of simplicity to describe it from the point of view of the key sites at the early and late ends of the sequence, To.2 and To.6. However, since we shall be interested in comparing decorated and undecorated pottery in terms of rim features and development, reference will sometimes be made to the evidence from the pooled early levels, decoration being so uncommon in the late period that it can be ignored for present purposes. We conclude the section by integrating the information on rims with the various vessel shapes, Series A-H + J, of the early part of the chapter.

RIM DEVELOPMENT: INDIVIDUAL FEATURES

All rims

Tables 55-58 refer, drawing on data in Tables 15-17.

Orientation (Fig.29, categories 2-3)

Inward rim orientation was always quite rare and then as a rule at degree 1, i.e. very moderate.

Outward rim orientation was quite common in the early but became very rare by the late period, with pronounced degrees (3 and 4) more frequent in the former and moderate (1 and 2) in the latter period. The rare moderate degrees were almost confined to plain rim sherds, while the dominant pronounced degrees were equally typical of both plain and decorated rims. Practically speaking, pronounced outward orientation is always at degree 4, i.e. horizontal.

Vertical orientation was as common as outward orientation by the beginning of the sequence, but in the course of time it gained in importance, to become quite dominant by the late period. It may be recalled that moderate degrees dominated amongst outwardly oriented rims in this period, thus emphasising the trend towards vertically oriented rims over time.

All three kinds of orientation are known on both plain and decorated sherds. At To.2 the proportions in which they occur on decorated and on undecorated rims is remarkably similar. The main difference is that there are more plain than decorated rims in the collection.
**Body-rim inclination (Fig.30, categories 4-5)**

Inward body-rim inclination was fairly common early, but it became positively rare by the late period. Slight inclination was always more common, i.e. degrees 1-2 as against 3-4.

Outward inclination was very common in the beginning, but it definitely became more so in the late period, where it was dominant. Slight to moderate degrees (1-4) were always more popular than pronounced (5-9) and had become absolute by the late period. In other words, pronounced body-rim inclination is a feature confined to the early period. In the early pottery the dominant moderate mode was about equally popular decorated and undecorated, while the less popular pronounced mode seems to have been mostly used with plain rims.

Both inward and outward inclinations occur decorated, with the latter somewhat more so than the former.

**Rim form (Fig.26, category 12)**

Parallel rims were always common.

Convergent rims, both on ordinary pots and on collared pots, represent the dominant early rim form that became positively rarer by the late period.

Divergent rims show the opposite development. They were rare early but by the late period had become as popular as parallel rims.

Divergent rims were unusually decorated, something expectable from their very infrequent occurrence in the early period. The other two rim forms were common decorated but even more common undecorated. The most popular decorated rim form was the convergent variety.

In addition to these fundamental rim forms, three rare forms deserve mention: swelling rims (Fig.26, category 12/4-6), very short rims (Fig.26, category 12/7; Plate 36.1-4) and a series of rather elaborate pieces called unique rims, though in truth they may not all be rims but some as yet unidentified part of a pot (Fig.54; cf. Fig.61.8-11). Swelling rims were always known but in very small numbers (14 sherds from To.2, 16 from To.6). The same observation applies to the very short rims which appear to have been made more often in the late than in the early period (20 sherds from To.2, 50 from To.6). The very rare unique rims, which are all decorated, belong exclusively in the early period.

**Rim thickenings (Fig.26, categories 13-20)**

Thickenings of the rim always took place, whether purposely or accidentally, but the practice was more pronounced in the late pottery. Inner thickenings became less, outer thickenings more frequent with time. All classes of form (see Table 14, nos 78-83; Fig.27, categories 13, 15 (and 16)) are represented throughout the sequence, though the data are not reproduced here. Owing to the difficulty in correctly understanding the phenomenon, however, further comments must be restricted. 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, a by-product of the manufacture of flat lips. This suggestion springs from a consideration of the relationship between thickenings and flat lips which, combined as entry 160 in Table 22, show a positive increase between To.2 and To.6.

**Rim reduction (Fig.27, categories 21-27)**

Reduction of the rim appears to have been present almost exclusively late in time and is largely confined to divergent rims.
Lip form (Fig.27, categories 29-30; Fig.28, categories 30-32; Fig.31, category 33)

There is a pronounced trend in lip development. The earlier pots show a roughly equal proportion of flat, round and hybrid forms, whereas on the later pots a preference for flat lips becomes the prevailing fashion. The other two forms continue to be used as much as each other. It is difficult to point out any typological relationship between the three main lip forms to explain the changes over time, though it is possible to see the hybrid form as a link between the other two.

All three lip forms occur commonly on the early decorated rims, but they were all used still more frequently on plain rims. Regarding the decorated ware itself, no variety of lip was preferred to any other.

As between the two main kinds of flat lip, the flattened and the flattish, it appears that the former and more pronounced variety, from being less popular on earlier pots, became as common as the latter variety on later pots, as if the concept of a flat lip became clearer with time. The grooved variety of flat lip was always extremely rare (24 sherds from To.2, 35 from To.6). The inclination of asymmetrical flat lips was more often slight than marked (cf. Fig.33).

The flat lip underwent an interesting development in some other respects. Horizontality (cf. Fig.28, category 31) 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 the later pots the reverse is the case (cf. Fig.28, category 32). The lip transitions, interior as well as exterior, were always more often of the not marked variety (cf. Fig.28, category 34).

Decorated rims

It appears from Part B of Table 57 that in the early ware of To.2, between 30 and 41% of the occurrences of individual rim features are on decorated rims. Only two features, divergent rim form (entry 199) and inside and outside rim thickening (entry 76), at 23% and 7% respectively, fall below these values. Looking at this evidence this way, we may conclude that practically all the features concerned were commonly used on both decorated and plain rims, though they are more frequent on the latter because plain rims are more numerous than decorated ones; interestingly enough, decorated rims range between 33 and 42% of all rims at To.2 and To.5 Horizon 0-1. Looking now at the evidence of Part A of Table 57, we can see that within the two classes of decorated and plain rims the representation of the different rim features is remarkably similar. For example, the occurrence of inward, outward and vertical rim orientation (entries 192-194) is 9%, 49% and 42% for decorated rims and 8%, 43% and 49% for plain. There is little deviation from this pattern; inner and combined inner and outer rim thickenings (entries 74, 76) are the only examples.

Retrieving the evidence from the pooled early levels of Table 58, it is possible almost to double the sample size, the main contributor being the material from To.1 Horizon I. The resulting percentage patterns are very nearly identical with those for To.2, so there seems to be good reason to accept the conclusions of this section.

Decorated pottery is exceptional in the late period. Nevertheless, there are a few signs of frequency change with time in the occurrence of some individual rim features on decorated rims (Table 57, the evidence set out in the right-hand column). Thus the always very rare occurrence of inward rim orientation seems to become more frequent with time, as does the similarly rare occurrence of divergent rim. The conclusion seems to be that although decorated pottery was declining in quantity over the course of time, a few decorated pot types were rising in relative importance.
RIM DEVELOPMENT: COMBINED FEATURES

The basic data relating to the nature and development of Tongan pottery from the viewpoint of combined rim features are to be found in Tables 20-22. Before we consider them, however, there are some general questions to be discussed.

Combinations as evidence of cultural selection

No combination can be more frequent than the least frequent of its constituent elements. Naturally, the higher the individual frequencies of features, the more likely they are to occur in combination, provided this is technically possible. It is thus appropriate to talk about the potential for combination, which is very different from talking about the actual occurrence. Even when individual features occur with high frequencies, cultural selection is always a relevant factor, regardless of whether the resulting combinations are rare or common. The comparison between what is potential and what is observed then pertains to cultural selection at play.

Cultural selection as a dynamic process relating to the passage of time may operate in two opposite senses or directions: negatively, if cultural elements are given up or become increasingly more neglected, reflected in decreasing trends; and positively, if cultural elements occur suddenly as quite new features or become increasingly more popular, reflected in increasing trends. Cultural selection is also in operation, however, when elements are used at the same rate over some period of time, frequently or infrequently. This is appropriately termed neutral selection and is reflected in constant trends.

Trends are called increasing or decreasing according to their direction over time in terms of rising or falling frequencies of statistical significance. In our examination of the combined features, however, we have to include a second way of characterising trends: combination trends may be convergent, divergent, mixed and unilateral as a function of the directions of the significant trends of their constituent elements. Some examples will clarify the terms, with To.2 as a whole standing for the early period and To.6 as a whole for the late.

A combination displays a convergent trend if its direction is similar to those of the trends of its constituent elements, as exemplified by the combination of outward orientation of rim and round lip, where all trends are decreasing:

<table>
<thead>
<tr>
<th>Feature no.</th>
<th>Identification</th>
<th>% occurrence</th>
<th>Difference in %</th>
</tr>
</thead>
<tbody>
<tr>
<td>147</td>
<td>OWO + RL</td>
<td>33</td>
<td>2</td>
</tr>
<tr>
<td>66</td>
<td>OWO</td>
<td>45</td>
<td>10</td>
</tr>
<tr>
<td>88</td>
<td>RL</td>
<td>55</td>
<td>9</td>
</tr>
</tbody>
</table>

1 Data from Table 21, last two columns
2 Data from Table 16, last two columns

A combination shows a divergent trend if its direction is different from both of those of its constituent elements. However, in the present material no such case can be demonstrated.

A combination displays a mixed trend if its direction is similar to only one of those of its constituent elements, i.e. if the trends of the elements go in opposite directions, their pottery spectra thus being, so to speak, inversely proportional in the early and late periods.

In the example below, the combination of outward orientation of rim with flat lip decreases over time, while one of the constituent elements decreases and the other increases:
Unilateral trends are shown by combinations where only one of the constituent elements shows a significant trend over time. They all involve parallel rim (PR). This occurs with a frequency of 32% early and 36% late, a difference of no statistical significance, and the direction of the combination trend depends on the direction of the individual feature with which PR is combined (cf. Tables 61, 62).

Neutral cultural selection

The evidence is set out in Table 59, with reference also to Table 60. The majority of these combinations is rare indeed, which is partly because in many of them the quite uncommon feature of inward orientation (IWO) is involved. As for the three combinations of more common occurrence (entries 154, 158, 183 of Table 59), it is important to note that the frequencies of the constituent elements are of such a nature that they do not automatically imply combined occurrence of the features on the same pots. Thus it was a matter of cultural selection to make pots with flat lips and thickenings and pots with parallel rims and thickenings and the habit was characteristic throughout the Tongan ceramic period. But pots with flat lips and parallel rim did not become common until the late period (entry 186 of Table 62).

Changing patterns in cultural selectivity

We now turn our attention to the nature of the evidence on changing patterns of cultural selectivity in pottery making over time. Combinations expected to display negative selection are those involving features showing statistically significant declining trends in comparisons between To.2 and To.6: outward orientation of rim (OWO), inward body-rim inclination (IWI), convergent rim (CR), inner thickening of rim (ITH) and round lip (RL) (Table 60). Combinations displaying positive selection should comprise features showing statistically significant increasing trends: combined vertical orientation of rim (CVO), outward body-rim inclination (OWI), divergent rim (DR), outer thickening of rim (OTH), combined thickenings of rim (CTH) and flat lip (FL) (Table 60). While individually all these features behave significantly over time, the question is whether they behave accordingly in combination.

Negative cultural selection

The evidence is set out in Table 61. There is only half the number of convergent as of mixed trends, which seems to reflect a complicated and heterogeneous kind of pottery development over time. The early period pattern was one of experimentation with many possibilities, only some of which were seriously carried over into the late period. It is important to note that the realisation of potential combination of the more commonly occurring individual features is quite variable, whether looking at convergent or mixed trends. Therefore the combinations realised must all be considered the result of cultural selection. Three examples will illustrate this.

In the convergent trend 147 in Table 61, OWO and RL each show similar trends and comparable frequencies in Table 60. Even in the early period, where the frequencies involved are pretty substantial, 45% and 55% respectively, they could refer entirely to different pots.
But the observation over time is that the combined trend is convergent and its frequency is comparable in both periods to that of both the constituent elements. In conclusion we have a good case of cultural selection amongst independent ceramic elements, representing in addition a good example of negative selection in the development of pottery-making standards with time.

With the mixed trend 146 of Table 61, OWO decreases by 35% and FL increases by 46% in Table 60, the values for To.2 for OWO and FL being respectively 45% and 44%, for To.6 10% and 90%. Combined occurrence early at least is thus quite possible, as possible in fact as in the preceding example. Yet the actuality is quite different: the combination was always pretty rare. The fact that the combination in spite of this became significantly less popular with time (entry 146 in Table 22) may indicate that it always represented a specific though uncommon trait of the pottery industry.

The mixed trend 153 of Table 61 shows the opposite. Over time OWI increases by 22%, from 59 to 81%, while RL decreases by 46%, from 55 to 9% (Table 60). Frequent combined occurrence early at least is thus again very expectable and in this case the expectation is confirmed on inspection. While the foregoing combination was always rare, the present one was very common in the early period, though definitely losing its attraction with time.

**Positive cultural selection**

The evidence is set out in Table 62. The cases comprise only half of the total for negative selection, they exclusively involve convergent trends and all combinations formed part of the early period repertoire. This evidence suggests a simplification in pottery production over time, with no innovation.

As for the potentiality of combination, one might have expected the well-represented features of CVO (46%) and OWI (59%) (Table 60) to combine much more frequently in the early period than observable - 9% (entry 167 of Table 62). Combinations with DR naturally all appear with low frequencies in the early material. The only combinations of common occurrence here are nos 148 and 160, but they cannot be considered more expectable than in some other cases where potential frequency was not achieved.

From Table 62 we may conclude that the few common combinations in the early material are likely to represent well-established standards of pottery making of the period which grew more popular with time, while most of the combinations were of rare occurrence in the early period but were to grow in importance by the late period. The material is clear evidence of positive cultural selection in the course of time. The pottery features illustrating this (positive) type of selection are also known in early-period combinations showing the opposite (negative) type of selection. In other words, the early potters used rather freely of both ‘early’ and ‘late’ features, to use these as shorthand terms for features becoming in the first case less frequent, in the second case more frequent, over time.

**The course of cultural selection**

From the point of view of pottery development, the large group of mixed trends illustrating negative cultural selection (Table 61) poses an interesting question. In principle, increasing and decreasing frequencies over time for the combinations they represent are equally feasible. Yet all 13 combinations reflect decreasing trends. Why, therefore, are individual features that are becoming significantly more popular over time wholly without influence in determining the direction of the trends of the combinations of which they are part?

The answer seems to have to do with the fact that the general pottery development was one of simplification, in terms not so much of elements dropping entirely out of the repertoire, but rather of decreasing frequencies dominating over increasing frequencies, something which applies equally to individual and combined features. In such a process of simplification it is to be expected that an ‘early’ feature (one, that is, decreasing over time) will occur less and less
often in combination not only with other 'early' features but also with 'late' features (i.e. those increasing over time), which is exactly what can be observed in the material on convergent and mixed trends presented above. If 'early' features were to occur in mixed trends of increasing frequency, then we should have a case of positive selection. None such, however, can be observed, confirming the impression that cultural selection operated markedly in the negative sense.

Let us look at the data of Tables 61 and 62 in this light.

From the frequencies of occurrence of combinations in the early pottery at To.2 in the tables, these can be seen to vary quite a lot: from 3 to 56% in Table 61 for decreasing trends and from 8 to 70% in Table 62 for increasing trends. However, 12 out of the 23 decreasing trends have percentages for To.2 between 10 and 22%, while the percentages of eight out of the 12 increasing trends there fall within the same interval. In fact the average percentages at To.2 are 21% for decreasing trends and 20% for increasing ones. This means that in early context the proportion of the typically early combinations (Table 61) overlaps with the proportion of typically late combinations (Table 62) in the same context. Everything is there in the early period, many types were popular but only a few were excessively popular or unpopular.

Strictly speaking, all earlier types carry on into the late period, but the frequencies are clearly polarised. A great many of the earlier types were virtually avoided, including some which had been infrequent also in the early period. All typically early combinations are rare in the late period. The average late-period frequency of the three groups of Table 61 is 2%, 4% and 7.5% individually and 6% overall, reflecting a drastic decrease in popularity. In striking contrast, we have the high frequencies of the typically late combinations of Table 62, ranging between 26 and 95% overall. The two groups of the table register individual averages of 32% and 57% and a joint average of 51%, between eight and nine times the average for typically early combinations in the late period at To.6 (Table 61). Late pottery evidently concentrated on a limited number of combinations, while other combinations of early pottery manufacture were used but rarely, if at all.

The average of the differences relating to all decreasing trends is 15.5% overall, 12%, 15.5% and 17% individually (last column of Table 61), that relating to all increasing ones is 30.5% overall, 14% and 36% individually (last column of Table 62). This may give us some idea of the speed and definiteness with which the cultural selection actually occurred. The question arises as to whether this could reflect some kind of competition between the craft of pottery and another craft also producing containers, e.g. woodworking (cf. Green 1974d:249, 253).

The data set out in Tables 61 and 62 thus provide quite important evidence on the general nature of Tongan pottery and its development. They illustrate the standards of the manufacture of pottery over time and how this underwent clear if gradual changes. The basic continuity of the process is to be seen especially in the fact that no innovations appear, most of the original concepts diminished, while the remaining ones were given increasing dominance in the course of time. There is no reason to see more than one tradition behind the development of the Tongan pottery.

**Combined rim features on decorated rims**

From the frequency of individual rim features at To.2 (Table 57), it is expectable for combined features to occur commonly on decorated rims, though less so than on plain rims. The occurrence of individual rim features on decorated rims as a percentage of total rims, plain and decorated, is 31-41% (Part B of Table 57), excluding divergent rims (23%) and inner and outer rim thickenings (7%). A similar table for combined rim features at To.2 is not reproduced here, but Table 63 extracts the percentage occurrences for decorated rims. Fourteen combinations fall within the 31-41% range of the individual rim features, 21 below it and 13 above it. The pattern of these values describes an evenly rising curve from 25 to 50%, with a steeper rise from 0 to 12% and a single jump at the other end from 50 to 64%. We may note that combinations involving the infrequent categories of divergent rim and inner and
outer rim thickenings are almost totally confined to the low end of the range (Table 63, last two columns). In respect of rim thickening, the real ceramic significance of which is obscure, it might be suggested, on the assumption that decorated ware was perceived as a finer product than plain ware, that the early potters consciously avoided incidental thickenings on decorated rims.

The total evidence from To.2, not reproduced here, would indicate that most rim combinations were more or less commonly used on decorated rims, the difference from plain rims being that pottery undecorated at the rim was produced in greater quantity but with the same general rim types. The evidence from the pooled early levels, again not reproduced, roughly doubles the sample size. The conclusions reached from the analysis of the To.2 data hold up, with few and unimportant deviations in the figures.

**EXTENDED DESCRIPTION OF TONGAN LAPITA VESSELS**

Earlier in this chapter I presented reconstructions of a range of vessel shapes based upon the relationship between rim orientation and body-rim inclination and upon the available evidence on the nature of the body sherds regarding curvature and carination. A distinction between undecorated or plain and decorated ware was made, along with a characterisation of early and late preferences where such were in evidence. I shall now attempt a widened description of the vessel shape categories, drawing on the data on rim and lip form treated in preceding pages. The data are drawn exclusively from the early site of To.2 and the late one of To.6. The SPSS cross-tabulation program was used for this phase of the work, proving amazingly simple as well as powerful, and I am most grateful to Mr. J. Chr. Poulsen (then of the Data Processing Unit of the University of Aarhus administration) for his assistance in exposing these facets of my pottery data.

**Pots with inward rim orientation (IW) and inward body-rim inclination (IWI) (Tables 64-66)**

Virtually all the evidence relates to A vessel shapes: there are B pots in this category, but they are very rare. A pots have slight inward orientation of the rim. They were manufactured in both periods but always rarely.

*Early A pots* predominantly had convergent rims, rarely parallel rims and almost never divergent rims. Lips were flat or round and combine, as expected, mostly with convergent rims. These observations apply similarly to decorated and undecorated examples. A pots were equally popular in either ware. In spite of the small sample available, the suggestion is that the typical early A pot had a convergent rim, with flat lips tending to prevail in decorated and round lips in plain ware.

*Late A pots* were practically speaking only made plain. The early undecorated A pot seems to have continued in production in the late period, with a convergent rim and round lip.

The matter of the close relationship between the A series and the G series is taken up when the latter series is discussed below.

**Pots with outward rim orientation (OW) and outward body-rim inclination (OWI) (Tables 64-66)**

The summed evidence given in Table 35 on this basic combination shows differences between the early and late occurrences of vessel shapes of Series C, D, E and F. F shapes predominate early, while the rarer occurrence of the OW/OWI combination in the late period involves mainly C and D shapes, with few E and F shapes.

*Early F pots* as a whole (i.e. not discriminating between decorated and plain) had rims oriented quite horizontally outwards. Tables 64-66, which analyse the combined sample of specified and unspecified F rims, i.e. rims whose degree of outward body-rim inclination is and
is not specifiable (see the discussion of the F series in sections 2.5 and 5.2 above), show that
their rims were mostly of convergent form, less commonly parallel and rarely divergent. Lips
were predominantly round, though flat lips were by no means unknown. Parallel and
convergent rims were mostly provided with round lip, the less popular divergent rims equally
often with flat lip. Flat lips are found to the same extent on all three rim forms, while round
lips combine mostly with the convergent rim. The typical F pot thus had a convergent rim
ending in a round lip.

The F pots of the combined sample were roughly equally popular plain and decorated. The
above conclusions about frequency of rim and lip form seem to apply fairly similarly to plain
and decorated rims, with only a few and possibly insignificant divergencies. Parallel rims, for
example, were almost equally often finished with flat and round lips when decorated, while
when plain they were more often combined with round lips. In the matter of the continuity of
the ceramic tradition, it is perhaps worth noticing that the late-favoured combination of
divergent rim and flat lip was not only present on early F decorated rims but also relatively
common on the plain-rim version.

Thus the typical F pot had a convergent rim and round lip, whether decorated or not. This
might mean that, from the viewpoint of the role of pottery, shape was as important as
decoration in the case of this characteristically early vessel type.

We now turn our attention to the smaller sample of specified F rims, those with precisely
measurable degrees of rim orientation and body-rim inclination, in order to describe more
specific patterns within the generalised picture presented above (Tables 67-69). The
distinction made within the specified sample is between shallower shapes with moderate body­
rim inclination and deeper shapes with pronounced inclination.

The shallower pots of the moderate group were more commonly made as decorated than as
plain ware. Whether decorated or not, rims were mostly convergent, commonly parallel but
almost never divergent. Round lips were used far more than flat lips, but while flat lips appear
to be almost confined to decorated rims, round lips were common on both plain and decorated
rim sherds, though possibly somewhat more common on decorated.

The deeper pots of the pronounced group were more popular as plain than as decorated ware
and, as we have seen above in the discussion on the carinated ware (end of section 5.2), the
majority of the carinated sherds probably belongs on these deeper F vessels. Plain and
decorated rims were predominantly convergent, the other two rim forms being rarely used,
that is including the parallel rim common on the shallower pots. Both decorated and
undecorated rims are predominantly round- rather than flat-lipped.

Thus both moderate and pronounced F vessels, plain and decorated, conform satisfactorily
with the general type concept of the series as a whole. The only difference seems to be
quantitative in nature: the shallower representatives of the series were in wider production as
decorated ware, its deeper versions as plain.

The late C and D pots were rarely made and practically confined to plain ware. Their rims, of
moderate outward orientation, were either parallel, convergent or divergent, the lips mostly
flat, though round ones were not uncommon. Parallel and divergent rims were usually
provided with flat lips, convergent rims equally often with flat and round. With due regard to
the small sample available, there is some interest in the association of convergent rim with
round lip. This combination is typical of the older F series and since the D pots have rim
orientation closer to F than do C pots, its occurrence with these later series might suggest that
the material in question refers more to D than to C, as a possible reminiscence of the earlier
standards. If so, the C series would have mainly parallel or divergent rims with flat lips, the
D series convergent rims and round lips.
Pots with combined vertical orientation (CVO) and inward body-rim inclination (IWI) (Tables 64-66)

These belong to the G series. In previous discussion (sections 2.5 and 2.6 above), this series was subdivided into deeper and shallower versions. The latter are so poorly represented that the following treatment refers to the deeper varieties only. They were manufactured throughout the ceramic period, being common early and rarer later on. They exhibit significant aspects of ceramic development that speak in favour of continuity of tradition.

Early G pots were commonly provided with parallel or convergent rims, almost never with divergent rims. Lips were flat or round, with the flat variety dominant.

Some evidence of differentiation seems to exist. Both parallel and convergent rims in the main had flat lips. Round lips appear to have been dominant on convergent rims. Early G pots thus share in this typical early combination. We may also note that the very rare divergent rims were exclusively combined with flat lips, a 'late' combination present in the early pottery.

The typical early G pot thus had a flat lip on either a parallel or a convergent rim.

In late G pots all three rim forms were equally commonly present, but now their lips were almost exclusively of the flat type.

The early and late G pot types were thus not quite identical in rim modification. The difference was the growing importance of flat lips and divergent rims in combination.

At the end of the discussion about uncarinated vessel shapes above (final paragraph of section 3.2), I remarked on the close similarity of Series A and G in terms of rim orientation combined with body-rim inclination. This similarity, expressed in the common possession of slight inward body-rim inclination and verticality of rim orientation (considering that the degree I of inward orientation of Series A, cf. Table 35, is not far removed from this), can be now extended to include convergent rim form and flat lip, as well as rounded base and body contour.

No distinction has so far been made between plain and decorated ware. As the latter is virtually unknown in the late pottery, our characterisation of late period G pots refers only to plain ware. We can examine the matter of plain and decorated for the early period. The evidence is set out in Tables 65 and 66.

G pots of the early period were about equally popular in both wares. As for the pattern of rim and lip variation which we have described above for early G pots in general, flat lips and round lips appear in similar proportions to each other on plain and on decorated rims and the same is true of the combinations of lip types with rim forms. In other words, the G series represents a fairly homogeneous type concept in the early pottery.

Pots with combined vertical orientation (CVO) and outward body-rim inclination (OWI) (Tables 64-66)

This material relates exclusively to vessel shapes of the H series, the large majority of which is late. The presence of a small number in the early period allows us to trace the origin of the series back into the diversified early stage of Tongan ceramics.

Early H pots had rims mostly divergent, sometimes parallel, rarely convergent. Both lip types were used but the flat one was preferred. These observations apply to plain rims, since decorated ones are extremely few and exclusively round-lipped. The typical early H pot was thus plain, with a parallel or perhaps preferably a divergent rim and a flat lip.

Late H pots were as a rule plain. Divergent rims were in the majority, parallel rims common, convergent rims very rare. All rims were almost without exception provided with flat lips. We can thus safely define the late pots of this series as representing a very homogeneous type of plain ware characterised by divergent rims and flat lips. Their typological relationship with the early H pots is clear in terms of the lack of decoration and aspects of rim modification. The continuity in ceramic tradition is therefore evident.
Pots with outward rim orientation (OWO) and inward body-rim inclination (IWI)

These are all dishes of the J category, a predominantly early series. They had parallel or convergent but rarely divergent rims, frequencies of occurrence being respectively ten (33%), 15 (50%) and five (17%) of a total of 30 rims. On 27 of these there were 15 flat lips (56%), eight round lips (30%) and four hybrid lips (15%).

Conclusions

If we look back at the above analysis of combinations of pottery features, it is striking how often the general pattern exhibited by the pottery as a whole is similar to the specific patterns of plain pottery on the one hand and decorated pottery on the other. One is perhaps inclined to expect a general pattern to represent an average, to chart a middle course between two extremes, these expectably to be represented in the present instance by decorated ware and plain ware, classes understandably anticipated to have greater function distinction. Since these expectations are not fulfilled, we may therefore legitimately ask whether the significance of decorated ware was not fairly independent of preferential details in rim morphology. At the same time it seems possible that certain vessel shapes (cf. the shallow plates and bowls of the F series) had special significance whether the pots made in those shapes were plain or decorated, with decoration, where present, adding something extra. We may recall here that decorated versions seem on the whole to have been in the minority compared with the plain versions of the same basic pot shapes, but not always (cf. the shallow F plates and bowls). Modifying this line of argument is the fact that the pottery as a whole falls into two categories of deeper, storage/cooking types less frequently decorated and shallower serving/eating types more frequently decorated.

An important question in this connection, unfortunately not answerable with the broken and predominantly small pieces of pottery at my disposal, is how valid is the distinction I have made between plain and decorated ware throughout the analyses on the basis of the presence or absence of decoration on rim sherds. How many plain rim sherds actually derive from pots decorated below the rim? This issue presented itself in severe form in the discussion of decorated angled sherds (section 5.2 above). We shall probably have to reckon with the possibility that the true proportion of decorated pottery in the early period was larger than appears from my treatment based on rims. The solution to all this is the future excavation of complete or more reconstructable vessels.

DECORATION AND ITS DEVELOPMENT

We now proceed to consider in some detail various aspects of pottery decoration, beginning with its chronology and frequency of occurrence, passing over to a general characterisation of its elements and following this with a survey of their application to the original pots from the evidence of the analytically and actually reconstructed vessel types.

Chronology and frequency of decoration

Decoration of pottery was practically confined to the early and middle periods, its presence in the latest levels of the ceramic period being at best sporadic. One question which arises but is extremely difficult to answer is what proportion of the total early pottery production was made up of decorated ware.

Going by the occurrence of decorated rims as a percentage of total rims, the quantity varies between 21 and 42% in early levels (entry 1 of Table 16). For To.2 as a whole it is 33%, which is a fair average. The weight of decorated rims as a percentage of that of total rims at To.2 gives exactly the same figure of 33% (Poulsen 1967b:Table 30). From this evidence decorated pottery must be considered a fairly common feature of the early pottery.
With sherd counts, of course, there is the problem of incidental sherd breakage leading to apparent increases in frequencies. This can be controlled by also measuring sherd size and weighing, something which has not been done. However, the effect of incidental breakage is unlikely to manifest itself in the gradual and logical way that is shown by the seriated order of horizons as discussed in Chapter III. The proportion of decorated rim sherds is thus thought to be an acceptable way of measuring the proportion of decorated pottery.

Another way of assessing this quantity is to calculate the proportion by weight of decorated sherd s of the grand total of excavated sherds. Such data can be provided for each of the sites as total samples, but unfortunately not for horizons (Poulsen 1967b:Table 30). To.2, which is the only truly chronologically homogeneous site, gives the unexpectedly low figure of 12%, only one-third the proportion of decorated pottery given by the counting method.

For several reasons the truth is believed to fall somewhere in between the extremes of 12% and 33% for this key site. As we have seen from Chapter III (section 2) and subsequent analyses, the counting method enjoys some support from the seriation exercise, while the proportion of decorated rims/total rims for To.2 is the same by number and by weight. Add to this the fact that, as previously argued, some decorated vessels may have had plain rims and it may be thought that the truth could be nearer 33% than 12%. On the evidence, then, it must be concluded that early Tongan ware comprised decorated pottery in not unimportant quantities, ranging possibly between a quarter and a third of the total ceramic production. Better preserved material is required to advance the argument further. For present purposes we shall have to maintain the distinction between plain and decorated pottery in terms of presence or absence of decoration on rim sherds.

The vessel shapes and function of decorated ware

Decorated vessel shapes

Here I shall briefly review the evidence on the kinds of pots that were decorated.

Firstly, there are just eight cases where decorated vessels could be reconstructed from the fitting together of sherds.

Uncarinated

1. one constricted, round-based A4 dish from To.1/1, the only complete pot amongst the decorated ware (Fig.46.3)
2. one constricted, round-based A6 dish from To.5/II (Fig.46.1; Plate 51.1)
3. one constricted, round-based B2 jar from To.1/1 (Fig.45.9; Plates 37.15, 44.11)
4. one unique pot, not classified, having the extreme inward orientation of degree 3, probably with rounded base, a late find from To.6/II (Fig.46.2). It is probably related to the B series, as suggested in discussion of that series above (section 2.3).

Carinated

5. one flaring C0/1 dish with rocking base from To.1/1 (Fig.48.4; Plate 44.10)
6-7 two flaring dishes of class F6, both with rocking base, from To.1/1 (Fig.48.1; Plate 44.3) and To.2/surface (Fig.49.2; Plate 47.1)
8. one flaring, truly shouldered F8 bowl with rounded base from To.3/1 (Fig.49.1).

Secondly, we have reconstructed vessel forms analytically and have concluded that only three were commonly decorated, the flaring-rimmed F varieties, the open-rimmed G varieties and the related A varieties with constricted rims (Table 46.B). Series A is, however, very much a
minority ware and Series F and G together constitute over 80% of the decorated ware of the early period and 70% of the middle period. Both represent half of the early period plain ware and a third of that of the middle period. This goes to show yet again how the decorated ware was really an integral part of the ceramic tradition, with a range of shapes not generally different from that of the plain ware.

The B, C, D and E shapes were altogether rare and less commonly decorated, while H, an important series, was rarely decorated (Table 46.B).

The decorated A pots were round-based and uncarinated and had slightly inwardly oriented rims and moderate body-rim inclination. The rims were mostly of convergent form, terminating preferentially in flat lips. The pots are thought to have been on the whole of shallow depth, representing the idea of dishes.

The similar but better represented G pots were also usually round-based, but it is not altogether impossible that some of the commoner deeper ones, the bowls, could have been made with a rocking base or a flat base. Truly shouldered G pots cannot really be demonstrated in the material. Rims on the decorated G pots were vertically oriented, while the range of body-rim inclination was on the whole slight, resulting in the bowl shape mentioned above. The rim form was preferably convergent but commonly also parallel and the lip was mostly flat. Though G pots were thus relatively deep, various considerations indicate that shallower G pots were of some importance in the manufacture of decorated ware, mainly in terms of dishes.

There are two kinds of F pots according to the strength of the body-rim inclination, both with horizontal rim orientation outwards. F pots with moderate inclination appear to have dominated as decorated ware, comprising uncarinated plates and some dishes, though some of them must have had flat bases and a few others probably rocking bases. The rim form was parallel but more often convergent and the lips were mostly round but not infrequently they were flat. This range of F pots is taken to have been generally shallower than the representatives of the other group of F pots, the shapes with pronounced body-rim inclination comprising bowls and some dishes.

Judged on the evidence of the rim sherds, these pronounced shapes appear to have been less popular as decorated ware than the others. They had rounded bases and some of them definitely rocking bases (cf. the cases of actually reconstructed vessels listed at the beginning of this section), but not flat bases. Their rims were convergent, ending in round lips. They are considered the most likely of the early Tongan forms to have had a shouldered vessel contour, though this is a matter extremely difficult of quantitative documentation. The number of pronounced F pots on the basis of decorated rim sherds is very small, while the quantity of decorated angled sherds is considerably larger, amounting to 22% of the total decorated sherds excavated.

Vessels with collar and flange rims were sometimes decorated (Tables 51, 52), the latter twice as frequently as the former (Table 51.A). Rim orientation was vertical or slightly inward (Table 53), rim form convergent and lip round. It is suspected that both plain and decorated collar rim pots were mainly of A and G shapes, though the question was not made one of specific analysis. They are assumed to have been generally deep pots, as is to be seen from one example of a pot (undecorated) reconstructed from actual sherds (Fig.53.2; Plate 34.3), but this question too was not examined.

The main points about the general vessel shape of the decorated ware then are that only two categories are of numerical importance, the G and F series; that shallow vessel shapes must have played a significant role; and that carinated vessel contour, mainly true shoulders but also rocking base corners and flat bases, are all features practically confined to the decorated component of the pottery.
Decorated vessel function

The question of the function of decorated and plain ware cannot be satisfactorily taken up with the present materials. I shall confine myself to the suggestion that the decorated ware was for some finer, more selective use in the consumption of food and beverages, while the plain ware assisted in the cooking, preparation and no doubt short-term storage of food. The decoration itself, the original white infilling of the surface impressions (section 15.7 below) and the neat surface treatment observable on the better preserved sherds naturally suggest such a distinction. In addition, there is the elaboration of vessel contour and, perhaps the most significant feature of all, the indications of the shallowness of many of the vessels concerned. It is likely that this is a reflection of function in terms of such pots having been used for the serving and eating of food, perhaps in specific cultural contexts. We may go somewhat further and see the deeper decorated vessels as containers also specifically made for such occasions and from which the food was actually transferred to the shallower vessels before consumption. The decorative motifs and patterns may have themselves been of symbolic importance.

In the conclusions to the Extended Description of Tongan Lapita Vessels (section 11.6 above), the question was raised whether decoration may not have simply represented something extra added to certain pot types that occurred also as plain ware, something possibly expressing degrees of significance between the persons making use of the pottery and perhaps involving questions of taboo. Obviously, for the investigation of such sociological questions, it is fundamental to be able to make a more satisfactory distinction between decorated and plain ware than is possible with the present material (cf. Kaeppler 1973).

The character of the decoration: introductory

The fragmentary nature of the study material and the very few pots physically reconstructable even in part make it impossible to say much in detail about the relationship of decoration to the pots on which it appeared. The same circumstances make it impossible to extend examination of the combinations of the elements making up the decorative repertoire beyond those already incorporated in the Decoration Code (Figs 32-41).

In this section I describe and comment on the decoration in general terms, regardless of vessel type and treating the features, individually and in combination, by the categories of the Decoration Code. I proceed in a somewhat different order from that of the code, beginning with aspects of the distribution of the decoration and passing on to the details of the decoration itself.

The data are set out in Table 70 in terms of pooled early period levels (To.2 all excavated, To.5/0-I and To.1/I), pooled middle period levels (To.5/II, To.3/I-II, To.6/IB, To.1/II and To.5/III) and for the pooled late levels (To.6/IT-III). The varying population totals used for the calculation of the percentages are included.

The overall purpose is to investigate whether the decorative tradition in Tongan pottery underwent any essential development over time, apart from its indisputable decline in production, which is illustrated in Table 71 in terms of the three periods. For the stated purpose only the decorated ware from the early and middle periods needs to be considered, that from the late period being very small and the subject of separate discussion later in this chapter. The evidence from the individual levels of the sites/horizons making up the pooled evidence of Table 70 has been studied in order to isolate any possible deviation from the average patterns represented there. Such deviations were found to be few in number and generally of inconsistent order and direction according to the rim sequence. The overall conclusion, therefore, is that these deviations reflect sampling problems rather than culturally significant differences. This justifies the presentation of the evidence in the pooled form of Table 70.

To avoid repetition, I shall make statements on the relationship of the early and middle period decoration only where essential differences appear to exist between them. In all other cases
the descriptions and comments will simply refer to the nature of Tongan pottery decoration as a whole, which can thus be followed unchanged through early and middle levels.

A few of the code categories have not been catered for in Table 70. Comments on these mostly unusual features are made where relevant.

The character of the decoration: placement

Type of sherd decorated (Category 1)

Within the class of early decorated sherds 24% are rim sherds, 22% have shoulders and 52% are simple body sherds. We can calculate from Tables 70 and 71 that of the total 1739 rim sherds, classified and unclassified, from the pooled early levels, 516 (30%) are decorated. We know from the discussion on Angled Sherds (section 4 above), that the great majority of shoulders was decorated. I do not have figures on the proportion of decorated to undecorated body sherds, except that at To.2 84% of the total pottery by weight consisted of plain body sherds, with decorated body sherds (including shoulders) accounting for 9%, decorated rims 3% and undecorated rims 5% (Poulsen 1967b:Table 30). This suggests that decorated rims at 24% are much overrepresented in comparison with decorated body sherds at 52% in the pooled early levels. The conclusion must be that on decorated pots rims were very commonly decorated and that whole areas of the body were left undecorated.

Such undecorated areas are likely to have been the base and the lower parts of the pots in question. This suggestion may be supported by the fact that though angled sherds were commonly decorated when present, of the 474 such sherds in the pooled early levels 87% were only decorated to one side of the angle (Category 6/1, 2, 6, 7 of Table 70): the assumption here is the overwhelming statistical likelihood that Category 6/6 (28%) belongs with 6/1 (57%) and not 6/4 (6%); by definition it cannot belong with Categories 6/3 or 6/5 (see Fig.32), while the insignificant occurrence of Category 6/7 (2%) and of Categories 6/2 (4%), 4 (1%) and 5 (1%), with any of which it could belong, makes further discussion unnecessary. The decoration is likely to have been the upper side (cf. Fig.49 for actual sherds). The general picture must then be that decoration was mainly confined to the upper part and rim. There is a very rare class of flat-based vessels, almost all decorated, where the decoration runs to the base corner.

The figures for both the middle and the late periods in Table 70 give a similar picture to that described for the early period decorated ware.

Position of decoration on sherd (Category 3)

The decoration was placed predominantly on the exterior face of the pots, whether body or rim, and any additional ornamentation inside the vessel and/or on the lip was exceptional.

From experience, inside decoration is a feature which occurs only on rim sherds and is in practice confined to the rim itself. The few body sherds observed which have inside decoration either alone or combined with outside decoration are therefore interpreted as rim sherds with the lip part knocked off. The numerical differences of interest are shown in Table 70, with the occurrences on undisputed rims under Category 3E and G) and those on possible rims added in under Category 3H and I). For these two groupings the percentage proportions have been calculated against the population totals for decorated rims, in order to show what proportion of rims was in fact provided with this feature. It will be seen that inside decoration of rims was fairly common but tended to become less so with time (cf. entries 108, 110 in Tables 25, 26).
Distribution of decoration on inside of sherd (Category 4)

Only rim sherds are analysed in this category in Table 70. On these, decoration was almost without exception placed on the rim itself, continuing in rare cases only below the body-rim junction. Pots with inside decoration solely below the rim were hardly ever manufactured.

Distribution of decoration on outside of sherd (Fig.32, category 5)

Here only rim sherds and base sherds are analysed in Table 70.

Attention is first focused on the upper vessel part, the rim and the body immediately adjacent to the body-rim junction. This is, of course, my definition of complete rim sherds and they rarely have more of the body preserved than this. We are thus in no position to know whether any other body decoration was made in direct continuation of that on the body immediately below the rim or was separated from it by a blank space or zone.

On decorated sherds containing the rim and part of the upper body the rim was practically always decorated, while the body immediately below it was commonly so, though only half as often and then regularly in touch with the decoration on the rim. Pots with outside decoration confined to the body just below the rim were only rarely made.

Decorated ware with flat base as a rule had the decoration placed on the body part immediately adjacent to the base corner but never on the base itself.

Distribution of decoration on angled sherds (Fig.32, category 6)

Carinated ware was almost invariably decorated, as a general rule on one side of the corner and always touching this. Restricted to the early levels and always unusual was decoration on both sides of the angle. In the cases where this occurred, both decorative fields reached the angle.

The character of the decoration: style, techniques and motifs

Type of decoration (Category 2)

Decoration of the surface with geometric motifs is the paramount decorative style, the hallmark being its execution in dentate stamp technique. Surface decoration was mainly used on its own and, when combined with other techniques, was more commonly so with applied than with notched decoration. The use of these two subsidiary types appears to have diminished by the middle period if we look at internal developments at To.1 and To.5 (entries 105, 106 in Tables 25, 26), but the more generalised evidence of the pooled sites in Table 70 obscures any such change.

Nature of surface decoration (Category 7)

In the Tongan ceramics this was dominated by rectilinear motifs. Curvilinear ones were quite commonly used but less often alone than in combination.

Techniques of surface decoration (Category 8)

Dentate stamping was the prevailing technique, rarely combined and then almost exclusively with incision. Incision was used somewhat more often than the other uncommon technique of surface decoration, that of shell-edge impression. This latter, when used, stood mainly on its own.
Other techniques of surface decoration (Category 9)

Dots and punctuations (called 'insertion' in the Decoration Code) were so unusual that they have not been included in the tabulations.

Number of zones of surface decoration, total, inside and outside (Categories 10-12)

Surface decoration was organised in horizontal zones, the number of which perhaps tended to become smaller with time. As far as positive observations could be made on the fragmentary material to hand, one zone was the most usual, two zones uncommon and three zones extremely rare. The presence of more than three zones is unrecorded except at To.1 where eight joining sherds displayed the use of six zones in total (inside and outside) (cf. the description of the F6 pot from To.1/I in section 14.2 below). It is highly likely that the use of more than one or two zones was in fact more common than appears from the present fragmentary material.

The discussion of the distribution of decoration on the inside of sherds (Category 4) makes clear that inside decoration refers almost without exception to the rim. When utilised, the dominant practice was to put just one zone of surface decoration inside here.

Presence of surface decoration on lips, horizontal applied bands, flanges and combinations of these (Category 13)

These are unusual places for surface decoration, with the lip figuring most frequently: 11 out of 23 sherds from the early period levels and seven out of eight sherds from the middle period.

Filling of zones with different or similar motifs (Category 14)

Each zone normally contained one motif only, probably repeated continuously all the way around the pot. Cases with more than one motif in the same zone were rarely recorded. As far as observations could positively be made, that is, on sherds where more than one zone is actually preserved, the practice was clearly to fill different zones with different motifs, any other possibility having only been used exceptionally.

The evidence then seems to favour the conclusion that the decoration would be varied if pots carried surface decoration in more than one zone. We cannot suggest the quantities in which such decorated ware was produced.

Marking of zone borders by horizontal lines (Fig.32, category 15)

The zonally organised ornamentation was preferentially stressed by border lines to one or both sides, one line being the rule, two or three lines the exception. The horizontal motifs rarely stood without border.

Zone border formed by lip/outer profile angle (Category 16)

The zonal ornamentation of rims and shoulders was commonly in touch with the lip, the body-rim junction or the shoulder point. In many such cases the zone was not marked by horizontal lines, its delimitation having been satisfactorily achieved by the break in the profile of the pot.

Horizontal applied bands (Category 34)

Of the various observations catered for in the Decoration Code under this category, only those dealing with the presence of one band on the inside or on the outside of a sherd are important and dealt with in Table 70. The inside band seems without exception to sit on the rim, such use being a fairly common feature on rims with inside decoration (e.g. Plate 46.13, 14). As concluded previously, these sherds practically all derive from vessels of the F series.
Use of one band outside was the dominant kind of applied decoration in this category. At To.2 there were 254 examples of such bands, at least 226 of which were found on simple body sherds. The indication is that body sherds decorated in this way derive generally from regions of the pots that are not immediately close to either the rim or the shoulder proper. Without becoming too technical, I suspect that these body sherds originate predominantly from some general neck area not only on carinated ware but also on uncarinated pottery (Figs 44.6, 55.3; Plate 52.12). It is thought that rim and shoulder sherds would otherwise have shown applied bands more often than observed. There are examples in the actual sherdage of the application of such a band around the body-rim junction (Plates 44.10, 13; 47.2). A rocking-base pot from To.1/1 has a series of three bands alternating with zone ornamentation in a continuous pattern reaching down to the base-body corner (Plate 45.1; cf. Fig.56.1). It may be due to the fragmentary nature of the material that sherds with more than one band are almost unrecorded.

Applied knobs (Category 35)

The rarely recorded applied knobs were placed on the lip or more frequently between or inside surface decoration motifs and in association with horizontal and vertical applied bands (e.g. Plates 48.1, 14; 49.9; 51.3; 53.13; 54.6). They are rare outside the early levels and the clear majority is recorded from To.2. From this site there are 28 sherds with applied knobs, nine at carinations, seven on vessels lips.

Perforations (Category 36)

This feature of holes of very small diameter (1-2 mm) is extremely rare and observed almost exclusively on rims. This may indicate that it was not really for decorative effect but perhaps rather of functional importance, serving as a hole for suspension, for the fastening of some other object to a pot or simply for repairs. Perforated sherds are known mostly from the pooled early levels, predominantly To.2.

Sundry applied decoration (Category 37)

There are three classes in this category in the Decoration Code, vertical applied bands, special features, and the two in combination. Vertical bands were sometimes used on their own, sometimes together with horizontal bands, but always in combination with surface decoration. At To.2 there were 66 sherds with them, none of them rim sherds, 28 of them simple body sherds, the rest with carination. Indeed they appear to form a characteristic element on carinated pots, where they are placed in touch with the angle. This is particularly true of the early period ware, but the practice is still known in the middle period.

The special features mentioned above comprise a small number of distinctive examples both of applied decoration and of the reverse. This latter consists of bas-relief triangles sunk quite deeply into the clay and placed adjacent to a flat base and is seen on two sherds from the To.2 midden and on one sherd collected from the surface at To.1 (Plate 56.17, 18, 21). A symmetrical group of four large knobs, identically placed, is present on a white-clay sherd excavated at To.2 (Plate 56.16). On a simple body sherd from the midden at To.2 is a tiny arrangement of clay which looks like a bird figure with outspread wings (Plate 56.15). It is notable that most of these specimens come from To.2, which supplies the majority of observations made within the last few categories.

Position and character of notched decoration (Categories 38, 39)

In the discussion of type of decoration (Category 2) we saw from Table 70 that notched decoration was a relatively rare feature. Here we note that notching was used much more commonly on horizontal applied bands than on lips or carinations, a practice which may have become more popular with time; such a trend is significantly registered by the evidence from To.5/0-1 and III (entry 139 of Table 26).
The notches were predominantly placed in close formation, rarely spread and almost never grouped or alternating in direction.

**Motifs of surface decoration (Figs 33-41, categories 17-33)**

As regards frequency of occurrence, the range is wide, with a clear tendency for the simpler motifs to dominate over the more complex ones in the early as well as in the middle periods. It is, however, remarkable how on the whole the relative frequencies of individual motifs remain the same throughout.

The most popular motifs were the simple vertical arcs, A, occurring in one third of the decorated ware with surface decoration and even possibly increasing over time. The simpler submotifs, A1-4, 8, are in absolute dominance.

Next in order are the nevertheless uncommon panel motifs, P, with an early occurrence of 14%, also dominated by the simpler submotifs, P1 and 13. In the early levels at To.5 these motifs are in fact the commonest of all. They occur on 30 sherds, three in Horizon 0, 27 in Horizon I, and constitute 30% of the 100 sherds with identifiable motifs A-Q in those horizons. The evidence of this site is that P motifs were used more rarely in the middle period (Table 26).

The opposite change appears to characterise the similarly uncommon horizontal arc motifs, B, which get slightly more frequent with time, like the related A motifs. This change could perhaps be more apparent than real due to the relatively large number of sherds (13) with B motifs from To.6/IB, which make up 36% of the total of 36 sherds with these motifs from the pooled middle period sample. On the other hand, an increasing trend, though only of secondary significance, is recorded between Horizons 0-1 and II at To.5 (entry 123 of Table 26, run on rim sherds).

Other uncommon motifs with an average frequency of about 10% comprise the horizontal zigzag and triangle motifs, D; the vertical bar motifs, P; and the vertical or oblique bundles of close lines in various combinations of the J group.

Extremely rare motifs with a 1-5% representation are represented by C, a series of more or less circular motifs, a majority unfortunately of fragmentary appearance, not further definable (Fig.34, category 19, class 9); E, vertical angles and zigzags dominated by the characteristic ‘wolf’s teeth’ submotif (E6); G, oblique bars; H, horizontal lines as separate motifs, not as zone borders; K and L, composite motifs built up of the elements of the foregoing categories; M, labyrinth-like motifs; N, house- or net-like motifs; O, column-like motifs; and finally Q, a series of unique motifs. Of these more unusual motifs, E, M and N are not found in the middle period material.

**Digression on possibly early motifs**

Already during fieldwork certain motifs gave the impression of being of particularly early character owing to their similarity with the more elaborate motifs of the overseas Lapita ceramics in Melanesia. In the first round of analysis, directed towards problems of chronology, they were grouped together and labelled ‘possibly early motifs’ (entry 143 in Table 14), involving motifs B, E6 and K-Q. It was established that they were in fact used not only in the early period but also subsequently, but statistical testing (in Chapter III, section 8.1) demonstrated the presence of a few consistently declining tendencies of primary and secondary significance (entry 143 of Table 26). The initial belief in the earliness of these motifs was thus lent some, though not quite definitive support.

When I looked at the question, however, at the pooled level of analysis being employed in the current discussion on decoration and its development, it turned out that the early character of this motif grouping was more complicated than at first thought. The inclusion of the B motifs, well known in overseas contexts, cannot be as strongly supported in chronological
terms, as the suspected decline in popularity of the group over time comes out more satisfactorily with their exclusion. On the figures given in Table 70 (Categories 17-32, entry on possibly early motifs), in which motif B is not included, there is a decline of primary significance in their employment from the pooled early-period to the pooled middle-period levels. Indeed, the interesting conclusion is that of all these special motifs with their overseas analogues, only B enjoyed an increasing popularity in Tonga, as did the related A motifs, from the early into the middle period.

With this separation out of the B motifs, a more detailed examination of the stratigraphic distribution of the group of suspected early motifs in the light of the established rim sequence was undertaken in terms of their occurrence in the individual sites and horizons (Table 72).

Looking first at the evidence from To.1, 2, 3 and 5, we see that the motifs were used in both the early and middle periods. Measured both against their own total occurrence per site (A) and against the total occurrence of surface decoration per horizon (B), they appear to have become less popular with time. If we consider the material from To.6, the only site with late-period pottery, we find evidence of early-character decoration to be present here also. It is significant, however, that a clear majority of the To.6 sherds which are referable to horizons is from Horizon I, particularly from its bottom half, and involves B motifs.

These two sets of evidence allow two interpretations: either the motifs were not confined to the early period but were equally at home in the middle-period levels at To.1, 3 and 5, with their presence in the lowest levels at To.6 referable to the same period; or they were truly early period and the fewer occurrences in the upper levels at To.1, 3 and 5 were due to chance displacement from lower levels, while their presence at To.6 reflects an early-period occupation not otherwise detectable. In either case, the presence of these particular motifs on pottery from To.6 strongly suggested a use of this site prior to the main occupation in the late period. This was precisely the same conclusion as that reached from the examination of the rim evidence. The section devoted to the base of the midden at To.6 in Chapter III (section 10.3) establishes the presence of a middle-period occupation there and thus argues in favour of the first of the alternatives outlined above.

The motifs in question were then still applied to Tongan pottery of the middle period, though not as often as earlier. The concept of their earliness in the wider perspective can thus be maintained.

As regards the motifs taken individually, it should be noted that the various Q submotifs are very scarce in secure stratigraphic contexts. Of the two that are very similar to elaborate Lapita motifs in Melanesia, Q12 is only known from surface collections, while Q13 is recorded on one sherd only, from Zone I of the To.2 midden. The 'wolf’s teeth' motif, E6, is recorded exclusively from this early period site, Zones I-II of the midden.

**Decoration and its motifs over time**

The few differences observable between the early and the middle period in the relative frequency of occurrence of decorative motifs are mostly of insignificant nature. As the same result was obtained in the statistical analysis in Chapter III (section 8.1), it would seem most reasonable to explain the pattern in cultural terms: that the same motifs were equally popular in both periods. Exceptions to this are represented by the behaviour on the one hand of the A and B motifs (increasing) and on the other of the P motifs and the redefined group of possibly early motifs just discussed (decreasing). Overall, the indications are that although the simpler motifs were always in the majority, in the course of time the more complex motifs gave way to them. It is reasonable to see this result as another manifestation of the process of simplification characterising Tongan pottery development in many ways.

The general conclusion from the foregoing analysis, as for the sequence-oriented analysis of Chapter III, is that the standards governing the manufacture of decorated ware in Tonga were largely maintained throughout the span of time that such ware was in common demand. The
most obvious change concerned the decreasing quantities in which the ware was produced over time (Table 71).

THE OCCURRENCE OF DECORATED POTTERY IN THE LATE PERIOD

Stratigraphic distribution and the question of joining sherds

The purpose of this section is to examine the question of whether decorated ware was still being made in the late ceramic period in Tonga and, if so, how it compares with that of the preceding periods.

The evidence of relevance to the discussion is confined to a small sample of 76 decorated sherds from Site To.6, the only one with late-period pottery according to the rim sequence: 12 from Horizon III, 20 from Horizon II, 11 from Horizon IT and 26 from Horizon IB, with stratigraphic provenance uncertain for six sherds and one collected from the surface. However, though no fewer than 69 sherds are attributable to horizon, their interpretation is not straightforward.

In the first place the 26 sherds from Horizon IB (38% of the provenanced sample) belong to an arbitrary stratum which the discussion of the base of the midden at To.6 in Chapter III (section 10.3) shows is likely to contain a mixture of middle-period and late-period materials. In order to make the investigation of late-period decorated pottery as rigorous as possible, the decorated pottery from Horizon IB is treated, unless proved otherwise, as middle period in the analyses which follow, as indeed it is, more generally, in Table 70, where it is included in the pooled middle-period group.

The stratigraphic circumstances at To.6, with pit and posthole digging giving opportunity for displacement of sherds (see the relevant excavation report in Chapter II), mean that the recorded distribution of the decorated sherds in the higher, late-period, horizons (IT-III) cannot be relied upon with full confidence.

It is nevertheless difficult to believe that the 43 decorated sherds recorded from late-period levels at To.6, and representing 62% of the 69 decorated sherds referable to horizons, could possibly all have migrated upwards from an original distribution, of middle-period date, at the very base of an 0.5-1 m-thick midden. The fundamental stratigraphic evidence suggests then that decorated pottery was known and used in the late period, even though migration of sherds may have to an extent obscured the true distribution of decorated ware throughout the site. Thus the pooled late-period group of Table 70 is made up of the decorated sherds of Horizons IT-III.

However, the hard evidence is provided by the reuniting of sherds from the same pots, decorated sherds being so few at To.6 as to make it easier to try fitting sherds together than at the other sites. As will appear, such sherds are not always confined to the same horizon but may derive from two, sometimes even three different horizons.

In the sherd descriptions which follow, where nothing is stated to the contrary, the presence of zone border line(s) is uncertain and only a single zone of surface decoration and only outside decoration have been observed on the sherds concerned.

Regular reference is made to their spatial relationship to the component of Horizon II called the soft horizon in the To.6 excavation report in Chapter II. It is noted there that this soft horizon was not noticeably penetrated by features like pits and postholes.
Joins between Horizon IB (middle period) and Horizons IT-III (late period)

Involved are 13 decorated sherds from Horizon IB and 15 from Horizons IT-III, forming six groups.

*Group I* is represented by eight body sherds which have nothing to say on the score of vessel type. Seven are from Horizon IB and one from Horizon IT. They were found within a maximum distance of 4 m, within the area subsequently sealed in by the soft horizon of Horizon II. This group of sherds therefore belongs quite reliably to the middle-period occupation, but one sherd has migrated upwards to the adjoining unit IT.

The decoration features are: surface + applied + notched decoration; rectilinear and curvilinear motifs; shell-edge + incision technique; two zones of surface decoration; zones with different motifs; zone border lines present and absent; motifs A4 and B2; one applied band, notched.

*Group II* is represented by five sherds from a collar-rim pot. Two of the sherds are from Horizon IB, two from Horizon II and one from Horizon III, all found within or on the border of the area of the soft horizon, at a maximum 6 m apart. Migration of sherds must have occurred, but its direction cannot be deduced. Dating is therefore uncertain.

The decoration features are: surface decoration on the rim; rectilinear and curvilinear; dentate stamp + incision; two zones; zone border lines present; motifs A3 and B1.

*Group III* is represented by five sherds from a carinated vessel, but it is uncertain whether the carination is a shoulder or a rocking base. One sherd is from Horizon IB, one from Horizon IT and three from Horizon II, all found within the area of the soft horizon, at a maximum 4 m apart. The indications are perhaps in favour of downward migration and thus of a likely late-period date.

The decoration features are: surface decoration, one side of the carination, not reaching the corner; rectilinear; incision; zone border line present; motif D7.

*Group IV* is represented by six body sherds from a pot of unknown type. One sherd is from Horizon IB, two from Horizon IT and one from Horizon III, while two derive from Pit W, whose most realistic allocation is to Horizon II (see Chapter II, section 10.5). They were all found within and on the border of the area of the soft horizon at Pit W, at a maximum 5 m apart. The majority of the sherds being recovered from late levels, downward migration of the single sherd found in Horizon IB would seem to provide the best explanation of the distribution. The dating of the pot is most probably late period.

The decoration features are: surface decoration; rectilinear and curvilinear; shell-edge and incision; three zones, all with different motifs; zone border line present and absent; motifs A2, A4 and J4.

*Group V* is represented by two body sherds from a pot of unknown type, one found in Horizon IB, one in Horizon IT, within and on the border of the area of the soft horizon, at a maximum 4 m apart. Dating is uncertain.

The decoration features are: surface decoration; rectilinear and curvilinear; dentate stamp; two zones with different motifs; zone border line present; motifs A2 and H3.

*Group VI* is represented by two body sherds from a pot of unknown type, one found in Horizon IB, one in Horizon II, both within the area of the soft horizon, at a maximum 2 m apart. Dating is uncertain.

The decoration features are: surface decoration; curvilinear; dentate stamp; motif A4.
Joins within Horizon IB (middle period)

Involved are six decorated sherds, forming three groups.

*Group VII* is represented by two body sherds from a pot of unknown type, found within the area of the soft horizon, 3 m apart. A middle-period date is most likely.

The decoration features are: surface decoration; rectilinear and curvilinear; dentate stamp; zone border line present; motif B1.

*Group VIII* is represented by two rim sherds from an F3 pot, found in the same excavation square within the area of the soft horizon. A middle-period date is most likely.

The decoration features are: surface decoration on the rim inside and outside, below the rim, not reaching the rim; curvilinear; dentate stamp and incision; two zones with different motifs; zone border line present; motifs A4 and B1. This F3 pot has outward rim orientation degree 4, outward body-rim inclination degree 3, convergent rim form and flat lip.

*Group IX* is represented by two rim sherds from an H pot, found in the same excavation square within the area of the soft horizon. A middle-period date is most likely.

The decoration features are: surface decoration on the lip; rectilinear; shell-edge; motif D1. This H pot has vertical rim orientation, outward body-rim inclination degree uncertain, divergent rim form and flat lip.

Joins within Horizons IT-III (late period)

Involved are six decorated sherds, forming three groups.

*Group X* is represented by two body sherds from a pot of unknown type, both found in Horizon III in the same excavation square outside the area of the soft horizon. A late-period date is most likely.

The decoration features are: surface decoration; curvilinear; incision; motif A4.

*Group XI* is represented by two body sherds from a pot of unknown type, both found in Horizon II, one in Pit W, both on the border of the soft horizon, 3 m apart. A late-period date is most likely.

The decoration features are: one notched applied band.

*Group XII* is represented by two body sherds from a pot of unknown type, one sherd from Horizon IT, one from Horizon II, both in the area of the soft horizon, 2 m apart. A late-period date is most likely.

The decoration features are: surface decoration; curvilinear; dentate stamp; motif A4.

The examination of the distribution of the above 40 sherds, 58% of all those allocatable to horizons, shows that migration has taken place to a limited degree, upwards, downwards and sideways. Nevertheless, the general conclusion is reasonable that decorated ware was used during both middle- and late-period occupations at the site. Of the 12 groups, which could represent an equivalent number of individual pots, four are dated to the middle period (I, VII, VIII, IX), involving 14 sherds; five are dated to the late period (III, IV, X, XI, XII), involving 17 sherds; and three are of uncertain date (II, V, VI), involving nine sherds.

Looking at the recorded stratigraphic provenance of the individual sherds involved in these groups, we see that of the 19 sherds recorded from Horizon IB, only 13 belong to groups acceptable as middle period, while of the total of 21 sherds recorded from Horizons IT-III, only 15 belong to groups acceptable as late period. Two stratigraphically middle-period sherds belong to two groups assigned to the late period and one stratigraphically late-period sherd belongs to a group accepted as middle period. Four stratigraphically middle-period and five stratigraphically late-period sherds belong to three groups whose dating is uncertain.
Unjoined sherds

There now remain 29 decorated sherds which apparently do not link with each other or with any of the above groups. Their recorded distribution and more important ceramic features are set out below:

**Middle period: Horizon IB (7 sherds)**

- Body sherd: surface decoration; rectilinear; incision; motif R1
- Body sherd: surface + applied + notched decoration; rectilinear; dentate stamp; motif R1; one notched applied band
- Body sherd: surface decoration; rectilinear; dentate stamp; motif D21
- Body sherd: surface decoration; rectilinear and curvilinear; incision; motif K16
- Body sherd: applied decoration; one unnotched applied band
- Body sherd: surface decoration; curvilinear; incision; motif A4
- Carinated sherd: surface decoration, one side of carination, reaching corner; rectilinear and curvilinear; incision; zone border line present and absent; motif A3. What type of carinated pot is unknown.

**Late period: Horizon IT (5 sherds)**

- Rim sherd: notches on lip transition. The rim is from an H2 pot with vertical rim orientation, outward body-rim inclination degree 2, parallel rim form, flat lip and inner and outer thickening.
- Body sherd: surface decoration; rectilinear; incision; motif R1
- Body sherd: surface decoration; curvilinear; incision; motif A2
- Body sherd: surface decoration; rectilinear; dentate stamp; three zones; zones with different and similar motifs; zone border lines present; motifs D1 and P13 (in two zones)
- Carinated sherd: surface decoration, one side of carination, reaching corner; curvilinear; incision; motif A2. What type of carinated pot is unknown.

**Late period: Horizon II (9 sherds)**

- Rim sherd: surface decoration on lip; rectilinear; incision; motif D1. The rim is from a C or D2 pot with outward rim orientation degree 1-2, outward body-rim inclination degree 2, divergent rim form and flat lip.
- Rim sherd: surface decoration on lip; rectilinear; technique uncertain; motif G1. The rim is from a C3 pot with outward rim orientation degree 1, outward body-rim inclination degree 3, parallel rim form, flat lip, inner and outer thickening.
- Rim sherd: surface decoration on lip; rectilinear; motif R1. The rim is from an A2 pot with inward rim orientation degree 1, inward body-rim inclination degree 2, parallel rim form and flat lip.
- Rim sherd: surface decoration on lip; rectilinear; motif D1 (Plate 55.15). The rim is from a C or D2 pot with outward rim orientation degree 1-2, outward body-rim inclination degree 2, divergent rim form and flat lip.
- Rim sherd: notches on lip. The rim is from a pot of unique type with inward rim orientation degree 3, inward body-rim inclination degree 4, convergent rim form, flat lip and inner thickening (Fig.46.2).
- Rim sherd: perforation of rim. The rim is from a D pot with outward rim orientation degree 2, outward body-rim inclination degree uncertain, parallel rim form and flat lip.
Carinated sherd: surface decoration, one side of carination, reaching corner; rectilinear and curvilinear; incision; zone border line present; motif A3. What type of carinated pot is uncertain.

Body sherd: surface decoration; rectilinear and curvilinear; incision; motif K16

Body sherd: surface decoration; rectilinear and curvilinear; incision; zone border line present; motif A2

**Late period: Horizon III (8 sherds)**

Rim sherd: notches on lip. The rim is from a pot of unknown type with uncertain rim orientation and body-rim inclination, parallel rim form, atypical lip form and inner thickening.

Rim sherd: surface decoration on lip; rectilinear; dentate stamp; motif D1. The rim is from an H4 pot with vertical rim orientation, outward body-rim inclination degree 4, divergent rim form and flat lip.

Rim sherd: surface decoration on lip; rectilinear; dentate stamp; motif R1. The rim is from a pot of unknown type with uncertain rim inclination, outward body-rim inclination degree 2, divergent rim form and flat lip.

Carinated sherd: surface decoration, one side of carination, reaching corner; rectilinear; incision; motif R1. What type of carinated pot is unknown.

Carinated sherd: surface decoration, one side of carination, reaching corner; rectilinear; incision; motif R1. What type of carinated pot is unknown.

Carinated sherd: surface decoration, one side of carination, reaching corner; rectilinear; dentate stamp and incision; zone border lines present and absent; motif R1. What type of carinated pot is unknown.

Body sherd: applied and notched decoration; one applied band with notches

Body sherd: surface decoration; rectilinear; dentate stamp; motif R1

Of these 29 sherds (42% of all allocatable to horizons) three-quarters are from the late-period levels and, as with the joined-sherd groups, the conclusion is reasonable that the late occupations at To.6 involved the use of decorated pottery. Though it is not possible to tell if any of the sherds relate to any of the 12 sherd groups discussed above, some of them could feasibly derive from the same pots. A further point of similarity is that all but five of the 29 individual sherds were found within the geographical spread of the soft component of Horizon II, the significance of which is that it was not noticeably penetrated by features like pits and postholes.

To complete the recording of the decorated sherds recovered from the site, I describe seven more sherds, six ungrouped and unattributable to horizon, one a surface find.

**Sherds not securely provenanced**

*Uncertain horizon (6 sherds)*

Rim sherd: one applied band without notches. The rim is from a pot of unknown type with unknown rim orientation and body-rim inclination, convergent rim form and round lip.

Rim sherd: surface decoration, inside, on rim only; rectilinear and curvilinear; dentate stamp; motif P21. The rim is from a pot, in all likelihood of the F series, with outward rim orientation degree 4, outward body-rim inclination degree 2, convergent rim form and round lip (Plate 55.11).

Body sherd: surface decoration; rectilinear and curvilinear; dentate stamp; zone border line present; motif A2
Body sherd: one applied band without notches

Body sherd: surface and applied decoration; curvilinear; shell-edge; motif R1; one unnotched applied band

Carinated sherd: surface decoration, one side of carination, reaching corner; incision; motif R3. What type of carinated pot is unknown.

Surface (1 sherd)

Rim sherd: surface decoration on lip; rectilinear; shell-edge; motif R1

The nature of the late-period decoration

Now that we have established the credentials of the decorated sherds at To.6, we can now proceed to look at the character of decoration in the late period and its relationship with that of the earlier periods. The evidence is set out in Tables 73 and 74.

It is clear that by the late period a number of important changes had taken place in the manufacture of decorated pottery, along with the definite decline in its production (Table 71). Beside the obvious simplification in terms of the dropping out of features of the original repertoire (see the pooled evidence of Table 70), there are a number of specific changes characterising the development.

Lip decoration had become much more common, in fact as common as outside decoration, which itself had suffered some decline. Inside decoration had probably been totally abandoned. Surface decoration and applied decoration had both declined somewhat in popularity, but notched decoration was as popular as always (cf. Table 70). Looking at the evidence in more detail, we see that lip decoration, surface or notched, had become favoured by the late period.

The hallmark of the earlier surface decoration, the use of the dentate stamp technique, was much less common than incision, while shell-edge impressions had gained somewhat in popularity. It may be said that by the late period decoration was predominantly incised.

The rising popularity of the A motifs continued into the late period, representing a basic Lapita design element used throughout the Tongan ceramic period. The D motifs were also more common. Generally speaking, the motifs used in the final stage were the simpler ones. It is interesting to note, however, that the group of possibly early motifs (section 12.6 above) was not entirely unrepresented.

The indications thus are that the decorative style of Tongan Lapita had developed a particular character by the late period, in spite of the fact that the production of decorated ware had declined to very small amounts. It is interesting to see that the stratigraphic evidence for the persistence of decorated pottery into the late period receives good support from the typology of its decoration.

Similar typological support is provided by the decorated rim sherds from To.6, ten in all, one from Horizon II, six from Horizon II and three from Horizon III, the details of which are set out in the discussion on unjoined sherds above (section 13.5). In spite of the smallness of this sample, it is striking that their features of rim modification correspond predominantly with those of the late period: divergent or parallel rim form, flat lip, vertical rim orientation and moderate outward body-rim inclination, both individual and combined pairwise (see sections 9-11 above). The pottery series to which, when identifiable, they belong, H, C and/or D, all in versions of deep bowls or jars, are also representative of late-period preferences. The independence of this evidence in favour of a late-period dating of decorated ware is welcome support for the conclusions based on other grounds.

The decoration of these rim sherds, as itemised in the section (13.5) on unjoined sherds above, can now be generalised. It is practically confined to the lip and is very simple, consisting of
notches or motifs D1 or G1, where identifiable. In many cases the execution of the decoration gives an impression of carelessness. It is important to remember that very simple decoration of the lip alone had been part of the Tongan decorative tradition right from the beginning, though always rare (see under Categories 3, 13/1 and 38 of Table 70). Its application in the middle period is accepted on the evidence of Sherd Group IX from Horizon IB at To.6, representing a pot of type H (section 13.3 above).

Finally, there is a total of ten carinated sherds with decoration datable to the late period, five of which constitute Sherd Group III, whose chronological status is not quite indisputable. The details have already been given both for the sherds of Sherd Group III (section 13.2) and for the unjoined sherds (section 13.5). Plain or decorated, carinated pottery had become extremely rare by the late period (cf. section 4 above), like decoration itself. Since carinated sherds had always been almost exclusively associated with decorated ware, it is interesting that such sherds with decoration were not entirely absent from the late levels. Their identifiable motifs are A or D, which falls into line with the general popularity of these designs in the late period, as does the dominant use of incision technique recorded on them.

Late-period decoration in ceramic and cultural context

What can be concluded about the decoration element of late-period Tongan pottery is that it continues the process of simplification at work over a period of many hundreds of years. The continuity of the decorative tradition is clearly in evidence both through the nature of the observed changes and also through instances of lack of change. Change was never marked by the appearance of new features. In the long run interest in and need for ceramic ornamentation just, so to speak, dried up. The last stage illustrates the logical end-product of the deterioration of an old craft tradition, now predominantly of simple and impoverished character, content one might say with the left-overs of the earlier standards and apparently incapable of innovation.

The similarity of the trend with the development of pot types and rim modification is obvious, though these three different ceramic fields may have experienced somewhat different rates of change. The nature of decoration in the late period, together with its rare incidence, seems to indicate the same process at work as noted for the rim evidence: either an acceleration of ceramic change or the presence of an intervening phase as yet unrecorded by excavation, i.e. between Horizons To.5/III and To.6/IT on the rim evidence (see the discussion towards the end of Chapter III, section 6.3; cf. also remarks on Text Fig.D in section 10.3 of Chapter III).

The overall conclusion is that the Tongan Lapita tradition was in all respects homogeneous in structure as it developed into a stereotyped concept, concentrating in its latest known phase on utilitarian ware, almost reluctantly keeping alive the earlier standards of decoration and concentrating on its simpler expressions.

WHICH POTS WERE DECORATED AND HOW

Analytically reconstructed pots, especially Series F and G

We have looked so far at the decoration in its own terms. In this section we consider its application to the categories of vessel represented by the pottery of Series A-H. The evidence is assembled in Tables 75 and 76 for the pooled early- and pooled middle-period levels respectively and includes unspecified as well as specified rims (i.e. the degree of body-rim inclination measurable to degree in the latter case, not so measurable in the former). The percentages of the B part of each table express the relative occurrence of particular decoration features on vessels of the various pottery series, A-H. The percentages in the A part express the relative occurrence within each pottery series of decoration features of different classes, headings indicating the classes within which the decoration features are compared. Because different decorative features can occur on the same sherd, percentages within these classes will
sometimes add up to more than 100%: in Table 75, for example, surface decoration (entry 104) was recorded on 118 of 144 F rim sherds, i.e. 82%, while applied decoration (entry 105) was found on 58 = 40% of the 144, meaning that some F rim sherds have both surface and applied decoration. At the same time some percentages add up to less than 100% (zones of surface decoration, zone border lines, notching) because there are attributes in these categories not listed due to their infrequent occurrence.

Inspection of the tables shows that the patterns for the early and middle periods are very similar, though, as Table 71 shows, decorated ware as a whole was only half as common in the total pottery production of the middle period as in that of the early period. Some caution in interpreting the figures is necessary due to the fact that only one-fifth the amount of decorated pottery found in early-period levels was excavated from middle-period levels.

Common to both periods, however, is the unimportance of pottery of Series A-E and H in the decorated ware. Detailed discussion, therefore, is limited to the two remaining series, the flaring-rimmed F pots, which probably account for the bulk of the carinated ware, and the open-rimmed G pots. In characterising the decoration of these two pottery series, we are concerned with the frequency of occurrence of different decorative features both within the two pottery series themselves but also between each of them and all the other pottery series.

Decoration on F rims

Surface decoration was always predominant and applied band and notched decoration occurred equally frequently. Decoration of the lip was fairly common, decoration inside on the rim prominent, decoration outside frequent and combined inside and outside decoration fairly common. Inside decoration of the rim often involved the use of applied bands (cf. Table 70).

The surface decoration was dominated by rectilinear style, but curvilinear motifs were common also. It was executed predominantly in dentate stamp technique, very rarely by incision and never with shell-edge. As far as can be seen in the material available, the organisation of surface decoration was in one or two zones, inside and/or outside, and zone border lines were commonly incorporated in the ornamentation. Absence of such lines was rare early but perhaps getting more frequent by the middle levels, indicating a simplification of the general decorative style.

In the early period, notching occurred on 28 of the 38 decorated lips (entries 138, 107 of Table 75) and 24 out of 58 horizontal applied bands (entries 139, 105). In the middle period notching occurred on all seven decorated lips and on four of eight applied bands (see the same entries in Table 76).

As for the motifs of the surface decoration, the general pattern of occurrence outlined for the decorated ware as a whole (in Table 70) seems to apply to the F pots, except for the A motifs which were fairly common early (26%; entry 122 of Table 75) and less so by the middle period (17%; entry 122 of Table 76), thus showing the opposite trend. Motifs B, D, F and G were all fairly unusual, motifs H, J, K, L, N, P and Q rare. Some motifs were wholly ignored on F pots, four in the early and 11 in the middle-period levels, another likely indication of the simplification of the decorated ware with time. It is the falling out of some of these motifs in the middle period that led to the concept of 'possibly early motifs' treated in the Digression above.

Decoration on G rims

Surface decoration was absolutely dominant, with notched and applied-band decoration very unusual indeed in the early- , and absent altogether in the middle-period manufacture of this type of pot. Lips were very rarely decorated and rims were exclusively decorated on the outside. Rectilinear motifs were always dominant but perhaps especially in the early levels, while curvilinear motifs might have become more common over time. The technical execution was always dominated by the use of the dentate stamp; that of shell-edge impression was fairly common early and very rare late, while incision was always fairly rare.
The surface decoration was as a rule confined to just one zone, always outside. Zone border lines were fairly common and only very rarely absent altogether. In the early period four of the nine decorated lips were notched, but neither of the two applied bands. In the middle period there were no decorated lips and no applied bands.

In the early period F motifs might even have been slightly more popular than A motifs, both used fairly commonly. By the middle-period levels, however, A motifs were the dominant choice, used very commonly. The range of other motifs was restricted to the generally quite rare use of B, C, D, F, G, J, K and P, of which Motifs G and K were totally ignored in the middle levels. Some motifs were thus never used on the G pots, seven in the early and nine in the middle levels.

Comparison of decoration on F and G rims

Two types of decoration were practically confined to the F pots, the use of applied bands and the notching of these and of lips. Also the placing of decoration, regardless of type, on lips and on the inside of rims either alone or in combination with outside decoration was restricted to F pots. In reverse, the use of exclusive outside decoration was commoner on G pots. In the early levels at least, shell-edge impression was a technique found only on G pots, while incision was also commoner here than on F pots.

If we wish to investigate the distribution of motifs between F and G pots, sample size must restrict the survey to the early levels.

Let us see if any motif has a greater than expected occurrence on the pots in question. The standard by which to judge this is established by the 55% occurrence of F pots and the 28% occurrence of G pots in the corpus under discussion (Table 75B). By this standard, but ignoring those motifs which are represented by a total of less than 15 occurrences for the corpus, we have the picture as below:

<table>
<thead>
<tr>
<th>Overrepresented motifs</th>
<th>Normal motif preferences</th>
<th>Underrepresented motifs</th>
</tr>
</thead>
<tbody>
<tr>
<td>B, G</td>
<td>A, D</td>
<td>F, P</td>
</tr>
<tr>
<td>F, P</td>
<td>A, G</td>
<td>B, D</td>
</tr>
</tbody>
</table>

In F pots taken as a group, the list of motif preferences from greater to less is A, D, F, G, B, P; in G pots taken as a group the list is F, A, P, D, G, B.

This means that; while the overrepresented motifs are more diagnostic of a particular pottery series, as B and G for F pots and F and P for G pots, such motifs may nevertheless not occur particularly frequently: thus A motifs are more than twice as common on F pots as the ‘diagnostic’ Motifs B and G, though it so happens that with G pots the most diagnostic is also the most common.

Conclusion

Concluding this treatment, we may call attention to some convincing evidence of simplification in the manufacture of decorated ware with time, as well as to some interesting indications of a few specific standard combinations of pot shape and decorative style. The latter justify a tentative classification of the decorated ware into proper types: the more sophisticated or elaborated F pots, including the bulk of carinated ware, and the more simple G pots.
Physically reconstructed pots

In the light of the conclusions reached about decoration of the analytically reconstructed pots, how do the very few physically reconstructed decorated pots compare?

Series A pots

A4 from To.1/I (Fig.46.3): one zone with motif A1 in dentate stamp technique covering the whole of the rim outside

A6 from To.5/II (Fig.46.1; Plate 51.1): one zone with motif D1 in shell-edge technique covering all of the rim outside

Series B pot

B2 from To.1/I (Fig.45.9; Plate 44.11): one zone with motif F1 in shell-edge technique covering the whole of the rim outside, bordered by an unnotched applied band below

Series C pot

C0/1 from To.1/I (Fig.48.4; Plate 44.10): one zone with motif F1 on the whole of the rim, one zone with motif J3 on the whole of the body down to the rocking base corner, both in shell-edge technique; at the junction between rim and body one notched applied band

Series F pots

F6 from To.1/I (Fig.48.1; Plate 44.3): one zone with motif B1 on the rim inside; on the outside, in succession from the top: on the rim two zones with motifs G1 and B3; on the body below the rim but above the asymmetrical carination one zone with motif K3; on part at least of the rounded base from the carination two zones with motifs B5 and A4. All motifs are executed in dentate stamp.

F6 from To.2/surface (Fig.49.2; Plate 47.1): on the rim inside one zone with motif F1, bordered by one notched applied band; on the outside, in succession from the top: on the body below the rim one zone with motif F1, followed by a zone with some indeterminate surface decoration; on the lower part of the body down to the rocking base corner one zone with motif D1. All motifs are executed by dentate-stamp. The sherd is quite water-worn.

F8 from To.3/I (Fig.49.1): decorated outside with one broad zone with motif D26 reaching from the body-rim junction down to the shoulder point, executed in sharp incision.

A pots are morphologically very similar to G pots, as noted elsewhere (sections 3.2 and 11.3 above). The two A pots described above could give a good idea of the general decorative standard for G pots, especially since what we have proposed for the decorative characteristics of G pots is in agreement.

The three F pots in the listing have several essential things in common that exemplify the analytically defined F pots: the outwardly oriented rims with outward body-rim inclination, the carination of vessel shape in terms of rocking base or shoulder, the lavish decoration and the use of all three types of decoration, surface, applied and notched, inside and outside.

For the sake of completeness I mention in conclusion a pot of unique form from To.6/II (Fig.46.2), with close notching on the lip.
OTHER ASPECTS OF TONGAN LAPITA POTTERY

The observations which follow are only of a general kind but will serve to round off the picture of Tongan pottery.

Absolute dimensions

Very little will be said on this subject, the data for which is all held in the Computer Tables (see Chapter III, section 5).

The diameter of the vessel mouth varies between as little as 7 cm and as much as 40-50 cm.

Measurement of rim length and width and of body-wall thickness just below the rim (Fig. 28, categories 35-37) was performed on those complete rims from the key sites, To.2 and To.6, on which the general nature of body-rim inclination could be established: inwardly inclined rims 108 in number at To.2 and 38 at To.6 (entry 2 of Table 15), outwardly inclined rims 295 and 417 respectively (entry 3). At To.2 rim length was also taken according to the subdivision of the material into F pots (outward body-rim inclination) and G pots (inward body-rim inclination), going by the results of a previous analysis (cf. Table 35), which showed that inward body-rim inclination at To.2 and To.6 derives from pots of the A and especially the G series, while outward body-rim inclination in the early period belongs largely to F pots, in the late period to H pots. The numbers involved in this exercise, 176 F rims and 84 G rims, were smaller than in the previous one because the degree of body-rim inclination could not always be established in the material. The data from neither exercise are reproduced here and only general statements are made.

The thickness of the body wall immediately below the rim, as well as the maximum width of the rim, both vary consistently between 5 and 10 mm, centring around 6-7 mm and 7-8 mm respectively. Measurements between 10 and 14 mm were rarely recorded. There is no difference between rims with inward- and with outward body-rim inclination with regard to these observations. According to the Category 36 data of the Rim Code in Computer Table I, the evidence from all horizons at all sites is that Tongan Lapita ware is to be classified as a thin ware, in the late period no less than in the earlier periods.

Rim length on rims of inward body-rim inclination is similar in early and late pottery, the dominant range being 12-21 mm, while shorter and longer rims, involving lengths of 5-11 mm and 22-30 mm respectively, were rarely made. This pattern also applies to the G rims with slight to moderate body-rim inclination, plain or decorated, though there are indications of the decorated rims being relatively longer than the plain ones.

Rim length on rims of outward body-rim inclination are not quite the same for the early and the late pottery. The rims of F pots, characteristic of the former, cluster around 11-15 mm in length but are commonly shorter (5-10 mm) and longer (16-25 mm); 80% fall within the 5-25 mm range, with the decorated versions of the rims with pronounced outward body-rim inclination, though few in number, tending to fall at the upper end of the range, 16-25 mm. The rims of H pots, characteristic of the late period, have lengths of 16-25 mm dominant, while those of 11-15 mm are common and short rims of 5-10 mm fairly rare. Since H pots were virtually never decorated and were probably thus made exclusively for a utilitarian function, it may be that their relatively long rims were meant to facilitate binding a cover over the mouth.

Thick-walled pottery

There is some evidence (Table 77, feature 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. 59, e.g. 7, 12, 14). Thickness of vessel wall and rim would vary between 2 and 3 cm. Some of them could be connected with the so-called pot rests described below.

Other thick-walled sherds, 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 (a lamp?) (Table 77, feature 6; Fig.59.15, 16; Plate 40.1, 3).

Handling devices

Devices for facilitating the handling of pots are not common (Table 78).

There is a range from lugs at the rim of moderate to large knob form (Fig.59.3; Plate 39.1, 2), through more sideways-elongated (Figs 58.1, 2, 7, 8; 59.4, 5; Plate 39.3, 6), to more projecting (Fig.59.1, 2; Plate 39.4, 5) devices. Somewhat doubtfully, some flat and squarish pottery fragments may be interpreted as a kind of ledge grip (Fig.59.17-19). From To.1 and To.6 there seems to be evidence for strong inner ledge handles (Fig.59.11; Plate 40.4). Included in Table 78 but also listed separately as feature 2 of Table 77, they possibly belonged to heavy pots.

A few fragments may be attributed to both tiny (Fig.58.3-6) and quite substantial (Fig.58.9-11) loop handles, though in no case is any vessel wall preserved.

To.1 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 (Fig.60.2; Plate 40.5; cf. Poulsen 1964:189, Fig.25). A fragment from To.6 may well represent an identical specimen. Both are included in the totals of Table 78 but separately listed as feature 3 of Table 77.

Vessel legs and pot rests

From To.6 came six possible specimens of solid vessel legs of roughly cylindrical form, rounded at the bottom (Table 77, feature 4; Fig.60.4; Plate 40.2).

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 top (Table 77, feature 5; Fig.60.1; Plate 40.6-7). The very thick rim and body sherds just described above 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 here belonged in fact to some kind of distinctive thick-walled vessel with pointed base and thick rim.

Two objects that might conceivably be legs are included under Handling devices above (section 15.3).

Unique piece

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 (Fig.60.3; Plates 43.6, 53.13). 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 applied knobs outlining one of the openings (Plate 53.13).

Whitish coating on sherds

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 of the pieces in question is set out in Table 77 as feature 7; nearly all come from To.1 and To.6. The coating (Plate 43.2-5) is normally very thin, the exceptional cases with greater thickness not exceeding 1 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 diffraction (Appendix 4) 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 a decorative or some more practical reason.

**Whitish infilling of dentate-stamp decoration**

On some decorated sherds remnants of a similar white material are still visible as infilling in the dentate stamp-impressed lines, the purpose here obviously being to bring the decoration out (e.g. Plate 54.7). 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 for the ornamentation.

**Pottery clays and tempers**

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 (a clay pit was in operation at Ma'ufanga during my fieldwork) and on the neighbouring island of 'Eua, in the hills near the central east coast. The subsoil under Site To.6 was a clay of this kind. The clay being so pure and fine, large quantities of tempering were used to prepare it for pottery manufacture. The tempering materials consist, on the basis of a petrological analysis of a score of sherds by C.A. Key (Appendix 5), of a mixture of pyroxene and feldspar fragments, such as would be available possibly on 'Eua and certainly on the volcanic islands of the Tongan group.

Subsequently Key suggested that Fiji would be a more likely source of these tempers than Tonga itself (in Groube 1971:228, fn.55). Groube (1971:310) was inclined, quite sensibly, to doubt that the pottery excavated on Tongatapu could have been imported, owing to the sheer quantities in which it appeared to have been used. More recently, on the basis of a study of potsherds from throughout the Tongan islands, Dickinson (1974:345) concluded that 'the tempers in the Tongan sherds are indigenous to Tonga, with origins from the volcanic islands', adding that differentiation between alternative sources cannot yet be undertaken.

Standing apart from the normal ware are 43 sherds which appear to have been made of whitish clay (e.g. Plates 46.10; 47.14; 48.4, 24, 25; 49.18; 50.3). Half of them 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, along with the sherds so studied by Key, showed the presence of hornblende in the filler (Appendix 5). The hornblende may have originated in 'Eua or some other island on which continental-type rocks are exposed.

The suspicion was that these so-called white-clay sherds represented importations of pottery. The clay itself appeared to be of foreign character. This interpretation fitted well with the fact that almost all the sherds came from To.2, a site likely to represent a very early phase of settlement of the island. When later, thanks to the kindness of T.L. and H. Birks of Auckland, I was able to go through the Yanuca collection of Lapita pottery from Fiji (cf. Birks and Birks 1975) which is of a similar age, I noted similar sherds. Four decorated shoulder sherds excavated at To.2 and representing four different pots (cat. nos 69, 1615, 2537 and 3750) were therefore sent to W.R. Dickinson for petrographic analysis. In addition, two of these sherds (Plates 47.14, 48.4) display not only motifs but also a decorative style unusual in the Tongan Lapita repertoire but which would fit well into the classical Lapita of Melanesia.

Dickinson's conclusion, however, lends no support to the idea of imported pottery (Appendix 6). The tempers of the four sherds are volcanic sands typical of the pyroxene variant of Tongan tempers. He further suggests that the variously buffish colouring of the sherds is likely simply to reflect conditions during the firing of the pots concerned.
Firing and technology of the pottery

The firing of Tongan Lapita pottery was normally 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 (cf. on Oceanic ceramic technology Solheim 1952a, b, 1964a; for an older work Schurig 1930). On numerous sherds from all sites it can be seen that the wall consists of two layers (Plate 41.1-6). This presumably reflects a slab-building technique. If two such building components are not pressed properly together, the fired pot will have a weakness at their line of junction within the vessel wall, causing 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 cited in possible support. One is illustrated as Plate 43.1. The interpretation is based upon the fact that the whole of the transverse surface of the sherds is smooth and slightly hollow (cf. Troels-Smith 1953:40). Figure 61.16, 18 shows 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 body. The whole rim of normal pots could be made this way. Figure 61.15 illustrates the procedure. Plate 41.8, 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 also used for building up the walls of a vessel is unknown. Plate 41.7, 9-12 shows sherds with the same characteristics, but whether these are simple body sherds or really from rims whose lip is missing, it is impossible to say. Table 77 sets out the occurrence of the technique by site and horizon as feature 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 (Fig.61.1-7; Plate 42.1-7) and presumably all types of unique rim also (Fig.61.8-11). The separate sections were joined together by adding fresh moist clay to the spaces between and finally as a skin 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 Plate 42.5, 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 started manufacture with the rim, the lip 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, measured on rim sherds immediately below the rim, this was regularly quite thin, generally between 6-7 mm (see section 15.1 above, on absolute dimensions). 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 profile testify to this particular technique. Hollows and irregularities on the inside of a few body sherds may be traces of the anvil. Some sherds furthermore clearly show the traces of the paddle itself (Plate 57). 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 on a pot were regularly removed, for example by rubbing with coconut husk, is quite uncertain.

Sherds with striations on their outer surface (Plates 58, 59) were abundant on all sites. There is some variation in the way these striations were produced. In the main they were very light and shallow and as such could have been made with a handful of dried grass or coconut husk
on the still wet clay surface. In a few cases they appear to have been produced by scraping, perhaps with the edge of a shell, across a leather-hard surface. Whether these operations were a way of smoothing an uneven surface or 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 apparently is the use of a slip.

Flat lips were probably made by the use of some kind of flat and, judging by the marked nature of their corners, perhaps sharp implement. Since flat lips tend to be horizontal, such an implement would probably have been held in a horizontal position.

As to technique of decoration, the dentate stamp needs a little comment (cf. Poulsen 1964:185; Solheim 1964b:208). The tool producing the dotted line effect seems most likely to have been flat with a straight or slightly curved edge, rather than a small wheel. Plate 50.8-9, 12-13 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, for example, the A motifs. Applied bands were sometimes added to the surface along a line of dentate impressions, which would afford better adherence to the vessel side (e.g. Plate 54.7).

THE USE AND DISUSE OF POTTERY IN TONGA

From my investigations little can be offered about the sociology (Foster 1965), as distinct from the technology and typology of Tongan pottery. The interpretation of the functions of the 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 middens accumulations in the Tongan settlement pattern and the role of pottery in a proto-Polynesian society. Apart from a few immediate and general suggestions as to function, particularly in respect of the ratio of decorated to plain ware and the nature of the vessels which were decorated, I have not been able to address myself to problems such as these and a project designed to do so would employ a considerably different strategy from my own.

It is perhaps worthwhile, however, to conclude the detailed pottery analyses which are now complete with a consideration of the general question of the amount of pottery in use on the excavated sites, as background to its eventual disappearance. Because of the nature of the data available, this issue can be treated only at the grossest level.

The total weight (in kg) of pottery excavated at the more important sites is as follows: To.1 155.30; To.2 113.90; To.5 49.10; and To.6 151.30 (Poulsen 1967b:Table 30). I estimate that the proportion of these sites that was excavated is one sixty-fourth, one twentieth, one sixty-fourth and one twenty-second respectively. This gives a total weight of pottery for the four sites of nearly 10 tonnes for To.1, 2.25 tonnes for To.2, just over 3 tonnes for To.5 and between 3.25 and 3.50 tonnes for To.6.

These figures appear to suggest a considerable use of pottery, but without firm information about the growth rates of the sites where it was found, and about the nature of those sites within a total settlement pattern, the opposite is just as likely to be the case. With due acknowledgement of these factors, it is nevertheless instructive to consider the comparative status of our two key sites, at the early and late ends of the pottery sequence. The excavated volume which produced the 113.90 kg of pottery at To.2 was 18.80 m$^3$, giving a generalised weight of pottery per excavated m$^3$ of 6.06 kg. The excavated volume which produced the 151.30 kg of pottery at To.6 was 38.80 m$^3$, giving a generalised weight per excavated m$^3$ of 3.90 kg. Can we use this discrepancy in pottery density between To.2 and To.6 to suggest that the production of pottery declined in the course of time?

We may perhaps advance the argument a little further by relating the weight of undecorated sherds to the volume of midden in terms of the spits that would roughly reflect the rate of midden formation and the passage of time. This is done in Table 79.
It has not been possible to include within this analysis the weight of the very small plain sherds that were sorted separately as ‘insignificant’ during the processing of the pottery material. These sherds occurred commonly in all levels of all sites and would thus have added substantially to the weight statements in the table. Nevertheless, the available evidence is interesting because it shows consistent results from two sites each comprising three horizons of midden formation. The point is that the proportion by weight of pottery is less in the top horizons, III, than below them, especially at To.6 where the ratio is 1:4 for the late-period trend. The same trend may be read from the evidence of the rim sherds. The indications thus are that pottery decreased in quantity over time.
V THE FURTHER RELATIONSHIPS OF
THE TONGATAPU CERAMICS

Since I did my investigations on Tongatapu, there has been fieldwork and publication relevant to its interpretation elsewhere in the Southwestern Pacific. It is the aim of this chapter to review the pottery produced by these investigations in the light of the stylistic determinations and chronological conclusions that have been established as a result of my work on the pottery excavated on Tongatapu.

These determinations and conclusions have been so positive that I am encouraged, as an introduction, to give a brief survey and assessment of other pottery finds in Tonga itself, both before and subsequent to my own field research, as far as the published evidence will allow.

OTHER POTTERY FINDS IN TONGA

Tongatapu

McKern was the first to establish the presence of prehistoric pottery in Polynesia, a fact that tends to be overlooked. Though he worked throughout the Tongan archipelago during 1920-21, he made such finds only on Tongatapu and 'Eua, mainly during the excavation of shell-midden sites, collecting a total of 3194 sherds but no whole pots (McKern 1929:102-19).

The published treatment of this pottery and its distribution in the sites is very general. However, the scarcity of decorated sherds (just 11 were found) makes a late ceramic period date most probable for the great bulk of this undoubtedly Lapita ware, which is readily matched at To.6/IT-III, having a prevalence of divergent rims with flat lips and, frequently, thickenings. That some of the pottery is likely to be earlier, however, appears from the recorded presence of four flat-base sherds (McKern 1929:Fig.49b).

In 1957 Golson made test excavations at two pottery-bearing sites on Tongatapu, one in the village of Mu'a, the other on the outskirts of Nuku'alofa. This latter, the Mangaia Mound, was the scene of further excavations during 1959 by L. and H. Birks of Auckland (Golson 1961:173-74). No details of this work have been published, though in the reference cited Golson observes that decorated sherds occurred with a frequency of less than 1%, that the decoration was of Lapita type and that flat lips were in the majority. These indications of the late-period character of the Mangaia materials are confirmed by my own inspection of them. The pottery is generally identical with that from To.6/IT-III. The decorated sherds are concentrated at the bottom of the deposit, in Layer 3. None of the motifs on them is particularly complex, nor do they cover a particularly wide range. Together with their low numbers, all this confirms the impression of lateness. A very early radiocarbon date from Mangaia (NZ-726) thus constitutes a problem. Another Mangaia date (NZ-727) is thought likely to fall into the middle rather than the late period of my ceramic sequence. Both these dates are discussed in detail in Chapter III (sections 11.1 and 11.3).

Contemporaneously with my own fieldwork in 1964, J. Davidson (1969a) made independent investigations at two burial mounds in the grounds of 'Atele College, just southeast of the Pea-Ha'ateiho district where my own work was concentrated and belonging essentially to the inland zone of the island. Her excavations also uncovered structural remnants of an occupational character. She recovered a total of 75 potsherds, none apparently in primary position in the layers and structures where they were found and which they are thus assumed to predate. They were all plain and rather weathered and included simple body and a few rim sherds, but no decorated ones. By the rule-of-thumb, the smaller the proportion of decorated sherds, the later in time, Davidson's collection is most likely to be late in the local sequence, which is well documented at my sites only a few kilometres away in the lagoonal zone.

In 1966-67 L. Groube (1971:297-300) conducted excavations at a site he called Vuki's Mound, situated in the lagoonal zone at the village of Ha'ateiho. This is a shell midden and habitation
site, with a complex sequence of pits, postholes, house floors, fireplaces, ovens and other features. The abundant pottery is exclusively plain, except at the bottom where a few decorated sherds were found in a soil layer said to have nothing to do with the main site formation. The published information does not give much detail about the excavated pottery, but Groube (1971:301) says that it is exactly comparable with that recovered at To.6.

The physically reconstructed pots from Vuki's Mound represent three basic vessel types, two of which can be found in my analytically reconstructed pottery series. Prominent are H jars with bulging body (some of them apparently with collar rim), which forms the most prominent type of pot at To.6. There are also small J pots, so far documented only for earlier levels at other sites. Groube's description of his third type does not allow identification in my terms. It is interesting that most of the reconstructed H jars seem to have been very large pots with a capacity of 2 gallons (9 litres) and more, a size suggested by some of my own material from To.6 and elsewhere (cf. Plate 57).

Ha'apai and Vava'u

Pottery was not archaeologically recorded from the Tongan islands outside the Tongatapu group until the late 1960s.

In 1967 A. Kaeppler (1973) collected 151 sherds from the beach and inland on the island of Tungua in the Ha'apai group. As the collection is described only in the most general way, comparison with the material from Tongatapu is impossible. The author says that the sherds are mainly Lapita but that at least two appear to be Melanesian in type. One of these contains exotic temper and is highly likely to belong to a pot imported from Fiji.

In 1969 Davidson (1971a) collected potsherds from the surface of various islands of the Vava'u group. She came to the conclusion that pottery must have been in use throughout the group in prehistoric times, though in limited quantities and comprising both pottery of the Lapita tradition and later Fijian types. Decorated sherds were extremely difficult to find: some of Lapita type were recovered only on Kapa Island, others of Fijian character on Ofu and Kapa Islands.

In 1968 Groube and C.A. Key visited many islands in the Vava'u and Ha'apai groups and came to similar conclusions regarding the occurrence of Lapita pottery. They discovered only two potentially rich sites, one in either group (Groube 1971:292-93).

To suggest a dating of these pottery finds is very difficult on the evidence available. In view, however, of the fact that decorated sherds have seldom been recovered, it could be that the makers of Lapita pottery did not take up permanent residence on islands to the north of the Tongatapu group until the late ceramic period, though they may well have exploited the local resources prior to this. This seems to be confirmed by the fact that where found, with the possible exception of the two sites of Groube and Key in Ha'apai and Vava'u, pottery is in small quantities, as though it might already have been going out of use.

Niutatoputapu

We have better information on Niutatoputapu, the northernmost of the Tongan islands, midway between Vava'u and Samoa. G. Rogers' test excavations here in 1969-71 yielded important evidence on the Lapita settlement of the island, mainly pottery (Rogers 1974). Identical pottery was also found on the surface of the same topographic zone where the excavations took place, a former beachline.

The total collection numbers about a thousand sherds and involves a variety of pottery features that are all matchable on Tongatapu: collar rims, one with striations on the rim; parallel and divergent rims, many with exterior thickening at the lip; a majority of flattish lips; striations on vessel exteriors; fragments of handles and lugs; possible pot legs; a perforated pottery disc. Unparalleled in my material is a fragmentary pot spout.
Decorated sherds were very few indeed but represent the body, the rim and, in one case, also the shoulder. Surface decoration dominates, only one sherd displaying an applied band. One rim with exclusive inside decoration derives from an F pot. The motifs, executed in dentate stamp and incision, are mostly simple (A2, C1, D1, D2 and G1), but one sherd carries one of the so-called 'possibly early motifs' (rather like K4). Another sherd has three zones with decoration. Notching of lips is well represented, being the exclusive decoration on four rims and combined with surface decoration on one rim.

In the absence of the necessary data for correlating this ceramic information with the Tongatapu sequence, the best guide to a tentative dating is the index of decorated sherds over total rims x 100 (cf. Chapter III, section 8.2). With four decorated and 28 rims in the excavated collection from Loloke and 14 decorated sherds and 83 rims in the total pottery collection from the island, the indices are 14 and 16.8 respectively. These figures would place the material around the transition from middle to late period in the Tongatapu context. The other ceramic features do not contradict this suggestion. Allocation to any earlier phase would require a much better representation of decorated ware, in which connection, however, we should recall the excavator's comment (Rogers 1974:317) that many sherds were so badly eroded that decoration was difficult to detect.

However, the calculation of indices of decorated ware on the pottery from test excavations, as above, is suspect, as an experiment I did on material from To.5 clearly showed. I chose three excavation squares at random and calculated decoration indices for each, disregarding the stratigraphic provenance of the sherds and using them combined per square. Square 20/22, with nine decorated rims, 21 decorated body sherds and 34 rims in total, has an index of 88; Square 20/27 (seven, six and 26) one of 50; and Square 30/20 (none, two and eleven) one of 18.

Subsequent fieldwork on Niuatoputapu undertaken by P.V. Kirch in 1976 has brought more material to light, both decorated and plain (Kirch 1978). It is Kirch's opinion (1978:8, 12-13; Fig.6) that some of this material is related to the early ceramics of the Eastern Lapita as known from Tongatapu, and, as described below, also from Fiji and Samoa. From the available descriptions and illustrations it is impossible to make the close comparisons with early and middle Lapita on Tongatapu in order to get an idea of the relative age. The predominance of simple A motifs on the illustrated sherds, with a few examples of simple B motifs and a possible simple P motif, may point to the middle ceramic period on Tongatapu, rather than the early. The possibility exists, therefore, that Kirch's discoveries may entail some modification of any thesis of the late settlement of the outer Tongan islands, such as I raised in the last section.

For Niuatoputapu Kirch (1978:12-13) describes a devolution of the pottery into a plain ware and the subsequent abandonment of pottery making altogether, repeating the story of Tongatapu and, as we shall see, that of Samoa.

Conclusion

Increasing fieldwork has shown that Lapita pottery was known throughout the Tongan islands. On present evidence it appears that decorated pottery was never in extensive use outside the southern, Tongatapu, group. We could interpret this, as indicated above, in strictly chronological terms and conclude that the Lapita pottery tradition had established a proper foothold outside Tongatapu only by the late period, possibly reflecting an extension of more permanent settlement by its makers then. Such a situation is not easy to explain, considering the important economic resources available through the archipelago as far as Niuatoputapu, including raw materials for the manufacture of stone tools and pottery.

We must bear in mind, however, that pottery has a socio-economic role, so that its rarity overall in the other groups relative to Tongatapu, and the absolute rarity of decorated ware, may have something to do with the relationships of the southern group to the others. What is needed now is archaeological investigation beyond surface collecting and test pitting,
addressed to questions such as these. In this way we shall avoid a narrow concentration on
the chronological dimensions of pottery variation and thereby a simplistic and misleading
interpretation of the prehistory of the region.

RELATED POTTERY IN THE SOUTHWEST PACIFIC

To explore the external relationships of the Tongan ceramics in any depth depends on the
availability of similarly detailed analysis of materials excavated elsewhere in the region. So far
such conditions have only exceptionally been met in the Southwest Pacific area. An important
example is the continuing research on the Lapita decorative system and its division into
western and eastern provinces on the basis of a distance analysis (Mead 1975; Green 1976,
1978, 1979), while Golson (1971:70) has stressed the importance of interregional studies of the
plain ware. With the appearance of publications on the regional materials from Fiji and
Samoa, the possibility of examining a range of aspects of the ceramic relations between these
islands and Tonga has been brought an important step forward (Birks 1973; Birks and Birks
1975; Shaw 1975; Green 1969b, c, 1974b, c, d; Holmer 1980; Smith 1976b; cf. Davidson 1976,

These three archipelagoes form the major part of the Eastern Lapita province, contrasted with
the Western one, the accepted area of origin. The Eastern material has on the whole been
presented in greater detail in available publications than the Western in terms of vessel
features and decoration. I shall therefore in the present context confine myself largely to
dealing with the Eastern Lapita, and mainly in terms of vessel shape and rim features. Other
widespread ceramic features that have been, if at times unsystematically, treated in newer
publications (Golson 1971; Green 1974b, d; Smith 1976b), and some of which have only been
dealt with superficially by me in the Tongan context, will be disregarded. The basis of
comparison is thus those aspects of the Tongan ceramics that have been subjected to detailed
analysis in the foregoing.

EASTERN LAPITA: FIJI

Data on vessel shape and general rim modification in decorated ware are available for the
entire Fijian Lapita sequence, those for the plain ware only for the late period. The older
material comes from Yanuca and Natunuku (Birks and Birks 1975; Shaw 1975), the younger
from Level 1 at the Sigatoka Sand Dune site (Birks 1973). For purposes of discussing
developmental trends in the Fijian ceramics, I refer to these materials respectively as
constituting early and late Fijian Lapita or the Yanuca and Sigatoka phases.

Early Fijian Lapita and comparisons with Tonga

Vessel types

Yanuca Type A, flat-bottomed dishes with sides flaring out from the base (Birks and Birks
1975:8-10). This type dominates amongst the decorated ware at both Yanuca and Natunuku;
it is unknown at the late Sigatoka site. In vessel shape and kind and position of decoration
(e.g. inside rim decoration) it equals the shallow F pots (dishes or plates) of Tonga, with the
qualification that these are mostly round-bottomed and, when not, are more often of the
rocking-base than of the truly flat-base variety. The Yanuca evidence affords some support to
the conclusion from the Tongan material that Lapita decoration tends to concentrate on
shallower pottery forms, because Yanuca Type A is in fact the most frequent of the decorated
pot types at both Yanuca and Natunuku, as is its parallel in Tonga.

Perforation of the rim of these pots by holes of very small diameter is recorded in both regions.
Yanuca Type B, flat-bottomed, shouldered vessels (Birks and Birks 1975:11-12). This is an
altogether rare type, also present at Natunuku but unknown in the late period. In form and
general decoration it has much in common with the true shouldered bowls and jars of the Tongan F series, though possibly also with pots of the D and E series, depending on the rim orientation which, unfortunately, is not stated for the Fijian material. We are here dealing presumably with fairly deep pots, but the flat base is unrecorded in the comparable Tongan material. As in Fiji, however, where the shallower A type is much more frequent than the deeper B type in the Yanuca series, so in Tonga the plates and dishes of the F series are more prominent than the bowls and jars of the same series in the early decorated ware.

The bas-relief triangles located on the lip of one Yanuca B pot are paralleled in Tonga (Plate 56.17, 18, 21), where, however, they are found at the bottom of the body wall, adjacent to the body-base corner, of some flat-based but otherwise unidentifiable vessel shape.

Yanuca Type C, large bowls with convex base (Birks and Birks 1975:12-13). It is unfortunate that this type is incorporated in the Yanuca series, as it is not represented amongst the decorated ware from Yanuca itself: the question is whether it occurs plain there. By contrast, it is recorded at Natunuku and also at the late Lapita site of Sigatoka, though a rare occurrence at both. In the Sigatoka terminology it is Type 2E (Birks 1973:26).

This Fijian vessel form is readily comparable with the Tongan A4-6 dishes, and in rim and decoration features the similarity is also apparent. The main difference seems to be in size, the Fijian dishes being possibly twice or more as large as the Tongan ones. They are infrequent in both regions.

Yanuca Type D, shouldered vessels with a narrow flat or convex area above the shoulder (Birks and Birks 1975:13-14). This extremely rare type is unknown at Natunuku, and also in Tonga, where it cannot, as suggested by the Birks (1975:14), be matched, because its highly distinctive shoulder feature is entirely absent on the sherds they refer to (Fig.44.10).

Yanuca Type E, shouldered vessels with flat or convex area above the shoulder (Birks and Birks 1975:14-15). As no other pottery features, especially of the rim, can be directly related to these shoulder sherds, we are in the same situation as with much of the Tongan carinated material. Carinated sherds appear to be very rare at Natunuku and Yanuca, but they occur commonly, as we have seen, in early Tongan Lapita. On present evidence it is impossible to assess from which kind of pot they originate in the Fijian material, if indeed they are all true shoulder sherds. Being confined to an early part of the Fijian sequence, some of them might derive from deep carinated jars related to examples of the Tongan F series, carinated version; their decoration at least does not argue against this suggestion from my inspection of them.

Yanuca Type F, vessels with subglobular body (Birks and Birks 1975:15-16). They are rare in early Fijian Lapita and we have no information on their rims. It would seem that their general jar shape is common in the late Lapita at Sigatoka, in that Yanuca Type F appears to have much in common with Sigatoka Type 1A-C, which is, however, as a rule provided with collar rim. Basically, Yanuca Type F illustrates an inflected, uncarinated body profile. This is matchable in the Tongan material (see Chapter IV, section 1.3), where, however, it is likely to be a very rare feature. Yanuca and Tonga provide no evidence as to the total appearance of these inflected pots, nor of their rim details, but undoubtedly they had round bases. The presence of inside rim decoration on one Yanuca specimen may, by the Tongan evidence, suggest that sometimes they had horizontally oriented rims with pronounced body-rim inclination like Tongan F pots, on the deeper versions of which a similar location of decoration was not totally unknown (Table 39). Otherwise Yanuca Type F can only be compared with the rarely occurring pots of the Tongan C-E series with outwardly oriented rims, and necessarily with the deeper versions of these, i.e. jars.

Yanuca Type G, a wide-mouthed bowl or dish, represented by a single example at Yanuca (Birks and Birks 1975:16-17). The type is possibly absent from Natunuku, unless some of the 31 angled sherds here mentioned by Shaw (1975:47) are in fact from such pots. They are not recorded for Sigatoka. They are definitely present in early Tongan Lapita, where they are exemplified by two actually reconstructed F6 dishes with rocking base and decoration
Comparisons

As regards decorated vessel shapes of the two sites, Yanuca and Natunuku have much in common and may be readily taken to represent the early Fijian Lapita. This being so, we can see that there exist significant points of both similarity and dissimilarity with early Tongan Lapita.

In Fiji the shapes concentrate on pots with outward body-rim inclination and rims of varying outward orientation but in the main more or less horizontal as far as the positive evidence is concerned. In the Tongan terminology these are identifiable with shapes C-E but especially with F pots, whether carinated or not. The suggestion made for the difficult Tongan material, that carination belonged most probably with the F series of pots, is thus afforded fair support from the Fijian material. Carination appears, however, to have been a more frequent feature of the Tongan Lapita, if we exclude the angled sherds of the distinctive Fijian flat-base dishes from consideration. There is a much greater stress on this flat-base pottery in Fiji. The general dish form represents the dominant vessel type in early Fijian Lapita, bowl and jar forms being apparently rather infrequent.

The closely related Tongan A and G series are extremely rare in Fijian Lapita, though known early and late; in Tonga they together constitute the second-commonest kind of decorated ware in the early period and are almost as popular as F vessels in the middle period. Flange rims, which are rare in Tonga, are still rarer in Fiji. More importantly, collar rims appear to be unrecorded in early Fijian Lapita, though Golson (1971:69) seems to be referring to such rims at Yanuca; they are, of course, a distinctive feature of early Tongan Lapita, both decorated and plain, and also of late Fijian Lapita, as we shall see.

As regards the early Lapita decoration in Fiji and Tonga, reference is made to the recent treatment by Mead (1975). The very close genetic relationship in stylistic terms between these regions is clearly demonstrated, while at the same time it is shown that the Tongan Lapita is already in a stage of regional development as a result very probably of cultural differentiation due to isolation. The same is evidenced by the other ceramic features surveyed above.

Late Fijian Lapita and comparisons with Tonga

Vessel types

For this stage we have information about the plain as well as the decorated ware. The only site is Sigatoka, an open site on sand dunes, which may well have had special functions (Birks 1973:63) and so not be representative of the total range of late Lapita pottery.

Sigatoka Type 1, cooking pots of ovoid form (Birks 1973:19, 21-25). This type is the dominant pot form in Level 1 at the site. It is recorded as a very rare occurrence at the early Lapita site of Natunuku (Shaw 1975:47). In my opinion it is similar to Yanuca Type F and is thus known from the Yanuca site also. The specific rim form of Sigatoka Type 1 is, however, unknown in these two earlier sites.

The pots are round-based, wider than high and have short constricted necks. Subdivision is based on the relationship between the diameter at the orifice and the maximum diameter of the body. Subtype 1A is most common, 1B-D less common to rather rare. The rims are as a rule collar rims, with body-rim inclination slightly inwards or outwards or just straight. According to the illustrations of the 66 pots of Type 1 (Birks 1973:Figs 9-23), rim orientation is in nearly half the cases (32) exactly or approximately vertical. The remaining cases (34) are
equally divided between outward and inward orientation, with many examples falling close to the vertical, thus emphasising the importance of this generalised orientation. Lips are mostly rounded: the 38 examples include eight cases of pointedness depending on the thickness of the collar rim, which is, of course, of convergent form. The remaining examples are flat (6), flattish (21) and undefinable (1). Subtypes 1A-C are uncarinated, while 1D has an angled shoulder. The large majority of the pots is decorated, but this is restricted to a row of simple modifications along the collar base or, very rarely, along the lip.

All this would seem to illustrate how the Tongan collar-rim pots must have looked. By virtue of the specific rim type, a common origin cannot justly be doubted, in support of which the fair overlap in other main rim features may also be noted. In addition, the technology of collar-rim manufacture was basically the same in the two regions, though apparently more sophisticated in Tonga (Birks 1973:32; Fig.24; cf. Fig.61.1-7 here). When we come to vessel shape, decoration and chronology, however, differences can be noted.

The Tongan collar-rim pots were not decorated as often as the Fijian ones and only in the early period in Tonga. The decoration is also different, being most commonly surface decoration on the rim outside and only sometimes of the kind and in the position found on the Fijian pots. On such Tongan examples it is then exclusively a fine notching of the collar base, either alone or in conjunction with the more usual surface decoration. Reference is made in illustration of all these points to Plates 44.7; 46.5, 22, 24; 52.1-3, 6; 55.3, 12.

As regards vessel shape, the Tongan A and G series dominate the collar-vessel range both early and late according to the analysis performed (see Table 35). None of these displays the characteristic bulging ovoid body of Sigatoka Type 1A, the most frequent of the subtypes. In the light of the conclusion about the gentle nature of the convex curvature of the generality of Tongan pots (see Chapter IV, section 1.3), the suggestion is that the collar-rim pots of the two areas were not generally of identical shape. The maximum width of the Fijian pots was midway on the body, giving rise to proper jars; on the Tongan A and G pots it was most frequently at the rim itself, resulting rather in bowls of greater or lesser depth. The difference is then the degree of bulge of the vessel body, which is more marked in the Fijian than in the Tongan repertoire. The only physically reconstructed Tongan collar-rim pot (Fig.53.2; Plate 34.3) illustrates this principal difference, though by definition it is a jar and not a bowl (for definitions see Chapter IV, section 2.2). This pot shows another important thing, the lack of a proper constricted neck, instead of which there is a direct transition from the rim into the convex body profile.

It is not the case, however, that proper jars were unimportant in Tongan pottery. On the contrary, they dominate the late-period industry in the form of the H series, mostly with moderately bulging bodies like Sigatoka Type 1C rather than 1A and B. These H pots, however, seem only exceptionally to have been provided with collar rims, which thus on present evidence were made on different types in Tonga as compared with Fiji.

The conclusion to be drawn as regards general vessel shape, however, is that the concept of the subglobular or ovoid pot, i.e. the jar, was known throughout the Fijian and Tongan Lapita periods and that it gained in popularity over time, in Fiji as decorated ware and with more bulging body, in Tonga as plain ware and with less bulging body. Tongan jars were only exceptionally of other shapes than H; there are some possibilities in Series C-F.

Collar rims appear to be unrecorded in early Fijian Lapita, so the question arises as to how they became so prominent in late Fijian Lapita. A Tongan origin is not convincing, even considering the uniqueness of the rim type, which itself certainly argues for an ultimate common source. By the end of the ceramic sequence, collared pots are no longer as popular in Tonga as earlier and occur only as plain ware, while in Fiji they are the commonest Lapita ware and as a rule decorated, though in the most simple way. This contrast with the early Fijian Lapita may have something to do with the perhaps specialised nature of the Sigatoka site (cf. Birks 1973:63).
Sigatoka Type 2, involves a range of predominantly plain bowls or, in the Tongan terminology, flaring dishes of varying depth (Birks 1973:25-27). The subtypes are pretty well matched in the Tongan pottery. Subtype 2A is the commonest at Sigatoka, 2B-E are all very rare. Subtype 2E may be present at the early Lapita site of Natunuku (Shaw 1975:47).

Subtype 2A, a dish form, is known early, at Natunuku, where it occurs decorated and plain, but it is rare there. It is equivalent to the Tongan J series but appears to involve larger pots. Tongan J dishes are mostly known from the early period, though they occur in small numbers only, as in the early Fijian Lapita. The indications are that these pots of simple shape represent a late preference in Fijian and, as we shall see below, Samoan pottery production, without real parallel in late Tongan ceramics. Their origin in early Lapita is, however, clear.

It is interesting that a rim sherd collected at the surface of my site To.3 on Tongatatapu could represent an imported dish of this type (Fig.50.1). It is a thick-walled rim sherd in bright reddish ware illustrating shape J2 in the Tongan terminology. It is decorated on the flat lip with motif G1 executed in shell-edge technique.

As I have already mentioned, flange rims are excessively rare in Fiji. The only example to which I can point is on a Type 2A dish (Birks 1973:Fig.27, no. 46).

Subtype 2B, a dish form, known but very rare at the early Natunuku site, matches Tongan A and G pots.

Subtype 2C is represented by a single specimen, a bowl, unmatched elsewhere in Fiji.

Subtype 2D, a bowl form, fits well the concept of Tongan A pots with direct, incurved rim. It is unknown in early Fijian Lapita.

Subtype 2E, a dish form, is the equivalent of Yanuca Type C, described above. It represents a distinct decorated ware used, though rarely, throughout the Fijian Lapita. Its Tongan equivalents, A4-6 dishes, are confined practically to the early and middle periods.

Sigatoka Type 3, plain, bottle-shaped pots with constricted orifice (Birks 1973:27-29). They are unknown in early Fijian Lapita and are totally unrecorded in Tonga, unless represented by the heavy loop handles of the late period. Certainly no small constricted orifice sherds were recognised in the Tongan material.

Sigatoka Type 4, plain, knob-handled vessels or covers (Birks 1973:29), are unique to the Sigatoka site.

Fourteen ceramic pot rests (Birks 1973:37-40) were found at Sigatoka and are unique to this site. Their highly individual and sophisticated forms have no close counterparts in Tonga. However, the probable ceramic pot rests described in Chapter IV (section 15.4; cf. Fig.60.1, Plate 40.6-7), may be compared with Sigatoka Types B and C (Birks 1973:38-39; Plates 31, 32). The rather unique specimen from To.5/II (Fig.60.3; Plates 43.6, 53.13) could represent a form like Sigatoka Type A or D. It would be not beyond the bounds of possibility that other of the special pottery features described in Chapter IV, listed in Table 77 as nos 1, 3 and 6, come from objects of the same type. In Tonga these elements as a whole are fairly generally distributed through the sequence, in contrast to their restriction on present evidence to the one Fijian late Lapita site.

Comparisons

Birks (1973:30, 34) says that rim and lip forms do not readily correlate with vessel shape on the Sigatoka pottery and both may vary on the same pot. I shall restrict myself therefore to a comment on the lip forms. It is clear, by pooling Birks' lip types 3-5 as being all principally flat, that flat lips occur twice as frequently as round lips (Birks 1973:32, 34; Table 3). By the Tongan standard such a spectrum would fall into the middle, rather than the late period, but that standard refers to a regional pottery development taking place in an unknown degree of independence from what was happening elsewhere.
The decoration of the Sigatoka pottery appears to be rather different from the pattern at any stage of the Tongan sequence, except for that of the very rare 2E pots (Birks 1973:112-13). What decoration occurs is largely confined to Type 1 vessels and is dominated by simple but frequently pronounced notching of the collar-rim base; notching of the lip and use of surface decoration are rare, as is the presence of nubbins and horizontal applied bands. There is sometimes burnishing and slippine of vessel surfaces, especially on Type 2 pots, and this ranks justifiably as decoration. Though I did not systematically record these traits in the Tongan material, and certainly not in quantifiable terms, my impression is that such treatment was not normally given to that pottery.

The late Fijian Lapita as illustrated at Sigatoka testifies to a marked development away from the early Lapita style, though we must remember that as a possibly specialised site Sigatoka may not be very representative. Even so, the scale of difference suggests the presence of a middle phase yet to be defined. Late Fijian Lapita is also markedly different from the late Tongan pottery. The striking common denominator is simplification of a previous range of decoration and of vessel shape, jars being predominant, followed by dishes, bowls being very rare. However, on present evidence, some new features do appear in Fiji, as opposed to Tonga, in the late ceramic period, for example collar rims, abundantly represented, and rare items like bulging ceramic bottles, knob-handled covers and ceramic pot rests, most of uncertain origin and only some with parallels in Tonga. On the other hand, some ceramic features have been listed for the Tongan Lapita, though of rare occurrence, which are unmatched in Fiji at present (cf. Chapter IV, section 15.2-7). An interesting common trend is the growing importance of the jar over time, though it appears as a rule to be decorated in Fiji and plain in Tonga.

Conclusion

The impression gained from the above review is that if already in the earlier phase regional differentiation existed between Fiji and Tonga within the Eastern Lapita region, such a development had certainly not lessened by the later phase, neither qualitatively nor quantitatively, the total available ceramic evidence considered (cf. Green 1974d:245-53).

EASTERN LAPITA: SAMOA

The Samoan evidence is organised into two periods, here called early and late Samoan Lapita. This terminology differs from that of Green (1974d:249-53), who talks of a Lapita-style ceramic complex preceding in time a Plain Ware or Polynesian Plain Ware phase. This nomenclature would seem to obscure fundamental genetic relationships (cf. Kirch 1978:1-2 for the same point).

Early Samoan Lapita

This is illustrated by the submarine material from Mulifanua (Green 1974c:170-75). Qualitatively, the collection makes a distinct early impression by Tongan and Fijian standards. It is important to note that the pottery is locally made and that the open or restricted bowls that were to become absolutely dominant later on in Samoa are represented already now. Quantitatively, it is difficult to evaluate the collection owing to the small sample of significant sherds, as well as to the way in which it was recovered.

An immediate question, of course, is whether the origins lay in Fiji, Tonga or elsewhere. The answer depends on the proper excavation of a bigger collection, such as must be available at sites in the area (cf. Jennings 1974). It would, for example, be especially important to know the frequency in this Mulifanua phase, as it might suitably be called, of the bowl type just referred to. The bigger this frequency, the more likely would be a Tongan origin, all other things being equal, because at this stage such bowls were much more frequent in Tonga than in Fiji. The frequency of collar rims would also offer an interesting pointer on the matter of origins.
Late Samoan Lapita and Tongan comparisons

This is recorded from four sites at three locations on Upolu, Vailele, Sasoa’a and Faleasi’u (Green 1969b:128-30, 1969c:170-75, 1974b:117-31; Smith 1976a) and from two, Falemoa and Potusa, on Manono Island off its northwest coast (Lohse 1980; Holmer 1980), of which Falemoa provides the more reliable and important material. The phase is characterised by a plain, locally made pottery classifiable into fine thin and coarse thick ware. At Sasoa’a the fine ware predominated in the lower of the two pottery-bearing layers (Layer 5) and the coarse in the upper (Layer 4) and this provides the basis of Green’s characterisation of the Samoan Plain Ware phase as dominated by fine ware early and coarse ware late (Green 1974b:130, 1974d:247-50; also Green and Davidson 1974a:216-17; Tables 24-25).

Green (1974b:115-16) talks about the Sasoa’a stratigraphy in terms of the continuous deposition of Layers 5 and 4 over a short period of time and the radiocarbon dates are highly supportive of such a view (GaK-1441, 1840 ± 100 BP old half life, 1895 ± 100 BP new half life for Layer 5 and GaK-1341, 1800 ± 80 BP and 1854 ± 80 BP old and new half lives respectively for Layer 4, Green and Davidson 1974a:215). However, the great ceramic difference between the two layers (fine ware 91.3% Layer 5, 20.9% Layer 4, thick ware 8.7% and 79.1% respectively, Green and Davidson 1974a:Table 24) does not fit well with an interpretation of the situation at Sasoa’a solely in terms of a change over time, as seems to be offered by Green (1974d:248) in his remarks about a slow shift, the first century BC to the first century AD, from the predominance of thin ware to that of thick. Now that we have the additional pottery collections produced by the University of Utah excavations at Faleasi’u and on Manono Island, we can see that the picture is more complex than that suggested by Green (cf. Holmer 1980:Fig.42).

The analyses of this additional material (Smith 1976b; Holmer 1980) have concentrated on technological aspects and, though wall thickness has been one of the attributes considered, it is difficult to integrate the results with those obtained by Green. Since my own consideration of the Samoan ceramic evidence is based on the traditional aspects of form and decoration in terms of which the Tongan pottery was analysed, I can make little use of the new information and am largely restricted to Green’s material. Because this is most abundantly represented at the Sasoa’a site, I shall call the end stage of Samoan ceramic development the Sasoa’a phase.

How does the pottery of the Sasoa’a phase compare with Tongan Lapita? Though I have not handled the material but only examined the published data (Green 1974b:117-29), I venture the following comments.

To judge by the rim orientation of the 37 reconstructions illustrated by Green (1974b: Figs 57, 59, 60), shapes within the Tongan G series prevail, in both thin and thick ware, with fairly uncommon representation of shapes within the Tongan A series and exceptional representation of shapes within the Tongan J series (Table 80). These relative frequencies correspond with the Tongan ceramics at all stages. The vertical rim orientation of the Samoan pots correlated with the Tongan G series is in many cases within the vertical-inward range 0/1, as in Tonga.

The Samoan pottery has exclusively inward body-rim inclination. Slight degree of inclination is predominant, meaning deeper vessel shapes (bowls), examples of moderate inclination, meaning shallower vessels (dishes) being much fewer. The picture is similar in the Tongan G and A series, but not so marked there. This means that shallower dish-like pots were somewhat more common in Tonga, though they seem to have decreased a little in importance over time (Table 81). Functionally then the Samoan pots are generally true bowls, being open or restricted according to their rim orientation.

Table 82 gives my interpretation of Samoan rim forms as illustrated by Green (1974b:Figs 57-60) in terms of my Tongan categories, as far as I was able. Thin-ware Samoan bowls have parallel or divergent rims occurring in equal proportions. Convergent rims are rare in this ware, probably because the wall was in fact too thin to take the form. On thick-ware bowls convergent rims are as numerous as parallel ones, but the divergent form is most favoured.
The Samoan rim-form spectrum cannot be exactly matched in Tonga, but it would seem to come much closer to that of To.6 than to that of To.2 (cf. Table 64, for G pots).

Flat lips are almost absolutely dominant, as in the late Tongan Lapita.

Decoration is confined to the thin fine ware and comprises only various notchings of the lip. A similar kind of decoration is known in the Tongan late-period pottery (see Chapter IV, section 13.7) and occurs equally rarely.

The thin fine ware may have involved some extremely rare examples of jars, everted rims and angled body profiles (Smith 1976b:94). However, the collar rim cannot be considered securely documented for the late Samoan Lapita as suggested by Smith (1976b:94): the sherd he illustrates as Figure 21k has an ordinary exterior thickening.

This brief comparison makes it highly likely that the pottery of the Saso'a phase can be identified with Tongan bowls of the G and A series. The conclusion drawn from the Tongan analyses that the two series are typologically very close is confirmed by the Samoan material, where actual vessel reconstruction has proved very informative in this and other respects, for example that such pots had round base and convex body contour.

Conclusions

Between the early and late ceramic phases of Samoan prehistory there is a period yet to be discovered which saw developments similar to those we have described elsewhere in the Eastern Lapita province, the disappearance of decoration and a restriction in the range of vessel shapes (cf. Green 1974d:249). Evidence discussed by Green (1974d:249), Smith (1976b:92-95), Holmer (1980:Fig.42) and Dickinson (1976:102) suggests that the origins of the late-period pottery style are local and need not be sought outside Samoa.

In spite of the close typological relationships with late Tongan pottery which I have described, a late influence from Tongatapu seems unlikely. The main reason is that the H pots (jars) which dominate the late Tongan pottery series are entirely lacking in late Samoan Lapita, which is dominated by bowls. The similarities between the late pottery of Tonga and Samoa may be better explained by reference to the importance in Tonga of the bowl, though more so early than late (cf. Table 35), while it was apparently infrequent in both early and late Lapita in Fiji. This would suggest Tonga rather than Fiji as the source for its presence in early Samoan Lapita, should the chronology allow it. Its popularity in late Samoan Lapita would be evidence of a local development of the ceramic repertoire derived from this source.

The fact that everywhere flat lips dominate in late Lapita pottery should not be used as evidence of a conscious common desire among potters to favour flat lips for their own sake. It is more realistic to think in terms of whole pots and see this dominance as a matter simply of the preferential survival of flat-lipped pot types from the earlier wider range of vessels. In early Tongan Lapita both G and H pots were generally flat-lipped, but only the H pots continued to be produced in quantity. In early Samoan Lapita G pots at least were known and this pot type was the only one still in production by the late period. There is no need to invoke late Tongan influence to explain late Samoan pottery just because of flat lips. The available evidence would thus seem to be rather in favour of regional differentiation.

EASTERN LAPITA: FUTUNA

Recent archaeological fieldwork on Futuna and Uvea (Kirch 1976, 1981) has confirmed the expected presence of Lapita pottery on these islands midway between Fiji and Samoa (see map in Appendix 7).

The Futunan series is the most informative (Kirch 1976:43-47, 1981:135-37), especially the collection from the Tavai site (FU-11). There is a predominance of more or less vertically oriented rims of outward body-rim inclination, with divergent form and flat lips and
sometimes provided with thickenings. Rims of parallel form and some round lips also occur. Carinated sherds are hardly in evidence and typical Lapita decoration is totally unknown. The pottery is exclusively thin-walled, round-based and made from local materials. As regards vessel shape, only the jar form is represented, bowls and dishes being unknown except for the evidence of one surface-collected sherd, a rim with notched lip. The jars appear in detail to be readily identifiable with Tongan H and C vessels.

This Futunan pottery is surprisingly like late-period Tongan ware in manufacture (Kirch 1981:135) as well as general appearance. Jars have ordinary rims and not the collars they have in late Fijian Lapita and there is a lack of dish forms, which are quite common in Fiji but rare in Tonga at this stage. Heavy loop handles have parallels in both these other regions, while cylindrical pot legs are matched in Tonga only. The conclusion thus is that the Futuna pottery complex is definitely late in character and, interestingly, has its closest overall relationship in neither nearby Fiji nor Samoa but in the more distant Tongan group, in the material from Tongatapu. Unfortunately the relationship of the Futunan pottery to that on Niuatoputapu (Kirch 1978) cannot yet be properly assessed.

SOME COMPARATIVE OBSERVATIONS

Tonga-Fiji-Samoa

The general picture is that from a wide basic range of vessel shapes in the early Lapita of the major archipelagoes of the Eastern Lapita province, development over the course of time concentrated on a shortened list of original Lapita vessel types. The choice, however, varied between the regions: in Fiji, collar-rim jars and flaring dishes (and only few bowls); in Tonga, jars with uncollared rim and a less important component of open or restricted bowls/dishes; in Samoa, open or restricted bowls (and only few dishes). The key concept for future studies of this development is regional differentiation from an original common fund of ideas and standards. Somewhat paradoxically, this regionally independent differentiation followed a similar course towards simplification.

A look at Vanuatu

The archaeology of central Vanuatu has been published in detail by Garanger (1972). The material from the adjudged Lapita-affiliated Erueti site on Efate (Garanger 1972:29) is especially interesting in the present context because of the light it throws on a rather neglected aspect of Lapita ceramics, the plain ware (Garanger 1972:29, 110; cf. Golson 1971:70).

There is a variety of vessel shapes, including shoulder carination, and the presence of developed Lapita decoration (cf. Garanger 1972:28-29; Figs 9, 17-23). However, decoration of all kinds is rare, though incision and notching of vessel lips are more frequent than any other type. Jars with roughly vertical orientation of the rim and slight outward body-rim inclination, divergent rim form and flat lips are dominant (cf. Tongan H and C jars), while constricted bowls are rare (cf. Tongan A bowls).

Determination of the position of the Erueti material in a Lapita developmental sequence is difficult because at present it stands somewhat alone in its region, because it is distant from the province we have been discussing, with which some relationship seems to exist, and because at Erueti it is associated with pottery of the quite different Mangaasi tradition. Despite the difficulties, a late stage for the Erueti Lapita is nevertheless a reasonable suggestion on typological grounds, supported by a radiocarbon date of 2300 ± 95 BP (no. 18 of Table 83).
Some particular wider ceramic relationships

As would be expected, the early Tongan decoration proves to have close resemblance to the presumed mother style of Western Lapita (cf. Green 1979:40-44), the trend over the course of time being marked partly by simplification of the range of motifs as elsewhere in Eastern Lapita, partly perhaps by the development of local preferences, e.g. for applied band decoration and for the L motif (Fig.37), which latter may be an exclusively Tongan combination of elements. It is important to stress that many elements of the basic Lapita style of decoration have not yet been found in quantity in Tonga. Examples in the present material, e.g. motifs M, N and Q12-13 (Figs 37, 38, 41), 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.

Foreign parallels in the west to Tongan rim and other pottery features are difficult to give because decoration has attracted most attention so far in publication, though Golson's (1971) review has pointed other directions. A few observations are, however, possible.

Most puzzling is the absence of collar rims in the source area. The sherds that have been cited from Watom and New Caledonia do not provide convincing evidence (for Watom, Meyer 1909:Figs 5, 6, which may be illustrated upside down; for New Caledonia, Lenormand 1948:last plate, upper row, no. 3 from left; Avias 1950:Plate III.3, also upside down; Gifford and Shutler 1956:72, 75 (gambrel shoulder); Plates 16aj, 17q). All the more striking in this connection, therefore, is the identity in form and also decoration of collar-rim sherds found in western Micronesia in the Marianas (Spoehr 1957:112-14; Fig.50, lower row) and also in the Palau Islands, here called flanges and apparently falling late in the local sequence (Osborne 1966:99, 101, 103, 108, 146, 276; Figs 15, 19, 21-24).

Matched in New Caledonia are flat-base sherds, plain and decorated, loop handles and flat lugs (Gifford and Shutler 1956:72, 75). Ceramic pot rests are unknown in the west, but a possible pottery leg is reported from Watom (Specht 1968:127). Striation of the outer vessel surface is reported from New Caledonia (Gifford and Shutler 1956:Plate 12q-v, x).

Excavations at a Lapita site on Eloaue Island, at the northern end of the Bismarck Archipelago, have produced evidence for pots with cut-outs in the side (Egloff 1975:25, 29; Fig.12), similar in idea to the unique piece from an early context at To.5 (Fig.60.3; Plates 43.6, 53.13).

Definite and possible non-Lapita sherds on Tongatapu

To conclude this section, I leave wide-ranging survey for a brief discussion of a few sherds found during my work on Tongatapu, which may be foreigners in the total material.

Four sherds of thin, hard, medium-grey ware with applied bands and/or comma-like punctuations (Plate 50.4-6), surface finds from To.2, are as yet unmatched.

A sherd from Zone II of the early period midden at To.2 has a barely visible bas-relief stamped line, motif Q8 (Fig.40), without foreign parallels noted as yet (Plate 50).

One sherd (Plate 50.2), collected from the surface at Maka'unga, north of To.2, has parallels in incised ware from Fiji and New Caledonia (Gifford 1951:Plate 21, for Fiji; Gifford and Shutler 1956:Plate 14, for New Caledonia).

A surface sherd from the offshore islet of Monuafe near Nuku'alofa (Plate 50.7) has something in common with Mangaasi pottery from Vanuatu (Hébert 1963-65:Plate 9; Garanger 1972:Figs 72, 123, 125).

A white-clay sherd from Zone III of the early period midden at To.2 (Plate 49.18) bears an incised Q24 motif (Fig.41), which resembles some of the rather carelessly incised ‘Melanesian’ motifs represented in Father Meyer's Watom material (e.g. Garanger 1971:Fig.12) and on sherds with incised decoration from Vanuatu (Hébert 1963-65:Plate 1; Garanger 1972:Fig.24),
New Caledonia (Gifford and Shutler 1956:Plate 13f-g) and Fiji (Gifford 1951:Plate 21, lower group).

Obviously further examples, preferably provenanced to defined horizons, are required in order to determine the implications of such apparently foreign sherds. At the moment the list can do no more than suggest possible connections with the Melanesian area. Because it contains many surface finds, we cannot know to what period such presumed influences refer, except the last-mentioned early-period case from To.2. To conclude, we should note the presence of Fijian sherds in the northern Tongan islands (section 1.2 above) and the Fijian origin considered for the thick-walled sherd of bright reddish ware from the surface at To.2 (under Sigatoka Type 2 in section 3.2 above).

THE CHRONOLOGY OF EASTERN LAPITA

There can be no doubt, however, that the branch of the Lapita ceramic tradition that established itself in Tonga developed as a native style without much foreign influence.

We have concluded that the development of Eastern Lapita pottery is characterised by a shared trend towards simplification coupled with regional differentiation as regards vessel shape, an essential ceramic aspect. This is accompanied by a similar trend in the decorative systems (cf. Mead 1975; Green 1976, 1978, 1979). The question now is the nature and the timing of the development in question. Did the trend begin about the same time everywhere or at different points in time? And behind all this, was the area settled from only one, external mother community from which a differentiation subsequently took place in all the regions, or were two or more related external groups responsible for the settlement at the same or different points in time, followed similarly everywhere by the developmental trend identified?

In what follows I assume that the ceramic evidence is suited to throw light upon problems of this kind, though the more convincingly, the more detailed the pottery spectra at hand from the relevant regional sequences. Table 83 gives the available radiocarbon dating evidence.

Fiji and Tonga

In Fiji the early Lapita period begins with the base of Natunuku, followed by the base of Yanuca. The relevant radiocarbon dates are nos 2 and 4 of Table 83: 3240 ± 100 BP, calibrating to 1420-1640 BC, and 2980 ± 90 BP, calibrating to 1190-1385 BC. Though defining the end is difficult, because of limited data and the consequent uncertainty as to the possible existence of a local middle period, it seems to have lasted a long time. The end date is in all probability provided by a sample (no. 14 in the table) for either the top of the Lapita occupation or the bottom of the subsequent ceramic phase at Yanuca, giving 2660 ± 90 BP or 795-905 BC (cf. Groube 1971:283 and fn. 39). The possibility exists, however, that it could be closer to the date for the base of the late Lapita occupation at Sigatoka, 2460 ± 90 BP or 400-790 BC (Table 83, no. 17).

Beginning about this date, the late Lapita in Fiji must end sometime prior to 1720 ± 80 BP or AD 225-415 (no. 24 of Table 83), the date for the post-Lapita Level 2 at Sigatoka (Birks 1973:57).

The earliest well-defined and reliably dated Lapita in Tonga is at To.2, at 2650 ± 95 BP*, calibrated to 800-920 BC (Table 32). However, a slighter older date from To.1 of 820-1050 BC (no. 2 of Table 32) is likely to be associated with human occupation. Both overlap with the later part of the early Lapita in Fiji. It should perhaps, therefore, occasion no surprise that the Tongan early Lapita is different from the early Lapita in Fiji at Natunuku and Yanuca.

This consideration is directly relevant to an understanding of the course of settlement in the Fiji-Tonga-Samoan triangle.
If indeed Fiji is the place of origin of this settlement, the Tongan branch as represented at To.2 could well be an offshoot of a stage in Fijian Lapita development not yet established. Alternatively, the Fiji-Tonga-Samoan triangle was settled from outside by one, two or more related groups.

Take the case of the collar rims, apparently lacking in early Fijian Lapita, common in early Tongan Lapita at a later point in time. Their Tongan presence may mean either a different outside origin for Tongan Lapita than the Natunuku/Yanuca Lapita of Fiji or local invention in Tonga or, for that matter, in Fiji, at a stage not yet discovered. Some of the many other differences between the known early phases in the two regions might be interpreted in a similar way. Whatever the specific origin of early Tongan Lapita, it appears at a different stage of development compared with the Natunuku/Yanuca Lapita. The evidence from Sigatoka Level 1 indicates that the preceding stage in Fiji, the middle phase, would be as different from the Natunuku/Yanuca Lapita as is the early Tongan Lapita. This missing link in the Fijian Lapita chain could in fact be identical with the latter and represent its origin.

The early Lapita period not only started but also ended earlier in Fiji than in Tonga. This difference in end dates underlines the paradox to which I have referred, a common trend in pottery development taking place in regional independence.

**Samoa and Tonga**

We now turn to the chronology of Samoan Lapita. There is one radiocarbon date for its early stage, represented so far by the material from one site, the submerged deposits at Mulifanua. The date is NZ-1958B, 2890 ± 80 BP on the old half-life (Jennings and Holmer 1980a:10), which calibrates to 1120-1255 BC (Table 83, no. 6). This is somewhat older than both the earliest securely dated Tongan Lapita at Site To.2 (800-920 BC) and the oldest date on record likely to be in human association (820-1050 BC) (see nos 3 and 2 respectively of Table 32) and overlaps with the basal Yanuca date (no. 4 of Table 83) for early Fijian Lapita (1190-1385 BC).

The first dates for late Samoan Lapita were based on a series of charcoal samples (Green and Davidson 1974a:216-19; Table 23) putting the Plain Ware sequence into the general period 300 BC to AD 200 or 300 (Green 1974d:247-49). Some of the relevant dates are included here in Table 83 as nos 19, 20, 22 and 23. Subsequent excavations of coastal pottery-bearing sites in western Upolu and on the island of Manono off its northwest coast have produced a somewhat more complex picture (Jennings and Holmer 1980a:6; Holmer 1980:115), but in chronological terms the results extend rather than challenge the previous conclusions. Dates for occupation at Faleasii'u (Stratum II) and Falemoa (Stratum II) (Jennings and Holmer 1980a:6, 9-10, for the former NZ-2726B, 2727B, 2728B, for the latter NZ-4343B) take the beginnings of the phase back to about 800 BC (cf. nos 15 and 16 of Table 83). However, the latest dates associated with pottery there and at Potusa (Stratum II) (Jennings and Holmer 1980a:Table 1) fall somewhat short of those for the previously excavated sites reported by Green.

Green (1974d:248-49) argues that pottery production ceased on Upolu between the 3rd and 6th centuries AD and probably earlier in this interval than later. The upper limit for the corresponding development in Tonga is set by the radiocarbon date (no. 13 of Table 32) for Oven M at Site To.2, AD 380-530. The latest secure date for pottery use is from Vuki's Mound, 385 BC-AD 50 (no. 10 of Table 32). The chronologies for neither Tonga nor Samoa are particularly tight on the point, but the general contemporaneity of cessation for a craft that had been in existence for a millennium and more is striking.

**Summary: Fiji, Tonga, Samoa**

As far as the settlement of the Eastern Lapita province is concerned, the available evidence of absolute chronology indicates that Fiji was first settled by the middle of the second millennium BC, followed by the roughly contemporaneous settlement of Tonga and Samoa.
towards its end. At the present stage of investigation and publication it is archaeologically impossible to suggest the exact origin of the first Lapita settlement not only of Fiji, but also of Tonga and Samoa, though a Tongan origin for early Samoan Lapita rather than a Fijian one could be argued on ceramic evidence, though not at present on chronological grounds.

I have already said that the end of pottery production is not particularly well dated in either Tonga or Samoa, though in both it probably occurred in the early centuries AD. About the same time Lapita, at least as a recognisable entity, ceased in Fiji, by the evidence of a date of AD 225-415 (no. 24 of Table 83) from a post-Lapita level at Sigatoka.

Over the previous hundreds of years of ceramic history in the three archipelagoes, there is regional divergence in pottery development, though a common trend towards simplification over time. It remains for future research to tackle the difficult problem of why and how this came about. Obviously analysis of other aspects of culture than pottery is required for this.

**Futuna and Tonga**

The Futuna pottery presents interesting possibilities of interpretation. It is so similar to late Tongan Lapita as to suggest a direct link, while the radiocarbon date for Tavai of 2120 ± 80 BP (no. 21 of Table 83), which calibrates to 305-355 BC, provides support, since pottery production on Tongatapu went on beyond this date, by the evidence of Vuki’s Mound (Chapter III, section 11.2). Whether the link was with Tongatapu itself or with Niuatoputapu (section 1.3 above) is yet unclear. At any rate we now have evidence of a Tongan Lapita wedge, at least in the late period, intruding between the two other main regions of the Eastern Lapita area, Fiji and Samoa. It is interesting to see that Tongan interest in these distant islands is not confined to the end of the prehistoric period.

**THE RELATIONSHIP OF EASTERN TO WESTERN LAPITA: CHRONOLOGICAL PROBLEMS**

Green (e.g. 1979:42-43, 45) has made a case for a simple west-to-east progression for the arrival of Lapita in the Fiji-Tonga-Samoa triangle. This is based on a particular interpretation of the fact that Lapita in the west is more complex and sophisticated than it is in the east. Green’s thesis might in fact be read the other way. Why should the most complicated and sophisticated stage necessarily be the oldest and represent the geographical source of origin, with subsequent development everywhere leading exclusively to simplification, disintegration and impoverishment? Would it not be equally feasible that it took some time for the most complicated and sophisticated stage to be reached?

The following argument is based on Green’s (1979:42-43) analysis of the Lapita style, establishing a differentiation between western and eastern sites, but recasts it in terms of sites of low-, medium- and high-order stylistic development. The point I wish to make is that while the known stylistic climax is of medium order in Eastern Lapita and of high order in Western Lapita, the present evidence, with the exception of the Elauea site discussed below, is that the former is earlier than the latter. To make this point, I take the oldest radiocarbon dates for Lapita sites outside the Eastern Lapita province from the list of ‘most reliable radiocarbon age estimates’ published by Green (1979:Table 2.1). As will be noted, my calibrated results differ from those of Green not only because I have used a different calibration method (see Appendix 3) but mainly because of the correction factor I have applied to dates on shell (also Appendix 3).

I begin with two dates, both on charcoal, from the Main Reef Islands of the southeast Solomons, nos 5 and 11 of Table 83. In order they are 2955 ± 95 BP and 2775 ± 100 BP and they calibrate respectively to 1340-1380 BC (or 1020-1320 BC, as the calibration curve is cut twice) and 830-1050 BC.

Also from the southeast Solomons, we have two dates from Santa Cruz, nos 9 and 13 of Table
83, both on shell. According to H.A. Polach (in Appendix 3), the Sydney University Laboratory which ran these dates reports results conventionally, so that dates on shell must be corrected for environmental effect. For particular reasons which he explains in Appendix 3, Polach advised me to subtract 410 years from the reported age. Doing so gives corrected ages (\(^*)\) of 2840 ± 80 BP* (no. 9) and 2730 ± 80 BP* (no. 11). These calibrate respectively to 1205-1210 BC, 970-990 BC, or, alternatively, 900-1190 BC and 810-950 BC, as both cut the calibration curve in two places.

There are two dates in Green’s list from northern Vanuatu, the island of Malo. Both are on shell and run by the Australian National University Laboratory, which, like the Sydney University Laboratory, reports ages conventionally. As before, a correction factor of minus 410 years is in order, giving corrected ages of 2740 ± 75 BP* and 2570 ± 75 BP*. I have only entered the older of these two dates into Table 83 (no. 12). It calibrates to 820-990 BC.

Of the New Caledonian dates in Green’s table, I was tempted to ignore the two (both on charcoal) from Gifford and Shutler’s Site 13 (1956:89) as not only presenting problems of interpretation due to stratigraphic inversion but also having such large errors (±350, ±400) as to be useless for the present exercise. However, I include the older, stratigraphically higher, sample as no. 10 of Table 83: 2800 ± 350 BP, calibrating to 820-1430 BC. The entry for Ile des Pins in Green’s table is no. 8 of Table 83, on charcoal, 2855 ± 165 BP, calibrating to 840-1300 BC. I include an additional date of similar age reported subsequently to Green’s 1979 publication. It is from the Nessadiou site of Frimagacci (1980:7 and fn. 1). Number 7 of Table 83, and presumed to be on charcoal, it has a radiocarbon age of 2875 ± 115 BP, which calibrates to 915-1260 BC.

The New Caledonian evidence for Lapita has recently been critically reviewed by Green and Mitchell (1983:31-41), with particular reference to its chronology. A major point of discussion is the age of the basal layer (Layer 4) at the Vatcha site on Ile des Pins, where Layer 2 is dated by the already mentioned no. 8 of Table 83 to 2855 ± 165 BP (840-1300 BC). Layer 4 itself has a radiocarbon date of 4010 ± 130 BP, from the Gakushuin Laboratory (Frimagacci 1970, 1974:69 fn. 1). As a single date on landsnail shell (Placostylus), Green and Mitchell, like the excavator, Frimagacci, before them, treat it with caution (Green and Mitchell 1983:39). However, on the basis of stratigraphic, geological and ceramic evidence, they favour some antiquity for it and estimate its age between 1400 and 1600 BC (Green and Mitchell 1983:39; cf. Frimagacci 1981:115).

Apart from this estimated age, all the other dates reviewed allow the possibility of a medium-order stylistic climax, represented by Natunuku (no. 2 in Table 83), being early in place in Fiji and exerting its influence westwards. From this point in time the style would have developed further only in the west, exhibiting high-order climax at the Reef Islands/Santa Cruz sites, for example, some centuries later. Meanwhile the process of simplification was getting under way in the east, accompanying the widening settlement there.

This interpretation would require the presence in Fiji and westwards of low-order sites representing the original movement of Lapita settlers into the area and medium-order sites in the west representing the postulated back-movement from Fiji. Since, however, no such low- and medium-order sites have yet been found, it is equally possible to suggest that the evolution from low-order to high-order status took place in western Melanesia on sites yet to be discovered.

A further possibility to be considered, of course, is that the Lapita style entered the Melanesian area already fully formed, even though no homeland for it can at present be suggested. This possibility is raised by early dates for Lapita pottery obtained at a site on Eloaue Island at the northern end of the Bismarck Archipelago, where the few sherds illustrated in the preliminary report (Bafmatuk et al. 1980) represent the mature and sophisticated Western Lapita style (for other Lapita sites on Eloaue, undated, see Egloff 1975:15-31).
The dates in question actually pose a problem. Both of them were run on charcoal extracted from a lump of coral excavated in an oven and thought to be the product of the disintegration by heat of coral cooking stones and their subsequent consolidation as cement under the action of water (Bafmatuk et al. 1980:78, 80). Charcoal from the upper half gave 3030 ± 180 BP (no. 3 of Table 83), calibrating to 1000-1500 BC. Charcoal from the lower half of the oven is dated to 3900 ± 260 BP (no. 1 of Table 83), which calibrates to 2120-2880 BC. The authors think that the upper sample may have been contaminated by more recent garden charcoal and prefer the older date, which would be the oldest date for Lapita yet on record. One implication of the acceptance of this date is that the elaborate Lapita style was current in western Melanesia for something like a millennium and a half. We should note about the two dates, however, that they overlap at two standard deviations.

We may conclude by remarking that much of the problem of internal Lapita relationships revolves around the question of radiocarbon dates, their validity, comparability (as, for example, between different materials) and calibration in terms of calendar years. On the evidence as we have it, however, it appears that it is too early to be certain that the Lapita ceramic phenomenon underwent crucial aspects of its development in the west and not in the east. A greater integration of the Western Lapita exchange system (Green 1979:44) may have encouraged further development there that simply did not take place in the east, where initial settlement beyond Fiji was everywhere also the developmental climax, at least ceramically.
VI MATERIAL CULTURE AND TECHNOLOGY

The material to be described in this chapter has been organised, as far as practicable, into functional classes, so as to give at a glance an idea 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. Class 9 covers aspects of raw materials and their use. In each case the distribution of the implements through the Tongan sequence is reviewed. Extra-Tongan parallels are sought, as far as the published evidence allows. The general implications of such distributions and parallels are then discussed.

THE DISTRIBUTION OF MATERIALS WITHIN SITES

The question of stratigraphic integrity

In contrast to the potsherds which have been dealt with in preceding chapters, the items now to be described generally occur in small numbers. We can no longer rely on sheer volume of finds to cancel out the effects of stratigraphic displacement due to disturbances of various kinds, something we could do with the potsherds, whose abundance allowed the coherent definition of periods in terms of their ceramic characteristics (Chapter III). It is obvious from the excavation reports of Chapter II that there are differences in stratigraphic integrity between the various excavated sites, and between different horizontal and vertical segments of each of them. Thus the midden at To.2, protected from disturbance for a considerable amount of time by the burial mound built over it, and the deeply buried lower horizons at To.5, with a coral-limestone basement not far below to inhibit pit digging while the early occupation of the site was in train, give a marked degree of reliability of provenance to the materials excavated there. The case is much less clear with Trenches I and III at To.1 and with parts of the To.6 excavation, where pit digging has disturbed the occupation deposits in ways for which the excavations were not normally able to control.

Before proceeding, therefore, to a description and assessment of the classes of material culture in question, I propose to look at the horizontal and vertical distributions of the finds to see if any patterning exists at individual sites. Recognition of such patterning should allow more confident assessment of the chronological status of items of less secure stratigraphic provenance where these are consistent with well-established patterns of occurrence. Also, it should add to our knowledge of the functions of the sites.

Distributions at To.1

At this site 165 artifacts were excavated belonging to the classes of material culture which are the subject of this chapter. This total includes 52 Anadara net sinkers (Class 3D), but this is not a representative sample since they were not systematically searched for during the excavations here. The following discussion will omit them from consideration. Also omitted are 13 artifacts found in test pits away from the main excavation and 16 fragments of worked shell counted as one artifact since they could possibly belong to the same piece and represent a broad bracelet (Class 5B). With one exception these fragments came from the 'small area' of Trench I discussed below, the exception falling a couple of metres beyond. We are thus dealing with 99 items.

Trench I

Of the 99 items, 72 were excavated in Trench I (38 m²), with 41 of the 72 being found in a small (6 m²) area between Pits A and P (Fig.7). Only three of these 41 finds were made in spits belonging to or at the level of Horizon II: a piece of red ochre and a stone-adze fragment
were found at the very top, actually in the topsoil, while another piece of red ochre, from a disturbed square (82/57; for disturbed and undisturbed squares see Chapter III, section 10.1), came from Spit 2, which is at the level of lower Horizon II. Eleven finds were made in the fill of pits below the level of the surrounding subsoil: three in stratigraphically later pits, M (a piece of red ochre) and N (an awl and an adze fragment); and eight in features of unknown stratigraphic status, K (three ornaments), L (four ornaments) and Q (one ornament). Two other finds, from depths equivalent to the bottom spit of the Horizon I midden, may just belong to the fill of an undated pit, K (two ornamental items). Twenty finds came from spits belonging to or at the level of Horizon I: nine (a fish gorge, five ornaments, one bowling stone and one piece of obsidian) were from the lower spit of the horizon in undisturbed squares and thus definitely in the base of the early-period midden, while two ornaments were in disturbed squares in the equivalent spit; five items (four ornaments and a bowling stone) were found in the upper spit of Horizon I in undisturbed squares and thus are safely early period, while three other items (a complete adze, an awl and a coral grinder) belong to the equivalent spit in disturbed squares; the nineteenth piece is an ornament at the interface of the upper and lower spits in an undisturbed square. Three further pieces, two of them definitely ornaments and the third possibly so, were found in the subsoil beneath the midden, two of them in disturbed squares. Finally, there are two ornamental items of uncertain stratigraphic provenance.

I wish to make two observations following the above display of data. Firstly, the finds were predominantly made in the lowest levels of the site: three came from Spits 1 and 2, equivalent to Horizon II, eight from Spit 3, equivalent to the upper part of Horizon I, and 27 from Spit 4 (equivalent to the lower part of Horizon I) or below, while one was on the boundary of Spits 3 and 4 and two are of uncertain provenance. Secondly, ornaments predominate: no less than 27 out of the 41 items belong to the ornamental class, Class 5, while an additional piece (Class 7: unique pieces) may be ornamental also. These two circumstances apply whether the finds are provenanced to undisturbed midden, or to the fill of pits, or to contexts where disturbance by pit digging is a possibility. Since the occurrence by midden horizon and by undisturbed/disturbed squares are independent variables, this evidence would seem to be in favour of only restricted disturbance of the artifactual material recovered in this part of Trench I.

All this could suggest some focus of early specialised activity in Horizon I, partially disturbed by subsequent pit digging and with some artifacts possibly displaced into later stratigraphic contexts by such activity (cf. the discussion of the tattooing chisels, Class 5Q, section 9.22 below). I therefore regard finds from this small area of Trench I as highly likely to be early. The finds in the rest of Trench I, north and especially south of the small area just dealt with, are relatively fewer in number (31) and less concentrated, not only horizontally but also vertically. There are 11 items recorded in the shell-midden spits, seven at the level of Horizon I and four at that of Horizon II. The Horizon I finds are three ornaments and an awl from undisturbed squares, two ornaments and an adze fragment from disturbed squares. The Horizon II finds are an adze fragment and a piece of raw material from undisturbed squares and the same from disturbed squares. Another six midden finds are of uncertain horizon provenance, being four ornaments and two stone-adze fragments. There are two finds from subsoil contexts, both from disturbed squares, an ornament and a piece of raw material. Finally there are 12 finds from the fill of structures: three from early pits (an ornament, a coral file and an awl), eight from stratigraphically later pits (four ornaments, three tools and a piece of raw material) and an ornament from a small undated hole.

The 31 finds described above are, in contrast to the small area of the trench, almost equally divided between ornamental and technological items, 16 of the former, 15 of the latter, including seven fragments of stone adzes and four pieces of raw material, being red ochre. There is no pattern of occurrences, therefore, as there was for the small area of the trench, which would give me confidence to suggest an original provenance for finds actually or possibly affected by pit digging: seven finds from disturbed squares, eight from stratigraphically later pits and one from a small undated hole; to which are to be added six
midden finds of uncertain horizon provenance. The dating of all these items must remain, therefore, uncertain.

Trenches II-V

As regards the other excavated trenches, not only were the finds made there which fall into the categories dealt with in this chapter fewer in number (27), but amongst them technological items (21) were more numerous than ornamental ones (6). There are some interesting additional points. No finds were made in Trench II and only three in Trench V and that at the very end, Squares 60-61/75, closest to Trench IV. This trench produced 19 of the 27 finds in the four trenches now under discussion.

The vertical distribution of the 22 finds from Trenches IV and V combined is similar to that of Trench I, and especially of the small area, in that most of them belong to the lower spits. Thus only three finds were made in Horizon II midden (an ornament from Trench IV and a piece of red ochre from Trench V); a stone-adze fragment from Trench V came either from the bottom of Horizon II or the top of Horizon I; and three finds came from the top 20 cm of Horizon I midden, all from Trench IV, 25-45 cm below the surface, a stone-adze fragment, a shell adze and a shell bracelet. In Horizon I, however, between 45 cm and 75 cm below the surface, there were no fewer than 11 finds, all from Trench IV with the single exception of a coral file from Trench V. Finally, four finds were made in the fill of two early pits of Trench IV, AP (1) and AQ (3). There are no pits in Trench V, where between 45-60 cm below ground surface in Horizon I there is evidence of extensive fires (Fig.5), as well as the presence of undated postholes. This raises the possibility of some interrelatedness between the two trenches: Trench V containing fires and (?) house structures and only three finds of the types under discussion; Trench IV, 4-11 m away, pit structures and many finds.

To round off this survey, we may note that five finds were made in Trench III, four of them from Pits AF and AH, for which I have argued a middle-period date (cf. Chapter III, the discussion of pits in section 11.4), the fifth being undatable.

Concluding observation

As regards the excavated parts of the site in general, the much greater concentration of finds in the early-period levels is striking. I estimate, using the lines of argument developed above, that 25% of the 99 finds under discussion cannot be dated, but that 60% of them can be firmly or reasonably attributed to the early period.

Distributions at To.2

The interpretation of this site is that part of a midden of the early period was covered and thus protected by a later burial mound, the material for the build-up of which was derived from other parts of the midden and from other early-period deposits presumably close by (cf. Chapter III, section 10.2). This interpretation is based on the evidence of excavation, on the analysis of the ceramics from the midden and from the mound, which showed no differences from each other, and on the demonstration that some pieces recovered from the mound fitted together with pieces recovered from the midden. I conclude, therefore, that material-culture items of Classes 1-9 from the mound are highly likely to have been transferred together with pottery from early contexts. This is a matter of no small importance, since no fewer than 68 come from the mound (including two joining pieces of stone adze counted as one), as compared with 154 from the midden, while 65 items are held to be uncertain. Below the burial mound the early-period midden is not significantly disturbed by structures and most of these are contemporary with the build-up of the midden itself (Figs 11-13).

The small scale of the excavation at To.2 does not make it profitable to pursue questions of artifact distributions within the undisturbed midden. We should note, however, that both technological and ornamental categories are well represented, and generally so through the levels.
Distributions at To.3 and To.4

The very small excavations made at these sites make it impossible to discuss the distributional aspects of the items of Classes 1-9 discovered there, of which in any case the numbers are small: 20 at To.3 and eight at To.4.

As regards chronology, this will be discussed when the items themselves are reviewed with the classes to which they belong.

Distributions at To.5

At this site (Fig. 18) 137 items in the classes under review were excavated, 62 in Trench I and 75 in Trench II. However, of the total, no fewer than 94 are of one class, 3D, *Anadara* net sinkers, of which 24 were found in Trench I and 70 in Trench II.

Trench II is an area where the shell-midden deposits of Horizons I and II have been disturbed by various diggings (A, AG, AH, AM), which, however, do not penetrate more than half-way into Horizon I (Fig. 20). In levels below the range of this disturbance, and therefore securely early period in date, 27 of the 70 net sinkers of Trench II were found. It is hard to think that the next immediately higher levels were extensively disturbed, so that the 23 specimens found here are highly likely to be early period also. Of the remaining 20 net sinkers from this trench all but one are referable to spit and they are distributed in small numbers through the upper levels; some or all could well have been displaced from the deeper parts of the trench, where they were abundant. The same pattern of vertical distribution is shown by the fewer net sinkers of Trench I.

It is evident that finds in categories other than that of net sinker were few, and in Trench II almost non-existent. In Trench I, where 38 of the 43 other types of find were made, the great majority (26) came from the lower levels (Horizons O and I) most secure from disturbance by later pit and posthole digging. In this trench the technological items of Classes 1, 2, 8 and 9 are four times as numerous as the ornamental items of Class 5 (25 against six), while in Trench II there were no ornaments. We may also note the presence of other items of fishing gear, in the form of octopus lures (Class 3C), to add to the numerous net sinkers already discussed.

Distributions at To.6

*The base of the midden*

Besides the question of possible site disturbance by later digging, there is the problem, treated at length in previous chapters (see especially Chapter III, section 10.3), of the nature and composition of the middle-period occupation at the site. The fact that of the 221 items (counting as one the joining pieces of a stone adze) recovered from the site, 37 were recorded from the bottom spits of Horizon I, incorporating some middle-period potsherds, makes it a matter of some importance. This is particularly so in respect of stone adzes, for of the 31 classifiable whole and broken adzes (two of them each comprising two joining pieces) and 43 unclassifiable adze fragments recovered by my Tongan excavations overall, no less than 21 of the former (one of two joining pieces) and 16 of the latter were found at To.6, six of the classifiable specimens coming from the bottom spits of Horizon I. As a result the stratigraphic evidence relating to each of the To.6 adzes is discussed in detail in the relevant section of this chapter.

To anticipate the conclusions there, it is argued from their nature, size and condition that the adzes found in the bottom spits of Horizon I are much more likely to belong to the earliest stages of the late-period occupation at the site than to have been left over from the middle-period occupation. The fact that amongst the 31 finds other than stone adzes in the bottom spits no less than 24 are complete or practically so (Classes 2A (1); 3C (9); 3D (4); 4B (1); 5C
(1); 5D (2); 5G (1); 6 (2); 7 (1); and two pieces from Class 8) argues in favour of looking upon these at least as part of the late-period occupation: the other seven items are two pieces of stone raw material (Class 9) and five fragments of, or broken, tools of Class 8 (stone cutters, coral and stone grinders). Where necessary, a specific discussion of chronological problems will be taken up during the individual treatment of each category in the sequel. It may be noted that all classes of item represented in the bottom spits of Horizon I at To.6 occur in later levels (i.e. Horizons IT-III), with the exception of Classes 4B and 7.

The site in general

I now turn to the vertical and horizontal distributions of the materials at the site, taking only the datable evidence into account, 189 items in all, of which, however, four adzes have 'either/or' horizon designation. The 185 items left contain many more technological than other pieces - Classes 1, 2, 4 = 20.5%; Classes 8, 9 = 35.5%; Classes 5, 6, 7 = 16%; the fishing gear of Class 3 = 27.5% - and this pattern, in comparable proportions, is typical of the three horizons (I-III) taken separately. What is notable is the regular drop in numbers of items over time, with 52% of the 185 pieces under review found in Horizon I, 30% in Horizon II and 18% in Horizon III, and all four broad combinations of classes employed above (Classes 1, 2, 4; 8, 9; 5, 6, 7; 3) being affected. This decline is all the more striking when we consider the volume of earth represented by the three horizons: 99 spits in Horizon I, 74 in Horizon II and 232 in Horizon III, giving 100 items respectively from 103, 134.5 and 682 spits. It is interesting to recall that pottery by weight also appears to be less in the top horizon (III) of To.6, as indeed in that (also Horizon III) of To.5 (Table 79, referring to the discussion at the end of Chapter IV, section 16). This I have tried to explain in terms of the decrease in manufacture and use of pottery over time.

If we look at the spatial distribution of items within Horizon I, the observations to be made apply equally whether they relate to the lower (IB) or higher (IT) spits, or just to Horizon I generally. Industrial tools (Class 8) and the raw materials on which they functioned (Class 9), at least those of shell, were largely localised to the open spaces between the groups of early ovens (Fig.24). Some of the fishing gear was found in the same general area and could be the product of the manufacturing activities represented. Other classes of artifact of Classes 1, 2, 4, 5 and 6 overlap these occurrences but extend to the north of them. It is difficult to interpret these distributions with the evidence available, but the presence within Horizon I of ovens, hearths and postholes, together with the occurrence of serviceable stone adzes, shows that we are dealing not simply with midden dumping, but with habitation and associated activities (cf. Chapter II, sections 10.4-6 and 11).

Within Horizon II, with its smaller number of items, different classes do not separate out as in Horizon I. However, about 45% of the items overall were found towards the southern end of the main excavation and the western end of Trench I. This coincides with a similar concentration in Horizon I, in the area of the ovens and hearths K, N, M and DN, thus suggesting some kind of continuity in the use of the site. Also the two soft areas of Horizon II (Fig.24) correspond in a general way to the major distribution of items within Horizon I, again supporting the idea of continuity. The same conclusion was reached as a result of the analysis of the structural evidence at the site (Chapter II, section 10.7).

As regards Horizon III, the shell midden and structural evidence of this phase cover a more extensive area than previously and the deposition of the items of material culture and technology dealt with in this chapter follows the same pattern. However, there are concentrations at the southern end of Trenches II-VI/the western end of Trench I and at the northern end of Trenches II-VI, overlapping respectively the main concentration of Horizon II and a weaker one around Pit W. The seven stone adze items of Horizon III were evenly represented in both clusters, while the two shell adzes and the Class 2 artifacts were found in the southern one. We may note finally that plotting the distribution of plain potsherds by weight reveals concentrations in each horizon which tend to coincide with or lie adjacent to the concentrations of other items described above.
Concluding observations

The conclusions to be drawn from the above discussion, seen in the context of the information about To.6 set out in Chapter II, is that a wide range of activities was carried out at this site, with some continuity in type and localisation throughout its use in the pottery period. Post-ceramic disturbance of the deposits no doubt occurred, but apparently not on a large scale. Discussion of various classes of artifact in the sequel will try to take note of this, where appropriate.

Implications for site functions

The evidence of material culture and technology reviewed above tends to support the conclusions already drawn from the structural features uncovered by the excavations (see Chapter II, section 11), that much more was happening at the sites, especially To.1 and To.6, than the mere dumping of rubbish. This is confirmed by certain circumstances of occurrence to which I shall draw attention in the review of the classes of material culture and technology on which we are about to embark. They are: the striking proportion of whole items in the excavated stone-adze collection (Class 1), nine out of 23, excluding fragments, and in the corpus of long ornamental units (Class 5D), ten out of 27; the find spot of the tattooing chisels (Class 5Q) at To.1 and its associations; and the particular representation of industrial tools and waste (Classes 8, 9) at To.6.

STONE ADZES (Class 1)

The present corpus

Because of the lack of a published ethnology of Tonga and because McKern’s unpublished manuscript on Tongan material culture (McKern n.d.:422 ff) has very little to say about adzes, our knowledge about this important tool category is very restricted.

The present collection of 62 adzes therefore constitutes a major addition to the available corpus. For this reason all examples have been drawn (Figs 62-75) and some have also been photographed (Plates 60-65). The 23 excavated adzes and eight classifiable fragments are essentially 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 plus three classifiable fragments 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 and studied in 1957 by J. Golson, who kindly made available to me his drawings and accompanying notes; Golson states that few of these adzes are localised.

It is worthwhile emphasising the large proportion of whole adzes in the excavated collection: two of the three examples from To.5 and seven of the 21 from To.6, in addition to an adze blank. This must have implications for site functions, as mentioned above (section 1.7).

Besides the adzes, the eight classifiable excavated adze fragments are described and two are illustrated (Figs 71, 74). In addition to these eight fragments are two others, To.2/5, joining To.2/73 to make specimen E1 of Figure 71, and To.6/50, joining To.6/167 to make specimen E10 of Figure 72, separately entered in Table 84, which sets out the distribution of all the classifiable specimens of excavated adzes. Table 84 also gives the distribution of 43 excavated and six surface fragments from ground-stone cutting tools, presumably adzes, which cannot be classified in the system by which the larger and more complete specimens have been ordered.

In the following discussion I use the terminology of Davidson (1961) (cf. Hewitt 1980:132).
Technology and raw material

Technology

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

Most adzes have been given or have acquired 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 eight adze fragments actually brought back from Tonga.

Raw material

These 38 adzes, 23 excavated and 15 surface finds, were inspected by A.J.R. White (1966, Department of Geology, Faculty of Science, Australian National University), who chose five of the excavated adzes for detailed petrological examination (Appendix 7). Of these, two, T.5/38 (E3) and To.6/158 (E11), 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 (E12), is an altered fine-grained porphyritic andesite belonging to the association 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 (1966, the then Department of Anthropology and Sociology, Research School of Pacific Studies, Australian National University). To.6/32 (E18), a fine-grained grey adze, proved to be a finely laminated trachyandesite and To.6/171 (E22), an adze of distinctively 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 islands of Ha'apai. To anticipate the chronological section, we may note that both sources were being exploited early (To.1/1914 (E12), To.5/38 (E2)) and late (To.6/158 (E11), To.6/171 (E22)).

Two of the adzes selected by White for close examination are, however, foreigners. To.6/20 (E21) and To.6/170 (E5) are of hawaiiite, 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 to the north or from the Loyalty Islands or Vanuatu to the west, to name the nearest sources. The chronological position of the adzes in question will be discussed later (e.g. section 2.18 below).

Typological considerations

The adzes do not readily fall into Duff's (1959) classification, largely based as this is on Eastern Polynesian forms. Rather than attempt to erect a typology of the small number of adzes available, the material has been organised into groups by the criterion of cross-section. This choice was deliberate. Traditionally, Melanesian adzes have been differentiated from Polynesian adzes this way (lenticular to round cross-section, 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 (1930:334-56)
differentiates his types mainly by cross-section, as do Green and Davidson in their study of these adzes (1969). The results of recent archaeological work involving adzes in other Pacific islands were also taken into consideration (especially Suggs 1961:105-15 (Marquesas); Emory and Sinoto 1964 (Society Islands); see also Green 1971, 1974d:253-65). By organising the Tongan material by cross-section some comparability with adzes from other areas and regions 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 (Duff 1959; Green 1971:36-37). 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 sharply cornered and (2) fully or partially curvilinear cross-section, and (3) miscellaneous adzes. Each of the two main groups has a number of subdivisions, designated with a small letter. All references to Duff adze types are to Duff 1959. All references to Samoan adze types are to Green and Davidson 1969, abbreviated to G/D. See also Green 1971:Fig.2 for correlations between the various adze classifications available at that time.

Group 1

1a (Figs 62, 71): cross-section severely quadrangular to more rounded quadrangular, the front of the same width as the back or very slightly wider. Represents Duff Type 2A and some of his Type 2B. There is no corresponding category in the Samoan material.

1b (Figs 63-65, 72): cross-section trapezoidal with front slightly narrower than back and narrower towards the poll than at the cutting edge. Equivalent to Duff Type 2C, the so-called West Polynesian adze type, and to G/D Type III.

1a/b (Figs 66, 67, 72): established to include a common variety of Tongan adze, with only few parallels elsewhere, where an adze of basically quadrangular cross-section 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 the corner), extending the whole length of the adze or affecting only the butt. In Samoa this is G/D Type Id (see also Green 1974b:133).

1c (Figs 67, 72): cross-section clearly trapezoidal, with front wider than back. Compare Duff Type 2A in part for cross-section. Contained within G/D Type IV.

1d (Fig.68): triangular or subtriangular in cross-section, apex to front. Duff Type 4E. Compare with G/D Types VI, VII.

1e (Fig.69): triangular cross-section, apex to back. Duff Type 3G and G/D Type VIII.

Group 2

2a (Figs 69, 73): cross-section lenticular, oval or round. There are no true sides and the transverse planes of front and back are strongly curved. I do not attempt to differentiate further. Not catered for in Duff's typology and absent from the Samoan material.

2b (Figs 70, 74): 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, that is with the corners between narrow front and insloping sides ground away to produce an almost semi-circular cross-section. Equivalent to G/D Type Va and b.

2c (Fig.70): plano-convex in cross-section, front flat. Like G/D Type IVb.

2d (Fig.75): rounded quadrangular in cross-section. Duff Type 2B might cover some cases, but there is no relevant category in the Green and Davidson typology.
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, chosen as potentially the most productive for purposes of cultural comparison. Other features which cut across this grouping may well prove to have importance as the corpus of Tongan adzes grows. Some of these features are mentioned in the discussion that follows. Here adze descriptions are kept to a minimum since each example is illustrated. The bracketed references, with E = excavated, EF = excavated fragment and SF = surface find, identify the specimens in the line drawings.

The treatment of each excavated adze concludes with a statement of its stratigraphical position and adjudged dating. In the case of To.6 Horizon I, adzes found in the top part (Horizon IT) are dated with certainty to the late period. Those found in the bottom spits (Horizon IB) are considered to be in all probability late also, but the possibility that they belong to the middle-period occupation cannot definitely be ruled out.

**Adze Group 1a**

*Excavated (Fig. 71)*

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, providing the specimen with some resemblance to Group 1c. Polished towards the cutting edge, sparsely above. Stone light grey. Found in Square 50/50, Spit 8, Zone IV, in blackish earth with shells under the grave area (Zone V) in the centre of the mound. An adze fragment, To.2/5, found in Square 50/62, Spit 2, in the topsoil near the foot of the mound in Zone VI fits with it and thus belongs to the same implement. Both specimens, though found in the mound horizon, doubtless belong to the midden, whence they have been redeposited with potsherds and shells in the make-up of the mound. Almost certainly early period.

To.5/38 (E2): the butt end of a well-made, ground and polished adze, with four sharp corners and a back and a front of noticeably transverse curvature. The rounded poll is carefully bruised into shape. Stone light grey, determined by White as tholeiitic basalt (Appendix 7). Found in situ in Square 20/21, Spit 12, in the lower of the two cultural deposits (Horizon 0) in the coral sand beneath the base of the midden proper. Early period.

To.5/57 (E3) (see also Plates 60-62.2): a complete or virtually complete adze, well ground and polished, with sharp corners and marked transverse curvature of back. Stone grey-green. Found in situ in Square 19/27, Spit 5, in Horizon II. Middle period.

To.6/29 (E4) (see also Plates 63-65.4): a complete adze, well ground but unevenly polished, with fairly rounded cutting edge ground flat for resharping, or first sharpening. 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 (E2) 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. Found in Square 25/24, Spit 8, in the bottommost spit of Horizon I, it is most probably late period, but a middle period date cannot be totally ruled out.

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. The cross-section tends to be slightly trapezoidal, with front wider than back as on To.2/73 (E1) above. Determination of these two adzes as Group 1a may therefore not be quite certain owing to their similarity with Group 1c adzes. Stone grey, determined by White to be hawaiite, a non-Tongan rock (Appendix 7). Found in Square 25/21, Spit 6, in a small disturbed area uppermost in Horizon I, definitely sealed in by a continuation of Horizon II. Belongs therefore to the late period occupation.

To.6/102 (E6): a small, very thin tool with upper part missing, well ground and evenly
polished. Stone dark grey. It was found in Square 24/24, Spit 7, and seems to belong to Horizon IT or the very bottom of Horizon II, though the caption on Figure 71 attributes it erroneously to Horizon II only. Late period.

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 Square 50/63, Spit 6, in the top of Zone III of the midden horizon, it is from the early period.

To.6/1514 (Fig.71, EF2): 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 Square 25/26, Spit 6, in the upper part of Horizon I, it is from the late period.

Surface (Fig.62)

SF1: the butt end of an adze picked up in pig disturbances on the site of the To.1 midden and catalogued as To.1:3421. The flaked and rounded poll is somewhat similar to To.5/38 (E2) and To.6/29 (E4) 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 (Duff 1959: Figs 2-4, 6).

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 in the early part of the century during building of the church. The butt end is broken off. In its undamaged state it was almost certainly fully ground.

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

Adze Group 1b

Excavated (Fig.72)

To.6/109 (E7) (see also Plates 60-62.4): a fully ground and well-polished example of Duff Type 2C, which because of the grinding would be Type III in the Green and Davidson Samoan adze typology. The inwardly sloping sides have long ground facets. Stone black. Found in situ in Square 24/29, Spit 3, in the bottom part of Horizon III, it is late period.

To.6/165 (E8): a small, well-made, chisel-like adze, long and narrow, with sharp corners, overall grinding and thin polish. The lower part with the bevel is missing, but the slight curvature of the different planes gives the impression that the slightly narrower face is the front of the adze, i.e. it is Duff Type 2C and G/D Type III. Stone black. It was found in Square 34/20, Spit 6, in a shallow depression in the subsoil, at the eastern margin of the midden where only Horizon III is present. It is thus most likely to be late period.

Surface (Figs 63-65)

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

SF8: Tupou College collection. Buck Type III, G/D Type III. Note, however, that the corners
between front and sides have been rounded by grinding, a typological step towards Group 2b (Buck Type V, see cross-section Buck 1930:354, no. 2 of V, and G/D Type V).

SF9 Nukuleka (the village of Site To.2): a specimen typical of a series within Duff Type 2C, where the 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 and G/D 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. Golson (pers. comm.) mentions another five similar adzes in the Tupou College collection.

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 G/D Type II and with Buck Type II, more perhaps with his 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 and G/D Type II.

Adze Group 1a/b

Excavated (Fig.72)

To.6/134 (E9): an adze, wide and thin for its size, which lacks the regularity and definiteness of form of the adzes of Group 1a with which it belongs in terms of basic cross-section. 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 1a/b. Stone grey. Found in Square 23/24 in Posthole Y of uncertain stratigraphic status. Since the hole penetrates very deeply into the subsoil, it could well be the beginning of the late period occupation, Horizon IT or II.

Surface (Figs 66, 67)

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 and G/D Type II adzes. Golson (pers. comm.) reports that there were 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 were two similar adzes in the collection, according to Golson (pers. comm.).

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 IIb and G/D Type II, flaked sides and flaked, transversely convex back. The left side on the other hand belongs to Group 1a/b, 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: 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 (see also Plates 60-62.5): Pea village. The specimen 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 unlocated find of identical description to the last, but with wider and less marked faceting beginning nearer the cutting edge. Stone ?grey.

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

SF23: 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 in the early part of the century on the site of the church, the specimen, the bottom part of a large quadrangular adze, shows a polished facet along one corner which might qualify it for inclusion here rather than in Group 1a.

**Adze Group 1c**

*Excavated (Fig.72)*

To.6/50, 167 (E10): the lower part of a rather wide and thin adze, found in two pieces. This and the following specimen seem to resemble G/D Type IVa. 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. Found in Square 26/24, Spit 6, and in Square 28/22, Spit 7, both pieces were *in situ* in Horizon II. Late period.

To.6/158 (E11) (see also Plates 60-62.6): an adze with upper part missing, whose back and sides, not fully ground and polished, still carry signs of bruising. Polish of the front is thin. Stone pale grey, determined by White as tholeiitic basalt (Appendix 7). Found in Square 24/32 in Pit AN, the adze is attributed to Horizon III and the late period.

*Surface (Fig.67)*

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. It corresponds with G/D Type IV. 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 and G/D Type IV.

SF28: Pea village. This adze, ground and polished on all surfaces, has a proportionately wider back than the previous specimens. It also has a ground facet on the left side of the face of the butt. Buck Type IVa and G/D Type IV. Stone dark grey.
Adze Group 1d

Surface (Fig.68)

SF29: Tupou College collection. The lower part of a large adze of triangular cross-section, apex to the front. Buck Type VI, G/D 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 and similar to G/D Type VII. Not strictly triangular in cross-section, it is nevertheless distinguished from the trapezoid adzes (my Group 1b, Buck Types I-III, G/D Type III and Duff Type 2C) by its thickness relative to width.

Palmer (1963) puts on record two adzes in the Pigorini Museum in Rome, allegedly from Tonga, which belong in this group in terms of cross-section. The doubt as to their authenticity as Tongan specimens derives from their marked similarity to Eastern Polynesian forms of Duff Type 4A (Duff 1959:137, Fig.6), characterised by lashing grip and concave back.

Adze Group 1e

Surface (Fig.69)

SF31: Tupou College collection. A fully ground adze of triangular cross-section, apex to the back, Buck Type VIII, G/D Type VIIIa, Duff Type 3G. Golson (pers. comm.) refers to another adze of this type in the collection, cross-section, however, subtriangular rather than triangular.

Adze Group 2a

Excavated (Fig.73)

To.1/1914 (E12) (see also Plates 63-65.1): an almost complete, fully ground and well-polished adze of oval cross-section, with bevel triangular in plan and a somewhat curved cutting edge. The sides converge slightly towards this. To judge from the little that is preserved, the poll was flat. Stone black, determined by White to be an altered porphyritic andesite (Appendix 7). Found in a disturbed square (82/58; on disturbed and undisturbed squares see Chapter III, section 10.1) of the so-called small area of Trench I, in the bottom of Horizon I, the adze is judged to be from the early period (see section 1.2 above, the discussion of Trench 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 for bevel and central ridge. Stone black. Found in Square 24/26, Spit 6, in situ in the middle of Horizon II, late period.

To.6/27 (E14): a complete adze of broad oval cross-section and straight cutting edge, with sides tapering inwards from the cutting edge to the poll. Original flake scars interrupt the grinding, which is characterised by good polish. Stone black. Found in Square 27/30 in Posthole BH in an area of confused stratigraphy (Fig.21 lower), the adze is of uncertain date.

To.6/172 (E15): complete except for cutting edge. Differs from the above examples in that 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 stratigraphically unprovenanced find from Square 32/19, its date is unknown.
Surface (Fig.69)

SF32 (see also Plates 63-65.5): 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.

Adze Group 2b

Excavated (Fig.74)

To.6/25 (E16): a complete adze which illustrates well the possibility of typological relationship between Groups 2b and 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. G/D Type V, probably variant a. Stone dark grey. Found in Square 27/28, Spit 5, in situ in the bottommost spit of Horizon I, it is most likely to be late period, though a middle-period date cannot be wholly ruled out.

To.6/26 (E17): a less carefully made adze, with bevel and cutting edge missing, which shows the process of obliteration described for the last adze less far advanced. It has a thin but even polish. G/D Type V, probably variant a. Stone grey, laminated like To.6/32 (E18). Found in Square 27/30 in an undated feature, D, which is deep. This suggests, as for adze To.6/134 (E9), a date early in the late-period occupation at the site, Horizon II or III.

To.6/32 (E18): a specimen with bevel and cutting edge missing, which exemplifies the features described under To.6/25 (E16) above in an example which is narrower and thicker. The rectilinear form to which typologically this appears to be the curvilinear equivalent might indeed be said to be, not Group 1b (Duff Type 2C), but Group 1d (Duff Type 4E). In the Green and Davidson typology, the adze is probably Type V, variant b. It is well ground, thinly but evenly polished. Stone grey, determined by Key as a finely laminated trachyandesite. Found in Square 25/29, Spit 5, in situ in the very bottom of the soft deposit of Horizon II, which here rests directly on the fill of Oven O, it is late period.

To.6/33 (E19) (see also Plates 60-62.1): a complete adze, 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 resemblance to To.6/27 (E14) and To.6/108 (E13) in that group. It is well ground and highly polished. Stone black. Found in situ in Square 25/29, Spit 5, in the bottommost spit of Horizon I, it is most likely to be late period, though a middle-period date cannot be totally ruled out.

To.5/10 (E20): a miniature implement, which, if it is to be grouped at all, 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 Square 20/24, Spit 5, in situ in the bottom of Horizon III, it is middle period.

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 Square 55/75, Spit 5, in Trench IV, it is from Horizon I and dates to the early period.

To.2/21 (Fig.74, EF1): 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 incompleteness, can be compared with Suggs’ early Ha‘e‘eka type from the Marquesas (Suggs
1961:111). It has a flat back and a smoothly convexly curved front, both evenly ground and polished. It comes from Square 50/58, Spit 7, which is the bottom of Zone III of the midden horizon at the site. Early period.

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 Square 50/56, Spit 11, which is the top of Zone II of the midden horizon. Early period.

To.6/1193: the semi-circular cutting edge and bevel of what must have been a beautiful, highly polished adze of black stone. Found in Square 24/27, Spit 4, which is the bottom of Horizon III. Late period.

Surface (Fig.70)

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 and G/D Type V, possibly variety a rather than variety b.

SF35: Tokomololo village. This specimen, fully ground and well polished except for a few deep original flake scars, is like To.6/32 (E18) above in general proportions and nature of cross-section. Type V in Buck's Samoan typology, G/D Type Vb. Stone grey.

SF36: Tupou College collection. A fully ground adze, long, narrow and thick, with cross-section like the last and To.6/32 (E18), except that the back is less flat. Buck Type V and G/D Type Vb.

Adze Group 2c

Surface (Fig.70)

SF37: picked up during gardening on the site of To.5 and catalogued as 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 is as thick and narrow as our specimen, which does not compare readily with any of the G/D types. The grinding is good, the polish thin and patchy. Stone ? pale grey.

SF38: said to be from Pea or Tokomololo village. 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 Group 1a/b, 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 (see also Plates 60-62.3): said to be from Pea or Tokomololo village. 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 the back more differentiated. The grip itself is not so completely novel a feature, for it is simply a continuation across the fact 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.
Adze Group 2d

Excavated (Fig. 75)

To.6/20 (E21) (see also Plates 63-65.3): adze with poll missing and a thin sliver removed from the entire front surface. It 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 (see Fig. 70). In its original state it was evidently well and fully ground and polished. Stone dark grey, determined by White as hawaiite, a non-Tongan rock (Appendix 7). Found in Square 27/22, Spit 8, in situ in the bottommost spit of Horizon I, it is most likely to be late period, though a middle-period date cannot be wholly ruled out.

To.6/171 (E22): a specimen with transverse curvature of front, back and sides so marked that the cross-section is almost oval. Like To.6/20 (E21), the sides show ground longitudinal facets. There are also two bevels, a modest one being superseded 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. The adze is a not fully controlled find from Square 25/19, Level 99, i.e. around Spit 6, and therefore most likely to be from Horizon IT or the bottom of Horizon II. Probably late period.

Adze Group 3

Excavated (Fig. 75; Plates 63-65.2)

To.6/30 (E23): 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. Found in Square 25/27, Spits 5-6, in situ in the middle of Horizon I, i.e. partly in the bottommost spit and immediately beneath Horizon II deposit. Its date is thus most likely to be late period, though a middle-period origin is perhaps just possible.

Excavated fragments

To.2/2678: a fragment showing traces of grinding on two sides at right angles. It may be part of an adze of possibly quadrangular cross-section. Stone grey. From Square 50/60, Spit 7, in the bottom of Zone III of the midden horizon. Early period.

To.6/69: a fragment of dark grey stone, well ground and polished, containing parts of two planes of an adze whose characteristics cannot, however, be reconstructed. From Square 26/25, Spit 8, which is Horizon I, bottom spit. Most probably late period, but a middle period date cannot be wholly ruled out.

Chronology of Adze Groups

Table 85 summarises the date of this section.

Stratigraphic credentials

Group 1a is known in the early and middle periods by the evidence of To.5/38 (E2) in Horizon O and To.5/57 (E3) in Horizon II. This is supported by the evidence of the fragment To.2/9 from the midden horizon and of To.2/73 (E1) which, though found in the mound horizon, was almost certainly transferred there from the midden. There are three late-period examples of the group: To.6/102, 170 and 1514 (E6, E5, EF2), of which E6 differs from all the other adzes, being small and very thin. Group 1a is thus known throughout the ceramic sequence and well represented.
Group 1b is represented by two excavated adzes, of which To.6/109 (E7) is definitely late, while To.6/165 (E8) is almost certainly so.

Group 1a/b is known in the excavated record by a single adze, To.6/134 (E9), which is possibly late.

Group 1c is represented by two excavated adzes, To.6/167 and 158 (E10, E11), both of them late. If, however, specimens E1 and E5 of Group 1a are accepted as representing at least a trend towards the 1c concept, then it is also documented for the early period.

Groups 1d and 1e have no dated examples.

Group 2a is known by four examples, judged early by the evidence of To.1/1914 (E12) in the bottom of Horizon I and late by that of To.6/108 (E13). Specimens To.6/27 (E14) and To.6/172 (E15) cannot be dated.

Group 2b is present in the form of To.6/26 (E17), which, though found in an undated posthole fill, is probably attributable to the late-period occupation at the site, and of To.6/32 (E18), which is definitely late. Of the four fragments, To.6/1193 is late. The three others, To.1/2547 from Horizon I and To.2/21 and 38, both from the midden horizon, are early. The group is therefore known from the early and late periods of the ceramic sequence and is quite well represented. If the miniature implement (To.5/10) can be typologically accepted into the group, it is present in the middle period also.

Group 2c has no dated examples.

Group 2d has only two representatives, somewhat different from each other. The more surely dated of these, To.6/171 (E22), does not have impeccable status stratigraphically but can probably be accepted as late.

Adzes at the base of To.6

There is a chronological problem with the adzes excavated from the bottom of Horizon I at To.6, where evidence of a middle-period occupation unrecognised during excavation was revealed by the pottery analysis (Chapter III, section 10.3). Of the 18 adzes and three classifiable adze fragments found at To.6, no less than five of the former and one of the latter came from the bottom spits of Horizon I. The pieces in question belong to Group 1a: To.6/29 (E4); Group 2b: To.6/25 (E16) and To.6/33 (E19); Group 2d: To.6/20 (E21), made of foreign rock; and Group 3: To.6/3 (E23) and To.6/69, a fragment. The question is whether all or any of these belong to the middle-period occupation or whether they derive from the beginning of the phase of main site formation in the late period.

The conclusion reached about the middle-period occupation at the base of To.6 (Chapter III, section 10.3) was that it was unassociated with structures like pits and ovens and unaccompanied by midden formation, so that the pottery by which its presence was recognised was, so to speak, lying around to be incorporated in later deposits when real midden formation began. In these circumstances it is difficult to believe that adzes, as distinct from potsherds, could have survived relatively undisturbed from the earlier period, especially when large (like To.6/20 and 29, E21 and 4) or complete (like To.6/25, 29 and 33, E16, 4 and 19) and made, like all adzes on Tongatapu, of stone that had to be brought from outside the island and is thus likely to have represented material of value.

All this suggests that the adzes in question are to be referred to the beginning of the late-period occupation, with the possible exception of the fragment To.6/69, for obvious reasons. If so, the explanation for them having survived in the positions in which they were found, and not having been reused during subsequent stages of the continued occupation of the site, is to be sought in the fact that the start of the late-period occupation saw the beginning of real midden formation, which would have covered them over and sealed them in. I do not wish to open up a discussion of the general phenomenon of the survival of complete and usable artifacts on archaeological sites, but would point to the presence of other types of artifact in
this state amongst the excavated finds described in subsequent sections of this work. An
interesting parallel of relevance is the survival of a large number (21) of stone adzes at one of
the Sasoa'a sites in Western Samoa, SU-SA-3, associated with various domestic activities
(Green 1974b:131, 137; Fig.55; Table 12). The ratio between whole, broken/fragmentary and
unfinished adzes here (8, 12, 1) is very similar to that at To.6 (7, 13, 1), though at To.6 the
collection is recorded from various levels, at SU-SA-3 from only one, Layer 5, 10-30 cm thick.

Concluding observation

In terms of dating, my conclusions about the chronological status of adzes from the bottom of
To.6 do not alter the picture based on more securely provenanced specimens. The four adzes,
E4, 16, 19, 21, provide support to the dating already obtained for Groups 1a, 2b and 2d, while
the late date of the thick adze blank, E23, is of no assistance in the present context.

Extra-Tongan parallels for the rectilinear and curvilinear series

While there are many South Pacific adzes on record, most of them are chance finds, though
the corpus of excavated adzes is growing. As the subject has been treated in detail by Green
(1971, 1974d:253-65), I shall make comparisons with emphasis on sites chronologically and
areas geographically relevant. There may well be some differences of detail in my attributions
and comparisons and those of Green.

Rectilinear adzes

Group 1a: early, middle and late periods in Tonga

This group is like Duff Type 2A and also some that he would call 2B. Duff notes the general
distribution of Type 2A throughout Polynesia and explains 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 Island (Duff 1959:131, 133). One or both varieties are present in the
early (9th century AD) level at Hane in the Marquesas (Sinoto and Kellum 1965:21-22,
Groups 3 and 4, representing both varieties) and in the Society Islands at the important
Maupiti burial site (9th-12th century AD) (Emory and Sinoto 1964:155, Fig.4b, Plate 4b,
Form 3A, representing Duff Type 2A; for radiocarbon dates see Emory and Sinoto 1965:96)
and the Vaitootia village site on Huahine (9th century AD) (Form 3A, Sinoto and McCoy
1975:156, Fig.6e).

To the west of Tonga there are parallels in Lau (Thompson 1938:Fig.5; Plate A3) and in Fiji
(Gifford 1951:Fig.3e, i, j, the last from the post-Lapita shell midden, Site 26). One Lau
specimen in the Fiji Museum, no. 651/30, is like To.6/21 (E4). From the drawing, a specimen
in late Fijian Lapita context at Sigatoka (Birks and Birks 1968:106; Fig.1.1; cf. Birks 1973:47;
Fig.8a.1) might be compared with this group, but its cross-section is described as ‘almost oval’
and so it is perhaps more strictly comparable with Group 2a. However, the 1a form is on
record in a broken specimen from the Erueti site, Vanuatu, with its Lapita connection
(Garanger 1972:30, 104; Fig.25.1). The adze figured by Green (1979:Fig.2.4) from a Reef
Islands Lapita site and dating about 3000 years ago, is described as having a lenticular cross-
section with flat sides, but can be closely compared with my Figure 71, E4; Plate 53-65.5,
assigned to this group.

The type is unrecorded in Samoa (cf. Green 1974d:Fig.91).

Group 1b: late period in Tonga

Duff notes its wide distribution, as his Type 2C, but numerical preponderance in Samoa, i.e. in
later prehistory (Duff 1959:133; cf. Buck 1930:334-44, Types I-III). It is present at the
Maupiti burial site (Emory and Sinoto 1964:153, Plate 4a, Form 2) and the Vaitootia village
site on Huahine (Sinoto and McCoy 1975:156, Fig.6c, Form 2A).
The form is known in Lau (Thompson 1938:Figs 6, 8, 9; Plate A5), Rotuma (Fiji Museum, nos 607/30, 658/30) and Tikopia (Firth 1959: Plates VI, VII left, the latter very like To.6/165 (E8)).

It is recorded from early Lapita contexts in Fiji (Birks and Birks 1968:108-10; Fig.2.7, 8, 10) and from late Samoan Lapita contexts (in my terminology, see Chapter V), where it equals G/D Type III (Green 1974d:Fig.91; Smith 1976a:68; Hewitt 1980:137). It is also known from Uvea (Kirch 1976:Fig.11a, d).

**Group 1a/b: late period in Tonga**

The form is recorded from late Samoan Lapita (Green 1974d:Fig.91; Hewitt 1980:136).

**Group 1c: late period 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 resemblance to G/D Type IV in Samoa, the form bears some similarity in terms of cross-section to Suggs' Mouaka adze type in the Marquesas, common from the beginning to the end of his Nukuhiva sequence (Suggs 1961:107-9). In these same terms the relationship between Suggs' Hai and Mouaka adze types, the former displaying a greater thickness in relation to width (Suggs 1961:109), is echoed by that between SF26-28 and To.6/50, 167 (E10) and To.6/158 (E11) within Group 1c. The Hai type seems to be confined to the early levels both on Nukuhiva and at the Hane site on neighbouring Uahuka (Suggs 1961:107, 109; Sinoto and Kellum 1965:21, Group 2). If these comparisons have any validity, we might expect adzes of Group 1c to turn up in early contexts in Tonga. Indeed, the slightly trapezoidal cross-section of many of the Tongan adzes of Group 1a is a reasonable indication of this.

The form is known from late Samoan Lapita levels (Green 1974d:Fig.91; Smith 1976a:68) and as surface finds on both Futuna (Kirch 1976:Fig.12a) and Niutoputapu (Rogers 1974:322). A broken adze from an early Lapita context in Fiji (Birks and Birks 1968:108; Fig.2.6) may represent Group 1c.

**Groups 1d and 1e: not yet found in datable contexts in Tonga**

They are known from late Samoan Lapita (Green 1974d:Fig.91). Compare G/D Types VI and VII and Duff Type 4E for Group 1d. There is an example at the early Vaitootia village site on Huahine (Sinoto and McCoy 1975:156, Fig.6d, Form 2B) and one from Lau (Thompson 1938:Fig.7; Plate A4).

For Group 1e, compare G/D Type VIII and Duff Type 3G. This type is known from the early habitation site of Vaitootia on Huahine (Sinoto and McCoy 1975:156, Fig.6g, Form 4) and, slightly reduced frontally on the butt for lashing, at the Maupiti burial ground (Emory and Sinoto 1964:156, Plate 6a, b, Form 4).

**Curvilinear adzes**

Unlike the adzes of rectilinear cross-section, these 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 become clear that adzes of curvilinear cross-section were once a basic and integral part of the Polynesian adze kit.

I begin with parallels from Lapita or Lapita-related sites.
Group 2a: early and late periods in Tonga

Unknown in Samoan Lapita (cf. Green 1974d:Fig.91), it is on record for early Fijian Lapita (Birks and Birks 1968:108, 110, 112; Fig.2.5, 11). Birks and Birks 1968:106; Fig.1.1 (cf. Birks 1973:47; Fig.8a.1) is likely to represent the form in late Fijian Lapita. The example illustrated by Gifford and Shutler (1956:Fig.1c) is from the talus slope at the New Caledonian Lapita site, Site 13. From Vanuatu there are examples from the Lapita-related Eruteti site (Garanger 1972:30, 103-4; Fig.25.2-5).

Three stone adzes from Watom (New Britain) in Meyer's collection at the Musée de l'Homme may appropriately be mentioned here, catalogue nos 34.188:1282-1284. No. 1283 (Poulsen 1967b:Fig.97.3) is the reworked lower part of an adze like To.1/1914 (Fig.73, E12; Plates 63-65.1). The other specimens, 1282 and 1284 (Poulsen 1967b:97.2, 1), could perhaps be described as irregularly oval in cross-section. Similar adzes have been found in later excavations on Watom (Specht 1968:127).

Group 2b: early and late periods in Tonga

This is well known, as G/D Type Va, b, in late Samoan Lapita contexts (Green 1974d:Fig.91; Smith 1976a:68; Hewitt 1980:136). In Fijian Lapita it is both early (Birks and Birks 1968:110; Fig.2.9) and late (Birks and Birks 1968:105-6; Fig.1.2, 3; cf. Birks 1973:47; Fig.8a.2, 3). It is recorded from Uvean and Futunan Lapita (Kirch 1976:Figs 11b, c, 12b, 13a-c).

Group 2c: not yet datable in Tonga

It is recorded, as G/D Type IVb, from late Samoan Lapita (Green 1974d:Fig.91).

Group 2d: late period in Tonga

It is unknown in Samoan Lapita but may be represented by a somewhat atypical adze from Sigatoka, which is, however, of uncertain chronological status (Birks and Birks 1968:105-6; Fig.1.4; cf. Birks 1973:47; Fig.8a.4).

The first adzes of curvilinear cross-section to be reported as such from excavations in Polynesia were Suggs' Hatiheu and Ha'e'e'eka types, restricted to the early part of the sequence on Nukuhiva (1961:110-11). Suggs, who adduces Melanesian parallels for the two types, describes them as very similar, with Hatiheu having oval to circular cross-section, Ha'e'e'eka plano-convex, base at the back. Subsequently the designation Hatiheu has occurred in discussions of adzes from other Polynesian excavations, such as the late Lapita period in Samoa (Green 1969a:111-12; cf. Green 1974b:138-39), the early Hane horizon on Uahuka (Sinoto and Kellum 1965:21, Group 1) and the Maupiti burial site (Emory and Sinoto 1964:156; Fig.4a, Plate 7a-c, Form 5), invariably, however, and apparently erroneously, with reference to adzes described as of semi-circular cross-section with flat base. The type is also present at the early village site at Vaitootia on Huahine (Sinoto and McCoy 1975:156, Fig.6h, Form 5).

My Group 2a could be, by Suggs' published definition, likened to the Hatiheu type, specimen To.2/21 (EF1) of Group 2b to the Ha'e'e'eka type. As the terms have been subsequently used, 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 cross-section at Vailele and Faleasitu, Western Samoa. Form 1 at Maupiti (Emory and Sinoto 1964:153; Plate 3a-c) and at Vaitootia (Sinoto and McCoy 1975:156; Fig.6a, b) might be compared, admittedly not very specifically, to my Group 2d and possibly to some adzes classified by me within Group 1a.

Parallels both general and more precise exist, therefore, amongst early adzes in Polynesia with curvilinear cross-section to excavated adzes in Tonga (cf. Green 1969a:111-12). It is possible that Group 2d, so far only definitely known from the late period, and Group 2c, not yet excavated, will both be discovered in early contexts in Tonga.
Melanesian and Micronesian parallels

**Melanesia**

Suggs (1961:111) said of his Marquesan adzes with curvilinear cross-section that they seemed more at home in Melanesia than Polynesia, specifically comparing his Hatiheu type (equivalent to my Group 2a) with two Fijian surface finds (Gifford 1951:FIGs 3m, 4e) and his Ha’e’eka (equivalent to my Group 2b) with another Fijian surface find (Gifford 1951:FIG.4d), Emory and Sinoto (1964:156, fn. 17) refer to Hatiheu adzes, defined by them as plano-convex in cross-section (i.e. my Group 2b), in the Fiji Museum, while in a general way Suggs (1961:111) compares the adzes (mainly surface finds) described by Gifford and Shutler (1956:68-69; FIGs 1-3) for New Caledonia with their lenticular to oval cross-sections, to his Hatiheu type (i.e. my Group 2a).

Here I wish to do no more than emphasise Suggs' point about the curvilinear cross-section being typical of the stone adzes of Melanesia, insufficiently studied and badly represented by excavated examples as they are. We may note that the categories of cross-section used by Garanger (1972:103-4; FIG.285C) in his description of stone adzes from central Vanuatu echo those of my Group 2. The same is true of Hinderling (1949:246) in his general survey of adzes in the Southwest Pacific, from New Guinea to New Caledonia (see his distribution map of cross-sections, II.1).

**Micronesia**

I am grateful to J. Craib (pers. comm.) for providing information.

With reference to Group 1b he comments that in general outline and cross-section the form has a wide distribution and cross-cuts raw material (cf. Craib 1977: Type 1, in shell). In western Micronesia (Palau, Yap, Marianas) the form is found in both stone and shell.

In terms of cross-section Group 2a can be compared with stone adzes on record for the Marianas (Thompson 1932:33-35; FIG.16; Spoehr 1957:131-36; FIGs 63, 64; Reinman 1977:FIGs 25, 27), but any resemblance really stops there.

Adzes of plano-convex cross-section, characteristic of my Group 2b, are, according to Craib, widespread in Micronesia, but all are made in shell, *Tridacna, Terebra* and *Cassis* (cf. Craib 1977:Type 5, in *Tridacna*). Craib (pers. comm.) cites Palau (Osborne 1966, 1979; Craib 1977); Ulithi (Craib 1980); Nomoi (Mortlocks) (Takayama and Intoh 1980); and the Polynesian outlier of Nukuoro (Davidson 1971b).

**Tongan adzes of foreign rock**

There are two broken adzes, To.6/20 (E21) and To.6/170 (E5), which are made from a type of stone, hawaiiite, not found in Tonga but occurring in Uvea, Samoa, the Loyalties and Vanuatu (Appendix 7). Both these imported adzes, or adzes made in Tonga from imported rock, are late period. They were found in Horizon I at the site, just 2 m apart, one (E21) in the bottom (at level 110-115), the other (E5) in the top (at level 93), both in the likely cooking area at the southern end of the main excavation. These circumstances may indicate their having been discarded roughly at the same time, and thus possibly also their having been imported and in use simultaneously, though representing different types.

Green (1974b:143) favours one of the Polynesian island sources as the most likely one and has argued that the appearance of the rock type in Tonga means that the source islands were already inhabited. We now have the evidence of strong ceramic relationships between Tongatapu and Futuna, possibly via Niuatoputapu, in the late Tongan Lapita period (Chapter V, section 5), which might suggest the Uvea region as the source, with rock exploitation one of the features of the connections. The knowledge underpinning this might have resulted from earlier Tongan voyaging, if the tentative indications of the ceramic comparisons are correct, that Tonga could have played a part in the settlement of Samoa.
One adze recorded from Futuna, a surface specimen (Kirch 1976:Fig.12a), can be compared with one of the Tongan adzes concerned, To.6/170 (Fig.71, E5), belonging to Group 1a. The Futunan specimen would be Group 1c in the present grouping. The distinction between Groups 1a and 1c tends to be a fine one, as has been indicated on a number of occasions in the foregoing. However, the date of the Futunan adze is unknown, so that its evidence is of limited use in the present context.

**Tonga and the Polynesian adze kit**

Of the ten groups I have defined for Tongan adzes and the one miscellaneous category (3), eight are recorded from excavations at four sites and all of these are present at the late-period site, To.6 (see Table 85). Disregarding Group 3, the number of adze forms could be said to have increased over time from three in the early period, of which only the two are recorded from middle-period levels, to a total of seven in the late period. The three early-period groups are all found in the late period, while the four additional late-period groups, 1a/b, 1c and 2d, might represent a trend towards elaboration opposite to what was happening in the sphere of pottery, a trend which continued into the post-ceramic period.

Of the three Tongan adze groups known throughout the pottery sequence, 1a, 2a and 2b, only one is so far recorded from Samoan excavations, 2b, representing a major type (G/D Type V) in the late Lapita period there (Green 1974d:Table 28; Figs 91, 92). This might support the hints in the pottery that Samoa was not settled as early as Tonga. In addition, Group 2b could be looked upon as the prototype for the development of Groups 1b and 1a/b and related adzes (cf. Green 1974d:Figs 91, 92), wherever this took place.

The first three of the four late Tongan groups, 1a/b, 1b, 1c and 2d, form part of Green's (1974d:Fig.91) Tongan-Samoan adze continuum. This pattern could in theory be the result of contact either way, something which I consider unlikely on the ceramic grounds mentioned above, though Green (1974d:262) has a different view. It is difficult to assess on present evidence to what extent regional differentiation was taking place in adzes as it was in pottery in the final centuries BC. The immediate fact that Tongan adzes were generally ground and polished all over, the Samoan ones generally not, might support a view of differentiation, were it not for the other fact of the differences in available and suitable raw materials in both island groups (Green 1974b:144). It is significant in the matter of adze differentiation, however, that Green (1971, 1974d:253-65) has been able to argue strongly that Samoa played a leading role early in the first millennium AD in forming the basis of the subsequent Polynesian adze kit.

Disregarding the implications of important differences in time and in sample size, the overlap in adze forms between Tonga and Samoa is evident from the above review and has been discussed in detail by Green (1971, 1974d:253-65). Their range of cross-sections is seen to parallel that of Eastern Polynesian adzes, though the predominance amongst the better known Samoan adzes of those with trapezoidal cross-section, front narrower than back, has tended to obscure this fact. Excavations over the past 30 years have shown the occurrence on early sites in the Marquesas, the Society Islands and Samoa of a range of similar types of adze, some of which were traditionally thought of as characteristic of the different culture areas of the South Pacific, Melanesia and Western and Eastern Polynesia. Though the number of early prehistoric adzes in Tonga is small so far, this region would appear to share in the early adze continuum.

The one fact 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 the east, apparently unknown in the west. Buck (1930:355), for example, classed Samoan adzes as 'tangleless'. There is, it is true, a record of the two gripped adzes collected in Tonga in the 19th century (Palmer 1963), but this is no guarantee that they were made and used there. Among adzes in the present corpus there is one gripped specimen, SF39 (Fig.70), 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 (Fig.70).
To test the proposition that the gripped specimen could not have been an import, old or new, from Eastern Polynesia, it was examined petrologically by C.A. 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 early adze kit of the South Pacific, becoming important in the east but disappearing in the west (cf. Green 1971:36-37). Green (1974b:138; Fig.62c) cites an adze of G/D Type Vb with incipient tang dating from late Samoan Lapita. The grip as exemplified by the Tongan specimen SF39 is after all only one device for facilitating the lashing of the adze head to its haft. The features characterising Groups 1b, trapezoidal cross-section, front narrower than back, and 1a/b, frontal facets either flaked or ground, are alternative procedures. The chronological and typological relationships between these various methods are 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 (cf. Green 1976:71).

**SHELL ADZES (Class 1A, B)**

Nine shell adzes were found, five of them complete, one of these apparently being a grave gift. Their distribution is set out in Table 86 and their illustrations given in Figures 76 and 77 and Plates 66 and 67.3.

While discussion of the numerous and varied stone adzes from my excavations has benefited from the considerable attention the class has received in the Pacific literature, it is much less the case with the class of shell adzes now under review. However, of recent years increased attention has been paid to them in the region (see the literature review for Micronesia in Takayama and Intoh 1980:13). Of particular interest, as has been pointed out by J. Craib (1977; pers. comm.), is the fact that adze morphologies cross-cut stone and shell, though the almost universal practice has been to look for comparisons only within similar source materials.

*Technology and typology*

All nine examples are of *Tridacna* shell, the characteristic feature being that they were made from 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. 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 (shell, excavated) prefixes the number of the adze in the line drawings.

**Class 1A: rectilinear cross-section**

There are six examples, illustrated in Figures 76 and 77.

To.1/2293 (SE1) (see also Plate 66.2): a complete adze, associated with Burial AK in Pit AF (Plates 6, 7). It has an offset cutting edge which is slightly hollow-ground. I have argued a middle-period date for the pit and the burial (Chapter III, discussion of pits in section 11.4).

To.1/2294 (SE2) (see also Plate 66.1): a complete adze, found near the bottom of the midden of Horizon I in Trench IV where this seals in Pit AL, and thus belonging to the early period. The cutting edge, which is hollow-ground, is ground flat for resharping.

To.1/2388 (SE3): a fragment from the hollow-ground cutting edge of what would appear to have been a well-ground and well-shaped adze. The two broken margins seem to have been subsequently ground and one carries signs of wear. Found in the top fill of Pit AM in Trench IV, it is early period.
To.2/77 (SE4) (see also Plate 66.3): 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 the upper part of Zone III of the midden horizon, it is early period.

To.2/3696 (SE5) (see also Plate 66.4): 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 (cf. Group 1a/b among the stone adzes). This adze was not excavated in the main trench, but in a testhole 2 m 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 top of the mound horizon, Zone VI, from the early shell midden and thus be from the early period.

To.6/117 (SE6) (see also Plate 66.7): an unfinished late-period adze from the middle of 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 (SE7) (see also Plate 66.5): a complete late-period adze found in the middle of Horizon III, very well made, with an offset cutting edge slightly hollow-ground.

Class 1B: curvilinear cross-section

There are two examples, illustrated in Figure 77.

To.1/2484 (SE8) (see also Plate 67.3): the butt portion of a long narrow chisel-like tool of round cross-section with somewhat flattened back. Found in the undisturbed top of the concentrated shell midden of Horizon I in Trench IV, it would seem to be early rather than middle period.

To.2/44 (SE9) (see also Plate 66.6): a well-ground oval-sectioned adze with damaged cutting edge. Found in the layer of Ostrea shell in Zone IV of the mound horizon, it is quite likely to be early period in date.

Chronology

From the stratigraphic evidence reviewed above it appears that shell adzes were known throughout the pottery sequence, those of rectilinear cross-section in all three periods of it, the two of curvilinear cross-section possibly both belonging to the early period. It may be noted here that McKern refers to the use of shell-bladed adzes, though he does not describe them in detail (McKern n.d.: 422).

Comparisons

Ventral margin and hinge technologies

Shell adzes of Tridacna (perhaps including some made from other large shells) are widespread in the Pacific, from the Ryukyus, the Philippines and eastern Indonesia, throughout Micronesia and parts of Melanesia, into some islands of Polynesia (Takayama and Intoh 1980:37-38). It has become customary to differentiate between those made from the thinner ventral margin of the shell, the natural corrugated surface of which is to a greater or lesser extent preserved, and those made from the thicker central or hinge area (see Davidson 1971b:56-58 and Fig.24; 58, 62 and Figs 25-27, and Garanger 1972:Figs 286 and 288, 289, for the two kinds on Nukuoro and in central Vanuatu respectively). The thinner ventral adzes, ‘exterior’ in the terminology used by Kirch and Rosendahl (1973:68-77), are common and widespread in Micronesia, have a wide if less clear distribution in Melanesia but are restricted in Polynesia to Tuvalu, the Tokelau and the northern Cooks (Davidson 1971b:57-58; cf. Garanger 1972:129-32). The ‘interior’ adze, because of its bulk, lends itself to greater
typological variation, but the general class is well known in Micronesia, widely if less commonly distributed in Melanesia and, in Polynesia, reported for Tonga, Niue and the Tuamotu (Davidson 1971b:58; cf. Garanger 1972:129-32).

As Davidson (1971b:58) points out, ‘interior’ adzes fall into two major divisions, according to whether they retain some or none of the original shell surface. I have already indicated that my Tongatapu specimens retain at the back the natural corrugations or grooves of the inside of the hinge. Two shell adzes from Lapita contexts on Niuatoputapu are identical to them in this respect (Rogers 1974:322; Fig.5c; Kirch 1978:Fig.7b), as is one excavated from the post-Lapita Site 17 in Fiji (Gifford 1951:Fig.1f). Also in Fiji shell adzes of shapes possibly related to Tongan examples are known from the surface of Natunuku (E. Shaw pers. comm.) and perhaps also from Yanuca (L. Birks pers. comm.).

None of the large series put on archaeological record for central Vanuatu, and notably the Lapita-linked Erueti site, by Garanger (1972:30 and Fig.26; 105-6 and Figs 288, 289) preserves the internal hinge element characteristic of the Tongatapu adzes, except for one specimen (more like my 1A than 1B) found on the surface at Erueti (Garanger 1972:Fig.27c). Kirch and Rosendahl (1976:237) say explicitly that none of the four ‘interior’ adzes excavated in ceramic and post-ceramic contexts of Site An-6 on Anuta are like the Tongan specimens in respect of the hinge. We may note that ‘exterior’ adzes were absolutely dominant in all levels of this site dating back into the first millennium BC (Kirch and Rosendahl 1973:73).

Shell adzes are unrecorded from the Samoan Lapita, except possibly for the recent report of a fragment of a heavy adze excavated on Manono Island (Janetski 1980b:123; Fig.43e). Its date is uncertain since it was found in Stratum IV at Potusa, a site whose stratigraphy is very disturbed.

**Chisel-like specimens**

Specimen 2484 from To.1 (SE8) resembles Suggs’ cylindrical adze from Nukuhiva in the northern Marquesas (Suggs 1961:Fig.35m), one of two chisel-like types defined by him, made from the thick lip of Cassis shells (Suggs 1961:115-16). Sinoto (1970:Fig.3) figures Cassis shell chisels from the Hane site on Uahuka, two of Suggs’ cylindrical type (c, d) and two where the Cassis shell is less modified and retains much of its original shape and surface features (a, b).

Cassis chisels are present from the beginning of the Marquesan sequence and the less modified variety, on the Hane evidence (Sinoto 1970:107, 110), seems to be restricted to it. An example of this variety from Huahine in the Society Islands is also thought to be early by Sinoto and McCoy (1975:159; Fig.7c), who record the presence of similar chisels, undated, on Fanning Island and Rotuma.

Examples from Reao in the Tuamotu illustrated by Sinoto (1978:157, 159; Fig.26a, b) have wider cutting edges and to that extent are more like adzes than chisels. A collection from Napuka in the same island group, briefly described by Emory (1975:110), seems to encompass the range from chisel-like to adze-like, the figured specimen (Fig.89b) being definitely in the latter category.

Takayama and Intoh’s rather confusing review of the topic (1980:40-41; cf. Davidson 1971b:68) has particular reference to Micronesia and neighbouring areas and is only marginally germane to our present concern, in that they are not essentially dealing with cylindrical chisels but the less modified Cassis shell examples, predominantly with adze-like rather than chisel-like cutting edges. We may exemplify this functional contrast by reference to an example from a ceramic context on Anuta (Kirch and Rosendahl 1973:69; Figs 22a, 24), where both ends are bevelled, the wider end adze-like, the narrower poll chisel-like.
Terebra shell chisels (Class 1C)

Two examples were found, distributed as in Table 86. Specimen To.4/2 (Plate 67.2) is of *T. maculata*, To.6/3079 (Plate 67.1) of *T. dimidiata*. The artifacts were made by bevelling the long thin shell at the pointed end. The To.6 specimen has one bevel and its short working edge is somewhat damaged. The other is double-bevelled and its short sharp straight working edge is 6 mm long between marked corners. The To.4 specimen cannot be dated, but that from To.6 was found in Posthole CE related to Horizon I (or possibly II) and is thus late period.

Comparisons

Archaeological parallels are known from Kabara in the Lau Islands (C.D. Smart pers. comm.), the Society Islands (Emory and Sinoto 1965:86; Fig.12a right; Green et al. 1967:Fig.21d; Sinoto and McCoy 1975:159; Fig.7a, b) and the Marquesas (Suggs 1961:133). Davidson (1971b:54), reporting the archaeological presence of the type on the Polynesian outlier of Nukuoro, tentatively recognises it also on Pukapuka in the Cook Islands and in Tuvalu and stresses its essentially Polynesian distribution. The Polynesian record has been extended by Sinoto (1978:157, 159; Fig.26c, d) to Reao in the Tuamotu. Takayama and Intoh (1980:42) have reported the occurrence of the *Terebra* chisel in western Micronesia (Guam, Tinian and Palau), though Craib (pers. comm.) is inclined to accept the record for Guam only (Haddock 1974; Reinman 1977:Fig.40r).

Interestingly, two of Davidson’s Nukuoro examples are composite tools, with the chisel edge at the top of the spire combined with bevelling of the lip of the shell at the other end (Davidson 1971b:53, 54; Fig.22D). *Terebra* shells worked at the lip alone (that is, lacking modification of the spire tip) form a numerous class of artifact on Nukuoro and elsewhere, referred to below in the discussion of Conus gouges.

Conus gouges (Class 1D)

Seven examples of these implements with pointed or narrow butts were found, distributed as in Table 86. Six are 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; the illustrated specimen (Plate 67.4) 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.

Six were found at To.2, of which one is definitely early period and the others, given the nature of the site, are probably so. The former (no. 3125) was from Zone II of the midden, while two of the latter (nos 1592, 1610) came from the *Ostrea* shell layer in Zone IV of the mound, three (nos 3671-73) being of uncertain stratigraphic status within the mound. The seventh specimen was found at To.5 (no. 7) in undisturbed position in the middle of the Horizon I midden. In sum, To.2/3125 and To.5/7 are securely datable to the early period, the five others, all To.2, may well be transfers from old midden into the mound fill and thus possibly also early.

Comparisons

Both Davidson (1971b:55-56) and Takayama and Intoh (1980:40-41, Group III) discuss the distribution of artifacts to which they think the Tongan *Conus* gouge is equivalent, but made on a variety of shells.

I have noted (Poulsen 1967b:Fig.97.4) an archaeological parallel in *Conus* in the Meyer collection from the Lapita site on Watom Island in New Britain (Musée de l’Homme, Paris, cat. no. 1286). One of Davidson’s (1971b:55; Fig.23B) examples from the Polynesian outlier of
Nukuoro could be in *Conus* and she mentions *Trochus* specimens found there. J. Craib (pers. comm.) has drawn to my attention a *Conus* gouge/adze recorded from Ant atoll near Ponape in the eastern Carolines (Ayres *et al.* 1981:Fig.55).

Examples from the inner lip or outer body whorl of *Cassis* are recorded by Davidson (1971b:55; Fig.23A) for Nukuoro and by Takayama and Intoh (1980:23-24, Group III; Fig.14.4, 5; Plate 7.7, 8) for the Nomoi (Mortlock) Islands of Micronesia, between Nukuoro and Truk. The type is present on Fefan in the Truk lagoon (Takayama and Intoh 1980:40), while on another island there, Tol, a rather different type is also known (Takayama and Intoh 1980:40, cf. Takayama and Intoh 1978:36; Fig.16.5; Plate XIII.9). Takayama and Intoh (1980:40) also update Davidson (1971b:56) by referring to a surface find in Palau (Takayama *et al.* 1980:Fig.13.2; Plate 7.11).

In their review Takayama and Intoh (1980:40) cite parallels in *Cassis* shell from the Tuamotu (Emory 1975:110), where indeed the specimen figured by Emory (Fig.89c) is very close, and from the Marquesas (Suggs 1961:104), which, from Suggs' figure (Fig.29e), seems less convincing.

The herminettes-gouges (Type B-3) of central Vanuatu reported by Garanger (1972:107; Fig.292), made on *Lambis* shell (cf. Fig.291), may well be the equivalent of the Tongan *Conus* gouge. They are not represented amongst the shell tools of the Lapita-related Erueti site (Garanger 1972:30).

Other types of herminettes-gouges of *Terebra* and *Mitra* from central Vanuatu (Garanger 1972:107-8, Types B-4 and B-5; Fig.293) are unknown in Tonga and indeed elsewhere in Polynesia, but are widespread in Micronesia and parts of Melanesia (Davidson 1971b:54; cf. Takayama and Intoh 1980:41). To what extent these *Terebra/Mitra* artifacts are comparable to the Tongan *Conus* gouge is uncertain, particularly since they may display other types of cutting edge than the gouge form. Some of the difficulty arises from our insufficient knowledge on the score of function, to which I now turn.

**FUNCTION OF SHELL ARTIFACTS OF CLASS 1**

In the studies by Davidson (1971b) and Takayama and Intoh (1980) on which I have drawn so heavily in the foregoing discussion, all the tools surveyed are treated together as members of the same technological class, under the heading of adzes. For Davidson (1971b:66-67), drawing on limited ethnographic information, they are woodworking tools of various functions. Amongst the possible exceptions to this generalisation which she considers are the *Cassis* tools discussed in the section on *Conus* gouges (1D, section 4.2 above). The *Conus* gouges themselves would certainly be covered by her qualification, and possibly the *Lambis* items discussed by Garanger for central Vanuatu. Takayama and Intoh (1980:23) comment on the thinness of their Class III *Cassis* adzes and suggest they may have been used as spoons or scrapers (cf. Takayama *et al.* 1980:13). The canoe adze ethnographically recorded by LeBar (1964:7; Fig.2) for Truk, which is mentioned by both Davidson (1971b:68) and Takayama and Intoh (1980:40) in their review of *Cassis* adzes, has some resemblance, but is larger and sturdier than some examples reviewed as 1D - and certainly than the Tongan *Conus* tools - and makes obvious provision for hafting. Much more similar to Tongan 1D in size, shape and basic mode of manufacture are the *Conus* tools described as straight knives by Gifford and Gifford (1959:188-90; Plate 38a-c) on Yap and as scrapers by Takayama *et al.* (1980:14-15, 22-23; Fig.12.6-10; Plates 9.20-28, 10.1-20) in Palau. However, the cutting edge on these specimens is found along one of the long sides and, at least for Palau, they are thought to be tools of food preparation, such as are discussed in the next section.
SHELL SCRAPERS AND PEELERS (Class 2)

**Tonna** scrapers (Class 2A)

Suggs and Sinoto found such scrapers, interpreted as vegetable peelers, only in the early part of the northern Marquesan sequence (Suggs 1961:127-28; Fig.29g; Sinoto 1970:110), but Skjølsvold (1972:32-33; Fig.22) describes possible equivalents in *Turbo* shell from a late prehistoric site in the southern Marquesas. The characteristic of the type is that the outer whorl of the shell is perforated and the edges of the hole abraded. Suggs cites an ethnographic parallel from Samoa obtained by Buck (1930:109; Plate IVC) and used for scraping taro. Buck (1938b:204-5; Fig.10b) says the identical implement is present in Mangareva, used for scraping breadfruit. Suggs notes the presence of scrapers of other types of shell made on the same principle in Fiji (ethnographic), New Caledonia (archaeological; cf. Golson 1961:170) and the Marianas (archaeological). The last-mentioned example (Spoehr 1957:157; Fig.83; cf. Takayama and Egami 1971:21; Plate VIII.3) is a species of *Turbo* and similar specimens are now on record archaeologically for Yap (Gifford and Gifford 1959:190-91; Plate 40g), southern Vanuatu (Shutler and Shutler n.d.;Plate 3E), Samoa in post-ceramic contexts (Davidson 1969b:246; Fig.102a) and Fiji (Gifford 1951:220) from the surface in localities near Sigatoka where Lapita and other types of pottery have been found (cf. Birks 1973:7). A recently published example from Stratum III at Falea'i'u (Janetski 1976a:Fig.17k) comes from a late Samoan Lapita context.

There are two specimens of *Tonna* shell from the Tongan excavations, both *T. perdix*, distributed as in Table 86. 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, one from its top, the other from its bottom half, and are so likely both to be late period, though the latter (To.6/2011) could possibly relate to the middle-period occupation at the site.

**Anadara** paring knives (Class 2B)

This artifact, made on the same principle as the foregoing, is known by three specimens from Tonga, distributed as in Table 86. The only two in secure chronological position were found at To.6 (nos 756 and 1919) in the upper and middle part of the Horizon III midden, dating to the late period; one of these is illustrated as Plate 73.12. The third example, To.4/124, cannot be dated.

In seeking parallels I am conscious of the danger of confusion with the *Anadara* net sinker (Class 3D), where a hole is knocked through the umbo. Thus I differentiate between Plate 41c and d of Gifford and Gifford (1959) for Yap, the former perforated at the umbo, the latter on the body of the shell, though neither specimen is interpreted as either net sinker or paring knife. Of specimens on record for Palau (Osborne 1979:41; Fig.22e; Takayama et al. 1980:15; Plate 11.2, 3), the example figured by Osborne with its ground perforation is the closest to the Tongan type. Takayama and Intoh (1978:44; Fig.19.6; Plate XVII.13) speculate whether their specimens from Truk are net sinkers or scrapers in the Tongan fashion.

Nearer Tonga, the type is known on another kind of bivalve from central Vanuatu in early levels of the Mangaasi site, which dates back about 2500 years (Garanger 1972:51, 108; Fig.108.12).

The perforation on these objects may alternatively be interpreted as a fastening hole for the use of the shell as a coconut-grater head, as recorded ethnographically, for example, from the Solomon Islands (Foy 1904:Plate 13.12) and from Tuvalu and the Admiralties (personal observations in the National Museum, Copenhagen). Garanger (1972:51) offers this as a possible explanation of the Mangaasi perforated bivalves mentioned above. On coconut graters in general, see the full discussion by Davidson (1971b:72-75).
**Strombus paring knives (Class 2C)**

Four specimens of this type, made from *S. luhuanus*, were excavated both early and late in the ceramic sequence, distributed as in Table 86. One was found at To.1 (no. 2431) in the middle of Horizon I shell midden in Trench IV and dates early. Three came from To.6 (nos 995, 1173 and 2004), one in the middle of Horizon IT and another in Horizon II being late period, the third deriving from a disturbed square and not datable. The paring perforations appear to have been abraded by use rather than deliberately, since they are of rather irregular shape; see the illustrated specimen of Plate 72.9.

The type is recorded archaeologically for Yap (Gifford and Gifford 1959:190-91; Plate 40h) and New Caledonia (Gifford and Shutler 1956:65; Plate 8ac, ad). In New Caledonia it is not reported for the Lapita site (Site 13) but is present on a number of the later sites.

**Oyster scraper-knife (Class 2D)**

There is one possible example from To.5 (no. 53), a shell which is unmodified except for some abrasion at the broader end (Plate 74.4; Table 86). It was excavated in Trench II in the top of the typical shell-midden deposit of Horizon I in a position right beneath Burial AM and not apparently disturbed by this. It would therefore fairly reliably belong to the early period.

It conforms in part to the description given by Suggs and Sinoto for examples recovered in small numbers from all periods of Marquesan prehistory, as well as in the Maupiti burials in the Society Islands (Suggs 1961:129; Sinoto 1970:119; Fig.8b, d).

**Shell food-preparation tools in the Pacific**

With Classes 2A-D we are evidently dealing with Tongan representatives of specific types of shell artifact widely distributed through the island cultures of the South Pacific. The evidence adduced by Gifford (Gifford 1951:220; Gifford and Shutler 1956:65; Gifford and Gifford 1959:190) and Suggs (1961:127-29) suggests that these implements were for the preparation of tree fruits and root crops for food and their presence in Tonga, as elsewhere, is amongst the best evidence we have in the archaeological record for the presence of the domesticated plants which do not themselves survive.

In this context we may note the presence elsewhere in our region of types of shell artifact, interpreted as food-preparation tools, which are not reported as yet from Tonga or differently interpreted when found there.

In the first connection we have a number of implements found in late Lapita sites in Western Samoa (Janetski 1976a:71, 73, 74, 81; 1980b:123, 125, 127, 130; note that those from Potusa are less securely provenanced). They comprise scrapers and peelers of cowrie (*Cypraea*) (1976a:Fig.17n and 1980b:Fig.44g, j, k for scrapers; 1980b:Fig.44a-e and possibly f for peelers) and scrapers of *Conus* (1976a:Fig.17l; 1980b:Fig.44i). The *Conus* scrapers differ from the Tongan *Conus* gouges discussed above (1D, section 4.2) in that, though formed out of the outer whorl of the shell, they retain the inner whorl, while the figured example is bevelled on the outside, not the inside of the transverse working edge. The *Conus* implements from Palau and Yap mentioned in the discussion of Class 1D, which possibly operated (Takayama et al. 1980:14, 22) as breadfruit scrapers, are also different in that the inner whorl is removed and the cutting edge formed along one of the longitudinal edges.

The *Cypraea* peelers are identical with artifacts put on record for the Marquesas archaeologically by Suggs (1961:128; Fig.29f, Nukuiva, northern Marquesas; see Skjølsvold 1972:33; Fig.23 for a possible example from the southern Marquesas) and ethnographically by Linton (1923:351; Plate LV11.C), described as a tool for peeling the ripened breadfruit. Linton says, without referencing his statements, that the identical tool is known in Kuschay (= Kosrae) in the eastern Carolines but has not been reported elsewhere in Micronesia, while its Polynesian distribution is unknown, apart from the fact that it is used in the Society Islands,
but not in Hawaii or apparently in Tonga. Ethnographic specimens of another type of cowrie tool described for the Society Islands by Phelps (1976:111, 421; Plate 59 nos 485, 490, the former attached to a wooden breadfruit splitter) are said to be for scraping the green outside of the fruit before splitting. They are identical with that figured by Buck (1938b:204-5; Fig.10a) for Mangareva, which he describes as being cut transversely near the middle of the shell, the cut edges being used for the scraping.

If I interpret the evidence correctly, this implement belongs to the first, not the second of the groups into which Takayama and Intoh (1978:41-42; Figs 17.7, 10, 18.6 and Plate XV.8 for group one; Figs 17.9, 18.1-5 and Plate XV.9, 10 for group two) divide the cowrie breadfruit scrapers from a second millennium AD midden on Tol in Truk lagoon. As I understand them, group one has the working edge formed at the end of the shell, while in group two a large part of the dorsum of the shell is also removed. A specimen from the lower pottery-producing layer of Site An-6 on Anuta (Kirch and Rosendahl 1973:89; Fig.29B), dating back into the third millennium BP, is similar to group two so defined. The breadfruit scrapers from ceramic levels of Western Samoan sites (Janetski 1976a:Fig.17n, 1980b:Fig.44g, j, k) represent extreme cases of dorsum removal, transferring the working edge from end to side. I can find no parallels for this tool.

The matter of Tongan artifacts similar to tools described as food scrapers elsewhere but differently interpreted by me for Tongatapu also concerns cowrie shells. There are two such cases. One involves the cowries with dorsum removed found in Lapita contexts in Western Samoa and Niuafo'ou and interpreted as for food preparation on the evidence respectively of wear along the broken edge (Janetski 1980b:125; Fig.44h) and association with pits thought to be for starch-paste fermentation and storage (Kirch 1978:11; Fig.7m). The other case is that of the caps which result from the removal of the dorsum, which Kirch and Rosendahl (1976:238) think may be scrapers on the evidence of the edge-damage patterns on similar objects from Anuta, found in the lower pottery-bearing layer of Site An-6 and dating to the third millennium BP (Kirch and Rosendahl 1973:89; Fig.29A). I deal with both these cases under Class 3C (octopus lures) (section 7.3 below).

Concluding remarks on use of shells as tools

Throughout the middens there were many fragments of Gaftrarium and Anadara shells, originally thought of as scrapers (Plate 73.7, 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. Edge-Partington (1895:Plate 43.8) shows an Arca shell from Samoa used in tapa manufacture and (1890a:Plate 67.10) a similar example from Niue. For Samoan archaeological material of this general category, see Davidson 1969b:246 and Green 1974d:268. Other archaeological reports describe a variety of shells put to useful purpose as knives, scrapers or even spoons (e.g. Takayama and Intoh 1978:43-44 for Truk; Davidson 1971b:75, 80-81 for Nukuoro; Kirch and Rosendahl 1973:89-90 for Anuta).

FISHING GEAR (Class 3)

Fish hooks (Class 3A)

The rather complex evidence now under review is set out by site and horizon in Table 87.

One-piece hooks

The only certain specimen (To.2/24) is a small complete one-piece hook of shell, 2 cm long, with a slight thickening at the end of the shank (Plate 68.19). In the terminology (Emory et al. 1959:10; cf. Kirch and Rosendahl 1973:63) it is a jabbing hook. It is well polished all over, especially at the point, which is without barb. It was found in the Ostrea shell layer of Zone IV of the mound horizon at the site and in all probability derives from an early-period context.
Plate 68.12 is a fish-hook blank of pearl shell, 2.5 cm in length, found at To.1 (no. 2107) in Pit AH, Trench III, whose stratigraphic status most realistically relates it to the middle-period occupation at the site (Chapter II, section 5.5; Chapter III, section 11.4, discussion of pits).

A doubtful case is represented by an unmodified shell-edge fragment of *Tellina* (*Quidnipagus*) *palatam* of otherwise unique shape, To.6/2656 (Plate 68.9). It was found in Posthole J which on circumstantial evidence belongs to the Horizon I occupation generally and dates in all likelihood therefore to the late ceramic period (Chapter II, section 10.6).

The scarcity of fish hooks in the archaeological record of Tongatapu is consistent with the picture elsewhere in Western Polynesia and the single authenticated example is not revealing on the question of cultural relationships, since it lacks the elaboration of the shank head which has proved a sensitive cultural and chronological indicator (e.g. Sinoto 1967:345).

A few fish hooks have been discovered on excavations in Western Samoa: from pottery-bearing levels (II, IV) at Falemoa (Janetski 1980b:Fig.43j, l, n, o); from layers here (V, VII) and at Potusa (Stratum IV), where the finds may be later; and from the post-ceramic Lotofaga midden (Davidson 1969b:Fig.103a; Plate 23). The Lotofaga specimen, of *Turbo*, is unfinished (Davidson 1969b:244) and thus typologically uninformative. With one exception, all the others are of pearl shell (Janetski 1980b:125); none of these retains the hook point and only one the shaft head, which is grooved on the outer side. The exceptional hook (Janetski 1980b:125; Fig.43j), which is of *Turbo*, has no elaboration of the head for line attachment, but could be either broken or unfinished there.

Three one-piece fish hooks of either *Turbo* or *Trochus* were recovered from sites with Lapita pottery on Niutatputapu (Kirch and Dye 1979:69; Fig.6). Two examples preserve the shank head, which in both cases is notched for lashing. They are said to be similar to the one-piece fish hooks from pottery-bearing layers of Site An-6 going back into the 3rd millennium BP on the Polynesian outlier of Anuta in the southeastern Solomons (Kirch and Rosendahl 1973:62-66; cf. Kirch and Rosendahl 1976:236-37).

*Composite hooks*

In view of the importance of composite lure hooks in Tonga in the early phase of European contact and probably also in the later part of prehistory (Anell 1955:158-69; cf. discussion in Green 1974d:273-74), the archaeological question is how far back in time this fishing technique was known.

Whether the modified piece of shell (To.2/66) illustrated as Plate 68.10, a find not more precisely provenanced than to the Mound Horizon at To.2, is the point of a composite hook or a fish gorge of the bent variety known in Micronesia (Anell 1955:77; Spoehr 1957:157-58; Fig.85 middle row) or something quite different is unknown, but it is counted with Class 3A and is a likely transfer from the early-period midden. 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.

Of further interest are two of the incomplete *Tridacna*-shell artifacts discussed below (section 9.21) under ornaments as Class 5P (Plate 68.1, 3), for which an alternative explanation as lure shanks could be offered. The To.1/1881 piece, found at the base of the Horizon I shell midden in an undisturbed square (83/59) of Trench I (on disturbed and undisturbed squares see Chapter III, section 10.1), is early period, the other, To.6/1814, found in the Horizon II midden, is late. A coastal midden site at Lotofaga in Western Samoa, datable to some time in
the second millennium AD, has also provided a possible fragment of a lure shank (Davidson 1969b:244; Fig.103b), though of a different shape and size. The Potusa midden site on Manono Island has yielded three lure shanks in shell, which are given a historic date (Janetski 1980b:130-31; Fig.43p-r). Kirch and Dye (1979:73-74) have some general remarks of interest to make as a result of their ethnoarchaeological and archaeological investigations into fishing on Niuatoputapu.

**Fish gorges (Class 3B)**

The sole definite example (To.1/3544, Plate 68.11; Table 87), of fish bone, is from To.1, Trench I. Found at the level of the base of the Horizon I shell midden in one of the undisturbed squares (83/57; on disturbed and undisturbed squares see Chapter III, section 10.1), it is highly likely to be early period, despite the closeness of undated Pit H. It is of slightly bent form with tapering ends, well polished all over. A possible gorge of shell (Plate 68.10) has been mentioned above under composite hooks (in section 7.1) and tallied with Class 3A in Table 87. Sharply bent in form, it is likely to be redeposited in the Mound Horizon at To.2 from an early-period context.

Fish gorges are widely distributed ethnographically in the South Pacific: Anell (1955:72, 77) describes Micronesian gorges as bent, the Polynesian type as straight. Archaeological specimens found in the Marianas are ‘bent’ to nearly 90° (e.g. Spoehr 1957:Fig.85). Fish gorges made from fish bone exactly like the slightly bent To.1 specimen are known ethnographically from Samoa (Beasley 1928:23; Plate XXXVII). A bone example almost identical with the Tongan piece is on record for Hawaii (Emory and Sinoto 1961:Fig.47a). A possible early Marquesan gorge of pearl shell is described by Suggs (1961:84) as obtuse-angled, but in the absence of an illustration it is impossible to say whether it is more like the To.1 piece or the possible gorge of shell from the mound at To.2, which, if really a gorge, could be likened to the Micronesian bent variety. A straight gorge of coral has been reported archaeologically from southern Vanuatu (Shutler and Shutler n.d.: Plate 3F).

**Octopus lures (Class 3C)**

*Ethnographic and archaeological presence in the Pacific*

The specialised octopus lure of the South Pacific, essentially a Polynesian instrument (Beasley 1921), is now well represented in the archaeological record for the region, in the shape of its stone weight (of various types) and/or the cowrie-shell (*Cypraea*) caps which form its lure (Suggs 1961:89-92 and Sinoto and Kellum 1965:20 for the Marquesas; Emory *et al.* 1959:28-29 and Emory and Sinoto 1961:56-57 for Hawaii; Emory and Sinoto 1965:89-90 for the Society Islands, with qualifications in Emory and Sinoto 1964:158; Green 1974d:269 for Samoa).

The device now in use in Tonga is like that described by Buck (1930:434-36) for Samoa, which has a stone sinker 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 (n.d.:333ff.), both caps were perforated. Edge-Partington (1890a:Plate 88.7) illustrates a complete Tongan *makafeke*. The Hawaiian and Marquesan caps from archaeological contexts are perforated, but no information on this score is yet available for the more recently reported Tahitian archaeological specimens. Possibly notched examples are known ethnographically from the Loyalty Islands (Edge-Partington 1895:Plate 64.3; note that only one cap is used in this example).

When seen against the ethnographic and archaeological record, there are two peculiarities about the excavated Tongan material. No definite stone octopus-lure sinkers were found, a circumstance also reported for New Caledonia (Gifford and Shutler 1956:66). In historic times Tahitians did not use sinkers with their octopus lures and Emory and Sinoto (1964:158) wonder whether the few surface finds on record are truly Tahitian. Also none of the Tongan cowrie-shell caps interpreted as belonging to octopus lures has 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 (Gifford and Shutler 1956:66; Plate 7j, 1). They are now also on record in Lapita contexts in Fiji (L. Birks pers. comm., for the Yanuca site) and in Western Samoa at Falesi’u (Janetski 1976a:71, 73; Fig.17b; 1980b:125; Fig.43b; note that Fig.43a and c from Stratum VI at Falemoa and Stratum IV at Potusa are apparently post-ceramic). Davidson (1969b:244) reports an unperforated cowrie-shell piece from the post-ceramic Samoan site of Lotofaga as possibly from an octopus lure.

Cowrie caps in the Tongatapu excavations

Forty-three shell caps were found in Tonga, of which one is illustrated in Plate 67.6. They measure 5-7 cm across and were probably all broken out of the shell of the large cowrie, *Cypraea tigris*, and their edges left unsmoothed. They were recovered from all four main excavations and in both early and late contexts (Table 87), while nine of the 20 caps found in Horizon I at To.6 derive from the bottommost spits and could belong to the middle-period occupation of this site. All this suggests that they represent finished implements, not ones awaiting perforation or notching. Two caps were recorded from the same spit and square in five instances: once at To.5 (at the bottom boundary of Horizon I in Square 20/26), four times at To.6 (one in Horizon IB, Square 27/20, two in Horizon IT, Squares 27/20 and 29/20, one in Horizon II, Square 28/20). The question is whether such double occurrences might not be evidence for the use of two caps per complete octopus lure as recorded ethnographically.

Cowrie bases and their interpretation

Three cowrie shells were found, from which a cap had been detached: they are listed in brackets in Table 87 under column 3C and one is illustrated as Plate 67.5 One was excavated in Horizon I at To.5 (no. 31), two at To.6, one in Horizon II (no. 795), one not precisely provenanced (no. 3397). Numerous parallels to these are to be found in New Caledonia, though none from the Lapita site itself (Gifford and Shutler 1956:66; Plate 7j). From Yap Gifford records so-called pottery smoothers looking exactly like Tongan cowrie shells with cap detached, but the caps themselves are not recorded (Gifford and Gifford 1959:192-93; Plate 38d, e). Large cowries with dorsum removed found at Falesi’u, Western Samoa, are interpreted (Janetski 1976b:76, 78; Fig.18c, d and cf. b) as representing the standard way of getting at the meat, but an identical specimen from a ceramic level (III) at Falemoa, showing wear along the broken edge, is thought to be a scraper (Janetski 1980b:125; Fig.44h), as already indicated in the discussion of shell food-preparation tools in the Pacific (section 6.5 above). Also mentioned there are the examples excavated in association with pits thought to be for starch-paste fermentation and storage at a site on Niuatoputapu and interpreted as food scrapers (Kirch 1978:11; Fig.7m). Finally, from the same discussion (section 6.5), I repeat the suggestion made by Kirch and Rosendahl on the basis of finds from a first-millennium BC level of occupation on Anuta that the caps have nothing to do with octopus lures but are really scrapers (Kirch and Rosendahl 1976:238; cf. Kirch and Rosendahl 1973:89; Fig.29A).

In this context attention may be drawn to the discrepancy at To.6 between the 32 caps and only two *Cypraea* bases recovered. This might mean that the manufacture of the caps took place away from the site and that the bases found at the site represent by-products of such manufacture brought back to serve other purposes, while already the detaching of the caps would have facilitated getting the meat out of the shell.

That unambiguous functional interpretation is difficult with unmodified or only slightly modified shell may in the case of cowrie-shell bases be stressed from the ethnographical observation that such specimens were also used as net and line sinkers, a point I take up below.
Anadara net sinkers (Class 3D)

No fewer than 266 of these artifacts were registered, predominantly at To.2 and To.5 (for the situation at To.1 section 1.2 above, for circumstances at To.5 section 1.5), and in both early and late ceramic contexts (Table 87): two are illustrated as Plate 73.9, 11. Examples were also found during excavations at 'Atele, datable to the early post-ceramic period (Davidson 1969a:279). The hole was easily knocked through the top of the valve, where the shell is thin.

Interpretation and comparisons

The interpretation of function seems safe, since shells worked in the same way are still occasionally used in Tonga and also in New Caledonia (Gifford and Shutler 1956:Plate 3a). McKern (n.d.:283) describes the use of small shell-weighted nets in Tonga, although he does not specify the kind of shell. Edge-Partington (1890b:Plate 326.7) illustrates a drag net from New Guinea provided with perforated bivalve shells as sinkers. Other ethnographic information on simple shell net sinkers is available, for example for the western Carolines, the St Matthias group of the Bismarck Archipelago and Tokelau (Eilers 1935:390; Fig.171; Nevermann 1933:91; MacGregor 1937:97; Plate 2C).

Archaeological parallels are on record from central Vanuatu (Shutler and Shutler n.d.:Plate 7B) and from New Caledonia, where they were found at the Lapita and later sites (Gifford and Shutler 1956:63; Plate 7h). Identical specimens from Yap were said by Gifford's informants not to be sinkers (Gifford and Gifford 1959:192; Plate 41c). Difficulties in interpretation have been mentioned previously in the section on Anadara paring knives (Class 2B, section 6.2 above) and in this connection reference is made to discussions about perforated arc shells in Truk (Takayama and Intoh 1978:44) and Palau (Osborne 1979:20, Fig.9; Takayama et al. 1980:15). J. Craib (pers. comm.) tells me there are surface finds in the Marianas.

Buck (1930:497-80; Fig.279) describes Cypraea mauritiana bases as weights on shrimp nets in Samoa; Beasley (1921:111; Fig.9) describes for Tahiti a tiger-cowrie base provided with line and hook, the base frame to be filled with roasted breadfruit, i.e. functioning both as weight and bait container, the whole device aimed at both octopus and other fish. Edge-Partington (1895:Plate 19.9) shows a cowrie base used as a line weight for a one-piece fish hook in Tahiti.

Finally, Kirch and Dye (1979:69) mention the excavation in Lapita context on Niuaotoputapu of a small cowrie shell (Cypraea moneta) with the dorsum removed, remarking that such prepared shells are widely used as weights for dip nets in Polynesia. A similar item from To.6 I have interpreted as a shell bead (under Class 5L, section 9.17 below).

Stone net sinkers (Class 3E)

Only two specimens were recovered, one from the surface at To.1 (no. 3422), the other from the late-period occupation of Horizon III at To.6 (To.6/104, Plate 77.10; Table 87). Both are made from volcanic pebbles of the type called makahunu from the islands of western Ha'apai. 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 the present time.
NEEDLES AND AWLS (Class 4)

Needles (Class 4A)

Only two examples were found, To.6/3401 (Horizon II midden) and To.6/3402 (Posthole B, possibly Horizon I), the former certainly, the latter in all likelihood in late-ceramic context (Table 86). They are made of smoothed bird bone, 2 mm thick, with the perforation through one wall only and the edges of this finely polished. To.6/3401 (Plate 68.18), 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.

After describing needles from her excavations on Nukuoro, Davidson (1971b:77) remarks, without further specification, that bone needles are well known from archaeological contexts in Polynesia and will doubtless be found to be widely distributed. Here I simply note instances from Easter Island (Ferdon 1961:247; Heyerdahl 1961:412-13; Fig.109a-h) and New Zealand (Golson 1959b:40; 58; cf. Duff 1956:219, 221; Fig.60).

Awls (Class 4B)

Seven specimens were found, as set out in Table 86; one is illustrated as Plate 68.8. Five items were excavated at To.1. Two of these are clearly of early ceramic period date: To.1/1909 found in the lower part of Horizon I midden in an undisturbed square (82/72; for disturbed and undisturbed squares see Chapter III, section 10.1) of Trench I and To.1/1908 from Pit AC; a third example, To.1/1906, from a disturbed square (82/59), is less securely in situ in Horizon I. Of the other two To.1 pieces, no. 1907 is from Pit N and no. 2109 from Pit AH, both argued to be middle period (Chapter II, section 5.5; cf. Chapter III, section 11.4, discussion of pits at To.1). Two specimens were found at To.6: one (no. 1579) in Horizon IB midden dates to the late-ceramic period, unless it is a survival from the middle-period occupation; the other (no. 2276), in a disturbed context, is undatable. The type seems then to have been known throughout the Tongan ceramic sequence.

Four specimens are of bird bone, two possibly of fish bone. Two unbroken specimens are 5 cm and 7.1 cm long (To.1/1907 and 1909 respectively), the other four, broken, examples being shorter. All are 4-5 mm thick. The pointed end is formed by a single bevel, which is well polished together with the rest of the implement.

Duff (1956:217, 219; Figs 55-57) records awls of bone from early archaeological contexts in New Zealand and Emory and Sinoto (1965:86) interpret as awls some shell items from Tahiti. An artifact of hollow bone from a late Samoan Lapita level (III) at Faleasapu (Janetski 1976a:73; Fig.17h) is described simply as a polished bone point but could be an awl.

Sinoto (1978:163; Fig.27f) describes two bone objects excavated on Reao in the Tuamotu as probable awls of a type commonly found in Eastern Polynesia.

ORNAMENTS (Class 5)

Classification

McKern devotes some attention to ethnographic ornaments in Tonga (McKern n.d.:150-218, in various contexts). Most common was the use of perishable items like flowers, fruits, leaves, seeds and feathers for garlands round the neck, waist, wrist, elbows, ankles and knees, some types being restricted to persons of rank. 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. In default he draws on the writings of early explorers and visitors. 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 quite a 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 Tables 88 and 89.

Groups A and B comprise narrow and broad bracelets, 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 popular in Tonga (McKern n.d.:150, 194-97) and although 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 ornament in its own right.

Groups I, J and K include respectively pearl shell, pule-shell (Cypraea) 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 (n.d.:150, 196).

Groups L, M and N are beads respectively of shell, bone and stone, 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 is made up of some incomplete pieces.

Group Q comprises tattooing chisels and introduces an aspect of body adornment of quite a different character.

Narrow bracelets (Class 5A)

Seventy-eight fragments were found, 15 made of Tridacna and 63 of Conus shell. Their site distribution is set out in Table 88 and examples are illustrated in Plate 69.

The type is predominantly an early-period form, only three being definitely from the late period, in Horizons IT, II and III at To.6. There are two other pieces from To.6, whose stratigraphic status is uncertain, so that the total number of pieces from this normally well-provisioned site is very low indeed. This indication of an early decline in popularity may make understandable McKern's total lack of mention of shell bracelets, apart from a reference to Cook who saw a pearl-shell bracelet worn on the upper arm (McKern n.d.:194). It is worth noting that although there is a clear preference for Conus as raw material overall, the few To.6 specimens are mainly in Tridacna.

Little information about manufacturing procedures is provided by the archaeological specimens, which seem to represent fragments of complete and well-polished ornaments. Two fragments, To.5/23 and 24, found a quarter of a metre apart in the midden, join together to make the only complete bracelet in the collection (Plate 69.1). 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 subclasses, the distribution of which is detailed in Table 88.
**Subclass A1: roundish cross-section (Plate 69.5)**

There are two specimens in *Tridacna* (To.1/1903; To.6/1351) and two in *Conus* (To.2/78, 2371), varying from 4 to 7 mm in thickness (inside to outside) and 4 to 6 mm in width (side to side). The specimen from To.1 was found in an undisturbed square (82/71; for disturbed and undisturbed squares see Chapter III, section 10.1) of Trench I at the base of the Horizon I shell midden, thus dating early; the two from To.2 derive from Zone III of the midden, dating early; the one from To.6 was found in the bottom of Horizon III, dating late.

**Subclass A2: semicircular cross-section (Plate 69.10)**

There are 17 specimens, all in *Conus* shell (To.1/3048; To.2/47, 53, 56, 58, 81, 228, 1456, 2211, 2721, 3674, 3676; To.3/1; To.4/1; To.5/11, 1270, 1364). In cross-section they are always wider than they are thick, width varying from 4 to 9 mm, thickness from 2 to 7 mm. The inner surface of the bracelet forms the base of the semicircle.

The piece from To.1 was found in a test pit (50/94) in the lower half of shell midden of Horizon I type and is thus thought to be early. Of the 11 pieces excavated at To.2, four (nos 53, 58, 228, 1456) were found in Zone I of the midden, another four (nos 47, 56, 2211, 2721) in Zone II; all are from early-period date. One piece (no. 81) was found in the sand of the burial area in Zone V of the mound, 5 cm below the fragment of a human leg bone in Square 50/50. The question is whether this bracelet relates to the post-ceramic burials made in the Mound Horizon at To.2. Two circumstances make this unlikely. No grave gifts were made with the numerous post-ceramic burials excavated at 'Atele (Davidson 1969a). The type of bracelet concerned, A2, is not securely recorded from late ceramic period context, and at To.2 itself was only found in the lower half of the early-period midden. For these reasons it is likely that the bracelet fragment in question was a transfer from the early midden. Two more pieces from To.2 are of uncertain stratigraphic status.

The one piece from To.3 was found in the top of the Horizon III midden, whose chronological status is uncertain. The fragment from To.4 cannot be dated. Of the three pieces from To.5, one (no. 1364) was found in the lower of the occupation lenses of Horizon O, dating early; one (no. 11) was found at the base of the Horizon II midden, dating to the middle period; the third one (no. 1270) was found in the fill of the post-ceramic Pit C, a circumstance that makes the dating of it uncertain (Chapter III, section 11.4, discussion of pits).

In sum, Subclass A2 can be securely dated to the early and middle periods, with evidence for any later dating being questionable.

**Subclass A3: domed cross-section (Plate 69.1, 2, 6, 9)**

There are nine examples in *Tridacna* (To.2/15, 29, 31, 40, 46, 59, 65; To.3/262; To.5/23,24 fitting together) and five in *Conus* (To.1/1900; To.2/43, 71, 3675; To.6/1136). Thickness is on the whole the same as width, both varying from 8 to 10 mm. To.3/262 (Plate 69.2) is exceptional in that width and thickness are 15 mm. On the complete specimen from To.5 (Plate 69.1) thickness is 10 mm, width 8 mm and the inner diameter is 6.8 cm. All specimens are finely polished on all surfaces.

The example from To.1 was found right at the western edge and almost at the bottom of Pit X in Square 83/66. Given the complex problem of assigning firm dates to specific pits in this part of the site, it is best to consider the piece as of uncertain chronological status.

Of the ten specimens from To.2, five were found in Zone IV of the mound horizon, four of them (nos 29, 31, 43, 71) in the *Ostrea* shell component, the fifth (no. 15) in a position below skull fragments of the isolated burial of Pit Z in Square 50/58, which penetrates into the southern edge of the *Ostrea* shell deposit. As regards this latter piece, remarks made above about To.2/81 (Subclass A2) apply. In sum, these five pieces are possibly all transfers from early-period contexts. Four other fragments are definitely early, being found in the
undisturbed shell-midden horizon, two in Zone I (nos 59, 65), two in Zone II (nos 40, 46). The tenth item (no. 3675) from the site is not further provenanced.

To.3/262 was found in Posthole C of Horizon I, dating to the middle period. The two parts of the complete bracelet from To.5 were found in situ 25 cm from each other right at the base of the Horizon I shell midden, dating early. The example found at To.6 derives from a disturbed square and cannot be dated.

Subclass A3 by the above evidence dates to the early and middle periods.

Subclass A4: thick cross-section

Two examples only are represented, one in Tridacna (To.2/636), one in Conus (To.6/23). 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.

The piece from To.2 was found in Zone I of the midden, dating early, that from To.6 in the Horizon II midden near Oven L, dating late.

Subclass A5: thin cross-section (Plate 69.3, 4, 7)

The 11 specimens classified here are all of Conus (To.2/22, 25, 28, 60, 64, 1155, 1156, 2271, 2517, 3946; To.6/12). 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 with one exception between 7 and 14 mm, the latter between 2 and 4 mm. To.2/25 (Plate 69.7) is the exceptional specimen, being 16 mm wide and only 3.8 cm in inner diameter.

Five specimens from To.2 are possible transfers into the mound from early contexts: one was found in the burial area of Zone V (as in the case of subclasses mentioned above) and three in the Ostrea deposit of Zone IV, while one was not precisely provenanced. Five specimens were found in Zone I, dating early. The piece from To.6 was found in an undatable (planting?) hole, DR, disturbing Oven Complex DA in Trench I.

The stratigraphic evidence thus securely puts Subclass A5 into the early period. The chronological implications of the single piece from To.6 are obscure.

Subclass A6: square cross-section

The two examples are of Conus shell (To.2/2406, 2463). The cross-section exhibits four flat sides with sharp corners. Width and thickness are 5 mm. The pieces were found in Zones II and III of the To.2 midden, dating early.

Subclass A7: triangular cross-section (Plate 69.11)

There is only one specimen, of Tridacna (To.2/19). The base of the triangle is the inner surface of the bracelet. Thickness is 16 mm, width 13 mm. It was found in the middle of Zone VI at To.2, the top of the mound horizon, but may be a transference from the early midden, thus possibly dating early.

Subclass A8: unstandardised cross-section (Plate 69.8)

All 21 specimens are made of Conus shell (To.1/29, 30, 1612, 1613, 1872, 1901, 1902; To.2/33, 34, 53, 68, 159, 329, 1548, 2500, 3277, 3947; To.3/260; To.4/97; To.5/5; To.6/81). The cross-section varies greatly in shape according 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 outer surfaces, with no attempt to eliminate the natural configuration of the shell on the inner surface. Thickness varies from 2 to 6 mm, width from 4 to 8 mm.
Of the seven pieces from To.1, two (nos 29, 30) are of uncertain stratigraphic status. Four were found in possible Posthole L and one (no. 1901) in the adjacent Pit K in Trench I. These features belong to the ‘small area’ of the trench, where finds in the lower spits are considered to be in all likelihood early (see section 1.2 above).

Of the ten examples from To.2, the stratigraphic relationship is uncertain for two, one of them being a stray find, the other deriving from a buffer spit between midden and mound. A third one was found in a position which by reconstruction corresponds to midway in recent Posthole X which disturbed the Ostrea shell deposit of Zone IV at a point where this had previously been disturbed by the burial digging of Zone V. Its true age is therefore unknown, but, like other mound finds, it is possibly a transfer from an early context. Seven pieces were excavated in the midden itself, two in Zone III, one in Zone II and four in Zone I, all dating early.

The To.3 specimen was found in Pit A, dating to the middle period. The example from To.4 cannot be dated. To.5/5 was found in the middle of Horizon II, dating to the middle period. The piece from To.6 was recovered in Horizon I/5 midden, dating late.

Subclass A8 is thus on secure record throughout the pottery sequence but not unequivocally beyond it.

Subclass A9: indefinite cross-section

The indefiniteness stems from the small size of the fragments, of which there are five of Conus (To.1/1905, 2598; To.2/75, 207, 5705) and one of Tridacna (To.1/1904). Thickness varies between 2 and 5 mm, width between 2 and 7 mm.

Of the three pieces from To.1, no. 2598 came from the upper part of Horizon I in Trench IV and dates to the early ceramic period. No. 1905, from Pit K of Trench I, is likely to be early, following the conclusions about the ‘small area’ of that trench reached above (section 1.2). No. 1904 is best reported as of uncertain date, given the uncertain status of Pit AA in which it was found (Chapter II, section 5.5; Chapter III, section 11.4, discussion of pits at To.1).

The three pieces from To.2 were all found in the midden horizon, one in Zone I, two in Zone III. All are of early date.

This rather miscellaneous group conforms to the chronological distribution of shell bracelets as a whole.

Narrow bracelets in the Pacific

On present evidence few parallels for Tongan narrow bracelets of shell exist elsewhere in Polynesia. There are a number of examples from pottery-bearing sites in Western Samoa, which from the information cannot be confidently ascribed to subclass, though the unstandardised category A8 might cover the case. They are from Stratum III of Faleasi'u (Janetski 1976a:73; Fig.17c, which is perhaps the same as Janetski 1980b:Fig.45c) and from Stratum III at Falemoa (Janetski 1980b:127; Fig.45d-g, all Trochus). There is a Conus bracelet from Falemoa Stratum V (Janetski 1980b:Fig.45b), but this horizon is considered to be of recent formation (Lohse 1980:30). A Tridacna piece from Potusa Stratum IV (Janetski 1980b:123; Fig.45h) looks like my Subclass A7 (triangular cross-section), but this is a disturbed site and Stratum IV has European items included (Lohse 1980:22). There is an example from a ceramic context on Niutoputapu, probably of Subclass A8, made in Trochus (Kirch 1978:Fig.71).

Two Fijian examples are recorded from Gifford’s excavations at the post-Lapita site, Site 17, one of Trochus, the other of Conus, similar to Tongan specimens of Subclass A8 (Gifford 1951:220; Fig.1d, i), while others are recorded from the excavations at the early Lapita sites at Natunuku (Subclasses A2 and 6) and Yanuca (Subclasses A5, 6 and 7) (E. Shaw and L. Birks pers. comm.). Fragments likely to be of Subclass A8 have been found in New Caledonia, made
in *Conus* and *Trochus*, on both the early Lapita site, Site 13, and on later sites (Gifford and Shutler 1956:63-64; Plate 6d, e from Site 13, Plate 8r, t from Site 26). Golson reports fragments of shell bracelets from the Lapita site of St Maurice on Ile des Pins (Golson 1961:170), but no details are available. Green (1979:Fig.2.5a, c) figures fragments of *Trochus* arm rings from a 3000 year-old Lapita context in the Reef Islands, southeast Solomons. A shell bracelet much like Subclass A7 has recently been reported from an early Lapita site on Eloaue Island in the St Matthias group, northwest of New Ireland in the Bismarck Archipelago (Bafmatuk *et al.* 1980:79-80).

One *Conus* bracelet, like A8, has been found in southern Vanuatu, on the Polynesian outlier island of Futuna (Shutler and Shutler n.d.:Plate 51). The Eruei site in the New Hebrides is quite rich in narrow shell bracelets (Garanger 1972:30-31; Fig.29), very close to the Tongan material except that most are made from *Tridacna*, only few from *Conus*, the reverse of the Tongan situation. Unfortunately, Garanger's description and illustrations do not allow their comparison with specific Tongan subclasses. An ethnographic specimen in wood with triangular cross-section (Subclass A7) from Vanuatu may also be noted (Edge-Partington 1890a:Plate 146.2).

From early pottery-bearing levels of a site on Anuta going back to the first millennium BC Kirch and Rosendahl (1973:87; Fig.28J, K) report bracelet fragments of *Trochus*, of unspecified cross-section. Similar bracelets were apparently found in later contexts and are reported to be still used as dance ornaments. From levels of sites on Nukuoro likely to fall within the last 1000 years come bracelet fragments for the most part of oval to rectangular cross-section and thicker than wide (Davidson 1971b:49). One with triangular cross-section is compared with my Subclass A7 and another tentatively identified with my Subclass A5.

Arm rings of various cross-sections are recorded from relatively recent levels on Santa Ana in the eastern Solomons (Davenport 1972:170, 177, Fig.1A, B, D-G).

Excavations on Yap have yielded fragments of *Conus* shell bracelets, some of which seem to have cross-sections like Subclasses A3 and A7 (Gifford and Gifford 1959:191, nos 36165 and 36542 = A3, no. 36201 = A7; Plate 38i-1). A surface find on Saipan in the Marianas, which appears to have a cross-section of Subclass A5, is reported by Spoehr (1957:160; Fig.86), who says that similar examples are known ethnographically from the Carolines. Other archaeological finds in the Marianas have been made on Tinian (Pellett and Spoehr 1961:Fig.2d, e) and Rota (Takayama and Egami 1971:23; Plate X.3 F-H, two examples of which look wider than usual). Finally, from Palau, we have Osborne's reports (1966:458; 1979:42, Fig.26a; 287, Fig.201 right) of narrow shell-bracelet fragments from archaeological contexts. The two figured specimens are thought to be of *Trochus*, the others of *Conus*. Figure 26a has a triangular cross-section.

The above review emphasises the wide distribution in time and space of narrow bracelets in shell in geographical Micronesia (see Davidson 1971b:51 for ethnographic references) and Melanesia and their absence from Polynesia, except in early levels of Western Polynesia.

**Broad bracelets (Class 5B)**

Only seven specimens are present in the collections, of which three are less certainly assigned to the class. They were all 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. Their site distribution is set out in Table 89 and illustrations of them appear as Plate 70.8, 9, 11, 13.

The four certain examples are early and late in the ceramic sequence. There are two specimens from To.2: no. 2405 from Zone III of the early midden at the site and no. 3355 from Zone V, the burial area of the mound horizon, to which it was possibly displaced from the early midden. Two specimens come from late ceramic contexts at To.6 (Plate 70.8, 11): To.6/127 from Pit W of Horizon II, To.6/1942 from the midden phase of Horizon II. They are
all fragments, respectively 14 mm, 45 mm, 22 mm and 48 mm wide, the original ornaments having had 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 of the class are distinguished by being perforated and might therefore be regarded as ornamental units in their own right (cf. Class 5F below). To.6/14 (Plate 70.9) is from Horizon II midden at the site and late period in date. It is 38 mm wide, with an inner diameter of 7 cm, and has a perforation in the middle of each end of the 5 cm-long fragment, one conical and bored from the outside, the other biconical. Since the ends are roughly broken, while the sides and surfaces are smoothed, I prefer to interpret the specimen as the repair or refashioning of a broken broad bracelet rather than as an ornamental unit in its own right. Perhaps a similar explanation can be offered for the example from To.2 (Plate 70.13), which is 18 mm wide, with an 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. Found in Zone IV of the Mound Horizon, at the base of the Ostrea shell layer, it possibly derives from an early-period context, like other items in the mound.

From To.1 come 16 fragments (nos 1606, 1866 being four fragments, 1869, 1872 being five fragments, 1873, 1875, 1876, 1879, 1880), which, though no piece fits with any other, are thought possibly to belong to the same object. This is because all are fire-marked and were found within an area of about 2 m² in Trench I, except for one piece found 2 m away. Ten of the pieces were found in the lower part of the Horizon I midden, one in Pit K and five in Posthole L. The conclusion about such finds in this so-called small area of Trench I is that they are likely to be early ceramic period in date (see section 1.2 above). One of the fragments is perforated. If it and the others belong to a broad bracelet, the width of this would have varied from 20 mm to more than 35 mm; its diameter cannot be reconstructed.

Broad bracelets, though known both early and late in Tonga, were clearly much less popular than the narrow variety.

**Broad bracelets in the Pacific**

Amongst the external parallels to be noted, none is from elsewhere in Polynesia, except for one example in Conus excavated from a level (VII) mixed with European items at Falemoa (Lohse 1980:31) in Western Samoa (Janetski 1980b:127; Fig.45a). Broad bracelets are widely distributed in Micronesia and Melanesia ethnographically (e.g. Edge-Partington 1895:Plate 65.4 for an example from the Loyalty Islands and Gifford and Shutler 1956:Plate 6b for one from the east coast of New Caledonia). They form an important item in the kula exchange system of the Trobriand Islands (cf. Gifford and Shutler 1956:64).

Archaeological specimens, however, are few. They can be cited for New Caledonia, both at the early Lapita and at later sites, always in Conus shell (cf. Gifford and Shutler 1956:Plate 6g (Lapita site), a, c, f, h) and for the early Lapita site of Natunuku in Fiji (E. Shaw pers. comm.). A possible fragment was found by Davidson (1971b:49) at a second millennium AD site on Nukuoro. Takayama and Intoh (1978:Fig.19.16; Plate XVII.10-12, 15) figure fragments of broad Conus (?) bracelets from a shell midden of similar age on Tol Island in the Truk lagoon. Ulithi, an atoll to the west of Truk, has yielded a fragment of a broad Conus bracelet similar to that illustrated in Plate 70.8 (Crab 1980:182; Fig.74).

A curved piece from an undated site in Palau is thought by Osborne (1979:42; Fig.26b) to represent the repair of a single-piece cone bracelet, by reason of its perforations. If so, the original was a broad bracelet and the explanation in question may be compared to the Tongan piece To.2/30 (Plate 70.13). Similar explanations could be offered for three pieces with Lapita associations, each with two perforations in the corners at one end. One in the Meyer collection from Watom Island (Musée de l'Homme, Paris, cat. no. 1288, Poulsen 1967b:Fig.97.5) is rectangular in shape and strongly curved longitudinally, while the perforations remain as traces. The other two, smaller and square pieces of Conus, are from Site 13 in New
Caledonia (Gifford and Shutler 1956:64; Plate 8e) and a 3000 year-old site in the Reef Islands, southeastern Solomons (Green 1979:Fig.2.5e). In the same connection I note a Conus square without perforations from the late Samoan Lapita site of Falesi’u (Stratum III) (Janetski 1976a:73; Fig.17i). All of these pieces might, however, be considered ornamental units in their own right and are looked at again in this context under Class 5F (section 9.10 below).

Small rings (Class 5C)

Made from the broad end of univalve shells (unidentified) of small size, five specimens were recovered by excavation, their distribution summarised in Table 89 and form illustrated in Plate 71.3, 4, 6. There are three examples from To.1. Two of these are definitely early-ceramic period: no.1893 from middle Horizon I midden in an undisturbed square (83/72; on disturbed and undisturbed squares see Chapter III, section 10.1) of Trench I and no. 3055 from low in Horizon I midden in Test Pit 50/94. The third piece, no. 1891 (Plate 71.4), from upper Horizon I in a disturbed square (83/70) of Trench I is less securely early period and might be classed uncertain. This last, ground on the outer surface and both laterals, has an inner diameter of 15-20 mm and no. 1893 one of 17 mm. The other, found in fragments, has a reconstructed inner diameter of 15-20 mm. Of the two examples from To.6, no. 16 (Plate 71.3), found in the bottom spit of Horizon I, is more likely to be late than middle period, because of its intact state. Highly polished on all surfaces, it has an inner diameter of 22 mm. To.6/338 (Plate 71.6) comes from a Horizon IT midden context, which without doubt means that it is late period. It has an inner diameter of 15 mm.

These recorded dimensions 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 the Tongan ceramic sequence.

Extra-Tongan similarities

Few parallels for them have been found. A Conus ring from the Polynesian outlier of Futuna in southern Vanuatu, found with a burial of unknown date, is somewhat larger (38 mm outer diameter) than the Tongan specimens (Shutler and Shutler n.d.:Plate 5B). A fragment of a ring of unidentified shell from a level of probably second millennium AD age on Nukuoro is explicitly compared by Davidson (1971b:50) to Tongan Class 5C; its outer diameter is 23 mm. A Conus shell ring in uncertain context at the Potusae site in Western Samoa (Janetski 1980b:123; Fig.45i) falls within the Tongan size range, as does one of unspecified shell of from a Reef Islands Lapita site dating to the first half of the first millennium BC (Green 1979:Fig.2.5b). Shell rings of Conus, reported in quantity from the early pottery-bearing levels of An-6 on Anuta and compared by the excavators to Tongan Class 5C (Kirch and Rosendahl 1973:87; Fig.28G-I) are smaller, less than 10 mm in external diameter judging by the illustrations. I refer to these again under Class 5L (section 9.17 below).

Long units (Class 5D)

Like the shell adzes, these units, 27 in number and some of them illustrated in Plates 68.2 and 70.1-7, were made from the inner hinge part of the Tridacna, by the evidence of the broad natural groove on their bottom surface. They range in length between 17 and 69 mm, the majority being between 20 and 39 mm long, and are predominantly wider than thick, the majority being between 10 and 16 mm wide and between 5 and 8 mm thick. In cross-section they tend to be rounded, sometimes with slightly flattened upper surface. Triangular, trapezoid and circular cross-sections are rare and exemplified by four, one and two specimens respectively. 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.
Table 89 shows that long units were found at To.1 (17 items), To.5 (1) and To.6 (9). They are totally absent from To.2, an otherwise productive site, unless the fragmentary specimen, To.2/23 (Plate 68.4), found in Zone III of the midden and described under Class 5P (section 9.21 below), is accepted as related. Three of the To.1 pieces, the To.5 example and six of the nine from To.6 (one of which is fire-marked) are complete, ready, so to speak, for use. Five from To.1 and three from To.6 (two of them fire-marked) are finished, but broken. There are seven unfinished specimens from To.1, four unbroken (of which three are fire-marked) and three broken (two fire-marked). Two fragments from To.1, both fire-marked, complete the tally.

All this, together with the presence of other complete artifacts at the excavated sites, suggests that other activities apart from dumping took place at or immediately adjacent to the middens, a question already touched on several times in the foregoing (section 1.7 above; cf. Chapter II, section 11).

The 17 specimens from To.1 include the four examples with triangular cross-section. Five of the 17, including one of triangular cross-section (no. 257), are of uncertain chronological status and so cannot be dated. Two long units are attributed to the middle-ceramic period at the site: one (no. 2295, Plate 70.2) was found in the middle of the Horizon II midden in Trench IV; the other (no. 2111), of triangular cross-section, was recovered in Trench III from a position, 10 cm above the surface of the subsoil, which by reconstruction of all relevant evidence probably corresponds to the southernmost edge of the fill of Pit AH where it cuts through Pit AF, Pit AH almost certainly dating to the middle period (Chapter II, section 5.5; cf. Chapter III, section 11.4, discussion of pits at To.1). The remaining ten examples are associated with Horizon I, with attribution to the early period varying from certain to possible. Two were found in early pits, W (no. 1777) and AQ (no. 2634, Plate 70.6); six (nos 290, 1883, 1884, 1896, 1898, 2618, the third and the sixth being triangular in cross-section) at or in the bottom of the Horizon I shell midden, two of them (nos 1883, 1884) very close together and just in or above the fill of the southeastern part of shallow, undated Pit K; and one (no. 1894) in the middle of the Horizon I midden. The tenth example (no. 1895) comes from an undisturbed square (83/67) of Trench I (on disturbed and undisturbed squares see Chapter III, section 10.1), in the top of shell midden of Horizon I where this was quite elevated.

The only specimen from To.5 (no. 19) is one of the two in the entire collection with circular cross-section (Plate 70.3). It is securely early period, having been found 5-10 cm below the base of Horizon I of the main midden.

The nine long units from To.6 include the second of the two with circular cross-section. It is from a small undatable hole (DB). Another unit from To.6 is also of uncertain chronological status. Two were found in the bottommost spit of the Horizon I midden and, because both are complete and unbroken, are less likely to derive from the middle-period than the late-period occupation at To.6. Three examples from Horizon IT (including the sole example in the entire collection with trapezoid cross-section) and one each from Horizon II and basal Horizon III all date to the late period.

These circumstances of recovery show that the type was in use throughout the ceramic period. It is not known in the ethnographic record, but there is little doubt that the items formed units of a necklace strung by means of the biconical perforations. Reference to units of bone which were probably strung as necklaces is made under Class 5M (section 9.18 below), where the appearance of bird-bone units in composite necklaces of the European contact period is also noted.

Long units and similar forms in the Pacific

Long units of shell identical with Tongan Class 5D are known from the early Lapita site at Natunuku in Fiji (E. Shaw pers. comm.). Close parallels in Tridacna shell and stone have been excavated in the Marianas (Spoehr 1957:147; Fig.77; Pellet and Spoehr 1961:Fig.2a, c; Reinman 1977:Fig.40j). They differ from the Tongan specimens only in being slightly curved
or angled. Amazingly similar counterparts can be cited from excavated contexts in Southeast Asia (Mansuy 1902:Plate XIII, 8-9; 1923:Plate III, 6-11).

A biconically drilled bead, possibly of sea-mammal tooth and quite like Tongan long units but much shorter, has recently been reported from late Lapita context at Falemoa, Stratum II, on Manono Island, Western Samoa (Janetski 1980b:127; Fig.45m). From the same level comes a very short longitudinally bored bead (Janetski 1980b:127; Fig.45m), probably also from sea-mammal tooth, that bears some resemblance to Class 5D but is probably better compared to Class 5M (section 9.18 below). A short segment found on the surface on Niua topu tapu has a system of three connecting drill holes bored from either end and the centre of one face (Rogers 1974:325; Fig.5b) and may reflect ornamental functions related to those of the long units and the class which follows. Two so-called elongated shell pendants from Site An-6 on Anuta, one broken and parallel-sided, the other complete and tapering to a point, both with a single, bevelled perforation at one end, are said by the excavators to have some stylistic similarity with the Tongan long beads (Kirch and Rosendahl 1973:86-87; Fig.28B, C). Both were found fairly deep in the site, in the pottery-bearing levels, the complete specimen described by the excavators as ‘associated with the island’s earliest occupation’.

**Squat units (Class 5E)**

Six specimens are allocated to the category, which is illustrated in Plates 68.5-7 and 70.12: one from To.2 (no. 1661) found in Zone III of the midden, dating early, and five from To.1 (Table 89). These latter, all fire-marked, were found within 1.5 m² in the southern end of the so-called small area of Trench I (see section 1.2 above). Four of them are recorded from the base of the Horizon I shell midden, three (nos 1866a, 1866b, 1870) from undisturbed squares and certainly early, one (no. 1871) from a disturbed square and probably early (on disturbed and undisturbed squares see Chapter III, section 10.1). The fifth is from the fill of shallow Pit K (no. 1607) and on circumstantial evidence possibly early period, too. On this evidence the Tongan squat units could be an exclusively early-period form.

To.1/1866a (Plate 68.6) and 1871 (Plate 68.5) can represent the type. They are made of *Tridacna* and are respectively 19 x 19 mm and 18 x 16 mm in dimensions, 2-5 mm and 5-7 mm thick. In the case of the former there is a biconical perforation at each end, leading from the underside to the flattened end facet. On the other the two perforations are in the corners at opposite ends of the same side and go from underside to flattened edge. The form of both is a rounded quadrangle. To.1/1607 (17 x 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 x 13 mm and 3-4 mm thick and may be a fragment. To.2/1661 (Plate 70.12) is somewhat different again. Rather angular in form, it measures 25 x 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 surfaces, and the trace of a fourth in one of the occupied corners. The type of shell could not be determined. To.1/1866b (Plate 68.7), possibly of *Conus*, has in common with this To.2 piece the angular form and biconical perforations in the two preserved corners, running from upper to lower surfaces. The preserved dimension is 29 mm, the incomplete one 12 mm; the thickness is 5 mm. It bears some similarity to Class 5B (section 9.4 above).

All specimens are finely polished.

**Extra-Tongan similarities**

No foreign parallels could be found, but it is worth mentioning that small units of various materials with one or two perforations are on archaeological record for Hawaii (Emory and Sinoto 1961:72-73; Fig.69) and Niua topu tapu (Kirch 1978:Fig.71) and a perforated shell tab for the Marquesas (Suggs 1961:134; Fig.35b).

There are some units, larger, thinner and mainly of *Conus*, which will be dealt with under Class 5F below.
Rectangular unit (Class 5F)

Only one specimen was found, To.2/26 (Plate 70.10; Table 89), from the Ostrea shell component of Zone IV of the mound at To.2 and therefore possibly a transfer from an early-period context. Measuring 52 x 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 overall. It bears a striking resemblance to the archer's wrist-guard of Early Bronze Age Europe (Childe 1957:224-25; Figs 112-13), but the use of such a device in Tongan archery, at least at the time of European discovery, is not revealed by our authorities (Martin 1827a:225; McKern n.d.:718 ff). A somewhat similar object, cut in whale bone, with serrated edges and perforated in only two corners, is on ethnographic record for Tonga as a breast ornament (Plischke 1939:Fig.4).

Extra-Tongan similarities

The closest parallel is the piece from Palau already mentioned under Class 5B (section 9.4 above), which is similar in its four perforations, but is squarer and has greater longitudinal curvature (Osborne 1979:42; Fig.26b).

In the Meyer collection from the Watom site in New Britain (Musée de L'Homme, Paris, cat. no. 1288) there is a piece with the characteristics of the Palau item, except that there are (signs of) two perforations in the corners of one end (Poulsen 1967b:Fig.97.5). Two pieces in Conus from other Lapita sites, Site 13 in New Caledonia (Gifford and Shutler 1956:64; Plate 8e) and a site in the Reef Islands (Green 1979:Fig.2.5e), are square and have only two perforations, in the corners of the same end. The former described as a bracelet unit, the latter as a pendant, both of them, and the Watom item too, could conceivably represent the repair of, or derive from a broken broad bracelet, as suggested under Class 5B (section 9.4 above) for all three, as well as for the Palau piece and three Tongan pieces from my excavations. A square Conus shell without perforations was found in late Samoan Lapita context at Faleasi'u (Stratum III) (Janetski 1976a:73; Fig.17i).

Other archaeological pieces with some resemblance are on record for southern Vanuatu (Shutter and Shutler n.d.;8; Burial 2, the rectangular perforated shell pendant) and Easter Island (Heyerdahl 1961:457, Fig.109r, bone pendant).

Ethnographical examples with common features may be noted from the Marquesas (Handy 1923:Fig.24b) and New Guinea (Edge-Partington 1890b:Plate 313.8; 1895:Plates 26.1, 174.5).

Circular units (Class 5G)

Nine specimens are classified here, some of them illustrated in Plate 71.1, 2, 5 and their distribution set out in Table 89. 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 (Plate 71.2) found in an undisturbed square (82/58) of Trench I (for disturbed and undisturbed squares see Chapter III, section 10.1), in the middle levels of the Horizon I shell midden (early period), To.2/661 from Zone I of the midden (early period) and To.6/1631 from the upper Horizon III shell midden (late period): the underside is ground smooth, the upper surface is ground flat or flattish and a perforation is made through the centre. The diameters of the three specimens are respectively 25, 20 and 24 mm and their thicknesses 5-6, 10 and 7 mm.

On two other examples there is a central perforation, but no flattening of the upper surface. These are To.1/1892, 15 mm in diameter and 5-6 mm in thickness, and To.6/610, 17 mm in diameter and 5-10 mm in thickness. The To.1 specimen was found in what would correspond with the middle fill of Pit X, which cannot be allocated a precise age (see Chapter II, section 5.5, and Chapter III, section 11.4, discussion of pits at To.1). The piece from To.6 is also of uncertain chronological status.
The other four pieces may be unfinished examples of the class. To.2/1590, found in the Ostrea shell deposit of Zone IV of the mound but perhaps deriving originally from an early-period context, 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 (Plate 71.5), found in the bottom spit of Horizon I midden and thus late or possibly middle period in date, is made from a large Conus, ground on top and below but lacking the central perforation. Its diameter is 68 mm, its thickness 8-15 mm. To 2/590, from Zone II of the early-period midden, is unmodified except for smoothing of the lower surface. It is 16 mm in diameter, 9 mm in thickness. To.6/995, from the Horizon II midden and thus late period in date, is at a similar stage (Plate 71.1). It is of Strombus shell and has a diameter of 32 mm and a thickness at the centre of 17 mm.

The ornament type is present early and late in the Tongan ceramic sequence and is one of the few to be established for the Tongan ethnographic record. It is mentioned by McKern (n.d.:194) 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 (1890a:Plate 89.3), which terminates in a shell disc of the type under discussion, measuring about 50 mm across and thus bringing specimen To.6/68 (Plate 71.5) to mind. Similar ethnographic shell discs from Tonga are held in the University Museum of Archaeology and Ethnology, Cambridge (cat. nos 22.942, 27.1641A).

Parallels and similarities for circular units

The form is widely known in Melanesia and Micronesia as far as the ethnographic record goes (e.g. Edge-Partington 1890a:Plate 174.2 (Kiribati); 1895:Plates 82.8, 9 (Vanuatu); 92.1, 2 (Kiribati); 145.1 (New Guinea); 153.6 (New Guinea); 158.10 (New Guinea)).

Archaeological parallels are on record in geographical Melanesia for the Lapita site in New Caledonia (Gifford and Shutler 1956:63; Plate 8i, the two examples apparently unperforated), southern and central Vanuatu (Shutler and Shutler n.d.:respectively Plates 1B and 7A, both perforated) and the Lapita-connected Erueti site on Efate (Garanger 1972:30-31; Fig.29.3), as well as in grave offerings at sites of later prehistoric times (Garanger 1972:Figs 43-46). In Micronesia there are archaeological records for the Marianas (Pellett and Spooner 1961:Fig.2f), Yap (Gifford and Gifford 1959:192, Plate 41k, unperforated Conus cap, ground on top and bottom surfaces) and Truk (Takayama and Intoh 1978:45, Plate XVII.23, two specimens described as unfinished, the figured one being unperforated). Of six worked tops of Conus found on the Nomoi (Mortlock) Islands between Truk and Nukoro, Takayama and Intoh (1980:27-28; Plate 9.5-10) accept only one (Plate 9.5, ground but unperforated) as an ornament, the rest being unground and reduced by chipping.

From a pottery-bearing layer at Site An-6 on Anuta comes a large cone shell with the spire ground flat and a hole put through the centre of the surface thus created (Kirch and Rosendahl 1973:88; Fig.28A). One wonders whether this is not a circular unit in the making, manufacture having stopped short of the detachment of the cap.

An object of similar character to Class 5G is known archaeologically from Hawaii (Emory and Sinoto 1961:76; Fig.71) but since it is without perforation and notched at the side, it is probable that it had quite a different function. Indeed, in shape it is almost identical with a group of so-called pitching discs from Hawaii described by Buck (1957:373; Fig.246b, second from right), though considerably smaller.

I might mention in this connection two Conus-shell discs excavated by Sinoto (1970:119; Fig.7a) at the Hane site on Uahuka in the Marquesas. Each has a hole in the centre and was produced by grinding the apex end of the shell flat to a thickness of 1.5-2 mm and shaping into an almost perfectly round disc of about 25 mm diameter. Sinoto also discusses pearl-shell discs of two types, one grooved on one side and with two holes in the centre, the other, found by Suggs (1961:133-34; Fig.35a) at Ha'atuatua on Nukuhiwa, serrated at the edge and with a
single hole, and the possible relations of these and the Conus discs to ethnographic ornamental units in the Marquesas and Melanesia. A pearl-shell disc 25 mm in diameter and perforated at the centre with two holes is recorded for the Maupiti site in the Society Islands by Emory and Sinoto (1964:150-51; Plate 2h).

A small polished pearl-shell disc was excavated at the early Fijian Lapita site of Natunuku (E. Shaw pers. comm.).

For completeness I conclude with mention of a flat shell disc, 4.3 mm in diameter, with small central perforation, from a post-ceramic layer of Site An-6 on the Polynesian outlier of Anuta (Kirch and Rosendahl 1973:87; Fig.28E). Such discs are still worn by Anutans, tied on the wrist or around the neck for dances.

**Curved segment (Class 5H)**

This unique artifact of Tridacna (To.1/2560, Plate 69.12; Table 89), from the bottom of the Horizon I midden in Trench IV and thus early period in date, 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 decoration from the neck, or it may have formed an element in a composite piece. It seems to be without close formal parallels, except for a carved ivory ornament of similar shape and size collected in Tonga on the Cook voyages (Kaeppler 1978:209; Fig.419).

**Pearl-shell pendants (Class 5I)**

Four fragments of pearl shell with the hinge part preserved (Plate 71.7, 9, 10; Table 89) probably represent breast pendants suspended by a fine braid of human hair, as described by McKern (n.d.:196). Pearl-shell pendants had the same function in composite necklaces collected in Tonga on the Cook voyages (Kaeppler 1978:209-11; Figs 420-21). To.1/3507 (Plate 71.9), To.1/3501 and To.4/8 (Plate 71.7) have one perforation; To.1/3502 (Plate 71.10) has two. All three specimens from To.1 are early period, being found in the subsoil below the main midden and belonging to an early stage of occupation at the site in circumstances described in the To.1 excavation report (Chapter II, section 5.3). To.4/8 cannot be dated.

**Extra-Tongan similarities**

Very similar objects are on record for Yap, ethnographically as shell money, archaeologically as presumed shell money (Gifford and Gifford 1959:193; Plates 35 and 41i respectively). The Shutlers record a parallel from Futuna in southern Vanuatu, with Burial 1 in a shelter where other burials were associated with other types of pearl-shell pendant (Shutler and Shutler n.d.:8). Duff, describing possible stone copies in New Zealand, comments on the occurrence of whole pearl-shell pendants in tropical Polynesia (Duff 1956:127-29). More recent finds in Polynesia of a related kind have been made at the Maupiti burial ground in the Society Islands (Emory and Sinoto 1964:150), on Reao in the Tuamotu (Sinoto 1978:163; Fig.27d) and in the Marquesas (Suggs 1961:135; Fig.35d; Sinoto 1970:119; Fig.8a).

**Pule (Cypraea)-shell pendant (Class 5J)**

Only one such cowrie-shell ornament was found (To.1/3475, Plate 71.8; Table 89), from the lower half of Horizon I shell midden in Test Pit 50/94 and therefore early. The pearly white shell has a rounded perforation at the narrower end. The shells are difficult to find and are much appreciated in Tonga today. Mrs Helu, mother of my interpreter, possessed such a shell worn as a pendant from the neck. The excavated specimen has not been determined as to species.
Trumpet-shell pendant (Class 5K)

The only excavated example is To.6/9, a *Charonia tritonis* shell provided with one circular perforation of 8 mm diameter near the mouth (Plate 71.11; Table 89). It was found in the upper part of Horizon I at the site, so that it is without doubt late in the ceramic sequence. 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.

Small shell beads (Class 5L)

Five examples only were found. Four are described immediately, the fifth (To.6/705) later. They are illustrated in Plates 68.20, 22; 72.4, 5, 7 and their distribution set out in Table 89.

Miscellaneous beads and comparisons

To.2/5715 (Plate 68.20), from Zone II of the early-period midden, is a well-polished specimen, 7 mm long and 7 mm thick, with rounded triangular cross-section and biconical perforation.

To.3/584 (Plate 68.22), found in the middle of the Horizon I midden and thus dating to the middle period, is a thin disc-like bead, 6 mm in diameter and 2 mm thick, with cylindrical perforation of 1.5 mm. Parallels are discussed below.

To.2/5734 (Plate 72.4), from Zone II of the early midden, 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 southern Vanuatu (Shutler and Shutler n.d.: Plate 3G).

To.1/1753 (Plate 72.5), found in undated Posthole Q in the so-called small area of Trench I linked in all likelihood to the early period (see section 1.2 above), 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.

McKern (n.d.:194) refers to belts decorated amongst other things with beads cut out of shell, while necklaces of a few or many shell beads (and bird long bones) were collected in Tonga on the Cook voyages (Kaeppler 1978:209-11; Figs 420, 423-25). Shell beads as a class are well known in Oceania and particularly noteworthy is the wide distribution of the disc bead represented on Tongatapu by the To.3 specimen shown in Plate 68.22. The type is the commonest ornament found in Davidson's largely second millennium AD sites on Nukuoro (Davidson 1971b:48-49, 50). It is known from excavations in the Marianas (e.g. Pellett and Spoehr 1961:Fig.2b for Tinian; Takayama and Egami 1971:21; Plate IX.2B for Rota) and on Yap (Gifford and Gifford 1959:191-92; Plate 38, especially m). Excellent archaeological finds are now on record for the later prehistory of central Vanuatu (Garanger 1972:e.g. Figs 43-47), while Shutler and Shutler (n.d.:5; 8-9; Plate 5J) found them, undated, in the southern islands.

One asks whether the *Conus* rings from the pottery-bearing layers of Site An-6 on Anuta (Kirch and Rosendahl 1973:87; Fig.28G-I), compared by the excavators to my Class 5C (section 9.6 above), are not, because of their small size and despite the greater diameter of the perforation, better thought of as belonging to the type now under discussion.

A cowrie bead and its parallels

I now pass on to a consideration of the item To.6/705 (Plate 72.7) from the upper part of the Horizon III midden, of the late ornamental period. This is a small cowrie with the back removed. Ethnographic parallels for the ornamental use of this simple type of small worked shell are not unusual in the Western Pacific, especially perhaps in the Melanesian region. From published illustrations it is not always easy to make sure of the extent of modification and sometimes the shells used appear smaller than the Tongan specimen in question. Edge-Partington illustrates some pieces of interest from New Guinea and New Britain (1890b:Plates 309.8, 313.4-5;
Specimens similar to the To.6 example and identified as *Cypraea annulus* were found at Faleas'i'u, Western Samoa, and are interpreted as items of personal adornment (Janetski 1976b:78; Fig.18g). What appears to be an identically worked item of *C. moneta*, found in Lapita context on Niuatoputapu, is thought by Kirch and Dye (1979:69) to be a dip-net weight (see under Class 3D, section 7.4 above). From a pottery-bearing layer at Site An-6 on Anuta Kirch and Rosendahl (1973:88) mention a worked cowrie, not further described, as a possible bead and illustrate another (Fig.28D), looking something like the Tongan piece, which they describe as possibly unfinished and to which they ascribe no function.

**Small bone beads (Class 5M)**

The initial specimen is To.6/260, from the upper part of the midden of Horizon III of late-period date (Plate 68.21; Table 89). Perhaps made from bird bone, it is polished into a barrel-shaped form. The cross-section is circular, the length 12 mm, the external diameter 5 mm. A bead of related form but thicker and probably made from a sea-mammal tooth is reported from late Lapita context at Falemoa, Stratum II, on Manono Island in Western Samoa (Janetski 1980b:127; Fig.45m). From a post-ceramic horizon at Site An-6 on Anuta comes a small bead or bracelet segment made from an unidentified tooth, the natural cavity of which forms the longitudinal perforation (Kirch and Rosendahl 1973:88; Fig.28F).

To be mentioned under this class are some very unusual artifacts made from the long bones of the tree-climbing iguanic lizard, *Brachylophus brevicephalus*, which do not appear in the tables of artifacts in this chapter. They were identified by Bland and Reed during their examination of the bone material excavated at To.5 and are described and illustrated in Appendix 8. Fifteen definitely or possibly worked long bones were isolated from the total lizard bone collection. The specifically described pieces, eight in number, fall into two groups: four parts of the shafts of long bones and four pieces of the distal or proximal ends of femur, tibia and humerus, all with marks of cutting and/or smoothing by way of modification and wear. Bland and Reed raise as a possibility that the end pieces are discards from the manufacture of the shaft parts into tube-like beads. The shaft parts range in length between 15 and 26 mm and in external diameter between 4.5 and 7 mm. Unworked as well as worked lizard bones at To.5 are found in Horizon 0 in Trench I and the lower part of Horizon I in Trenches I and II and are thus confined to the early period.

If the lizard-bone pieces are indeed tubular beads, they are reminiscent of the five segments of bird bone which McKern (n.d.:197) found associated with skeletal material in a burial cave on Kao in Ha'apai and which were presumably strung in necklace fashion. The units measured between 3.25 and 4.15 cm in length and were cut off square at the ends. Similar long bird-bone units form part of composite necklaces collected in Tonga on the Cook voyages (Kaeppler 1978:209-11; Figs 420, 421, 425).

**Stone beads (Class 5N)**

Table 89 sets out the distribution.

To.1/1910 (Plate 72.1), of uncertain chronological status, and To.6/125 (Plate 72.2), from Horizon II and thus late period in date, are the same type, circular in form and rectangular in cross-section, 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 is 18 mm across and 5 mm thick. The form somewhat resembles the shell bead from To.3 illustrated in Plate 68.22.

To.6/98 (Plate 72.3), from the top half of Horizon I and therefore without doubt late period, is a broken piece, 18 mm in 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.
All three specimens are, according to A.J.R. White, made of yellowish calcite, a material that occurs in veins on 'Eua. A somewhat similar yellow stone, suspended through a hole at the top and forming part of a composite breast ornament, is ethnographically recorded for Tonga (Kaeppler 1978:209; Fig.420).

**Pottery disc (Class 5O)**

Perhaps related to the type of ornament represented by the stone bead of Plate 72.3, described above, is the pottery piece To.1/218 (Fig.55.7; Table 89) found in the upper part of the shell midden of Horizon I in an undisturbed square (82/58; on disturbed and undisturbed squares see Chapter III, section 10.1) within the so-called small area of Trench I and thus on balance dating early (see section 1.2 above). 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 to a convex contour. A perforation has been begun centrally, 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.

**Extra-Tongan parallels and similarities**

Exact parallels are recorded from the Lapita level at the Sigatoka site in Fiji (Birks 1973:40-41; Fig.38), from Lapita context on Niuatoputapu (Rogers 1974:314) and from the early Lapita site on Eloaue Island in the St Matthias group of the northern Bismarcks, though without central perforation or pit (Egloff 1975:23). Similar ceramic objects, though more angular in form and without signs of central perforation, are reported from the late Lapita site, Fu-11, on Futuna (Kirch 1981:138; Fig.10a).

Rather irregular, unperforated discs, usually chipped into shape, are on record from Micronesia (Takayama and Egami 1971:15; Plate V.2K for Rota in the Marianas; Takayama et al. 1980:16; Fig.14.8; Plate 13.11, 15-18 for Kayangel in Palau), with a function as sinker, pot lid and gaming piece variously suggested. There is a perforated example of even more irregular shape from Rota (Takayama and Egami 1971:13; Plate IV.3). The hole is said to be too small for suspension. Osborne (1979:214; Fig.184b) describes a very large (9.8 x 9.5 cm) pottery disc from Babeldaob in Palau with ground edges.

**Incomplete pieces (Class 5P)**

Three objects of *Tridacna* shell would appear to be ornaments, possibly related to the long-unit type, Class 5D (section 9.7 above). Their distribution is set out in Table 89.

To.6/1814 (Plate 68.3), from the midden of Horizon II, of the late period, may indeed be a broken and/or unfinished specimen of long unit. The similarity can be seen by comparing it with the long unit figured beside it as Plate 68.2. Its dimensions are at the top end of the range for long units: broken at both ends, its length is more than 40 mm and its thickness is 12 mm, while its width, at 12-16 mm, is beyond the range.

To.1/1881 (Plate 68.1), from the base of the Horizon I shell midden in an undisturbed square (83/59; for disturbed and undisturbed squares see Chapter III, section 10.1) of the so-called small area of Trench I and thus favoured for an early-period date (section 1.2 above), is similar in shape to the last but even 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, as well as its tapering form with faceted cross-section, might justify putting it into a different class from the long units.

To.2/23 (Plate 68.4), from Zone III of the early-period 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. Its preserved length is 40 mm, its width 17-28 mm and its thickness 11 mm at the end, 18 mm in the middle. A biconical perforation extends from the flat end facet to the face.
If these objects are related to each other and to the long units, it is interesting to note that they, like the long beads, are found in both early and late contexts. They are unknown outside Tonga.

An alternative interpretation of at least the two slimmer specimens, Plate 68.1 and 3, is that because of their tapering outline, they could represent shanks of lure hooks (see discussion under Class 3A, section 7.1 above).

**Tattooing chisels (Class 5Q)**

Four examples were recovered in the excavations, all at To.1 (Plates 68.14-17; Table 89). 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 the pieces are highly polished.

To.1/1886 (Plate 68.15) is 32 mm long, 7 mm wide and 1 mm thick; the teeth are damaged. To.1/1887 (Plate 68.14) is 29 mm long, 6-7 mm wide and 1 mm thick; again the teeth are damaged. To.1/1888 (Plate 68.16) is 27 mm long, 6 mm wide and 1 mm thick; the functional end has been ground flat in preparation for the recutting of the teeth. To.1/1889 (Plate 68.17) 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 chisels were found within an area of one or two m², three of them in the lower part of the Horizon I shell midden in an undisturbed square (82/58; on disturbed and undisturbed squares see Chapter III, section 10.1) of the so-called small area of Trench I, where an early period date for the finds has been suggested as highly likely (section 1.2 above). The fourth, the fragmentary specimen, was in the fill of the southwestern quarter of the post-ceramic Pit A nearby, in Square 83/57. It is of additional interest that the only complete pot recovered during the 1963-64 excavations, the so-called Pea cup (To.1/197, Plate 34.2), was found in the same area as the tattooing chisels, in the bottom of the Horizon I midden, Square 82/58.

Now not only are the tattooing chisels which McKern describes for the ethnographic period in Tonga of the same type as the excavated specimens, but also the pigment used for tattooing was contained in a coconut cup (McKern n.d.:218; 439 ff). One wonders whether these containers could not at some stage have been ceramic. Perhaps the circumstances as I have described them allow the suggestion that a tattooist worked for a time at the northern end of the main trench of To.1. 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 of wood. The *in situ* placement of the chisels in Horizon I would have been disturbed in the post-ceramic period when Pit A was cut; one of the chisels was displaced and possibly damaged in the process and in the end it was incorporated, with other old materials, in the pit during its infilling. 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.

The plausible picture I have been able to reconstruct above from the distribution of a number of archaeological finds in the ‘small area’ of Trench I at To.1 is as compelling evidence as any for an early-period date for ‘small area’ finds in general, which I have argued on other grounds (section 1.2 above). This being so, we have established a fair antiquity for a practice which features prominently in the Tongan ethnographic record. A set of identical tattooing chisels was collected in Tonga on the Cook voyages, differing from the excavated specimens only in being perforated to facilitate lashing to the head of the *hau* (Kaeppler 1978:212; Figs 428, 429).
Extra-Tongan parallels

Almost identical specimens are known from Hawaii, where they are considered to be of considerable age (Emory and Sinoto 1961:73-74; Fig.70). Other parallels are in the archaeological record for the Marquesas, where they occur both early and late (Sinoto and Kellum 1965:26; Fig.4.12-15; Sinoto 1970:107), Easter Island (Ferdon 1961:247-48) and New Zealand (Duff 1956:223; Fig.58, especially no. 1222).

Ethnographic parallels may be noted for New Zealand (Buck 1950:Fig.85), Samoa (Edge-Partington 1890a:Plate 76.3, 4; cf. Green 1974d:268) and Fiji (Edge-Partington 1890a:Plate 122.3).

BOWLING STONES (Class 6)

There are seven specimens so interpreted, all made from basaltic pebbles of the kind called makahunu from the volcanic islands of western Ha'apai (Plate 77.7, 8). The pebbles were worked into round to broadly oval shape, with rounded quadrangular cross-section achieved by hammer dressing; the two faces and intervening side are slightly convex. Their distribution is set out in Table 90.

Two specimens were excavated at To.1: no. 1912 (Plate 77.7), 7.5 cm in diameter and 4.2 cm thick, and no. 1913, 9.1 cm in diameter and 3.5 cm thick. They were found 50 cm apart almost at the same level in the middle of the Horizon I shell midden in an undisturbed square (82/58; for disturbed and undisturbed squares see Chapter III, section 10.1) of the so-called small area of Trench I, where all the finds are considered likely to be of early-period date (section 1.2 above).

Five examples were recovered at To.6: no. 4, 11 cm in diameter and 3.5 cm thick, no. 19, 6.8 and 3.8 cm, no. 24 (Plate 77.8), 11 and 4.7 cm, no. 164, 7.3 and 4.1 cm and no. 1356, 6.8 and 3.8 cm. Two of them belong to Horizon IB and in all likelihood date late in the ceramic sequence, though a middle-period date cannot be wholly ruled out: no. 19, from the bottommost spit of the Horizon I midden in Square 27/22, and no. 164, found in the bottommost spit of the ashy Horizon I midden deposit in Square 31/20 right on the western rim of Oven CW. Two others, nos 4 and 24, were found in upper Horizon I in Squares 26/20 and 27/26 respectively and are thus without doubt late period, as is the fifth specimen, no. 1356, found in Horizon II midden deposit in Square 25/22.

The type was thus known in Tonga no doubt early as well as late in the ceramic period.

Pacific parallels

These Tongan pieces are the equivalent of the well-known Hawaiian 'ulumaika, whose use persisted into the 19th century (Buck 1957:372-73; Fig.246a). The disc need not be made from stone, as the Hawaiian name ('ulu = 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 (1930:663). McKern (n.d.:666) does not mention stone discs for Tonga but records that boys had a game resembling bowling in which they used the teka, a disc-shaped slice of kape root (Alocasia macrorrhiza) or indeed anything that would roll.

The archaeological discovery of stone discs extends the distribution of the game within Polynesia to the Cook Islands (Mangaia, in coral, Bellwood 1978:Fig.30d), Tahiti (Emory and Sinoto 1965:91; Fig.12b), Easter Island (Mulloy 1961:156, 166; Fig.45a, b), New Zealand (Skinner 1946) and Tuvalu, where the stone discs described by Skinner (1946) appear to be archaeological. Davidson (1971b:79) adds coral discs in Samoa and on Vaitupu in Tuvalu to this Polynesian distribution. There is a stone specimen illustrated by Jennings (1976c:Fig.5) in a preliminary report on the Falemoa site in Western Samoa, which could be a bowling stone or alternatively a hammerstone. This piece does not seem to be mentioned in the final report on the site in Jennings and Holmer 1980, where Hewitt (1980) describes the stone artifacts. Consequently we do not know the provenance of the piece within the site.
Beyond Polynesia we have archaeological evidence for possible bowling stones for a post-Lapita level at Sigatoka, Fiji (Birks 1973:17, 49, Plate 49K, described as a possible anvil used in pottery manufacture) and for the Lapita-related Erueti and other sites in central Vanuatu (Garanger 1972:30, 108; Figs 271, Tridacna, 28.1, 2, Tridacna and coral, 147.16, Tridacna; cf. Hēbert 1963-65:Plate 8, coral). Shutler and Shutler (n.d.:Plate 2G) record a stone disc from a burial on Tanna, southern Vanuatu.

Davidson (1971b:78-79) describes three coral discs from fairly recent contexts on the Polynesian outlier of Nukuro. Though she includes them in her section on artifacts of uncertain function, she reviews them in the context of bowling stones and says that they are very similar to the coral discs of Vaitupu. She also reports a surface find in Nukuro of a similar disc in Tridacna shell and suggests that Tridacna or Hippopus discs excavated in fairly recent levels on Yap (Gifford and Gifford 1959:191; Plate 40k, 1) may be related.

Reporting on excavations on the Nomoi (Mortlock) Islands between Nukuro and Truk, Takayama and Intoh (1980:28-29; Fig.16.13; Plate 9.11) discuss the possibility of one of two small Tridacna shell discs, both surface finds, being a bowling stone.

**UNIQUE PIECES (Class 7)**

There are three pieces included here, whose function is unclear. They are included in Table 90.

To.1/289 (Plate 68.13), found in the top of the subsoil and therefore belonging to an early stage of the early-period 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.

To.1/3047 (Plate 72.6), from the lower half of the Horizon I midden in Test Pit 50/94 and thus of early-period date, 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 (Plate 76), of coral, has undoubtedly been modified by man. Seven cm high and 4.5 cm across the flat base, it was found in the bottommost spit of Square 24/20, on the very margins of the late-period hearth DN, and a late-period date is preferred to a middle-period one. Its shape has some similarity to a bird's head on a conical neck. A somewhat similar sculpture, cut in bone, is recorded ethnographically from Tonga (Plischke 1939:Fig.5).

**INDUSTRIAL TOOLS (Class 8)**

The distribution of these by site and horizon is set out in Table 91. They are the common currency of craftsmanship throughout Oceania, so that little is gained by a review of the literature. Only in the case of a few of the more interesting forms do I undertake this (cf. Kirch and Rosendahl 1976:238). From time to time with the others I may make specific comparisons.

**Stone cutters (Class 8A)**

Four specimens were recovered, of various rock types which were not identified (Plate 77.3, 6; Table 91). They are thin pieces of stone, 8-10 mm thick, the sides of which curve in to a straight or convexly curved, bluntnish cutting edge. Two of them, To.2/16 (Plate 77.3) and To.6/2627, have a single working edge and two, To.2/700 and To.6/154 (Plate 77.6), 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.

To.2/16 was found in Zone I of the early-period midden, while To.2/700 came from low down in Zone IV of the mound and is a likely transfer from the early midden. To.6/2627 was found in Oven V which belongs to the earliest late-period occupation of the site, but the implement
could possibly represent a middle-period survival. To.6/154 came from half way down a deep posthole, AK, which is attributed on typological grounds (Chapter II, section 10.6) to the general Horizon I occupation, of late-period date.

The closest parallels are on record for Easter Island as saws (Heyerdahl 1961:402-5; Plate 73h) and saws or scrapers (Heyerdahl 1961:405; Fig.100c).

**Hammerstones, generalised and specialised (Class 8B)**

*Subclass B1: definite hammerstones* are represented by four excavated specimens, all on volcanic pebbles (Plates 77.9, 78.2; Table 91).

To.6/42 (Plate 77.9) is very small, 4.3 cm in diameter and 2.5 cm thick. It has a broad belt of coarse hammer-dressing along the edge. It was found in the lower part of the Horizon I midden and is likely to date to the late rather than the middle ceramic period. To.6/163 (Plate 78.2) is very large, 26 x 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. It comes from Posthole CP, which on typological grounds (Chapter II, section 10.6) is assigned to Horizon I and the late ceramic period.

There are two fragments with traces of utilisation at one end. To.2/425 is from Zone I of the early-period midden. To.1/3057 was found in the fill of Pit A, which was dug in late post-ceramic times into the ceramic-period midden; its true age is therefore unknown.

A hammerstone was found in a pit within the late Lapita pottery-bearing layers at Faleas'i'u, Western Samoa (Smith 1976a:70-71).

*Subclass B2: fragments of hammerstones* or, in some cases perhaps, of bowling stones are represented by seven specimens (Table 91). Three from To.2 (nos 143, 2407, 2520) were found in Zones I, II and III of the early-period midden; To.3/181 from the top of the Horizon III midden is of uncertain chronological status. The three remaining pieces are from To.6 (nos 1005, 1357, 3380), two from Horizon II belonging to the late ceramic period, the third being an undatable find.

**A specialised type and its parallels**

Of greater interest is a distinctive type of hammerstone with opposing hollows pecked centrally into the two flattish surfaces. These hollows are called finger grips by Kirch (1976:40, Fig.4; 1978:Fig.7e) and Hewitt (1980:141; Fig.48a) on specimens found in Lapita contexts on Futuna and Niuatoputapu and at Falemoa, Western Samoa, respectively. Birks and Birks (1972) put on record two identical examples, one from the Lapita site at the Mangaia Mound, Tongatapu, the other from post-Lapita levels of the Yanuc a rockshelter, Fiji. They discuss functions for the hollows other than as finger grips (e.g. in breaking open hard-shelled nuts), in the context of comparisons with similar artifacts from Australia, New Guinea and Asia. In the same year as their article Skjølsvold (1972:36; Figs 27, 28) described hammerstones with pecked thumb rests from a late prehistoric habitation cave on Hiva Oa in the southern Marquesas.

Commenting on the discovery of two hammerstones, one with a pecked depression on both sides, the other on one, during excavation of a second millennium AD midden on Tol in the Truk lagoon, Takayama and Intoh (1978:23-24, 64; Fig.11.2, 3; Plate IX.12, 13) remark that hammerstones with pecked finger grips are widespread in Oceania. They refer to some of the Polynesian occurrences which I have already cited and instance other Micronesian examples, in the Marianas and Palau. To their Palau record we may now add Osborne's finds on Babeldaob in stone (1979:119, 187, 214; Figs 88f, 153b, 184f) and on Pelilieu in shell (1979:37; Fig.19a).
Combined hammers and files (Class 8C)

There are two specimens in this category (Table 91). To.6/1569, from Horizon I but not the bottom spit and therefore certainly late period in date, is a piece of branch coral, 6 cm long and 4 cm thick, with traces of use as a file on its surface and with both ends flattened from hammering. To.2/536, from Zone III of the early-period midden, is a likely fragment from a similar implement. The type is thus known in Tonga early and late in the ceramic sequence but appears to be without overseas parallels.

Branch-coral files (Class 8D)

No less than 87 specimens were found by excavation and one on the surface, mostly in the form of small fragments (Plate 75.1, 3, 5, 7). The bigger specimens show how one end was used as a handle, the other as a file. Through use this part 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 early and late in the ceramic sequence: note (Table 91) its presence in quantity in the early midden at To.2 and the lower horizons of To.5 and its representation throughout the late period site of To.6.

Pacific parallels

Parallels are on archaeological record in Polynesia for Hawaii (Emory et al. 1959:Plate 6.4-12), the Society Islands (Emory and Sinoto 1965:Fig.5,9, 10; Sinoto and McCoy 1975:167) and Mangareva (Kirch and Rosendahl 1976:238, quoting Green) and for ceramic contexts in Western Samoa (Janetski 1976a:73; Fig.17m) and Niutaoatapu (Rogers 1974:325).

Branch-coral files are present in ceramic and non-ceramic levels of Site An-6 on the Polynesian outlier of Anuta (Kirch and Rosendahl 1973:82; Fig.26C, D) and, with other types of coral files and saws, in second millennium AD deposits on another outlier, Nukuoro (Davidson 1971b:69-70). To this record of archaeological distributions we can add Futuna, the Polynesian outlier in southern Vanuatu (Shutler and Shutler n.d.:7), and, in Micronesia, the Marianas (Takayama and Intoh 1976:19; Plate X.U; Reinman 1977:Fig.33 centre) and Truk (Takayama and Intoh 1978:Plate XX.6, 7).

They are thus widely distributed in time and space.

The files of Porites coral common in Eastern Polynesia (Kirch and Rosendahl 1976:238) are unknown in Tonga. Examples can be cited for Tahiti (Emory and Sinoto 1965:88), the Marquesas (Sinoto and Kellum 1965:23; cf. Suggs 1961:117-21; Fig.32; Sinoto 1970:106) and Hawaii (Emory and Sinoto 1961:53-54; Fig.48d-g). An Easter Island coral file (Heyerdahl 1961:410; Plate 73g) resembles some of Suggs’ Marquesan series.

Stone file (Class 8E)

The only example is To.2/3990 (Plate 77.5), an otherwise unprovenanced find from the mound, thus of uncertain chronological status, though an early-period origin in the midden is likely. It is a broken artifact of sandstone, some 6 cm long, with rounded quadrangular cross-section and showing signs of 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 (Porites) coral files, whose form is dealt with in detail by Suggs (1961:117-21; Fig.32). The Tongan specimen bears some resemblance to his Long Triangular type (1961:118; Fig.32e-g), well represented throughout his sequence, though the similarity may simply reflect the way that the Tongan example has been worn.
Sea-urchin files (Class 8F)

The three excavated examples (Table 91) are all worked at one end with a bevel at an angle of 45°. Two are complete (To.6/1063, 2918), the third broken (To.2/5763). One of the To.6 specimens (Plate 75.4) derives from the Horizon IT midden of late ceramic period date, while the other comes from Posthole AK, which on typological grounds (Chapter II, section 10.6) belongs to Horizon I and the late period. The example from To.2 is an unprovenanced find from the excavations and is therefore of uncertain chronological status, though an early-period dating is likely on circumstantial grounds. The type was apparently rare in Tonga, definitely known late in the pottery sequence and possibly also early.

Pacific parallels

The Tongan finds all fall within one of the types (Type 1 - bevelled) defined by Sinoto and Kellum (1965:23-26) on the basis of finds at the Hane site, Uahuka, in the northern Marquesas (cf. Suggs 1961:121, 129-31, 133, Fig.35f-i, for a now-superseded discussion of artifacts from Nukuhiva, all, after Sinoto and Kellum, reclassified as files). Skjølsvold (1972:31-32; Fig.20) fits his finds from the southern Marquesas into the Sinoto and Kellum typology. Elsewhere in Eastern Polynesia sea-urchin spine files are on record for Tahiti (Emory and Sinoto 1965:88; Fig.5.8), Reao in the Tuamotu (Sinoto 1978:160-61; Fig.27a, b) and Hawaii (Emory et al. 1959:19, 21; Plate 6.15-27; Emory and Sinoto 1961:56; Fig.48b, c).

The artifact is reported from ceramic contexts on Niuatoputapu (Kirch 1978:Fig.7c, d) and in Western Samoa at Falemoa (Strata II-IV) (Janetski 1980b:129; Fig.43f-h) and Faleas’u (Stratum III) (Janetski 1976a:73; Fig.17d-g). It is known in Samoa in the post-ceramic period (Davidson 1969b:245; Fig.103e). It is only possibly present in Fiji, in post-Lapita contexts (Gifford 1951:220). Shuter and Shuter (n.d.:5) report it, undated, from Tanna in southern Vanuatu.

Kirch and Rosendahl (1973:82; Fig.26E, F) describe six specimens from the ceramic levels of Site An-6 on Anuta.

Takayama and Intoh (1976:19, 20; Fig.4.25, 26; Plate X.R-T) record definite and possible examples from both levels of a site on Rota in the Marianas.

Coral grinders (Class 8G)

The 20 excavated specimens include various fragments of coral, other than 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 (middle or late ceramic period), is at all extensively modified, having a trapezoidal shape and also cross-section, with sharp corners. It is 19 cm long, 3.5 cm wide at one end and 7.5 cm at the other. Both ends are slightly curved. All surfaces are smooth.

These simple grinders were in use early and late in the ceramic sequence in Tonga by the evidence (Table 91) of, for example, two early-period specimens (nos 2477 and 2456) deep in Horizon I midden in Trench IV at To.1 and their good representation in horizons of the late-period site, To.6.

A squared piece of coral from late Lapita context at Falemoa (Stratum IV) on Manono Island, Western Samoa, is thought to be an abrader (Janetski 1980b:129; Fig.45o).

Pumice grinders (Class 8H)

The fourteen excavated specimens show evidence of having been used for grinding and polishing, in the form of facets and grooves of varying dimensions (Plate 78; Table 91). Only one example has been modified into a specific shape. This is To.6/2254, which is sausage-shaped (Plate 78.2). It is 8 cm long and 3 cm thick. Interestingly enough, all 14 specimens
came from To.6. The eight specimens in stratigraphic context were found throughout all three horizons except for the bottommost spit of Horizon I. They all belong therefore to the late ceramic period.

Pumice grinders are on archaeological record for the late Lapita level at Sigatoka, Fiji (Birks 1973:49; Plate 49F).

Stone grinders (Class 81)

Fifteen examples from both early and late in the ceramic period were found by excavation, being in the main fragments showing various traces of grinding and polishing (Plates 77.1, 2, 4, 79.1; Table 91). Two examples have a more specific form. These are To.6/162 (Plate 77.4), of sandstone, and To.5/1406 (Plate 79.1), of a feldspathic type of rock, both of uncertain chronological position. The latter displays one, the former two grinding hollows.

Of five specimens from To.2, three derive from Zones I, II and III of the early-period midden, while two of uncertain stratigraphical status could be transfers from the early midden. The only example from To.5 is without satisfactory stratigraphic details and thus undatable. Of the nine pieces from To.6, six are definitely late period, since they come from the midden contexts of Horizons II and IT. A seventh piece (To.6/162, Plate 77.4) was found in Posthole BM, which on typological grounds I assign to the general late-period Horizon I occupation (Chapter II, section 10.6). The last two were found in the bottommost spit of the Horizon I midden and a late- or middle-period date could be argued.

For Easter Island Heyerdahl records dished stone grinders similar to the piece from To.5 (Heyerdahl 1961:447; Plate 79a, b). Stone grinders are also known archaeologically from the late Lapita level at Sigatoka in Fiji (Birks 1973:49; Plate 49A, B, E).

RAW MATERIALS AND TECHNOLOGY (Class 9)

The range of artifacts described above includes tools for woodworking, food preparation and fishing, ornaments of a wide variety and bowling stones, as well as a number of implements used amongst other things in their production.

Shell

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. Plate 74.1-3, 5, 6 illustrates the type of waste and worked *Tridacna* present. Plate 72.8 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 Plates 73.1, 3, 4 and 75.6: 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 was weakened until a gentle blow could detach it cleanly; and the complete shell ground flat on top and sometimes with the central disc removed. The distribution of these items of shell technology, as well as of smaller univalves worked in a similar way (cf. Plate 73.2) for the production of small beads and discs like Classes 5L (Plates 68.20, 22; 72.4, 5) and G (Plate 71.1, 2, 5), is shown in Table 91 under the headings 9A and 9B. Note that they are represented both early (To.2 midden, lower horizons of To.5) and late (To.6) in the ceramic sequence.

McKern makes no mention of shell technology, only of craftsmen using whale ivory - the Tongan gold - and turtle shell as raw materials (McKern n.d.:420), 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 (cf. Kirch and Rosendahl 1973:81): 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 or 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 excavated 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.

**Stone**

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/classifiable fragments to nine of shell suggests that such import posed no problem. Petrological analysis of a number of stone adzes shows that the two sources of supply were being exploited throughout the Lapita period (see section 2.2 above and Appendix 7). Two of the analysed adzes came from even further afield, from some region of oceanic basalts (section 2.18 above and Appendix 7).

Pieces of siliceous rock were occasionally met with in the middens. Unfortunately these were not quantified. None of them had been worked, but it is possible that they provided the raw material for drill points, as in New Zealand (Davidson 1984:107; Fig.75h-i; cf. the drill points of obsidian and andesite recorded for Easter Island, Mulloy 1961:155, 164; Fig.49a-f).

Two pieces of obsidian, Class 9C, both unworked, were found (Table 91). To.1/3551 came from the base of the Horizon I midden in an undisturbed square (83/59; on disturbed and undisturbed squares see Chapter III, section 10.1) of the so-called small area of Trench I, thus very probably dating early (see section 1.2 above). To.3/261 was found in Pit A of late post-ceramic construction, the contents of whose infilling are undatable.

The source of the obsidian has not been investigated, but the material occurs on Tafahi Island in the northern part of the Tongan Group and found its way to nearby Niuafo'ou in Lapita times (Ward in Rogers 1974:345; Kirch 1978:11). Obsidian on late Lapita sites in Western Samoa comes from a different source (Ward 1974; cf. Green 1974b:146-49; Hewitt 1980:142).

**Ochre**

Forty pieces of red ochre, Class 9D, available on 'Eua, were excavated. Their distribution is set out in Table 91, where it is seen that they were brought in during all three ceramic 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 pottery and presumably tapa cloth. Similar occurrences are recorded in Lapita contexts at Yanuca, Fiji (L. Birks pers. comm.) and in Samoa (Green 1974d:269).

**INTERNAL DYNAMICS OF TONGAN MATERIAL CULTURE**

**Limitations of the data**

Since the conclusions from the pottery analysis has been that it represents a process of unbroken development, we might expect other aspects of material culture to show a similar continuity within the ceramic period. Unfortunately many items occur in such low numbers that it is uncertain whether their absence from a particular period is real or not, while few are...
present in sufficient quantities for us to talk about trends over time, as we can do with the ceramics. In addition, there are problems raised by site sampling and the functional differences that may have obtained between sites regarding the manufacture and use of the various kinds of material culture items in question. We may take warning from the example of tattooing chisels which, present archaeologically in the early period and ethnographically at a much later time, were not recovered from the later part of the Lapita sequence, where of course they are presumed to have been present. Significant changes in material culture would indeed seem quite likely to have taken place during the 1500 year-long span of time separating the pottery period from the time of European discovery and regular contact. Unfortunately the ethnographic record is deficient in the very data needed for many such comparisons.

I must therefore confine my comments to the Lapita period of Tongan settlement, on the evidence assembled in Table 92.

The evidence for continuity

There is substantial evidence for continuity in material culture from the early to the late period of the ceramic sequence. This applies to three of the eight dated groups of stone adzes (1a, 2a, 2b) and one of the two categories of shell adze, that with rectilinear cross-section (Class 1A), but not on present evidence to the shell chisels and gouges of Classes 1C and 1D.

In the sparsely represented category of shell scrapers and peelers, only one of the four classes is represented in both early and late periods, the Strombus paring knife (2C). Under the heading of fishing gear, only the two best populated of the five classes present provide evidence of continuity, octopus lures (3C) and Anadara net sinkers (3D). Awls (4B) do the same, but not needles (4A).

Turning to ornaments, there is continuity not only in the class of narrow shell bracelets (5A), but for some of its subclasses: this is not only true of A1, A4 and A8, but might also be argued for A2, A3 and A5, because even though the one example of each of this latter trio which was found at To.6 was not in secure stratigraphic context there, the logic of the situation is that they must all be either late period or post-ceramic. Broad shell bracelets (5B), small shell rings (5C), long and circular units of shell (5D, 5G) and small beads of shell (5L) and also of bone (5M), if we accept the lizard-bone items of To.5, are present early and late in the ceramic period.

The same is true of the rather special class of bowling stone (6).

In the class of industrial tools, some of the nine groupings which make it up, hammerstones, grinders and the like, are somewhat general and non-specific. It is not surprising therefore that only two of them, stone files (8E) and pumice grinders (8H), are not present continuously. Three items, being more specialised, are worth attention: stone cutters (8A) and files of branch coral (8D) and sea-urchin spines (8F).

The raw shell of Conus (9A) and other univalves (9B), which was amongst the materials worked by these industrial tools, is present in early and late contexts, as is red ochre (9D).

The evidence for change

Besides the factors of low numbers and the possibility of different site functions already mentioned, there is an additional difficulty when we attempt to identify trends over time in the classes of material culture surveyed above: the fact that some individual items in the various classes are not as secure in the time slots to which they have been allocated as are others should be evident from the discussions with which this chapter began.

Let us, however, accept the dating that has been argued in those discussions. Let us further, as an exercise in trend recognition, accept a doubling or a halving of numbers between the earlier part of the ceramic sequence (taken as early and middle periods combined) and the later part (late period, including the basal spits of Horizon 1 at To.6) as having some possible
significance. Let us now apply this rule to all classes where five or more dated items are present.

There is decline from early to late periods in shell adzes overall (1A + B) and explicitly in the variety with rectilinear cross-section (1A). There is decline also in Anadara net sinkers (3D) and bone awls (4B). In the sphere of ornaments decline affects the narrow shell bracelet (5A) overall and its subclasses A8 and (by the argument advanced above) A3 and A5 too. Also regarding ornaments, the same trend is marginally present with the poorly represented class of small shell beads (5L), but the formula we have adopted just rules out the reasonably well-represented class of long units of shell (5D). Branch coral files (8D) decline, as does Conus waste (9A) and red ochre (9D).

Conversely, there is an increase in the representation of stone adzes from early to late periods, including five new groups (1a, 1b, 1a/b, 1c, 2d), and in the classes of octopus lure caps (3C), bowling stones (6) and coral grinders (8G).

This is a very gross exercise and the patterns are correspondingly hard to interpret. Take the considerable decline in net sinkers, from around 200 to around 20. This is doubtless affected by the fact that the early/middle period is represented by a greater amount of excavated earth than is the late period. Yet the artifacts are represented at all sites and the pattern is similar if we look at sites individually; they are more abundant everywhere in the early levels. Perhaps there is a functional explanation related to changes in the local relationships of land and sea discussed in the next chapter. It is even more difficult to suggest an explanation for the opposite trend in the less well-represented octopus lure caps.

The decline in a number of varieties of shell ornament is interesting, particularly in the light of the fact that there are other shell ornaments which are represented only in the early period. Some of these, admittedly, are present only in ones and twos (e.g. A6 and A7 varieties of the narrow shell bracelet 5A, rectangular units 5F, curved segment 5H, pearl-shell pendants 5I), but the squat units (5E) have five, possibly six representatives in the early period. One gains the distinct impression that shell ornaments are declining both in variety and number and the question presents itself as to whether this may not be somehow connected with the simultaneous decline in ceramic standards, as described in previous chapters.

This downward trend in the production of shell ornaments might account for two other similar trends, in the number of coral files (8D), a possible tool in their manufacture, and in the representation of Conus shell waste (9A). Could the decreased use of red ochre (9D) in the late period be connected with the decline in standards of pottery production, on the assumption that it was used in part for giving a finish to pottery vessels?

Finally, one asks whether the opposite trajectories of shell adzes (declining) and stone adzes (increasing) are not in some way linked, perhaps as a result of secure access to the volcanic stone of other islands over time. One notes, too, that the shell gouge (1D) has only been found in early contexts, as has the variety of shell adze with curvilinear cross-section.

Other classes are in the same case, but represented by so few items that little can be said: 2D, 3A, 3B, 5O, 8E and 9C, this last being obsidian. About 5J, the pule-shell pendant, and 5Q, tattooing chisels, I note that though archaeologically present only in the early ceramic period, both are on ethnographic record.

There are a number of classes present only in the late ceramic period. Most of them are represented in such small numbers (1C, 2A, 2B, 3E, 4A, 5K, 5N) that I need spend no time on them. The exceptions are five groups of stone adzes (1a, 1b, 1a/b, 1c, 2d) and pumice grinders (Class 8H). The latter case may be explained by some special industrial qualities of the only site for which they are reported, To.6, except that the artifact is a simple one, in fragile material, and may have been present more widely than actually recorded. Regarding the stone adzes, reference is made to the section of this chapter devoted to their discussion.

Finally, it may be worth saying a word about the class of scrapers and peelers to which 2A,
the Tonna scraper, and 2B, the Anadara paring knife, belong. The class is represented by only eight examples in total, of which six are late period, two of 2A, two of 2B and two of 2C, the Strombus paring knife, which has one representative in the early period. The eighth item is one early-period oyster scraping knife. It would no doubt be pushing a small amount of evidence too far to associate the 3:1 late-period to early-period occurrence of these presumed tools of vegetable preparation with the increasing emphasis over the same time period on horticulture, such as is argued in the next chapter.

Conclusions

To conclude this review of material culture and technology during the ceramic period on Tongatapu, we may say that despite the real dangers of sampling error with a wide range of objects few of which are present in quantity, a consideration of the total evidence leaves an impression of a continuity of tradition accompanied by some important trends. There is no doubt that Tongan Lapita material culture as recovered archaeologically was richer in the early and middle periods than in the late period, especially in the realm of shell ornaments, a conclusion that is true of the pottery as well. Yet continuity in cultural tradition in ceramics and other aspects of material culture would seem to be beyond doubt. The conclusions presented here can only be provisional and we need investigations directed to an understanding of the functional differences between sites from which artifactual evidence is recovered. The relatively large number of stone adzes and other tools at To.6 would, for example, suggest a particular character for this site which need not have been peculiar to the late period.

It would appear from the archaeological evidence that Tongan culture by the end of the ceramic epoch had a restricted base to offer from which post-ceramic cultural development, so far very little investigated, could proceed. Perhaps that development was a matter of a gradual shift in emphasis towards the increased use of organic materials like wood, bark, fibre and feathers: without doubt, for example, ceramic vessels were replaced by ones in wood and the like, as in Samoa (Green 1974d:249, 253), a change happening earlier in Tonga than in Samoa. This shift in emphasis might be a main reason why, in terms of artifacts, the ethnographic record for Tonga is so far removed from that of the Lapita era many hundreds of years before.

EXTERNAL RELATIONS OF TONGAN LAPITA MATERIAL CULTURE: THE WEST

The nature of the data

A realistic appraisal of Tongan relationships in terms of the artifacts here under review is hampered by the lack of adequate comparative material, of sufficient interregional chronological control and of proper understanding of the functional and typological complexity of the artifacts themselves. At the present stage of study of South Seas prehistory caution is thus called for in interpretations that involve negative evidence and parallels of sometimes varying ages. The former point is strikingly exemplified by the development of the Samoan archaeological record over the past 15 years, with the first decorated Lapita pottery turning up at Mulifanua in 1973 (Green 1974c; Jennings 1974) and the first shell artifacts in Lapita context recovered at Faleas'i'u in 1974 (Janetski 1976a).

Despite this, a number of extremely interesting indications appear from what is already on record (cf. Poulsen 1970 for a special discussion of shell artifacts). This is largely due to the richness of the records resulting from the 1963-64 excavations on Tongatapu, which, in addition to the abundant pottery, produced artifacts in some 25 technological and 17 ornamental classes (together with a few supplementary groups), for the most part acceptably dated within the framework of a ceramic sequence. This record therefore provides a good base on which to attempt an investigation of Tongan and wider relationships in the South Pacific.
Lapita and related contexts

It is reasonable to begin with these our survey of parallels for the technological and ornamental classes into which the material culture of the ceramic period on Tongatapu has been ordered. The catalogue is, starting in the north:

_Eloaue Island_ (St Matthias group, northwest of New Ireland), a narrow shell bracelet (Class 5A7) and pottery discs (50).

_Watom Island_ (New Britain), stone adzes of curvilinear cross-section (Group 2a rather than 2d), a _Conus_ gouge (Class 1D) and a rectangular shell unit (5F), which last could be a repaired or reworked portion of a broad bracelet (5B).

_Reef Islands_ (southeastern Solomons), producing an important series of Lapita sites, cannot be satisfactorily reviewed, because the non-ceramic finds have only been selectively reported. Note, however, a stone adze of Group 1a, narrow bracelets of _Trochus_ shell of Class 5A, a _Conus_ piece either belonging to the broad bracelet class (5B) or a unit in its own right (Class 5F) and a circular shell unit of Class 5C.

_Site 13_ (New Caledonia), a stone adze of curvilinear cross-section (Group 2a) but found on the talus slope, cowrie-shell octopus lure caps without perforations (Class 3C), _Anadara_ net sinkers (3D), narrow shell bracelets (5A), broad shell bracelets (5B), rectangular and circular shell ornamental units (5F, 5G), with the possibility of 5F being a repaired or reworked portion of a broad bracelet (5B).

_Fiji_ (three sites, Natunuku, Yanuca, Sigatoka), stone adzes of rectilinear and curvilinear cross-section (Groups 1a, 1c (?), 2a, 2b), possibly shell adzes of Tongan type (Class 1A and/or B), unperforated octopus lure caps (3C), narrow bracelets (5A2, 5, 6, 7), broad bracelets (5B), long and circular units (5D, 5G) and pottery discs (50).

To this review I add the rather different Erueti site on Efate in central Vanuatu, which I follow Garanger (1971:61, 1972:29) and Golson (1971) in accepting as Lapita-connected.

_Erueti_ (central Vanuatu), stone adzes of rectilinear and curvilinear cross-section (Groups 1a and 2a), a shell adze (Class 1B) manufactured from the hinge part of _Tridacna_ but found on the surface of the site (the excavated shell adzes are made from the interior of the shell but either not from the hinge or not preserving its marks), narrow shell bracelets (5A), a circular shell unit (5G) and bowling stones (6).

Casting a wider net, I turn to the ceramic levels of Site An-6 on Anuta, because of their overlap in age with Lapita sites in the region (Kirch and Rosendahl 1976:235-36, 240) and the obvious question which the pottery raises of relationship with Lapita (Kirch and Rosendahl 1976:236).

_Site An-6, Anuta_ (southeastern Solomons), where the following may be noted. Adzes made from the thick part of the _Tridacna_ shell, which form a very small percentage of the shell adzes from the site, are of curvilinear cross-section, typologically equivalent to Tongan Class 1B, but differ in not being made from the hinge portion of the shell. There is a shell chisel that can be compared to the Tongan specimen To.1/2484 (Fig.77, SE8; Plate 67.3) of Class 1B, but it is of _Cassis_ shell and uniquely combined with an adze at the other end.

The Tongan simple fish hook (Class 3A) can be compared with the larger and more varied Anutan assemblage in a general way. The cowrie caps which I interpret as parts of octopus lures (Class 3C) on Tongatapu are thought to be shell scrapers on Anuta (i.e. my Class 2).

There is some equivalence in ornamental forms. Anuta has narrow shell bracelets (my Class 5A). There are shell rings said to be like my Class 5C, which I have suggested might be alternatively compared to the disc beads included in Class 5L. I have tentatively recognised one piece as an example of Class 5G (circular units) in course of manufacture. Two cowrie pieces might be equivalent to the cowrie-base unit included in Class 5L (small shell beads). A tooth bead has some functional similarity to bone beads of my Class 5M.
There are coral and sea-urchin files like my Classes 8D and 8F.

In the above review, from the Bismarck Archipelago to Fiji, I have concentrated on parallels in specific items. The number is not overwhelming and individual cases rarely occur in more than two of the locations. There are some ready explanations for this: the geographical spread of the sites in question and the small size of the excavations at some of them. It is instructive, moreover, to look at the occurrence of parallels to the Tongan artifacts which are known from other than Lapita contexts in regions west of Tonga.

Other contexts

The parallels are drawn from two main types of evidence: items excavated or otherwise recorded at non-Lapita (often post-Lapita) sites, and 'surface' finds, with no known cultural context, some of which could therefore conceivably be Lapita. I distinguish in the review below between the two cases: \( S = \) surface only; \( E = \) at least one case of an excavated (or recorded) piece, whether there are surface finds or not.

Class 1: stone adzes

rectilinear cross-section

Group 1a: Lau (S), Fiji (E)
1b: Lau (S), Rotuma (S), Tikopia (S)

curvilinear cross-section

Group 2a: Lau (S), Fiji (E), New Caledonia (E)
2b: Lau (S), Fiji (S)
2d: Lau (S), Fiji (S, but one example from the surface of a post-Lapita site)

Class 1A and B: shell adzes, made from Tridacna hinge
A: rectilinear cross-section: Fiji (E)
B: curvilinear cross-section, chisel-type, but of Cassis: Rotuma (S), Micronesia (E)

Class 1C: Terebra chisels: Lau (E), Nukuoro (Polynesian outlier) (E), western Micronesia (S)

Class 1D: Conus gouges: but on a variety of shells, central Vanuatu (E), Nukuoro (Polynesian outlier) (E), Nomoi Islands (central Micronesia) (E), Ponape (S), Truk (E), Palau (S)

Class 2A: Tonna/Turbo scrapers: Fiji (S, a site of both Lapita and post-Lapita occupation, plus an ethno graphic example involving a different univalve), southern Vanuatu (E), Yap (E), Marianas (E); an example on a different univalve is known from New Caledonia (E)

Class 2B: Anadara paring knives: Truk (E?) (but could be net sinkers), Yap (E, but differently interpreted by the excavator), Palau (S?); examples on a different bivalve are known from central Vanuatu (E)

Class 2C: Strombus paring knives: New Caledonia (E), Yap (E)

Class 3A: fish hooks: possible relationships with western Micronesia (E)

Class 3B: fish gorges: southern Vanuatu (E); Marianas (E), but of a different shape

Class 3C: octopus lure caps: New Caledonia (E); bases: New Caledonia (E), Yap (E, but differently interpreted)

Class 3D: Anadara net sinkers: New Caledonia (E), central Vanuatu (E), Truk (E?) (entered also under 2B because of uncertainty of function), Yap (E, but differently interpreted), Palau (S) (but said to be of unknown use), Marianas (S)

Class 5A: narrow shell bracelets: Fiji (E), New Caledonia (E), southern Vanuatu (Polynesian outlier) (E), eastern Solomons (E), Nukuoro (Polynesian outlier) (E), Yap (E), Palau (E), Marianas (E), a listing which includes examples with specific resemblances to Tongan subclasses
Class 5B: broad shell bracelets: wide distribution Melanesia and Micronesia ethnographically; archaeologically, New Caledonia (E), possibly Nukuoro (E), Truk (E), Ulithi (west of Truk) (E), Palau (E) (if not 5F)

Class 5C: small shell rings: southern Vanuatu (E), Nukuoro (E)

Class 5D: long shell units: Marianas (E), in stone and shell and slightly different in shape

Class 5F: rectangular shell units: Palau (E) (though possibly 5B); less definitely southern Vanuatu (E)

Class 5G: circular shell units: wide distribution Melanesia and Micronesia ethnographically; archaeologically, southern Vanuatu (E), central Vanuatu (E), Nomoi Islands (central Micronesia) (S), Truk (E), Yap (E), Marianas (E)

Class 5I: pearl-shell pendants: southern Vanuatu (E), Yap (E, and also ethnographically)

Class 5L: small shell beads: wide distribution ethnographically, especially the disc bead, which is represented archaeologically southern and central Vanuatu (E), Nukuoro (E), Yap (E) and the Marianas (E)

Class 5O: pottery discs: a number of mainly irregular and mainly unperforated discs of various suggested functions from Palau (E) and the Marianas (E)

Class 6: bowling stones: Fiji (E, differently interpreted by the excavator), possibly southern Vanuatu (E), central Vanuatu (E), Nukuoro (a Polynesian outlier) (E), possibly Nomoi Islands (central Micronesia) (S)

Class 8B: hammerstones: specifically the distinctive type with opposing hollows, Fiji (E) Truk (E), Palau (E), Marianas (E)

Class 8D: branch coral files: southern Vanuatu (Futuna, a Polynesian outlier) (E), Nukuoro (Polynesian outlier) (E), Truk (E?), Marianas (E)

Class 8F: sea-urchin files: Fiji (E) (possible only), southern Vanuatu (E), Marianas (E)

Assessment of the evidence

In the above listing there is a minimum of seven items not explicitly reported for the Lapita locations I have surveyed and the two sites (Erueti and An-6) which I have associated with them in my review: stone adze of Group 1b, Terebra chisel 1C, Tonna/Turbo scraper 2A, Anadara paring knife 2B, Strombus paring knife 2C, fish gorge 3B and pearl-shell pendant (5I). Some varieties of the narrow shell bracelet (5A) should be added to this list, but we do not have enough information on cross-sections to be definite. We may note that there are three items that do not appear in the list only because of their presence on the Anuta site: simple fish hooks (3A), coral and sea-urchin files (8D, 8F). Shell disc beads (in ornamental Class 5L) will be present or absent from the list, depending on whether the items from Anuta are interpreted as small shell rings (5C), as the excavators prefer, or as disc beads, as I suggest. Conversely, a few items in the catalogue for the combined Lapita and associated sites do or may not appear in the review of finds from other contexts: stone adze of Group 1c and possibly some varieties of narrow shell bracelet (subclasses of 5A), while pottery discs (5O) may have other functions.

It is difficult to make much of this evidence, given the spotty distributions recorded for most of the items in each listing. We should note, however, the wide spread in time and space of a rich technology in shell. The shell industry of New Caledonian sites, Lapita and others, is very reminiscent of Tonga, though no work in Tridacna is reported and the emphasis is on Conus and other univalves (Gifford and Shutler 1956:64; Plate 6). A similar shell technology has been reported for Yap (Gifford and Gifford 1959:191; Plate 40) and more recently has been discovered on Nukuoro (Davidson 1971b), Nomoi (Mortlocks) (Takayama and Intoh 1980), Ponape (Ayres et al. 1981), Ulithi (Craib 1980) and Palau (Osborne 1966, 1979) in
Micronesia, on Anuta in the southeast Solomons (Kirch and Rosendahl 1973), in southern and central Vanuatu (Shutler and Shutler n.d.; Garanger 1972) and in Fiji, at Natunuku and Yanuca (E. Shaw and L. Birks pers. comm.). The broad geographical and chronological spread of this technology perhaps reflects an ancient and widely diffused adaptation to oceanic conditions apart from any specific cultural connections. In this connection we should recall Davidson’s (1971b:68-69) point, made in respect of shell adzes, that their popularity on some islands where stone suitable for adzes also occurs shows cultural preference playing a part beyond mere environmental necessity.

EXTERNAL RELATIONS OF TONGAN LAPITA MATERIAL CULTURE: WESTERN POLYNESIA

The problem and the evidence

I have already discussed this question in the light of the pottery evidence (Chapter V) and have seen the situation characterised by a differentiation between the two main regions, Tonga and Samoa. The question is whether this ceramic trend is matched by differentiation in other aspects of material culture or whether we may be dealing with heterogeneous circumstances relating to the very origins of and/or early influences on Tongan and Samoan Lapita. In a very real sense this question cannot now be answered, because early Lapita outside Tonga is presently documented only in terms of ceramics and that really well at only one locality, Mulifanua in Western Samoa. The Samoan materials we have available for comparison, the result of fieldwork within the past 15 years, are confined to later Lapita contexts, while the evidence from Niuatoputapu, equally recent in acquisition, seems to be middle and late Lapita in terms of the Tongatapu ceramic sequence (Chapter V, section 7.2 for Samoa, section 1.3 for Niuatoputapu).

Samoa

Even allowing for the circumstances mentioned above, the similarities between Tonga and Samoa are fewer than might have been expected.

The important overlap in stone-adze types in Lapita contexts and later has been discussed previously in the stone-adze section of this chapter, and previously by Green (1974d:253-65). The Tongan groups involved are 1a/b, 1b, 1c and 2b; unknown as yet in Samoan Lapita are adzes of Groups 1a, 2a and 2d. There is a fragment of a heavy shell adze, but its true date is uncertain. The Tongan Conus gouge (Class 1D) is possibly unrelated to the Samoan implement with outside bevel, interpreted as a scraper.

As regards Tongan scrapers and peelers of shell, the Turbo scraper is the equivalent of the Tongan Tonna type (2A) with circular perforation in the shell wall, while the paring knives of Anadara and Strombus and scraper-knife of oyster (2B-D) are replaced by equivalents in cowrie shell.

There are simple one-piece fish hooks (3A) of shell and octopus-lure caps of cowrie shell without perforations (3C) but possibly with formalised stone sinkers (Green 1974d:269), such as are not found at Tongatapu sites. Cowrie-shell bases interpreted for Tongatapu as the by-product of detaching such caps are present in Lapita contexts in Samoa but somewhat differently interpreted (see the discussion under Class 3C, octopus lures, section 7.3 above). A possible awl (4B) is on record. There is a hammerstone (8B1), together with one of the specialised type reported by Birks and Birks (1972) for Tongatapu; coral files (8D); sea-urchin spine files (8F); and the rather generalised class of coral grinders (8G).

A few narrow shell bracelets (5A) are on record, as well as a small specimen of a long unit (5D), though apparently of ivory, not shell, as well as a small bead of ivory (?) equivalent to Tongan bone beads (5M). A square of Conus might be compared with the Tongan rectangular shell unit (5F), though it lacks perforations.
Finally a broad shell bracelet (5B), a small ring of shell (5C), small cowries with the back removed, which, if interpreted as ornaments, belong with the modified shell beads of Tongatapu (5L), and a possible bowling stone (6) are four types which cannot unfortunately be added to the Samoan Lapita catalogue because of uncertain dating.

Two things are worth noting. One is that quite a number of the Samoan artifacts cited are equivalents rather than parallels for Tongan items. The other is that while some of the technological items are recorded more or less securely from post-ceramic contexts in Samoa, including some of the adze types, shell food scrapers and peelers, items of fishing gear and the sea-urchin file, this does not apply to the ornaments.

**Niutatoputapu**

This review is of necessity incomplete because Kirch's excavations have yet to be fully published. We may note the following: a stone adze of Group 1c found on the surface; shell adzes manufactured from the hinge part of the *Tridacna* shell; simple one-piece fish hooks (3A); cowrie-shell bases interpreted by the excavator as scrapers, which could reflect the manufacture of octopus lure caps (3C); a hammerstone of the specialised type reported by Birks and Birks (1972) for Tongatapu; and files of coral branch and sea-urchin spine (8D, 8F).

A few ornamental artifacts can be listed: narrow shell bracelets (5A); a perforated segment of shell bearing resemblances to both Tongan long (5D) and squat (5E) units of shell; a small cowrie with dorsum detached interpreted as a dip-net weight (Kirch and Dye 1979:69) and similar to a Tongan specimen interpreted as a shell bead (5L); finally a pottery disc (5G).

**Conclusions**

There are important points of similarity between Tongatapu and Samoa, though numerically and formally they are not as great as might have been expected, an observation valid for Niutatoputapu also, a stepping stone, as it were, between the two. In terms of the material I have been reviewing in this chapter, however, there is a real distinction in the absence or rare occurrence in Samoa of most of the rich shell industry characteristic of Tonga: only a few of the Tongan ornament types in shell have been reported from Samoan sites. On the other hand, 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 (1938) could devote an entire monograph to their description and explanation.

Green (1966:12-14) has put forward reasons as to how this situation could have come about. Using Pawley's (1966) demonstration of the closer linguistic relationships of Samoa with the Eastern Polynesian languages than with Tongan, 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. Compatible conclusions were reached on the basis of the pottery (Chapter V, section 6.1) and would seem to enjoy some support from the present survey of other portable artifacts. The cultural similarities that mark Tonga and Samoa as Western Polynesia off 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 I (section 2.3), by oral traditions.

The more exact position of Lapita on Niutatoputapu in the early prehistory of Western Polynesia will have to await full reporting of the recent fieldwork undertaken there (see Chapter V, section 1.3). The same is true for Futuna and Uvea, for which (combined) a small number of adzes relatable to Tongan types are on record, besides the Lapita pottery from Futuna discussed in in Chapter V (section 5).

On present evidence Tongan relationships with Lapita in Melanesia and the rest of Western
Polynesia are clear enough, though very heterogeneous and complex of nature. Of the Lapita configurations of Western Polynesia, the Tongan one stands out as having a greater degree of formal similarity in technology and ornaments with the Western Pacific, whether Lapita or not, than is apparent, at present, for the rest of Western Polynesia. In addition, the rich Tongan Lapita record has a number of features, especially ornamental ones, for which no equivalents seem to be in evidence elsewhere in Western Polynesian Lapita.

EXTERNAL RELATIONS OF TONGAN LAPITA MATERIAL CULTURE: EASTERN POLYNESIA

Similarities in material culture

The feature of the archaeological parallels between Tongan Lapita and Eastern Polynesia, some of which are quite detailed, is that they concern technological much more than ornamental items. In this regard the ratio is significantly different from those evident in the comparisons drawn previously between Tonga and other Western Polynesian Lapita on the one hand and non-Lapita west of Tonga on the other. Let us look at the close similarities.

We have seen in the discussion of stone adzes early in this chapter that Tonga shares in the basic Polynesian adze tradition and Tongan Groups 1a, 1b, 1c, 1d, 1e, 2a, 2b and possibly 2d appear to be matched in the Eastern Polynesian record. Tridacna adzes are not widely known in the area, but Cassis shell chisels and narrow-bitted adzes have a long history, while the Tongan chisel in Tridacna (1B) is identical with Marquesan forms. Terebra shell chisels (1C) are well represented in Eastern Polynesia. The Conus gouge (1D) may have its equivalent in Cassis shell, but the evidence is not overwhelming.

The Tongan Tonna scraper (2A) has early Marquesan parallels and an ethnographic parallel in Mangareva. Oyster scraper-knives (2D) have counterparts in the Marquesas and the Society Islands. One-piece fish hooks (3A), fish gorges (3B) and perforated versions of the cowrie-shell cap of the octopus lure (3C), together with the broad class of stone sinkers (3E), are all known. Needles (4A) and awls (4B) are on restricted record. Stone cutters (8A) and files (8E), files of branch coral (8D) and sea-urchin spines (8F), as well as the rather generalised classes of coral, pumice and stone grinders (8G, H, I) are all known. Pearl-shell pendants (5I) are present there. The toothed tattooing chisels (5Q) are well known and the bowling stone (6), with its ethnographic equivalent in vegetable material, is widespread.

A not insignificant proportion of these items forms part of that widely diffused material culture of the Western Pacific, Lapita and non-Lapita, to which reference has been made and in which Tonga shares: stone adzes of Groups 1a, 1b, 1c, 2a, 2b and possibly 2d, shell adzes and chisels (1A/B) and Classes 1C, 1D (?), 2A, 3A, 3B, 3C (unperforated), 5I, 6, 8B (with opposed 'finger grips'), 8D and 8F, to which could be added the less specific items 3E, 4A, 4B, 8A, 8E, 8G-I. Against this the Samoan Lapita record, omitting the unspecific items, can at present offer stone adzes of Groups 1b, 1c and 2b, probably not shell adzes (1A/B) (which are certainly there on Niuatoputapu), 2A, 3A. 3C (unperforated), 6(?), 8B, 8D and 8F.

Differences in material culture

The major differences between Tonga and Eastern Polynesia in terms of the types of material we have been discussing concern pottery, ornaments and fishing gear.

Pottery

Alone in Eastern Polynesia, pottery has been found in early levels of the Marquesas, though in small amounts only. This Marquesan ware, undecorated, is not readily related to the Lapita tradition, though general points of similarity may be mentioned between Tongan pottery and
the 12 sherds put on record by Suggs (1961:95-98) and Sinoto (1970:113-14) for the Marquesas: flat and slightly grooved lips, outward rim orientation and surface striation (cf. also Green 1974d:246-47). In this context attention is drawn to the highly important results of petrographic investigations of potsherds from Fiji, Tonga and the Marquesas (Dickinson and Shuttle 1974), testifying to real connections between the Marquesas and this western area during the settlement phase.

Ornaments

In the sphere of ornaments there is a complete absence from Eastern Polynesia of the shell bracelets so typical of 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, including the custom of bodily adornment by tattooing. Thus the pendant, e.g. of pearl shell (5i), 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. The ornamental units of Eastern Polynesia (cf. Society Islands, Emory and Sinoto 1964:148-49, Fig.5c, d, Plate 1 (whale-tooth units); Marquesas, Sinoto and Kellum 1965:Fig.4b1 (reel), 2-5 (whale-tooth units), 8-9 (sea-mammal tooth and dog-tooth units)), are, however, not known from the Tongan excavations, while the various types of Tongan shell unit (5E, 5F, 5G) are not precisely matched in form in Eastern Polynesia. Yet the transverse perforations of units for stringing and back-to-front perforation for attachment testify to the same ornamental aims in the two areas. The typological differences may thus reflect development in terms of the time differences involved. In Tonga some of the characteristic features of the shell technology are the result of the forms of the ornaments 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.

Fishing gear

The Tongan archaeological record seems to lack, as the Tongan ethnographic record certainly does, the well-developed bait-hook fishing gear characteristic of early levels in Eastern Polynesia (e.g. Sinoto 1970:106-7, 117-19, for the Marquesas). The negative archaeological evidence is hard to evaluate, especially since the lure-hook gear that was highly evolved in Tonga at European contact (Anell 1955:161-62, 167-69) is likewise not definitely represented in the archaeological record (though Tongan specimens of Class 5P might be considered, as indicated in section 9.21 above). From the excavated fish remains discussed in the next chapter, it appears that fish traps and nets were probably the most important fishing devices and in the archaeological record Anadara net sinkers are common. The simple one-piece fish hook (3A), which is an element in the diversified bait-hook technology of Eastern Polynesia, was present. The fish gorge (3B) was known: a close parallel for the Tongan example has been cited from Hawaii and a possible one from the Marquesas. The rather complex octopus lure (3C) 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 scarcity 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 very few examples of the simplest of one-piece bait fish hooks are 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, though Kirch and Dye (1979:73) suggest that it has a great deal to do with fundamental contrasts in marine ecosystems. This lack of elaboration characteristic of Western Polynesia is typical of both the archaeological and ethnographic record of Melanesia (Kirch and Rosendahl 1976:236; Anell 1955:86-92, 241-43) and a similar question has arisen in discussions of western Micronesian prehistory (Takayama and Intoh 1980:35-37).
The conclusions we can propose on the basis of the degree and the nature of the correspondences between Tongan and Samoan Lapita and the Eastern Polynesian archaeological record 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 Southwest 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. The differences are to be seen in the sphere of ornaments, where many types are wholly unmatched outside Tonga. Tongan bracelets have only few and very simple 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 elsewhere, except for unperforated cowrie caps in Samoa, varying 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 Tonga and all other Polynesian languages. With the extended time scale now established by radiocarbon dating for the settlement of the Southwest Pacific, involving that of Tonga by the end of the second millennium 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 early differentiation within proto-Polynesian culture occurred more quickly and to a greater extent than expected, must remain for future research to determine. At the moment the latter view is perhaps more attractive than the former.

What has emerged from the overview presented in this chapter is the far-flung distribution within the Pacific west of Tonga of some of the items found in the excavations there. In so far as Lapita sites are concerned, this parallels the well-known homogeneity of the pottery itself over the vast spread of islands from the Bismarck Archipelago to Western Polynesia, to account for which the existence of interlocking networks of trade and exchange has been proposed (cf. Kirch 1978:13). The parallels concern more than Lapita sites within the region, however, and raise questions about the nature of the culture history of the Lapita phenomenon itself, including origins, early developments and later connections.
VII HABITAT AND ECONOMY

The purpose of this chapter is to describe the faunal and botanical remains present at the excavated sites and to interpret them in the light of the other evidence. Shells were the most conspicuous feature of the middens and provided good conditions for the preservation of bone. However, the excavations yielded a relatively small amount of bone. Botanical material was recognised only at To.1, in the infilling of Pit A.

SHELL-FISH EXPLOITATION

I begin with what was by far the most numerous dietary item in the excavated sites, the shell fish.

How much and what kind

I have described in Chapter II (sections 1.3, 5.2, 6.2, 7.2, 9.2, 10.2, 11) how column samples were taken at all sites (except To.4) in order to characterise the composition of the middens from the point of view of their shell-fish content and how analysis of these samples showed a great deal of variation from site to site and through horizons. On the basis of the restricted sampling undertaken it is difficult to see how anything can be said beyond this, except that at times the shell content by weight proved to be surprisingly low (see Table 93 for a summary statement, Tables 1-4, 6 for details).

The predominant types of shell fish at all sites were, according to identifications provided on the spot in Tonga in 1964 by H.A. Rehder, Smithsonian Institution, Washington, Gafrarium spp. (family Veneridae) (Plate 73.6), the Tonga to'o, including G. tumidum and G. pectinatum, and Anadara antiquata (family Arcidae) (Plate 73.5), the Tongan kaloo'a. These are still the most important food shells on Tongatapu. No systematic attempt was made to identify other species, amongst which, however, *sio* = *Ostrea* cf. *sandvichensis* and *mehingo* = *Tellina* (*Quindnapagus*) *palatam* are to be numbered. These other species were present in small amounts only, though together they at times reached appreciable proportions of total shell by weight (see Table 93 for summary information and Tables 94-99 for more details). Because they were not identified, it is impossible to speculate on the meaning of variations in their representation in different horizons of the same site (e.g. Horizon I and II at To.1 and Horizons I and III at To.6) and at different sites (note, for example, the relatively small proportions present at To.5).

Similarities and contrasts with other Western Polynesian Lapita

The incomplete data on shell-fish exploitation on Tongatapu limit the comparisons that can be made with what is available on the subject from other excavations in the region.

On Niuatoputapu, which Rogers (1974:311) describes as a reversed geographic image of Tongatapu with a remarkable similarity between the ecology and topographic setting of its Lapita pottery sites and those of the larger island, test excavations at one of them recovered ten species of shell, of which five constitute major shell-fish resources today (Rogers 1974:314). In their study of present-day fishing practices on the island Kirch and Dye (1979:60, 65) say that, while the lagoon is rarely fished, four large edible bivalves, including *Anadara antiquata* (*kaloo'a*), are regularly dug from its bed. This work, and that of shell-fish gathering on the reef flats at low tide, is considered a lowly task to be left to the women and children (Kirch and Dye 1979:65, 68). Kirch (1978:12) reports large quantities of shell fish being found during excavations at pottery-associated sites, with 20 species of gastropods and ten of bivalves being represented.

In Western Samoa, recent excavations at pottery-bearing sites at the northwest coast of Upolu, dating to the second half of the first millennium BC, have discovered midden layers with a preponderance of shell, the species present reflecting broad exploitation of the reef flats.
(Janetski 1976b:78-79, 82 for Jane's Camp, Faleasi'u; 1980a:118-20 for Potusa and Falemoa). As Janetski (1976b:82) points out with particular reference to Jane's Camp, these discoveries have softened one of the apparent contrasts between early Tongan and Samoan prehistory, abundance as against absence of shell middens, on the basis of which a number of propositions has been advanced about the settlement histories of the two areas (Groube 1971:312-13; Green and Davidson 1974b:279-80).

Even so, the point made by Groube and by Green and Davidson that Samoa cannot match the concentrated shell dumping exhibited by the Tongatapu sites is still essentially correct (cf. Janetski 1976b:81). The densest of the investigated Samoan middens, that at Falemoa, yielded about 6.75 kg of shell per m³ (Janetski 1980a:118, 121), with the densest concentration in the site (Stratum III) recording 21.71 kg per m³ (1980a:Table 12), as compared with 87.33 kg per m³ for the least dense of the Tongatapu middens, that at To.2 (calculated from the figures in Table 93 for the Midden Horizon at the site, which is represented by eight spits 50 x 50 cm in area and 10 cm deep; cf. Table 3). We should bear in mind, of course, that the submerged status of the early Samoan Lapita Ferry Berth site (Jennings 1974) may mean that the evidence for the early stages of Samoan settlement is now under water (Jennings and Holmer 1980a:7-8).

It is relevant in this connection to note that of three Lapita sites excavated by Kirch and Dye on Niuatoputapu, the one richest in shell-fish midden, Site NT-90, which is the earliest in time by their interpretation of the ceramic evidence (Kirch and Dye 1979:68), produced a modest 9.2 kg of molluscan remains per m³ (Kirch and Dye 1979: Table 7, which, presumably in error, records kg per m²).

At the Lapita site of Tavai on Futuna, dated to 2120 ± 80 BP (I-8355), no shell midden is reported at all (Kirch 1976:40).

**Gafrarium: the importance of Tongatapu's inner lagoon**

It is reasonable to think that these differences between Tongatapu and the other areas surveyed are to be explained by the productivity of Tongatapu's inner lagoon. Initially we may note that at the coastal pottery-bearing sites of Western Samoa gastropods are better represented (by number) than bivalves in all but one level (Janetski 1976b:80, 81, 1980a:119-20, 121) and the same is true (by weight) of all three Lapita sites on Niuatoputapu (Kirch and Dye 1979:70). On Tongatapu, by contrast, the bivalves Gafrarium and Anadara together make up over 50% (by weight) of all shell fish processed from column samples at each of five sites in all but two out of 40 midden spits, and 75% or over in 32 of those spits (Tables 94, 96-99). Gafrarium alone, which may be taken as the specific product of the inner lagoon, as discussed below, forms over 50% (by weight) of all shell in 24 out of 31 spits in the column samples taken at the four inner lagoonal sites, To.1, 3, 5 and 6. This superabundance of Gafrarium might explain why To.2, the site furthest away from its presumed habitat in the inner lagoon and which only registers it in low proportions in its sampled shells (Table 96), also stands towards the lower end of the range for overall shell content in the midden samples taken from different horizons at different sites (Table 93 for overview; Table 3 compared with Tables 1, 2, 4, 6 for details). The contrast of To.2 in shell content with the other early-period deposits, To.5/0 and I and To.1/1, is particularly striking: 6.6% as against 28%, 33.7% and 19.5% (22.8%)/11.7% (two columns) respectively.

**Gafrarium v. Anadara: the evolution of the lagoon**

The following analysis was prompted by the gross variation in the proportional representation of Gafrarium and Anadara noted during the processing of the shell samples, particularly, as already mentioned, between Sites To.1, 3, 5 and 6 on the inner lagoon and Site To.2 at its entrance.
*Gafrarium and Anadara within and between sites*

The numbers of individuals of *Gafrarium* and *Anadara* 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. Weighing was designed as a check on counting and generally speaking the picture by count and weight is the same.

**To.1** Throughout the midden there is a good correspondence between the results of counting and weighing, showing the absolute dominance of *Gafrarium* (Table 94). There is the very slight possibility of a change in the bottommost 5 cm of the midden, Spit 10 of the table.

In the subsoil (Table 95) there is more variation and the agreement between count and weight is not ideal. The figures, however, show *Anadara* to be much better represented than in the midden, most clearly in Spit 3 of the four sampled squares.

**To.2** We are concerned with the zones of the midden horizon only. *Anadara* predominates throughout (Table 96).

**To.3** Here there is a clear difference in Horizon I (cf. Fig.15), with *Gafrarium* predominating in the middle and upper parts, while *Anadara* occurs in roughly equal proportions with it in the lower part (Table 97).

**To.5** The proportions of *Gafrarium* and *Anadara* are fairly similar throughout the main midden horizons, I-III (Table 98).

Below the midden there is an interesting situation regarding the cultural lenses making up Horizon 0 (b and d of Table 98) and the coral-sand subsoil (a, c, e) in which they are contained (Fig.19). The lower and more substantial of these lenses (d) gives a picture like that of the main midden, with *Gafrarium* dominant. The coral sand above and below it, (c) and (e), gives a quite different picture, with *Anadara* dominant, except by weight in (e).

The evaluation of the two very small samples from the upper coral sand (a) and the upper cultural lens (b) is difficult. The similarity of (b) with the coral sand layers below (c, e) may reflect contamination in this very thin deposit from the coral sand contexts (a, c) on either side of it. Similarly, intermixture from the base of Horizon I of the main midden into the upper coral sand layer (a) might have caused the recorded pattern there, which is somewhat at variance with that of the other subsoil sand deposits below (c, e).

**To.6** There is some contrast between the bottom and top horizons (I and III), *Anadara* being somewhat better represented in the latter (Table 99). Horizon II is a relatively shell-free deposit overall, though the sampling column does not register this (cf. Table 6).

The analysis thus confirms, and quantifies, the contrast noted during sample processing between the predominance of *Gafrarium* at the inner lagoonal sites, To.1, 5, 6 and, less clearly, To.3, and the predominance of *Anadara* at the lagoon entrance site of To.2. It may be mentioned in this connection that the shell samples from the post-ceramic pits excavated at the 'Atēle School grounds, situated behind the inner lagoon, showed absolute dominance of *Gafrarium* (Davidson 1969a:259, 279).

**The ecology of Gafrarium and Anadara**

Many Tongans were asked about the collecting grounds for *Gafrarium* and *Anadara*. The answers were immediate and consistent: the former, *to'o*, in the lagoon, the latter, *kaloa'a*, outside. *To'o* can indeed be collected on the reef shelf off the north coast of Tongatapu, but only in muddy pools which hold water at low tide; they have a thinner shell and a stronger taste than lagoon *to'o*. *Kaloa'a* never occur in the lagoon, the Tongans say; if they did, they would invariably be collected, as they contain more meat than *to'o*. *Kaloa'a* occur everywhere in the offshore mud and sand 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 opinion (pers. comm.; cf. Allan 1959:254, 323 on the habitats of Arcidae and of Veneridae respectively) that they both inhabit much the same environments, quiet waters at the margins of a lagoon, often where there is some brackish influence.

Against the background of these somewhat conflicting statements, it is interesting that *Anadara* is indeed not absent from the inner lagoonal middens. Does this reflect collection directly from the reef by the lagoon dwellers or was it obtained indirectly by exchange? McKern (n.d.:347-48) talks about the exchange of products between coastal and inland groups (cf. Gifford 1929:146, 177; Sahlins 1958:202-4 also takes up this point). In the fill at the south end of stratigraphically late Pit P at To.1 (Fig.3) was a concentration, 10 cm thick and 60 cm wide, of *mehingo* shells (*Tellina* (*Quidnipagus*) *palatam*), said by informants to be only available on the sand flats off the north coast of Tongatapu.

**Evidence for the evolution of the lagoon**

Alternatively, did *Anadara* once live in the lagoon environment, even though now it does not seem to do so? We may note that there is a better representation of *Anadara* in the subsoil below To.1 and To.5 than in the middens above (Tables 94-95 and 98). This could indicate a change in the lagoonal environment from more tidally influenced to more enclosed conditions as today. Geomorphological support for this interpretation is provided by the nature of the subsoil on which the middens at To.1 and To.5 accumulated: sediments laid down in and on the margins of shallow salt water in the first case (Chapter II, section 5.3 and Appendix I) and coral sand instead of the present muddiness of the nearby lagoon in the latter (Chapter II, section 9.3). At To.2, at the mouth of the lagoon, where tidal influence is marked and *Anadara* is predominant in the midden, the subsoil is clean, shell-free coral sand.

If indeed there was lagoonal change, it was going on in the early stages of human settlement. At To.3 *Anadara* is significantly more abundant at the bottom of Horizon I, where it is represented in the same proportions as in the subsoil beneath (Table 97). If the *Anadara* were coming from nearby collecting grounds, these were available during the early occupation of the site, in the middle period. At To.5, where the coral-sand subsoil and its higher content of *Anadara* supply the evidence for lagoonal conditions different from those associated with the main midden above, there are two lenses of occupation (Horizon 0) in the coral sand. Interestingly enough, the earlier of these contains more *Gafrarium* than *Anadara* (Table 98), a circumstance open to a number of possible explanations, none in conflict with the interpretation of lagoonal change during Lapita times. Finally, the subsoil below the main midden at To.1, thought to be laid down in or adjacent to shallow salt water, contained artifactual material as well as a predominance of *Anadara* shells. By the ceramic analysis of Chapter III, the horizons with which the pottery from these subsoil occurrences at To.5 and To.1 were included for analysis belong to the early period and, by the evidence of their stratigraphic position, those occurrences must fall early in it.

The environmental change under discussion can be characterised as a retreat of the lagoon from Sites To.1, 3 and 5, to which it had been adjacent but from which it is now 400-500 m, 240 m and 150 m distant respectively. The evidence we have adduced for this, and for its occurrence early in the period of human occupation of Tongatapu, is confirmed by Groube's (1971:291-92) survey of the western tip of the island, which revealed pottery sites abundant along an old shoreline but absent from the flat land between there and the present shore over 100 m distant. We may also note an additional piece of evidence supplied by McKern (1929:100; Fig.46). This concerns the ditch-and-bank defence around the residential area, Lapaha, at Mu'a, the seat of former Tongan kings, the defensive works dating on genealogical evidence to the 14th century AD, Lapaha itself back to about AD 1100. The ditch and bank tie in with an old shoreline, 70-200 m inland from the present lagoon shore. There is a tradition (McKern 1929:100) which explains the difference between the old and present shore as the result of deliberate reclamation undertaken between the late 14th and early 15th
centuries. It should be noted in this connection that the pottery-bearing site at Mu‘a excavated by Golson was on this old shoreline (Golson 1961:173).

Some of the geomorphological circumstances we have described, particularly perhaps those pertaining to the low-lying inner lagoonal sites To.1, 3 and 5, are related to the fact that the sheltered north coast of Tongatapu is a zone of slow coastal progradation (Taylor and Bloom 1977:277, 278). However, the evidence overall is perhaps best explained, Tonga being a seismic region, by local tectonic uplift. Bloom (1980:510) favours this as the cause of a c. 2.2 m emergence of Tongatapu and 'Eua over the past 6000 or so years (cf. Taylor and Bloom 1977:279-80). Similar uplift has stranded Lapita pottery sites above the present coast on Niutoputapu (Rogers 1974:311, 312-14, 338-39; Kirch 1978:3, 5-7, 11; Kirch and Dye 1979:68) and on Futuna (Kirch 1976:31, 39, 40, 58). As a contrast, there is the drowning of the early Samoan Lapita Ferry Berth site in Mulifanua at the western end of Upolu, now 2.7 m below mean sea level and sealed by a coral crust, shells from which gave a date of 2890 ± 80 BP, no. 6 of Table 83, where the calibration is 1120-1255 BC. It appears that this is more likely to have been the result of long-term tectonic movements than a lower sea level during the Holocene rise from the glacial low stand, as seemed possible when Green and Richards (1975) first discussed the issues (Jennings 1976a:7; Bloom 1980:508-9).

**Gafarium shell size: evidence for human exploitation**

Tongan visitors to the site of the first excavations at To.1 expressed surprise at the size of the biggest of the excavated *Gafarium* shells. This raised the possibility that the size of the shell fish had decreased over time due to overexploitation or some natural cause.

Under my supervision Haikeni Helu, my interpreter’s brother, measured the length, i.e., the greatest linear dimension the shell had to offer, of all complete *Gafarium* in the shell samples at all sites, and of such incomplete ones as preserved the required dimension. Measurements were recorded to the nearest quarter cm and the data, grouped into six classes, A-F, were attributed to the early, middle and late periods of the ceramic sequence in the following way:

### Early-period samples

<table>
<thead>
<tr>
<th>Site</th>
<th>Horizon</th>
<th>Horizon Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>To.1</td>
<td>S8 (Tables 1, 94)</td>
<td>Spits 7-10 of Horizon I (i.e. above Spits 5-6, which constitute a buffer zone between Horizons I and II)</td>
</tr>
<tr>
<td></td>
<td>S11 (Table 2)</td>
<td>Spits 5-11 of Horizon I</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Spits 12-18 from the subsoil, which may incorporate naturally deposited shells</td>
</tr>
<tr>
<td>To.2</td>
<td>S2 (Tables 3, 96)</td>
<td>Spits 9-16 of the Midden Horizon</td>
</tr>
<tr>
<td>To.5</td>
<td>S1 (Table 98)</td>
<td>the total midden sample of Horizon I</td>
</tr>
<tr>
<td></td>
<td></td>
<td>the total sample from cultural lenses of Horizon 0: b = 9 shells and d = 159 shells</td>
</tr>
<tr>
<td></td>
<td></td>
<td>the total sample from the coral sand encapsulating cultural lenses b and d: a = 3 shells, c = 16 shells, e = 40 shells. Naturally or culturally deposited, these shells will reflect natural conditions offshore from the site.</td>
</tr>
</tbody>
</table>

### Middle-period samples

<table>
<thead>
<tr>
<th>Site</th>
<th>Horizon</th>
<th>Horizon Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>To.1</td>
<td>S8 (Tables 1, 94)</td>
<td>Spits 1-4 of Horizon II (i.e. above Spits 5-6, which constitute a buffer zone between Horizons I and II)</td>
</tr>
<tr>
<td></td>
<td>S11 (Table 2)</td>
<td>Spits 3-4 of Horizon II (no shells in Spits 1-2)</td>
</tr>
<tr>
<td>To.3</td>
<td>S1 (Tables 4, 97)</td>
<td>Spits 7-13 of undisturbed Horizon I</td>
</tr>
</tbody>
</table>
Spits 14-15 of subsoil, included because of the similarity of the shell content here and in the base of Horizon I, whether they are the result of natural or cultural deposition

no Horizon II is represented in the sampling column

Horizon III spits, withheld from the ceramic sequence, are also withheld here.

To.5 S1 (Tables 5, 98) the total midden sample of Horizon II

To.6 S1 (Tables 6, 99) the total midden sample of Horizon III

Late-period samples

To.5 S1 (Tables 5, 98) the total sequence of Spits 1-10, of Horizons I-III, including IB on the grounds of the homogeneity of the Horizon I shell-midden deposit (Chapter II, section 10.3)

Table 100 sets out the data and shows that while the smallest and largest classes (A and F) are poorly represented through the sequence, the larger of the remaining classes (D and E) decline in importance over time and the smaller (B and C) increase (though B not evenly). The same trends are less clearly seen if we look at the two sites where more than one ceramic period is represented, To.1 and To.5, both with early- and middle-period levels (Table 101). The reason for the smaller degree of clarity of trend in these individual instances may be the arbitrary nature of the division of the shells into size classes.

We may compare these figures with those for a market catch of 375 Gafrarium measured in Nuku'alofa in July 1985 by D.H.R. Spennemann, then a graduate student of the Seminar for Pre- and Protohistory, Johann Wolfgang Goethe University, Frankfurt-on-Main, who was preparing for forthcoming fieldwork on Tongatapu. I am indebted to Spennemann for permission to use his data, which translate into my classes as: Class A (10.0-19.9 mm) 1; Class B (20.0-29.9 mm) 117; and Class C (30.0-39.9 mm) 257. As he points out, the absence of any shells larger than 4 cm is striking. Given a distribution similar to those of the three pottery periods, between 50 and 120 shells of the modern sample should have been larger than 4 cm.

Spennemann also ran a Student's t-test on all the basic data on shell size (expressed to the nearest 2.5 mm), prehistoric and recent, and Table 102 gives the results. Note that there is a new category, Subsoil, in this table. This is made up of 1635 shells from Spits 11-14 of Column S8 of To.1, not used in my own previous analysis by class size (Table 94), and 19 shells from the coral sand beneath the main midden at To.5, which were included in that analysis (Table 98). These are from the coral sand lenses (a) and (c), while 40 shells from coral sand lens (e) were inadvertently omitted from his exercise.

Despite all the limitations of the data, Table 102 allows two interesting suggestions to be advanced. Firstly, the statistically very significant increase in mean shell size from the subsoil to the early-ceramic period could be interpreted to mean that while the subsoil samples contain Gafrarium of natural occurrence, the early ceramic period midden layers above reflect the operation of human selection. Secondly, not only does the evidence overall seem to confirm the view of Tongan informants that Gafrarium shells were larger in the past than at the present, but it suggests that the major diminution in size in fact took place within the ceramic period itself.

The question is to what extent this might have been due to human exploitation rather than to some natural cause. In the previous section on the proportional representation of Gafrarium and Anadara, I suggested that the development of the Tongatapu lagoon during ceramic times, following on changes in the relationship of land and sea, created more favourable conditions for the growth of Gafrarium. These circumstances we should have expected to be reflected in a larger size of shells. The fact that the trend during this period is towards smaller shells suggests that the factor of human exploitation may have been at work. If so, the importance of shell fish in the early Tongan economy is strongly indicated.
THE FAUNAL REMAINS: LIMITATIONS OF THE EVIDENCE

In addition to the problem of retrieval from the ground, which will be specifically touched on especially in respect of fish bones later, there are two general considerations which need to be aired now, before we embark on the discussion of the faunal remains.

The small number of items by which many of the species present are represented raises in the matter of their interpretation the issue of stratigraphic integrity which was discussed at the beginning of Chapter VI in connection with artifacts of stone, bone and shell of similarly infrequent occurrence. Again the conclusions I have reached must be judged against the fact that some sites and horizons, like the midden at To.2 and the lower horizons at To.5, are more stratigraphically reliable, because less disturbed, than others, such as the main trench at To.1. I have been at particular pains to establish stratigraphic credentials for particularly important items, such as bones of pig.

The second point relates to the circumstances of the bone identification. At the time I began my analysis of the excavated materials (1965), there were no faunal reference collections in the department to which I belonged and few faunal specialists in Australia able to help with the identification of the rather fragmentary bones I had brought back from my Pacific investigations. Preliminary sorting was done as well as possible in the department, with special attention initially paid to marine animals, bird and rat for which the interest of specialists had been engaged.

1. T. Abe (1966, Tokaiiku Fisheries Research Laboratory, Tokyo) was sent the remains of all presumed marine animals with the exception of turtle, which, though recognised as present, was left in the miscellaneous collections remaining after preliminary sorting.

2. The late A. Wetmore of the Smithsonian Institution, Washington, undertook the study of all presumed bird bone.

3. The late J.A. Mahoney of the Department of Geology and Geophysics, University of Sydney, was sent all the presumed rat bone.

I was helped in the preliminary sorting, and particularly with the bird bone, by R.J. Scarlett who was visiting the department in the course of leave from the Canterbury Museum, Christchurch, New Zealand. Scarlett also offered what help he could with the miscellaneous collections remaining after the preliminary sorting, which contained the fauna for which no specialist help had been obtained. As a result, the miscellaneous bone collection from To.1 was sent to him in New Zealand and I use his results in what follows.

About the same time C.L. Cram, recently arrived as a PhD scholar in the department, offered to sort the human bone from the miscellaneous faunal collections remaining for the other sites, To.2-6. Cram undertook a study of these human remains, in particular the large collections from To.6, while Scarlett identified human bone in the To.1 collection sent to him.

The skeletal remains from the formal burial (AK) at To.1 were examined by G.C. Schofield (1966, Department of Anatomy, Monash University, Melbourne), who reported in detail on the left femur (Poulsen 1967a:Appendix VI). Teeth and jaws from this burial, from the burial in Pit AM at To.5 and from the bone collections at To.6 were given detailed study by R.M.S. Taylor (1966, Department of Anthropology, University of Auckland) (Poulsen 1967a:Appendix VII).

Meanwhile, through J. Golson, the interest of C.A. Reed of the Department of Anthropology, University of Illinois at Chicago Circle (as it then was), had been solicited, unfortunately too late in the preparation of my dissertation for him to contribute to it except in a limited fashion, specifically the identification of turtle and particularly the study of pig bone at To.6 (included in Chapter X of Poulsen 1967a). Reed, however, maintained his interest in the materials. In 1968 he looked at a small collection of bone from To.1 identified as pig by Scarlett and reported as such in the dissertation. In 1972 he was able to contemplate a fuller
The aim was to make as complete a study of the excavated fauna as was possible and, to this end, I was asked to supply, amongst other things, identifications of faunal materials sent to other specialists. In the event it proved impossible to compile, from the information on collections farmed out to so many workers some years previously, a satisfactory master catalogue that could be used in the way Bland and Reed required. The report they wrote in 1978, on which Appendix 8 is based, is a study essentially of the miscellaneous faunal collections from Sites To.2-6 (that from To.1 having largely been taken over by R.J. Scarlett) and it highlights the occurrence of turtle, the identification of lizard and the analysis of pig. They record their inability to carry the analysis further because of the partial nature of the collections in their possession and their ignorance of the details of the stratigraphic situations from which the items had been recovered. Their contribution in Appendix 8 can now be read in the light of the more complete information on these matters which I am able to provide below. I have made use of supplementary information not included in their appendix, which they communicated by letter during the course of their analysis.

What follows is as complete a statement about the faunal materials recovered as is possible at this remove in time and space. Some of the difficulties and discrepancies involved are mentioned in the appropriate places. It must also be noted that during their detailed work on the miscellaneous bone collections from To.2-6 Bland and Reed found some bones belonging to classes - bird, fish, rat and human - earmarked for other specialists during the preliminary sorting of the collections in Canberra as described above. These occurrences have been noted in the appropriate places.

**MARINE ANIMALS**

Marine forms were dominant amongst the excavated bones 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 were possible, the material has initially been organised by families. For comments on habitat and habits I have used in the main Herald (1961) and Marshall (1964), though because of the nature of the identifications these comments must remain necessarily general. Similarly, close comparison with Gifford's list of fish excavated at post-Lapita sites in Fiji (Fowler 1955) and that of Kirch and Dye (1979:71) for Lapita sites on Niutoputapu is not easy.

**Marine turtle**

The remains were identified and analysed through the efforts of Bland and Reed, who report in Appendix 8. The information for To.1 was supplied by Scarlett.

The presence of two species is indicated, *Chelonia mydas*, the green turtle, and *Caretta caretta*, the luggerhead turtle. In previous correspondence Reed had mentioned a Pacific subspecies of the former, *Chelonia mydas agassizzi*, and the Pacific luggerhead, *Caretta caretta gigas*, as having been recognised by R. Zangerl and J.K. Bland respectively. He commented that both are common in the South Seas and characterised by a life cycle of seasonal migratory movements and nesting, this season for the green turtle in Tongan waters being from late October to mid-February.

According to Appendix 8, the weight of both species is normally less than 227 kg (500 lb), but maximum weights of 386 kg (852 lb) for the green turtle and 454 kg (1000 lb) for the luggerhead have been recorded. Obviously the catch of such large animals for food would have been significant in prehistoric times. Their shells doubtless provided raw material for the production of artifacts, though of this we have no archaeological evidence so far.

Turtle bones are recorded from all sites. The figures given in Table 103 differ somewhat from
those tabulated by Bland and Reed in correspondence with me, which I reproduce at the bottom of the table. However, the conclusions are the same, that turtle bones are much commoner at To.2, situated at the entrance to the lagoon from the open sea, than at all the other, inner lagoonal, sites put together and that at To.2 they exceed the total of all other bone remains.

Strictly speaking, a relatively small number of animals could be represented in the collections of turtle bones (that is, from sites To.2-6) examined by Bland and Reed. Nearly two-thirds of the turtle remains reported on by them were pieces of carapace and/or plastron (Appendix 8, Table, where the total of 415 pieces is discrepant with both totals in Table 103). These are skeletal parts which may be broken during butchering and continue to be broken subsequently. Twenty-five per cent of the remains were (broken) limb bones, with a minimum of three individuals represented by these in the collections overall, while skull and vertebrae were underrepresented. Interpreting the evidence more broadly, Bland and Reed conclude that the beach site at To.2 was a focus for the butchering of turtles, though some butchering may have occurred at the inner lagoonal sites. Today (Vaea and Straaatman 1954:204) turtles occur more commonly in the shallow waters of the Ha'apai group than around Tongatapu, which is surrounded by deep water except for the reef flats along the north coast.

I now turn to the distribution of turtle bones in the midden at To.2. As regards vertical distribution, their frequency decreases over time, from four bones per square/spit unit in Zone I to 2.5 in Zone II and 1.5 in Zone III, while in four subsoil units beneath Zone I there were 5.5 bones per unit. In the midden overall, they were present in 75 square/spit units and absent from 31, these latter being fairly evenly distributed through the midden, with a few exceptions, e.g. Squares 50/50 and 50/58. This pattern suggests that turtle bones were regularly dumped on the surface of the midden during its entire period of formation, but were deposited in relatively greater quantities during the earlier stages of its deposition, except for Squares 50/59-61.

When we come to consider the horizontal distribution of the bone, there seem to be two foci of concentration in the main excavated trench (cf. Fig.13) as far as the bottom spits are concerned. One is at the southern end near Pit S, where the bones in the top of the subsoil beneath the midden proper were also found; the other is at the northern end and reflects the dumping of bones in and around a large oven, U. Fair amounts of bone occur also around and between Ovens AK and L just to the north of Pit S. The turtle bones were never charred; if the spatial correlations are accepted, the indications are that ovens were sometimes used to steam-cook turtle meat. The evidence of distribution is thus in favour of variations in the functions of the site in so far as turtle bones are concerned.

Table 103 shows that turtle is represented throughout the ceramic period, and perhaps beyond, since some bones were found in structures likely to be post-ceramic, like Oven K and Pit C at To.5 and Pit AJ at To.6 (Chapter III, section 11.4). Even though numbers of bones are low at the inner lagoonal sites, that is all sites except To.2, the better representation of turtle in earlier than in later levels (To.1/1 and To.5/0-I early period; To.1/II, To.3/1-II and To.5/II-III middle period; To.6/I-III late period) is worth noting. Again, spatial distributions may not have much meaning with the small numbers involved, but we should note that the pattern conforms with that of other faunal remains, with most finds at To.1 at the northern and southern ends of Trench I, at To.5 in the southern part of Trench I and in Trench II overall and at To.6 at the north around Pits W and AJ and at the south, including the western end of Trench I.

Turtle bone is reported from Lapita contexts on Niuatoputapu (Kirch 1978:12; Kirch and Dye 1979:70) and the coastal pottery-bearing sites of Upolu, Western Samoa (Janetski 1976b:81, 1980a:119).
Porpoise

Three definite identifications were made by Bland and one possibility (Reed pers. comm.). They are entered in Table 103. From the early-period midden at To.2 came one of the definite bones, from Oven U of Zone 1, and the less definite one, from Zone III. The other two pieces are skull parts. One is from To.6, at the bottom of the site, either late or middle period. The other example is of uncertain stratigraphic provenance at To.5.

Porpoise is infrequently mentioned in the excavation literature of the South Pacific, but we may note the presence of porpoise-tooth pendants in Sinoto's Phase 1 (Initial Settlement) in the northern Marquesas (Sinoto 1970:107).

Crustacea

Identified, by Abe, on claw fragments. The following were represented:
1. Family Portunidae, swimming crabs
2. Family Scyllaridae, beach and mangrove crabs
   A. Scylla serrata
3. Family Xanthidae, shore crabs
   A. Etisus laevimanus
   B. Etisus sp.

Both live in littoral regions and on coral reefs.

Table 104 sets out the distribution of the archaeological remains. The figures refer to the number of identifiable parts, not the minimum number of individuals. The two specimens of Portunidae and two of Xanthidae attributed to Horizon II (late period) at To.6 are from structures, Posthole CE and Pit W, in the former case and from midden deposit in the latter. The firm To.2 records for Scyllaridae and Xanthidae are from the top zone of the early-period midden.

Crabs are reported from the Falemoa site on Upolu, Western Samoa (Janetski 1980a:119).

Sharks and Rays

Identified, by Abe, on teeth and caudal spines. The following are represented:
1. Family Isuridae, porbeagles or mackerel sharks
   A. Isurus oxyrinchus (formerly glaucus), mako shark
      Also found archaeologically by Gifford in Fiji (Fowler 1955:9).
2. Family Carcharhinidae, requiem sharks
   A. Prionace glauca, great blue shark

Both are large, fierce and voracious. Prionace is an inhabitant of the open seas and rarely in the tropics is found at the surface (Herald 1961:28). In New Zealand the Maori took Isurus by noose (Herald 1961:19-20) and the same method was used in Tongan shark fishing (McKern n.d.:338).

Table 104 shows the distribution of sharks at the excavated sites, recording the number of identifiable parts. They all come from To.1. Three of the five items of Isurus were found in undisturbed context in the subsoil occurrences of shells and artifacts which predate the formation of the main midden; they are securely early period in date. The other Horizon I specimen is from a square (83/57) heavily disturbed by post-ceramic Pit A and should be assessed in this light. The fifth example was found in Spit 1 of Square 82/71 and is probably
safely allocated to the middle period, this square being ‘undisturbed’ in the terminology used in the discussion of To.1 in Chapter III (section 10.1).

3. Family Dasyatidae, sting rays

The two occurrences of sting ray amongst the excavated materials are both at To.2, one in Zone II of the early-period midden, the other in Zone IV of the mound and perhaps derived from the midden during mound construction.

The rays identified from Gifford’s archaeological collections from Fiji belong to this family (Fowler 1955:21-22, *Taeniura lyamma*) and to another, Myliobatidae (Fowler 1955:5, *Aetobatus narinari*).

Sting-ray spines were used as fishing-spear points in Tonga (McKern n.d.:337).

Sharks/rays are reported in Lapita contexts on Niuatoputapu by Kirch and Dye (1979:70).

Eels

Identified, by Abe, on pre-maxillary 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 from the early period, the other in uncertain context (Table 104).

Porcupine and related fishes

These fishes have poisonous organs and/or flesh but are regularly eaten in some parts of the world, including the Pacific.

Identified, by Abe, 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. Recovered archaeologically from Lapita sites on Niuatoputapu by Kirch and Dye (1979:71).

2. Family Ostraciontidae, box fishes

A. *Ostracion* sp.

3. Family Tetraodontidae, puffers

Also found archaeologically by Gifford in Fiji (Fowler 1955:22)

4. Family Monacanthidae, file fishes

Site distributions are shown in Table 105, which records numbers of bones identified. The porcupine fishes are represented at the four main sites and securely throughout the ceramic sequence. The other types occur at single sites, the box fishes and file fishes in early levels (with the partial exception of the To.2 record in Zone VI of the mound), the single puffer bone in a middle-period context.

Needle fishes

The needle fish is a member of a ferocious and voracious family, Belonidae, inhabiting coastal waters and swimming at or near the surface at great speed.

Identified, by Abe, on pre-maxillary, only two bones were found, both from Horizon I at To.6, one securely in Horizon IB, the other from Posthole CO, attributed to Horizon I.

The needle fish was recognised amongst the faunal remains at the Western Samoan ceramic site, Jane’s Camp, at Faleasi’u, Upolu (Janetski 1976b:80).
Perch-like fishes

This rather generalised order accounts for the balance of the fish remains. The identifications were made by Abe on jaws, teeth and pharyngeal plates. Their site distributions are shown in Table 106, where the numbers of identifiable bones are recorded. Comments on these distributions are made where appropriate in the following listing:

1. Family Girellidae, nibblers

Abundantly present in shallow water around rocks and reefs, it includes some valuable food fish.

A. *Girellops* sp.

These fish are restricted, with one exception, to Site To.5, and to the early-period levels there, where there are two clusters, one in Horizon 0 of Trench I, the other in Horizon I of Trench II, coinciding with the distribution of lizard bones. The other bone, from To.2, was found in Oven E of Zone IV of the mound (Fig.11 upper) and could either originally have belonged to the early-period midden or to the post-ceramic feature in which it was found.

Also found archaeologically by Gifford in Fiji (Fowler 1955:8).

2. Family Labridae, wrasses

Reef-dwellers inhabiting shallow water, they include some valuable food fish. They are present at three of the excavated sites and securely provenanced to the early and late periods. One bone was found in Pit AF of Trench III at To.1, for which I have argued a middle-period date (Chapter II, section 5.5 and Chapter III, section 11.4, discussion of pits).

Also found archaeologically by Gifford in Fiji (Fowler 1955:9-10) and by Kirch and Dye (1979:71) at Lapita sites on Niutoputapu.

3. Family Lethrinidae

A small family of fishes swarming on coral reefs, with some species highly valued as food.

A. *Lethrinus* sp.

This is the best represented genus amongst the archaeological collections. It is present at the four main sites and throughout the ceramic sequence. Four bones from To.1 are from Pit AF, which I prefer to see as middle period (Chapter II, section 5.5 and Chapter III, section 11.4, discussion of pits). Two bones classed as of uncertain chronological status at To.6 were found in Pit AJ, which is highly likely to be post-ceramic. One of the bones from To.2/IV is from Oven E and could either be a transfer from the early-period midden or really belong with the post-ceramic structure in which it was found.

Also found archaeologically by Gifford in Fiji (Fowler 1955:10-12) and in Lapita context on Niutoputapu by Kirch and Dye (1979:72).

4. Family Haemulidae, grunts or sweetlips

Tropical reef fish, most of them good food fishes

A. *Plectorhynchus* sp.

The two bones found, one at each of two sites, are uncertain in age. The To.2 specimen, from Zone VI of the mound, could either be a transfer from the early-period midden or post-pottery in date.

5. Family Scaridae, parrot fishes
Known as 'cattle of the sea' from their habit of moving in with the incoming tide to graze over the reef. Marshall (1964:318) notes, with specific reference to Queensland, that although of good edible quality, parrot fish are rarely seen on sale because their feeding habits preclude capture by hook and line, the best method being a short-handled spear. Kirch and Dye (1979:63-64) describe the spearing of parrot fish, amongst others, especially at night, on reef flats and reef edge on Niuatoputapu.

The Scaridae are the best represented family amongst the excavated fish remains (Table 106).

A. *Calotomus japonicus*

The single bone, from To.1, is of uncertain date within the ceramic period.

B. *Calotomus* sp. or *Enscarus* sp.

Two bones were found, both To.1 and both from early-period contexts.

C. *Chlorurus* sp.

Again restricted to To.1, one of the three bones was found in a secure early-period context.

D. *Scarus lepidus* or *rubroviolaceus*

The nine bones were found at three sites, early and late in the ceramic period.

E. *Scarus aeruginosus* or *scaber*

Though this is the second best-represented fish in the collections, over half the 27 identified bones were found at To.1, a majority in early-period contexts. The occurrences at To.2 (five bones) and To.5 (one bone) are also early period. There are three bones attributable to the middle period (To.1/II) and one to the late period (To.6/II).

F. *Scarus* sp.

The two bones are from To.1, at the level of the early midden but from disturbed squares (on which see Chapter III, section 10.1) and therefore counted as of uncertain chronological status.

The Scaridae are represented archaeologically in Gifford's excavations in Fiji (Fowler 1955:14-19), at Lapita sites on Niuatoputapu (Kirch and Dye 1979:71) and at two Western Samoan ceramic sites, Jane's Camp, at Faleas'i'u, Upolu (Janetski 1976b:80) and Fa'emoa on Manono Island (Janetski 1980a:119, described as constituting most of the fish remains).

6. Family Serranidae, gropers and sea basses

Herald (1961:160) says of the serranids that amongst the 400 species are found many of the world's most important food fishes. On the whole they frequent rocky shores and reefs and are often of large size. Excavated by Gifford in Fiji (Fowler 1955:19-21) and by Kirch and Dye (1979:71) at a Lapita site on Niuatoputapu.

A. *Epinephelus* sp.

This is a comparatively well-represented fish, present at the four main sites and in early and late ceramic contexts.

7. Family Sparidae, porgies and sea breams

Includes some very valuable food fishes

A. *Monotaxis grandoculis*
This fish is represented by only two bones, both from To.1 and both registered as of uncertain status in respect to the two midden horizons. One is from an elevated portion of the early midden in a disturbed square (83/68) of Trench I (on disturbed and undisturbed squares, see Chapter III, section 10.1). The second bone has a designation of 'general midden' in Square 83/93.

Excavated by Gifford in Fiji (Fowler 1955:13) and by Kirch and Dye (1979:71) at Lapita sites on Niutoputapu.

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.

The single bone, from To.2, is from the early-period midden.

9. Family Sphyraenidae, barracudas

The whole family of 18 species is usually considered excellent and tasty food (Herald 1961:245). Some large species are included.

Of the four bones found, only one is in datable context and belongs to the late period at To.6.

Excavated by Gifford in Fiji (Fowler 1955:21).

**Nature and limitations of the faunal evidence for fishing**

The total number of items identifiable by Abe and dealt with in the foregoing sections on crustacea, sharks, rays, eels and fish is 194. This is only a portion of the total of 335 sent to Abe as likely to be identifiable. Furthermore, there was a smaller collection of bones sorted at an early stage from the excavated collections which were thought to belong within the classes under discussion but not to be further identifiable. This collection was not catalogued or in any other way worked upon. We must also remember that Bland and Reed recognised some fish bones in the miscellaneous collections sent to them. Finally, it must be admitted that the excavation methods employed were not such as to achieve retrieval of small and fragmentary bones needing ample time and special techniques to recover. These considerations are important for the interpretation of the evidence set out in Tables 104-106, though we should note that as far as the unidentified bones of the collection sent to Abe are concerned, they would not be likely to affect the picture of the identified bones in the matter of site distributions: 39% of the former and 37% of the latter at To.1; 21% and 24% at To.2; 8% and 14% at To.5; and 32% and 25% at To.6.

In general, the spatial distributions follow those of the other faunal remains for the sites and horizons for which sensible statements can be made: the northern and southern end of Trench I at To.1 for the early period, the southern end of Trench I and Trench II overall at To.5, again for the early period, and the southern part of the main excavation area (including the western end of Trench I) at the late site To.6, with those bones found in the northern part of the excavations concentrating in or around Pits W and AJ.

**Lapita fishing strategies on Tongatapu**

Even in view of the deficiencies of the evidence, the total range of identified fish is quite large, though by no means commensurate with the impressive list given by McKern (n.d.:353 ff.) for the ethnographic period, and it comprises edible species from a number of habitats. Clearly, however, reef and other shallow-water species, in particular the varieties of perch-like fishes, predominate, while pelagic fish like bonito (*Katsuwonus pelamis*) are absent.

The range of fish taken seems at variance with the limited fishing gear recovered archaeologically. The only equipment well represented comprises the caps of octopus lures and
net sinkers of *Anadara* shell. An individual fish hook or two, fish hook blank, gorge and stone sinker make up the rest, with the slight possibility of composite hooks being represented by the shell piece (To.2/66) included in Class 3A in Chapter VI and by what could be a fragment of shank in *Tridacna* (Class 5P of Chapter VI). The explanation is to be found in McKern’s survey (n.d.:275 ff.) of traditional Tongan fishing methods (cf. Vaea and Straatmans 1954). The most popular and productive devices were the fish drives and fish traps used in shallow water on coral reefs and sandy offshore benches (n.d.:275, 301). Nets were much in use (n.d.:292-96), again mainly in shallow water, while spears were employed on the reef and from boats (n.d.:337) and fish poisons in reef pools and in the lagoon (n.d.:344 ff.). These methods would leave little if any archaeological evidence, but the types of fish they would secure are those best represented in the middens, in which reef and other shallow-water species are dominant.

**Comparative evidence from Niuaotupapu and Western Samoa**

The general picture of prehistoric fishing on Tongatapu suggested above is supported by the conclusions reached by Kirch and Dye (1979) for Niuaotupapu. They made observations on present-day fishing there (1979:58-68), the fish caught, the technology used and the biotopes exploited, and interpreted in the light of this the fishing gear and bone remains excavated from three Lapita sites (1979:68-73). The technological evidence was restricted to three simple one-piece fish hooks and a worked cowrie interpreted as a dip-net weight. The identification of the fish bones showed a considerable correspondence between the species found archaeologically and those in present-day catches, where inshore fish predominate; pelagic fish were absent from the archaeological collections. The conclusion drawn is that the Lapita fisherman were familiar with the range of techniques employed by the modern inhabitants in their fishing-nets, spears and plant poisons, with the hook probably a minor component of the repertoire. The fish bones from my own excavations show the following correspondences with those recovered by Kirch and Dye and thus with the fishing strategies they identify (1979:72): Diodontidae, netting; Labridae, netting, spearing and poisoning; *Lethrinus*, netting and poisoning; and Scaridae, netting, spearing and poisoning. Fish traps, which McKern described as popular and productive on Tongatapu in the 1920s, are today rarely used on Niuaotupapu (Kirch and Dye 1979:65).

Fish bones recovered from the coastal pottery-bearing sites of Western Samoa are described by Janetski (1980a:122) as ‘generally being from reef fishes’. Jennings (1976b:97) specifically notes for Falesia’u the lack of evidence for the exploitation of deep-sea resources. Kirch and Dye (1979:70-71) also report that no large pelagic fish were found at the Lapita sites they investigated on Niuaotupapu, but they consider this reflects not the absence of pelagic fishing at that time, but a concentration, as today, on the less prestigious but more abundant and readily obtainable inshore species. The same explanation no doubt applies to the Tongatapu sites, where open-ocean fish are absent and the gear for taking them scarce, if present at all. Deep-water fishing in the ethnographic period was, according to McKern (n.d.:275, 325), largely under chiefly control, while there was regulation of rights to offshore fishing generally, tempered by exchange between coastal and inland inhabitants (McKern n.d.:348).

**LIZARD**

I owe the recognition and analysis of these bones to Bland and Reed, who report in Appendix 8. The bones are those of the tree-climbing iguanid lizard *Brachylophus brevicephalus* and comprise predominantly vertebrae of back and tail, but also some other parts of the skeleton, such as skull and long bones.

Their distribution is very restricted, since they are present at most at two sites. There is one probable bone from To.1, identified by R.J. Scarlett in 1965, which seems to have been in situ in Horizon I, therefore dating early. All the other bones come from To.5. There is some confusion over their actual numbers. In a tabulation of the identifications made of the faunal
collections sent to them, which is not reproduced here, they enter 220 lizard bones. In the catalogue which I attempted over the years to keep up to date as the complicated operation involving excavated bones proceeded, I have details for 144 (Table 107). Of these 27 were found in Trench I, the majority in Squares 20/20-23 (three in Horizon I, 22 in Horizon 0, two in uncertain context) and 117 in the minor Trench II (116 in Horizon I, one in uncertain context). The 120 vertebrae and nine long bones included in the tally were recovered from both trenches. Bones (13) of the rarer skeletal parts (acetabulum, skull, scapula, phalanx, metapodial) were only excavated in Trench II. Two innominate bones make up the balance, both found in Trench I. Where datable, all these specimens are early period.

Bland and Reed (Appendix 8) report the animals as considerably bigger than modern ones, which range up to 69 cm, the tail accounting for two-thirds to three-quarters of the total length. The archaeological specimens might have been nearly twice as long, with chunkier bodies, and thus theoretically an attractive food source. However, none of the bones is burnt. On the other hand, according to Bland and Reed, nearly one-third of the long bones show definite or possible signs of having been worked, perhaps for the manufacture of tube-like beads. I have not been able to examine these specimens myself, but have incorporated them in the discussion, though not the tables, of ornaments in Chapter VI (Class 5M, section 9.18).

BIRD

The excavated bird bone consisted mainly of limb fragments. Wetmore’s report was that of the 419 items sent to him, only 16 were identifiable. Table 107 sets out the distribution, the unidentifiable bones by simple horizon designation only. Some of these could belong to domesticated chicken. The same may be true of the 101 bird-bone fragments found by Bland and Reed in the miscellaneous bone collections from To.2-6 sent to them. Their figures are entered, where appropriate, in Table 107.

The identified birds are:

1. Gruiformes, rails

   A. Gallinula chloropus, a moorhen: one bone from To.1 in a safe early-period context and one from To.6 in Horizon II, almost certainly late period, though a middle period date cannot wholly be ruled out. According to the late W. Hitchcock (1966, Division of Wildlife Research, Commonwealth Scientific and Industrial Research Organization, Canberra, pers. comm.), this would appear to be the first record of the species further into the area than the Marianas.

   B. Porphyrio poliocephalus, the purple swampshen: one bone in To.6/II, of the late period. This gallinule is widely distributed through the western Pacific area.

2. Passeriformes, perching birds: three bones, all from To.1, one in Horizon I (early) and two in uncertain stratigraphic position. Three species are represented.

3. Puffinus sp.: one bone from the fill of Pit AH at To.1, allocated to the middle period (Chapter II, section 5.5 and Chapter III, section 11.4, discussion of pits). The bird present is a shearwater of medium size.

4. Tyto alba lulu, barn owl: all nine bones of owls were found in Pit AA at To.1, which is stratigraphically late and likely to belong to the post-ceramic period (Chapter II, section 5.5 and Chapter III, section 11.4, discussion of pits). This small form of owl is peculiar to the islands of the central Pacific.

I shall not go into great detail about the unidentified bones; as already indicated, they are entered in Table 107 simply by a horizon designation based on the spits in which they were found, and without the stratigraphic reassessment accorded to identified bones. However, the following remarks about To.1 and To.6 are of interest.
Trench I at To.1, an area more heavily disturbed by pit digging than any other of my excavations, produced 48 of the 111 unidentified bones at the site. As with other fauna, the majority of the 34 bones at the level of Horizon I in the trench was found at the northern (13 bones) and southern (17 bones) ends, few in the middle. If we divide Horizon I into an upper half and a lower half, the distribution of the bones between the two levels is biased in favour of the lower (18 bones as against three) as far as the undisturbed squares are concerned (on disturbed and undisturbed squares see Chapter III, section 10.1). As for the disturbed squares, the distribution of the bones is more even (five upper and eight lower), lending added weight to the undisturbed/disturbed distinction I have employed.

At To.6 the unidentified bones in Horizons I and II have a distribution in the southern part of the main excavation area and the western end of Trench I similar to that of other evidence, both osteological and artifactual. Those in Horizon III are more widely spread, while there are some from Pits AJ and AN, the former almost certainly post-ceramic, the latter possibly so.

**CHICKEN**

*Gallus gallus* is one of the domesticated animals introduced by humans into the South Pacific, so that the evidence for it deserves close attention. Seventy-four bones were positively identified by Wetmore, on the basis of the preserved ends of long bones and, in a few cases, spurcores of cocks. Site distribution is set out in Table 107. As already mentioned, some of the unidentified bird bones could belong to chicken.

The evidence from the essentially undisturbed midden at To.2, as well as from Horizon I at To.5, a site minimally disturbed in its lower levels, is sufficient to establish the presence of chicken in the early ceramic period. At To.2 one bone was found in Square 50/50 at the very base of the shell midden where it is thickest. There are two bones from Zone II of the midden and two from Zone III. At To.5 the three bones were recovered in an undisturbed square, 20/21, at the base of the Horizon I midden.

At the stratigraphically more complex site, To.1, there are two bones from the subsoil in Squares 82/65 and 83/73 of Trench I in a context antedating the main midden formation of Horizon I (cf. Fig.4), which itself is early period. There seems to be no good reason to suspect the early-period date of any of the 31 bones assigned to Horizon I, with one exception, in a disturbed square of Trench I, 83/71 (on disturbed and undisturbed squares see Chapter III, section 10.1). There were nine bones in Trench IV, an area not subject to disturbance by the later pit-digging, five in the lower part of the shell midden and four in early structures beneath (AM, AQ) (Fig.8). Square 50/94 south of Trench IV (Fig.2) yielded 14 chicken bones throughout what is interpreted as Horizon I shell deposit. Pit E of the early period in Trench I produced one bone. Elsewhere in Trench I, the most disturbed part of the excavation, there were seven bones, of which one in a disturbed square has already been mentioned and the other six were recorded from undisturbed squares. We may note, as far as Horizon I is concerned, that nearly all squares with chicken also produced unidentified bird bone, which recalls the statement that this latter category may include unrecognised items of the former category.

Eleven bones were found at To.1 in contexts later than Horizon I. Four came from the southern end of the disturbed Trench I in what was adjudged Horizon II, middle-period, midden. Six were excavated in Pits A, P, X and AA of the same trench (Fig.7), the first definitely, the others possibly dug into the midden in post-ceramic times, so that nothing definite can be said about the age of their contents (see Chapter II, section 5.5 and Chapter III, section 11.4, discussion of pits). The eleventh bone came from Pit AH of Trench III, which I attribute to the middle ceramic period (see the same references).

Of the seven bones from To.2, five are from the early-period midden, while two from Zone IV of the mound could be transfers from there or truly post-ceramic.

The single bone from Horizon II at To.3 is allocated to the middle period. It was found in Pit F (Fig.16)."
The 16 bones found at To.6 are confined, with two exceptions, to the southern half of the main excavation and the western part of Trench I (Fig.24), a type of distribution recorded for other classes of osteological remains. One bone was found in the bottom of Horizon I (= IB) in Trench I and two in the top (= 1T) in Trenches I and V. There are five bones allocated to Horizon II, one in Trench VI, the rest in Trench III. The seven bones allocated to Horizon III were found in Trenches I (2 items), II (2), III (1) and IV (2), while one was found in the fill of highly probably post-ceramic Pit AJ. Apart from this bone, which is strictly speaking undatable, and the item in Horizon IB, which could be middle period, the To.6 chicken bones are all securely late-ceramic period.

In the light of the evidence reviewed above, that chicken was present throughout the Lapita period on Tongatapu from its beginning, it is interesting that Wetmore was able to divide the material into two rough groups:

... one in which the bones, particularly the spurcores of cocks, are large. These suggest the larger birds of modern times. The other, more interestingly, is a considerable mass of smaller bones, some almost of bantam size, that I would suppose represented an ancient stock, possibly one brought in by the original colonies [sic] [letter of 10/1/1966].

Unfortunately he did not specify which was which amongst the bones submitted to him.

Chicken is reported from Lapita contexts on Niuatoputapu (Kirch 1978:12) and from Stratum II at the ceramic site of Jane’s Camp, Faleas’u, Western Samoa (Janetski 1976b:80).

**PIG**

Pig (*Sus scrofa*) was brought by man into the South Pacific as a domesticated animal (cf. Bland and Reed in Appendix 8) and its association with horticulture in the region is so close that its presence is often taken as an indication of that of cultivation (cf. Groube 1971:311). The questions of its identification and of its provenance within the excavated sites (Table 108) are therefore of some importance. They are addressed in detail below in terms of the three sites where pig was found.

**The evidence at To.1**

During his inspection of the faunal collection from this site, R.J. Scarlett separated out some bones which he considered belonged to pig, either certainly or probably. Most of these were skull fragments, especially from the vault. All of them were sent to C.A. Reed, who commented on them in a letter to J. Golson of 27/8/68. On the whole he accepted Scarlett’s identifications, but moved some from Scarlett’s ‘definite’ into a ‘most probable’ or ‘probable’ category and rejected three. These three, part of a rib, part of a long-bone shaft and a ‘little piece of bone’, he thought belonged to neither pig, dog nor man. The first two of these pieces were found in the fill of stratigraphically late pits at the site, AD and A respectively (Chapter II, section 5.5), the former probably, the latter definitely dug into the To.1 midden in post-ceramic times (Chapter III, section 11.4, discussion of pits), so that the age of objects in their fill is quite uncertain. The third piece was found in the fill of a pit of the early period, AL.

I shall proceed on the basis of Reed’s revision of Scarlett’s identifications. He accepts only two occurrences in the To.1 collection as definitely pig: a set of seven cranial fragments comprising the posterior part of a left parietal and other fragments of the skull of a young pig, and fragments of the horizontal ramus of a right mandible with two teeth, from a very young animal. According to Reed, numerous cranial fragments are undoubtedly pig; he could not identify them as anything else, but could not be positive that all were pig and so advised calling them ‘most probably pig’. There were 19 cranial fragments identified by Scarlett as definitely or probably pig and these are doubtless the ones meant by Reed in the comments.
referred to in the previous sentence. This leaves four other pieces which Scarlett had identified as definitely or probably pig, a rib fragment, a pelvic fragment, a very worn tooth and a fragment of calcaneum, of which only the last is explicitly mentioned by Reed, who thinks it is probably pig.

Let us look at the two occurrences definitely accepted by Reed as pig. The mandibular ramus, of three pieces, was recorded as found in the top of Horizon II just below the topsoil in Trench I, in an area that may have been involved in the construction of the stratigraphically and perhaps chronologically late Pit AB (Fig.4); it must, therefore, by the strictest reading of the evidence be pronounced of uncertain date (Chapter II, section 5.5). The posterior part of the left parietal and associated cranial fragments were found in the very top of the concentrated shell midden of Horizon I at a point (in Square 83/67 of Trench I, cf. Figs 3, 4), where this rises to the base of the topsoil, so that intrusion from a later period cannot be entirely ruled out and an early period date is strictly only a possibility.

There are two occurrences of a cranial fragment in the ‘most probably pig’ category which are quite securely early period, and a third which is highly probably so. In the two certain cases one piece was found in the very bottom of Horizon I shell midden or the very top of the shelly fill of early-period Pit AM (Trench IV) below it, while the second piece was found in similar stratigraphic circumstances in the top fill of early-period Pit AP (Trench IV). The third piece, though from a disturbed square of Trench I, 83/61 (on disturbed and undisturbed squares see Chapter III, section 10.1), was from the base of heavy shell midden likely to be undisturbed Horizon I. Highly probably of early-period date is a rib fragment found at the base of a heavy shell deposit of Horizon I type, though in a square (82/64) classified as ‘disturbed’ because of the presence of Pit S, a later feature, whose fill is of a different type. The piece, however, is Scarlett’s identification and is not mentioned by Reed. An early-period date for two other occurrences, one a single cranial fragment (‘most probably pig’), the other the pelvic fragment mentioned by Scarlett but not by Reed, is less probable.

There is no occurrence with absolutely unimpeachable Horizon II = middle-period credentials, though two instances probably belong here. The first is of two cranial fragments (therefore with the status of ‘most probably pig’) from an undisturbed square of Trench I, 83/65 (on disturbed and undisturbed squares see Chapter III, section 10.1), in small pockets of Horizon II midden in the top of Horizon I, though only 20-30 cm below the surface. As with the seven cranial fragments of definite pig, already discussed, from the same part of Trench I, intrusion from a later period cannot be wholly discounted. A second occurrence, of two cranial fragments (i.e. ‘most probably pig’), relates to the upper fill of Posthole CD (Fig.4), which is considered to be connected with the Horizon II occupation and thus likely to be middle period in date (Chapter II, section 5.6).

A cranial fragment of ‘most probably pig’ came from a spit constituting a buffer zone between Horizons I and II. However, the record of its discovery is not precise enough to be positive that it was one or the other, and not of a later period.

Five occurrences, comprising ten cranial fragments, therefore ‘most probably pig’, relate to pieces which were found in the fill of pits likely to have been dug into the To.1 midden in post-ceramic times and which therefore are of uncertain date: one occurrence of two pieces in Pit X and four occurrences totalling eight pieces in Pit P (Chapter II, section 5.5 and Chapter III, section 11.4, discussion of pits). Similarly undatable is the worn tooth identified by Scarlett but not mentioned by Reed, found in Pit A, of definitely post-ceramic construction.

The final occurrence, the fragment of a calcaneum of a young mammal, probably pig according to Reed, is from Square 90/120, dug to sample the midden on the southern margin of the site (Fig.2). Here the midden was fading out, so that the stratigraphic circumstances of the find are quite unknown.
The evidence at To.3

The three bones from this site were identified by Bland and Reed. One of them, part of a long bone, was found in Feature A of Trench I (Fig.15), whose infilling constitutes Horizon II and is assigned to the middle period (Chapter II, section 7.3 and Chapter III, section 11.3). The other two, recorded as one occurrence in Table 108, were excavated in the very first spit of Square 21/20 (Fig.15). They belong stratigraphically to Horizon III, whose chronological status is uncertain, and to its very top, so that they could be intrusions of a later date.

The evidence at To.6

The pig bones from this predominantly late-period site were studied by Bland and Reed. They report 183 items from the site, but from my own catalogue I make it 187, to which are to be added two pig teeth recognised among the fish remains sent to Abe for identification. Table 108 thus enters 189 items for To.6, of which all but 14 relate to a specific occurrence in connection with Pit AJ, which will be discussed separately below.

The 14 pieces which I shall now deal with, consisting of a tooth and fragments of skull, long bone and rib, are scattered thinly across the site and through all horizons. Only one of them do I consider to be in wholly dubious stratigraphic context, while a second might be thought suspect. Both come from the upper levels of the site, the first, a fragment of a long bone, from a disturbed context in Square 23/25, the second, a fragment of rib, from the zone of topsoil, though in apparently undisturbed circumstances (Square 25/25).

A third lower deciduous incisor and a long-bone fragment were found at the base of Horizon I midden (= Horizon IB) in Square 27/22, thus dating to the late-ceramic period, if indeed not surviving from the middle period. Another long-bone fragment was found in the upper Horizon I midden (= Horizon IT) in Square 27/26, while there are two occurrences in Horizon II, one of four fragments of the same long bone in Square 24/22, the other another long-bone fragment in Square 23/29 either just inside or just outside Pit W. Horizon III has four occurrences of one item each, recorded as the lower part of the horizon in two instances, Squares 23/26 (epiphysis) and 26/20 ('unique'), and the middle part in the other two, Squares 26/20 (skull fragment) and 26/23 (fragment of long bone).

I now pass on to a consideration of the occurrence of pig bone in connection with Pit AJ. There are two points to be made initially. The first is that strictly speaking the 175 items involved are catalogue numbers, a few of which refer to a now unknown number of bone fragments greater than one: 175, therefore, is the minimum number of pieces of bone we are dealing with. The second point is that AJ was a pit whose presence in the midden was not recognised until the subsoil was reached, so that bones previously found in the area had been recorded as belonging to midden and then, when Pit W was recognised, allocated to the fill of this shallower pit, through and below which Pit AJ was subsequently found to cut (Fig.22 lower). Thus seven specific concentrations of 28 bone fragments, recognised in the field and three-dimensionally recorded, were originally allocated to Pit W, but with further excavation found to belong to the fill of the shaft of Pit AJ. When all the records allocating a pig bone to the midden in this part of the excavation were inspected, it was very evident that a marked concentration existed in the four squares 23-24/30-31 which encompass Pit AJ, with over 90% of items falling in the two northern squares (23-24/31), which encompass most of it (Fig.24).

As a result, I am encouraged to conclude that all the pig bones in this area, to the total of 175 recordings, belong to Pit AJ. If this is so, since the finds extend almost from the present ground surface down into the basal fill of the pit below subsoil, their distribution would support the stratigraphic evidence (Chapter II, section 10.5) for Pit AJ having been dug from the top of Horizon III or very close to it. In other words, Pit AJ is likely to be an intrusive feature of post-ceramic times and, because of its uniqueness, its collection of pig bone probably has a similar date.

In this collection all parts of the skeleton are represented, with the most numerous recordings
for ribs (40), skull (27), mandible (21), teeth (19) and maxilla (17). It is, at least primarily, to the Pit AJ collection that Bland and Reed's remarks on pigs in Appendix 8 refer, since some of the body parts they mention (e.g. mandibles and maxillae) occur nowhere else on the site. They make no reference to the minimum number of individuals represented in the total collection studied by them, though in a letter of 26/1/1967 Reed had talked of at least five individuals, as I reported in my dissertation (Poulsen 1967a:313, referring to the contents of Pit AJ). They say, however, that no pig had been older than 24 months at death and most were between 4-12 months, suggesting control of the population and a rational selection of pigs to be killed. In previous correspondence in 1974 they had remarked that one of the skull pieces bore the mark of a blow from a blunt instrument, recalling the method of killing pigs seen by Mariner in Tonga, who reports (Martin 1827b:198-99) that 'the animal is first stunned by a blow with a stick, and then killed by repeated blows on both sides of the neck'. Unfortunately I do not know whether they are referring to one of the cranial pieces from the fill of Pit AJ or from elsewhere at the site.

The date of pig on Tongatapu

The balance of the total evidence for pig at the excavated sites is that it was present during ceramic times and from the early period of them. It is true that the early-period record is restricted to To.1, with no occurrences at To.2 or To.5. This circumstance must be judged in the light of the small number of pig-bone fragments found at To.1, though the excavations there were quite large, appreciably larger than at the other two sites. The same picture emerges for the late-period site of To.6, where also the excavations were quite substantial, but the pig-bone fragments recorded were few and scattered, apart from the unique concentration in Pit AJ, which without doubt dates to the post-pottery period.

As for the situation outside Tongatapu, Kirch (1978:11) reports the definite presence of pig at least one Lapita site on Niuatoputapu. It has not been found in the pottery-bearing levels of Samoan sites (Janetski 1976b:81, 1980a:120).

DOG

The historical evidence for the presence of Canis familiaris in Tonga at European contact is equivocal (Urban 1961:17-18). Equally equivocal is the osteological evidence for its presence during the Lapita period on Tongatapu.

The determination of two limb fragments, one rat-gnawed, from To.1 is uncertain (R.J. Scarlett pers. comm.). One is from Square 50/94, Spit 7; this is an outlying square (Fig.2), dug for a midden sample (S11), and the bone was found in a lens of ashy midden at the base of a heavy shell midden like that of early-period Horizon I in the rest of the site. The other bone is from the fill of post-ceramic Pit A and thus of uncertain date. A third bone is a fragment of vertebra found, in the same circumstances as a fourth bone described below, in Square 27/20, Spit 7, at To.6, i.e. in top of Horizon I, the late period. It is either dog or pig, as identified by C.L. Cram.

A fourth bone, a metacarpal, is with reservation attributed to dog by Cram. It was found at To.6 in Square 26/20, Spit 5, i.e. Horizon II, late period. The bone was recognised by Cram when sorting through the large amount of human bones from this area, 125 of which were in fact within Spit 5 (see section 10.2 below, Area 4). Since this large collection of human bones was without doubt an in situ deposit and since the bone in question was integrated in it, it is safe to assign the presumed dog bone to the occupation at To.6 during the late ceramic period.

Unfortunately these four specimens were never sent from Canberra for Reed's inspection, as had been intended in correspondence between him and J. Golson after my return to Denmark. Bland and Reed (Appendix 8) are inclined to doubt the presence of dog in Tonga in pre-European times. We may note, however, that Kirch (1976:40) reports it at a Lapita site at Tavai on Futuna. This site has close similarities in pottery with the late period on Tongatapu.
(see Chapter V, section 5), where the presumed dog bone discussed above belongs, and an appropriate radiocarbon date (no. 21 of Table 83), calibrating to 305-355 BC.

Dog has not been positively identified in the ceramic levels of early Samoan prehistory: Janetski (1980b:125) reports a possible dog canine in Stratum II of Potusa, a disturbed site.

RAT

Rat is presumed not to have been present in Tonga before man. Its use for food in the early 19th century is reported by Mariner (Martin 1827b:225), who, however, says that it was eaten only by the lower orders. McKern (n.d.:454) mentions that rat incisors, hafted to wooden handles, were used for fine woodworking, for example in the manufacture of wooden bowls.

Excluding a few bones recognised by Bland and Reed in the miscellaneous collections studied by them and included in a tabulation provided for me in a category ‘other bone’ amounting to only nine items, Mahoney reports that all but three of the excavated bones are of the Polynesian rat, Rattus exulans. The exceptions are from the recently introduced species, R. rattus and/or R. norvegicus: they come from To.1, a left pelvic bone from within Horizon II, a left humerus and right mandibular ramus from a buffer spit between Horizons I and II.

R. exulans was identified on femur, tibia, humerus, mandibular ramus, teeth and innominate bone, the femur being the bone most commonly represented. The distribution of the bones is shown in Table 109. In considering this information we should remember that exulans is not known as a burrower.

There is unequivocal evidence for the presence of rat in the early-ceramic period through its presence in early levels of demonstrated stratigraphic integrity: the midden at To.2, where four bones were found through its three zones; the deeply buried Horizon I at To.5 with one bone; and the pockets of shells and artifacts in the subsoil at To.1 antedating the main midden formation, where no fewer than 14 bones were found. For the middle period we have two bones in Pit A at To.3 and one from Horizon II at To.5. Rats are abundantly represented at To.6, where they were found in secure context in all horizons, so establishing the presence of the animal in the late period.

Abundance at To.1 and To.6

The main point of interest with the rats is their preponderance at To.1 and To.6 compared with the other sites, even allowing for the larger areas excavated there. Given the commensal habits of exulans, this may be linked with the fact that To.1 and To.6 are the two sites where the excavated evidence, especially structural, suggests habitation on the spot (see Chapter II, section 11 and Chapter VI, section 1.7). Especially at To.1, there is a high representation of rats in the infilling of pits, which could be explained by the suggested use of at least some of these for food storage, as discussed later (section 11.4 below).

Rat bone at To.1

Trench I, where the pit digging was concentrated at To.1, accounts for 90% of the total rat bones at the site, with 44% of this 90% being found in the infillings of pits. There is a great contrast between Horizons I and II. Allocated to Horizon I, and thus the early period, are 71 bones from the midden and 58 from associated pits, four in Pit E, three in Pit W, three in Pit Y and no less than 48 in Pit AC, which latter collection comprises seven different body parts (femur, humerus, tibia, innominate, jaw, vertebra and other) and at least 11 individuals by the evidence of the innominate bone. From the level of Horizon I there are a further 50 bones, entered in Table 109 under ‘uncertain’ because they were found in disturbed squares (on disturbed and undisturbed squares see Chapter III, section 10.1), as well as a further six bones found in Pit K, of uncertain age.

Against all this Horizon II, of the middle period, has to offer five bones from the midden, with
three further bones from the same level judged uncertain because from disturbed squares. There are 20 bones from two pits, M (19) and AB (1), which might belong with the middle-period structures whose existence on the surface of Horizon I has been argued in specific sections of Chapters II and III dealing with To.1. The collection from Pit M comprises four body parts (femur, tibia, innominate and vertebra) and six animals by the evidence of the femur.

Among the remaining bones from Trench I are three from Pit A of certain post-ceramic construction and 20 from two pits, P (7) and AA (13), likely to be so (Chapter II, section 5.5 and Chapter III, section 11.4, discussion of pits). All these bones are included under 'uncertain' in Table 109, because their origin is unknown. Finally, there are 19 bones from the midden, of uncertain horizon, and nine from Pit H, of uncertain date.

From the other trenches came a grand total of 30 bones, 17 in Horizon I contexts, six from Pit AF for which a middle-period date is favoured (Chapter II, section 5.5 and Chapter III, section 11.4, discussion of pits) and seven of uncertain attribution for one reason or another.

**Rat bone at To.6**

The occurrence of rat bones in pits at To.1 is echoed by the 31 bones found in the infilling of Pit AJ at To.6, 18 of them found in a concentration which Mahoney thinks may possibly represent a single individual. Pit AJ is almost certainly of post-ceramic date. As with the pig bones found in this pit, discussed above, the concentration of rat bones suggests that they too are post-ceramic, since the occurrence is unique at the site. Somewhat in contrast to To.1, rat bones at To.6 are characteristically from the midden, though some have found their way into the infilling of holes, most of which are undatable. Such finds make up a considerable proportion, 29 out of 45, of the chronologically uncertain entry in Table 109. Rat bone distribution at this site is not even and the concentration (78% of the total site sample) in the southern part of the main excavation area and the western end of Trench I echoes other distributions. Of particular note in this connection are 34 bones found in Horizon II in a single square, 26/22.

**Concluding observations**

Mahoney reported that the total collection from To.1 represented a minimum of 62 rats by the evidence of the femur and that from To.6 a minimum of 48 rats by the same evidence. The representation of the parts of the skeleton is more varied and somewhat more even at To.1, where the pattern is the same for pits and midden, than at To.6, where all but long bones and pelvis are very few.

Rat is reported in Lapita contexts on Niuatoputapu (Rogers 1974:314). Two fragments of possible rat bone were found at Falemoa, Western Samoa (Janetski 1980a:120).

**HUMANS**

I have already dealt with burials that took place at the excavated sites (To.1, 2, 5; cf. Appendices 9, 10). I now draw attention to the occurrence of human bones, identified as certain and probable by Scarlett and especially Cram and with further information supplied by Bland and Reed, which do not seem to be connected with burial. The vast majority was broken and the numbers referred to in the sequel are fragments, not complete bones.

Occurrences at sites other than To.1 and To.6 were few and are summarised in Table 111. In the early Horizon 0 of To.5 the one cranial fragment represented is worked. Note that Bland and Reed report additional fragments of bone as human or probably human amongst the miscellaneous collections from To.2-6 studied by them. From To.2 there are two pieces and from To.5 14, mainly cranial.
Human bone at To.1

Relative to the volume of earth excavated, the human bones found at To.1 are not so markedly more numerous than at To.2 and To.5 as they are at To.6. The interpretation of their distribution at this stratigraphically complex site is less easy, however, than at To.2 and To.5. Table 111 sets out the body parts represented and their allocation to stratigraphic horizons.

Of the 20 bones allocated to Horizon I, formed in the early period, three come from Trench I, where an indeterminate fragment was found in an undisturbed square (on disturbed and undisturbed squares see Chapter III, section 10.1), while two bones belong to the fill of early pits, in W a fragment of tibia, in Y a cranial fragment. Five other bones found at the level of Horizon I are listed as of uncertain age, because they derive from disturbed squares: two teeth and a fragment each of cranium, cervical vertebra and tibia. Considered as safely attributed to Horizon I are five bones from Trench IV, undisturbed by later pits: three from early pits (two cranial fragments in AQ and a piece of femur in AM) and two from Horizon I midden, one limb fragment and one not determinable. Outlying Square 50/94, undisturbed, has in what is interpreted as Horizon I midden 12 fragments of human bones, from femur (5), tibia (2, one possibly burnt), fibula (1), metacarpal (1), digit (1) and limb (2).

Human bones later than Horizon I are restricted to Trench I at the site. There are 18 fragments considered to be safely allocated because found in undisturbed squares: 16 in the southern part of the trench (Squares 82-83/65-73), nine cranial fragments, two of teeth, one of vertebra, three of limb and one indeterminate; two in the northern part of the trench (Squares 82-83/58-62), one cranial and one limb fragment. Fourteen fragments from the level of Horizon II, but from disturbed squares, are given uncertain chronological status: nine in the southern part of the trench, seven cranial fragments, one of femur, one of tooth; and five in the northern part, two cranial fragments and three indeterminate. Ten fragments from pits are similarly given uncertain status: limb and phalanx fragments in Pit X, two cranial pieces in Pit AA and, in the definitely post-ceramic Pit A, two cranial fragments, two phalanges and one piece each of femur and tibia.

There are an additional 15 bone fragments in the ‘uncertain’ column of Table 111 beyond those already considered: five cranial fragments, one of tooth, two of ulna, one of phalanx, one of rib, three of femur and two of limb.

Human bone at To.6

The predominantly late-period site To.6 is exceptional for the numbers of human bone fragments found there (489, with an additional 23, mainly cranial, reported by Bland and Reed), even allowing for the volume of excavated ground. They are not evenly distributed across the site and can be best dealt with in terms of five areas (Table 110), which account for all but 44 occurrences (cf. Table 111).

The 23 bone fragments of Area 1 were recovered from eight squares (23/29-31; 24/31-32; 25/30-32) in the northwestern section of the main excavation area. The majority was found in pits dug through the midden deposits, eight in Pit W, five in Pit AJ and one in Pit AN. These pits are discussed in Chapter II, section 10.5, where Pit W is attributed to Horizon II and Pit AJ most probably to the post-ceramic period, while Pit AN is stratigraphically late but of uncertain age. The human bones of Pit W are likely to belong to Horizon II, while those in the other two pits are of unknown age. Of the bones not found in pits, one belongs to Horizon II, seven to Horizon III and the status of one is uncertain. The complex stratigraphy of the area due to pit-digging makes it difficult to be sure of the exact status of the collection. It could be the result of a deposition of bones in Horizon II, subsequent incorporation of some into Horizon III and later disturbance by Pits AJ and AN, with fragments finding their way into the pit infillings. On the other hand, the localisation of the bones could be accidental, which is a more likely explanation.
The 32 bones of Area 2 are made up of finds in five squares (23/23-25; 24/23-24). Fifteen of them were found in two structures, seven in Posthole AO attributed to Horizon I and eight in Pit U, stratigraphically late but not more precisely assignable (Chapter II, section 10.6 for postholes, section 10.5 for pits). Of the remaining 17 bones, 16 are distributed through Horizons IB, IT and II, while the last is of uncertain chronological status. Being thus represented through all three horizons (Table 110), it is hard to see this collection as being other than fortuitous in its localized distribution.

The 34 bone fragments of Area 3 must be similarly interpreted. Recorded from seven squares (26/23; 26/26; 27/22-26), they were found in midden of all horizons (Table 111), with one - a cranial fragment - from Spit 2 of a somewhat disturbed square.

More interest attaches to two real concentrations of almost 2.5 kg of human bones in Trench I, one, Area 4, in Squares 26-28/20, the other, Area 5, in Squares 30-32/20, belonging to an almost identical part of the site but different horizons. Despite a too hurried excavation of the accumulations in question, because of pressure of time, they both gave the impression of single episodes of deposition, with no apparent order of the bones suggesting burial.

The stratigraphic distinction between the two occurrences is emphasised by their vertical distribution which in Area 4 is about 50-70 cm below ground surface, while in Area 5 it reaches from about ground level to 30-40 cm below. Also, human bone is very rare in Square 29/20 between the two.

No. 4 is recorded mainly from Horizon II, the so-called soft horizon, the bones embedded in earth heavily intermixed with ash, though none of them was burnt. Together with fragments in the top of Horizon I below, the excavated sample of the accumulation consists of some 200 pieces (Table 110). Taylor (Appendix 10) recognises the presence of at least two individuals (cf. nos 1776 and 2047), one possibly a young adult, the other relatively elderly.

The bones of Area 5 belong to Horizon III, with 140 items in the top three spits (Spit 1 = 35; Spit 2 = 53; Spit 3 = 52). I have included in the grouping eight bone fragments in Spit 4, whose status as regards Horizons I and II is uncertain, and, perhaps mistakenly, two in Spit 6, the top of Horizon I. Taylor (Appendix 10) recognises a fully adult individual amongst these remains (cf. nos 2129-2130, 2146). A scatter of bones eastward of Area 5 in Trench I, all from Horizon III, may represent a tail of the accumulation.

The representation of skeletal parts in the two bone concentrations is similar but apparently not identical (cf. Table 111).

In the To.6 material overall Cram (pers. comm.) noted at least five individuals. From his dental studies Taylor (Appendix 10; cf. Taylor 1971) recognises an adult individual represented in the To.6 material, amongst ungrouped finds from Trench I (cf. nos 2397-2400) but probably relating either to Areas 4 or 5, who had received a severe blow on the front of the face, like an individual present in Pit AF at To.1 (Appendix 9). In both instances the injuries had taken place some years before death.

Comments on the presence of human bone in midden

The available data on skeletal parts, based on the identifications provided by Cram, Scarlett, Bland and Reed, are set out in Table 111. The assignments to horizon should be read in conjunction with the site-by-site discussions in the preceding section.

The pattern at all sites is characterised by an unevenness of skeletal representation that does not suggest the remains of burials, even at To.6 which has the bulk of the material. Teeth, metacarpals and metatarsals are underrepresented, as are vertebrae, pelves and scapulae. Best represented are the cranium (especially the vault), long bones and, at To.6, ribs.

Observations on breakage and cut marks suggested to Cram that cannibalism was practised, as it was in contact times according to the evidence supplied by Mariner (Martin 1827a:172) and collected by McKern (n.d.:396). Perhaps the distribution of human material through the
layers of midden points in the same direction. No systematic listing was made of the human bones with marks of cutting, nor of those with signs of burning. Cut marks might mean, of course, that the pieces in question were being exploited as raw material for artifacts. We have already instanced a worked cranial fragment from To.5.

**EVIDENCE FOR AGRICULTURE**

**Botanical materials**

The only plant materials to be recognised came from the burnt layers in the fill of Pit A in Trench I at To.1 (Figs 6.1, 2; 7). They comprised charred fragments of shell and husk of the introduced coconut (*Cocos nucifera*) and provided part of radiocarbon samples K-961 and NZ-597, which date them well after the end of the pottery period on Tongatapu (Chapter III, section 11.5). From the late first millennium BC Lapita site of Tavai on Futuna, however, Kirch (1976:40) reports fragments of coconut endocarp, as well as endocarp of candlenut (*Aleurites moluccana*) and a *Pandanus* key.

**Domesticated animals**

As we have seen, of the three domesticated animals of the South Pacific chicken was present on Tongatapu from the beginnings of human settlement, while the evidence for dog at any stage is equivocal. Pig is the crucial factor, however, since domesticated produce provides much of its food (cf. Kirch 1976:36 for Futuna) and its presence is generally taken as evidence for that of agriculture. There is no doubt that pig was on Tongatapu by the middle period of the ceramic sequence and little doubt that it was there in the early period also. It has not been found in ceramic contexts in Samoa. Kirch (1978:11) reports it on Niua topu but at what stage of the Lapita sequence is unclear (cf. 1978:8 for Site NT-90).

**Implements of food preparation**

Other indirect evidence for the practice of agriculture on Tongatapu is afforded by the discovery of a small number of shell tools interpreted as scrapers and peelers for the preparation of tubers and fruits for cooking. They are discussed at length, together with their Pacific parallels, in Chapter VI, section 6, under Class 2. Those in secure stratigraphic position in my excavations belong to the late-ceramic period, with the exception of the *Strombus* paring knife (Class 2C), which was found in early ceramic context.

**Pits for storage and fermentation**

A range of pit types has been described for the excavated sites on Tongatapu, especially To.1 and To.6, some of these duplicated by Davidson (1969a) in her excavations at 'Atele, as discussed in Chapter II (section 11). According to McKern (n.d.:400-5) and some of my informants, pits were used for storage and fermentation of vegetable foods. Davidson (1969a:278) describes one pit (A), close to 2 m in diameter and penetrating almost 75 cm into the subsoil from her illustrations (1969a:276-77), which has a tunnel or funnel leading from it to another, minimally investigated, pit. According to her workmen, this is a feature of pits still in use for ripening bananas. The excavated pit seems to be amongst the latest of the pit complex with which it was found and whose earlier members bear an uncertain chronological relationship to the potsherds found in the surrounding soil (Davidson 1969a:278-79). Except for the tunnel/funnel, it bears a close resemblance to the circular pits with flattish base and undercut sides of my own excavations.

Rogers (1974:336-37) found deep pits during his archaeological survey of Niuatoputapu, some of them used within living memory for fermenting food like breadfruit and bananas, while Kirch (1976:37, 39; cf. 36, 60) noted abandoned pits for the fermentation of breadfruit during his survey of Futuna. He reports (Kirch 1978:11-12) the excavation of several symmetrical
pits at a largely plain-ware Lapita site on Niuatoputapu (i.e. late-ceramic period in terms of the Tongatapu sequence), which, on the basis of form and size (not further described) and of association with food scrapers of cowrie shell, he interprets as fermentation and storage pits.

Davidson (1974b:237-38) gives historical references to the use of pits for ripening bananas and fermenting breadfruit in Samoa and describes a range of pit types excavated and located in archaeological surveys, some of which may have had such functions. Amongst these are small pits in ceramic levels of early first millennium AD date at the base of sites at Vailele and Sasoa’a (cf. Green 1969a:121, 1974b:111). Smith (1976a:65-67) describes four pit features at the ceramic site at Faleasi’u, one interpreted as an oven, another as a possible oven, a third as a possible posthole.

As Davidson (1974b:238) says, it may be possible to identify recurrent types of pit amongst the regional record now accumulating and to document more fully the kinds of situation in which they occur. The deep circular pits with steep or undercut sides mentioned above are a case in point. They are now reported from a number of sites on Tongatapu, including the Mangaia Mound (Golson pers. comm.) and possibly Vuki’s Mound (Groube 1971:299), and Davidson (1969a:279) quotes parallels for them in Eastern Polynesia. On Tongatapu, where Pit A at To.1 is a dated example of post-ceramic times, I have argued that they go back to the middle ceramic period (Chapter III, section 11.4, discussion of pits).

The definition of such recurrent types is a necessary first step to determining those kinds likely to be associated with the food storage practices described ethnographically. Davidson’s (1969a:278) information about the tunnel feature associated with the ripening of bananas exemplifies this. Until more along these lines is known, however, the presence of pits on archaeological sites can be no more than suggestive of the presence of the ethnographically recorded practices relating to cultivated crops, and thus of the cultivated crops themselves, in the remoter past.

**Human biology**

Finally, I would draw attention to the implications for diet, and thus for the foods which supplied it, of Spennemann’s remarks on the teeth amongst the middle-period skeletal remains at To.1 (Appendix 9) and in particular of Taylor’s discussion (Appendix 10) of the dental condition of prehistoric Tongans represented in the excavated materials studied by him, not only from my own excavations (To.1, 5 and 6) but also from Davidson’s (1969a) at the ‘Atele burial mounds. Taylor notes the lack of marked wear of teeth, suggesting a diet not requiring ‘vigorous mastication’, and the prevalence of decay and periodontal disease. The potential of skeletal remains for providing evidence on prehistoric conditions of life is further illustrated by Spennemann’s report (Appendix 9) on the evidences of pathology and physical activity associated with the To.1 remains, including indications of ‘paddler’s shoulder’.

**Conclusion**

Taking the evidence overall, however, of domesticated animals, shell scrapers and peelers as well as pits and even perhaps skeletal remains, and for the region as a whole as Tongatapu itself, we may conclude that on balance it favours the proposition that agriculture and the plants on which it was based were introduced by the first settlers of the island.

**CHANGE IN SUBSISTENCE AND SETTLEMENT**

**Lapita economy and settlement on Tongatapu**

The picture that emerges is that the economy of the Lapita settlers of Tongatapu was twin-based, with the practice of agriculture, characterised by introduced plants and animals, and the exploitation of indigenous natural resources, particularly the salt-water fauna of lagoon
and reef. The same picture is reconstructed for the settlement period on Niuatoputapu (Kirch 1978:11-12), on Futuna (Kirch 1976:59) and for the early prehistory of Upolu (Jennings and Holmer 1980b:145). To this extent the subsistence economy of the colonists of Western Polynesia parallels that reconstructed for Lapita sites further west (cf. Green 1974a, 1979:35-37) and is of a kind with that practised by South Pacific islanders at the time of European contact.

The explanation which I have offered above (sections 1.2 and 1.3) for the much greater abundance of shell fish on Lapita sites on Tongatapu than on those elsewhere in the region is the high productivity of the inner lagoon in Gafararium. This would account for the concentration of pottery-bearing sites around the lagoon, as noted by myself and other workers (cf. Groube 1971:290-92).

There are two things that still have to be explained, however. One is the fact that not only are pottery sites concentrated along the lagoon fringe, they are virtually restricted to it (Chapter I, section 3; cf. Groube 1971:291), a situation very different, as Groube emphasises, from the dispersed settlement pattern described for Tongatapu by early European visitors. Second is the ‘strong evidence’ (Groube 1971:296) that shell-fish dumping on the scale characteristic of the pottery-bearing sites did not persist throughout Tongan prehistory. The evidence cited by Groube (1971:310) is the observation made during his field reconnaissances that ‘pottery in Tonga is invariably associated with shell-fish remains: inversely there are no reported middens without pottery . . . ’, a conclusion to which my own fieldwork on Tongatapu had led me also (Chapter I, section 3). In other words, pottery production and shell-fish dumping on a large scale appeared to have come to an end round about the same time, that is about 2000 or so years ago. Even if one were to presume some connection between these two events, for example because a major use of pottery had been for the cooking of shell fish, the apparent change in the intensity of shell-fish exploitation would still have to be explained.

For Groube (1971:310) this required ‘a significant shift in the orientation of prehistoric Tongan economy, or alternatively a change in the settlement-dumping habits of the population’, towards the end of the first millennium BC. He suggested therefore a restricted maritime/lagoonal economy for the Lapita colonists (thus accounting for the virtual restriction of pottery sites to the lagoonal fringe), followed by the development or introduction of an agricultural economy (to account for the disappearance of concentrated shell-midden formation) (Groube 1971:311, 312). The segment of his argument which has captured most attention is his dramatic characterisation of Lapita potters as Oceanic strandlopers expanding ahead of colonisation by agriculturalists (Groube 1971:312).

The role of shell fish in the economy

The question becomes how well-founded is the conclusion that a massive change in shell-fish exploitation did in fact occur. Groube (1971:310) has pointed out that because pottery is so prone in lagoonal sites on Tongatapu and (1971:295) so prone to disturbance and redeposition, the observation that there are no shell middens without pottery may be deceptive. Green (1972:82-84) has indeed assembled evidence from a number of sources, McKern’s (1929) early fieldwork, Davidson’s (1969a) excavations at ‘Atele and my own thesis (Poulson 1967a:52, compact deposits of Ostrea shells in the make-up of the burial mound at To.2; cf. Chapter II, section 6.3, Zone IV of the Mound Horizon), to suggest that concentrated shell dumping was not restricted to the ceramic phase on Tongatapu.

Even though I have rejected Green’s interpretation of the Ostrea shells at To.2 (Chapter III, section 10.2), the other examples cited by him shift the emphasis from a dramatic cessation of midden formation to the possibility of longer-term changes in the intensity of shell-fish exploitation to explain the alteration of the settlement pattern which prevailed on Tongatapu during the ceramic period. My own measurements on Gafararium in an earlier section of this chapter suggest some decrease in shell size during the ceramic period. This took place, as I have shown above (section 1.4), at a time when environmental changes in the lagoon at an
early stage of human settlement, due to its uplift following tectonic movement (Groube 1971:310; cf. Taylor and Bloom 1977:278), would have provided the conditions, not only for that efflorescence of *Gafrarium* which is so marked at the inner lagoonal sites, but also for an increase in its size, which is not in evidence. We are left, therefore, to consider the proposition that increasing exploitation of the molluscan resources of the lagoon signals wider developments in the society, which altered the balance of the economy as a whole and led to the shift of settlement pattern.

**A shift in subsistence and settlement emphasis**

This was a possibility canvassed by Groube in his 1971 statement when he spoke (1971:312) of the *development* of a viable horticultural economy based on the major Pacific cultigens, together with pig (1971:311), as an alternative to the thesis of a *later introduction* of domesticated plants and animals, which is the aspect of his presentation which has been seized on. At the time Groube favoured this latter explanation because of the lack of early evidence for pig in the region and because of the coastal and offshore location of Lapita sites (Groube 1971:311-12). More recent discoveries on Niuatopu, Futuna and Samoa, which I have reviewed above, as well as this re-presentation of my own earlier findings, suggest that basic elements, at least, of the horticultural economy were present from the beginning of human settlement in our area. Thus, components necessary to allow a shift in subsistence emphasis on Tongatapu from less to more horticulturally based were early in place, including the pig.

There is little archaeological evidence available to show that this took place, let alone to chart its progress. There may be some hint in the proportions of shell in the midden samples taken at the four inner-lagoon sites To.1, 3, 5 and 6 (cf. Table 93) that shell concentrations decreased over time, but this is so for each site considered internally rather than for horizons overall arranged in the chronological order determined by the pottery analysis. In any case I am unwilling to push the evidence of these minuscule samples of the original sites any further than I have already. On the other side, we have some evidence for inland operations of some kind during the pottery period in Davidson’s (1969a:255, 260, 269-70, 275, 279) discovery of potsherds (undecorated) at 'Atele, away from the lagoon, deposited in unknown circumstances, and in my own limited and unsystematic records of potsherds in the interior (Chapter I, section 3). In addition, there may be indications during the ceramic period of a growing importance of pits (cf. Chapter II, section 5.5 and Chapter III, sections 10.1, conclusion, and 11.4, discussion of pits), which might be interpreted as a sign of increased dependence on horticulture (cf. section 11.4 above).

**Parallel developments in Western Polynesia**

The evidence is at present unavailable on Tongatapu to test the proposition of the gradual nature of the shift in the balance of the overall economy from more to less lagoon-oriented and less to more horticulture-based. It is interesting to note, however, that other workers have suggested such a trend as characterising the prehistory of other islands in the region.

Thus Kirch and Dye (1979:69-70) describe the decrease over time of marine turtle and in the density of molluscan remains at three Lapita sites on Niuatopu. They ascribe these changes to human predation and, additionally, to the effects on molluscan habitats of successive uplift of the island. They conclude that one of the major differences between Lapita marine exploitation on Niuatopu and that of the contemporary population may be in the matter of utilisation of shell fish (1979:72), since today fish far outweigh shell fish in their contribution to total protein intake (1979:66).

For Western Samoa there are difficulties posed by limited data and by insufficient dates (cf. Janetski 1980a:120), but Janetski (1980a:122) suggests a decreased use of shell fish in historic as contrasted with early prehistoric times and a decline over time in the use of reef animals, some of it taking place during the ceramic phases of site occupation (cf. Janetski 1980a:Table 13). According to Janetski, although this might reflect an increasing dependence on
horticulture rather than the reef for food, it could simply be due to the pressure of continuous exploitation (cf. the case of sea urchin at Faleas'i'u, Janetski 1976b:80). In an earlier comparison of the Faleas'i'u site of the first millennium BC and Davidson's (1969b) Lotofaga site of the second millennium AD, Janetski (1976b:81) suggests that absence of pig from the former and its occurrence in nearly every stratum of the latter could symbolise a shift in subsistence habits from greater to lesser dependence on reef foraging and from lesser to greater dependence on horticulture and domesticated animals, thus explaining the differences in the character of the midden deposits at both sites. Certainly the discovery of pottery in beginning first millennium AD contexts in the upper Falefa valley (e.g. Davidson 1974a:161-62) establishes an inland aspect of the early Samoa economy, the later development of which has been so well documented by the work of New Zealand archaeologists (Green and Davidson (eds) 1969, 1974) and their colleagues from the University of Utah (Jennings et al. 1976; Jennings and Holmer 1980).

Elsewhere in Western Polynesia, Kirch (1976:39) notes that while settlement on Futuna has always been concentrated along the narrow coastal plain, the topography of Alofi has never presented the same obstacles to settlement inland, where a site with pottery has been found on the central ridge. Similarly on Uvea two sites with pottery were located on the interior plateau. All this pottery is late in terms of the Tongatapu sequence, a dating confirmed by the late first millennium BC radiocarbon age (no. 21 of Table 83) for the coastal pottery site of Tavai on Futuna (Kirch 1976:40).

Conclusions for Tongatapu

By this stage some inland settlement is indicated, by the presence of undecorated pottery, for Tongatapu itself, where the juxtaposition of the resources of dry land and salt water had for so long concentrated settlement along the margins of the large inner lagoon. We cannot document the process of interior settlement, whose results have been the distribution throughout the island of archaeological monuments in the form of mounds and the descriptions of dispersed settlement by early European visitors (cf. Green 1973:64-65, 71-72). Once we leave the period of pottery production, we enter what I have called (Poulsen 1974:265) the Dark Age of Tongan prehistory, the only window into which, apart from the scraps of information provided incidentally by my own differently focused work, is provided by Davidson's (1969a) investigations at 'Atlesi. We cannot doubt, however, that the changes in question, both the shift of balance within the subsistence economy which I have proposed and the demonstrated alteration in the settlement pattern which it would go far to explain, were made under the impetus of population pressure in a circumscribed environment, as has been suggested by Kirch (1976:60-61) to explain particular developments on Futuna and Uvea.
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APPENDIX I

ANALYSIS OF SOIL SAMPLES FROM TO.1

Samples of Formations A, B and C taken from the subsoil at Square 83/56 in Trench I at To.1 (see Chapter II) 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.

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 or 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.

K.A.W. Crook
1966, Department of Geology, Faculty of Science, Australian National University, Canberra
APPENDIX 2

CHI-SQUARE TEST OF TONGAN POTTERY DATA

The underlying statistical problem in this publication is to decide whether or not two given frequencies are statistically different. The standard method for deciding this is the Chi-square test, including Yates' correction.

The results of an investigation are presented in the form:

<table>
<thead>
<tr>
<th>Feature A</th>
<th>Number without Feature A</th>
<th>Number with Feature A</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( a_{11} )</td>
<td>( a_{12} )</td>
<td>( n_1 = a_{11} + a_{12} )</td>
</tr>
<tr>
<td>investigation unit</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>( a_{21} )</td>
<td>( a_{22} )</td>
<td>( n_2 = a_{21} + a_{22} )</td>
</tr>
<tr>
<td>number in second investigation unit</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>( a_{10} = a_{11} + a_{21} )</td>
<td>( a_{20} = a_{12} + a_{22} )</td>
<td>( n_0 = n_1 + n_2 )</td>
</tr>
</tbody>
</table>

\[ \chi^2 = \frac{n_0 \left( \left| a_{11} a_{22} - a_{12} a_{21} \right| - \frac{n_0}{2} \right)^2}{n_1 n_2 a_{10} a_{20}} \]

The number \( \chi^2 \) is approximately \( \chi^2 \) distributed with one degree of freedom. We only evaluate \( \chi^2 \) 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 92.0% fractile was chosen as the acceptance region. The remaining region could be called the region of doubt; \( \chi^2 \) there leads neither to rejection nor acceptance, but rather to a position of indecision.

A more detailed description of the test can be found in Chapter 33 of Kendall and Stuart 1967.

B. Isaksen
1972, Department of Psychology, University of Aarhus, Aarhus

REFERENCE

APPENDIX 3

THE INTERPRETATION AND COMPARISON OF THE RADIOCARBON RESULTS

Poulsen's Tongan research was well advanced before radiocarbon dating started at the Australian National University, the first dates being produced in 1966. He was thus unable to benefit from close interaction with a radiocarbon dater over the full range of the dating process from initial choice of materials for dating to the assessment of final results. He has described his difficulties in this respect in some detail in his text.

Poulsen obtained radiocarbon results for his original research from a number of laboratories, Copenhagen (K), New Zealand (NZ) and the Australian National University (ANU). Other dates relevant in a narrower or broader sense to his research had been or were subsequently produced for other workers by a still greater number of laboratories: for two of Poulsen's own sites (To.2, To.6) by ANU; for other sites in Tonga by ANU and NZ; and for sites in the Southwest Pacific outside Tonga by NZ, University of Sydney (SUA), University of Washington (UW), Gakushuin University (GaK), Teledyne Isotopes (I) and Geochron Laboratories (GX).

Thus, when Poulsen undertook the revision of his Tongan investigations which he has presented in this monograph, he was faced with the need to compare dates produced by a number of laboratories and involving shell samples as well as charcoal. He was also anxious to present the information in terms of calendar years. He asked my advice on procedures and the chronological sections of Chapters III and V, together with Tables 32 and 83 on which they are based, are the result.

The purpose of this appendix is to explain the procedures followed.

RADIOCARBON DATING STANDARDS USED

In order to determine the C-14 concentration of a sample, its radioactivity is compared to that of a standard. The aim of the standard is to represent modern activity. Internationally accepted primary standards are National Bureau of Standards (NBS) Oxalic I and NBS Oxalic II. Internationally accepted secondary standard is ANU Sucrose. However, many laboratories use, for reasons best known to themselves, other, local, standards. Hence it is possible that while results from one laboratory remain consistent within themselves, inter-laboratory cross-checks will show a systematic bias, i.e. results will differ in a systematic way. It is important, when comparing age determinations carried out by different laboratories, to bear this possibility in mind. It is highly unlikely that an archaeologist wishing to make such comparisons will know whether a bias exists in the results to be compared. A radiocarbon dater might be able to resolve the matter by detailed examination of each contributing laboratory's practices or by experiment.

In the present case I could assure Poulsen that as far as Copenhagen, New Zealand, Sydney and ANU are concerned, independent cross-checks have established the absence of bias in the results of any one of them compared with those of any other. Age determinations from these laboratories can thus be validly compared, subject to the considerations discussed below.

CORRECTION FOR ISOTOPIC FRACTIONATION

When the isotopes of carbon, C-12, C-13 and C-14, undergo chemical reaction, they do not do so at the same rate. This is called isotopic fractionation. As the degree of fractionation varies between different carbon compounds, e.g. shell versus wood, the quantity of original C-14 also varies somewhat. This means that different materials of the same age will differ in radiocarbon content, necessitating a correction to make them agree. In an ancient sample the
degree of fractionation cannot be known from the C-14 measurement, but can be established by measuring the ratio of the stable C-12 to C-13 isotopes (Craig 1954). This is done by mass-spectrometry and the age correction made on this basis is termed the isotopic fractionation correction. Stuiver and Polach (1977) summarise the procedure, recommending that the correction be routinely applied and that corrected results be reported as *conventional radiocarbon ages*. Before these recommendations were made, several laboratories made no such correction and a few still do not do so.

In the case of Poulsen's dates, no correction for isotopic fractionation was made for the Copenhagen (K) measurement on shell. Making this correction adds about 420 years to the reported age.

We should note that since the standard used to represent modern activity is oxalic acid and this standard is related to 1950 wood, there is no need for an isotopic fractionation correction in the case of charcoal samples.

**CORRECTION FOR ENVIRONMENTAL EFFECT**

The basic assumption that radiocarbon is uniformly distributed throughout the biosphere was early (1948-50) shown to be false through testing carried out by Libby, the founder of the method (Berger and Libby 1981). The notion that there are several carbon reservoirs, each with its own characteristic and generally well-defined C-14 concentration, has been well documented (e.g. Rafter 1955). Most submitters are aware of this and know that appropriate corrections have to be made. What they often do not realise, however, is that different laboratories, in reporting dates, have their own ways of accounting for these factors or their own reasons for ignoring them. The diverse practices are documented in the radiocarbon-dating literature.

In the present case Poulsen is dealing with some age determinations made on marine shell, a material which requires correction for the oceanic reservoir effect.

ANU and SUA results on shell are reported conventionally and must be corrected. We advise a correction factor of minus 450 ± 35 years for southeast Australia, the Coral Sea and the South Pacific (Gillespie and Polach 1979). We also recommend that the environmentally corrected result be annotated BP*.

NZ dates on shell are reported with environmental correction already applied. Where no appropriate standard is known, as is the case with the NZ shell dates considered by Poulsen, the correction is to estimated surface-ocean values, the surface waters being related to a shell-sample standard (Rafter et al. 1972). The cross-checks carried out at ANU indicate a correction factor of minus about 410 years.

The K shell dates reported to Poulsen have had no environmental correction applied. However, as indicated above, no delta C-13 correction has been applied either. Since the delta C-13 correction adds about 420 years to the age and the environmental correction requires about 410-450 to be subtracted, the two effects substantially, though not exactly, cancel each other out.

Because NZ applies a correction for the oceanic environment which from our point of view is equivalent to minus about 410 years, while the K shell result, in effect, is equivalent to minus about 420 years, I recommended to Poulsen that he apply a correction of minus 410 years to the ANU and SUA shell dates to achieve inter-laboratory comparability.

The NZ and K shell dates as reported and the ANU and SUA shell dates as corrected can be compared not only with each other but with dates on charcoal as reported by the same laboratories. I have made no evaluation of reporting practices of the other laboratories cited in the text, but since the dates from such other laboratories are on charcoal, comparability in age-reporting practices is assured.
CHRISTIAN CALENDAR CORRELATION

The radiocarbon chronology is not absolute. To derive Christian calendar years from radiocarbon age determinations, the past variations of C-14 concentration in the atmosphere need to be considered. Since de Vries (1958) first investigated the subject, much progress has been made and the literature abounds with increasingly precise data on the subject. The archaeologist is thus faced with a bewildering array of correction charts and tables. By and large, there are no significant contradictions between them. Nevertheless, some are better than others and I advised Poulsen to use Damon et al. (1972).

On the eve of publication there appeared a volume of Radiocarbon devoted to the calibration issue and I felt that Poulsen’s chronological data should be rerun using the relevant sections of this (Pearson and Stuiver 1986; Stuiver and Pearson 1986). I have performed the necessary recalculations and these are what now appear in the text. It will be noted that, as recommended, the calibrations are expressed in terms of age ranges at 1 s.d.. Where a particular radiocarbon date intersects the calibration curve at more than one place, both values are given but no preference for one or the other is expressed.

H.A. Polach
1983, 1987, Radiocarbon Dating Laboratory, Australian National University, Canberra

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APPENDIX 4

EXAMINATION BY X-RAY POWDER DIFFRACTION OF GREYISH-WHITE COATING ON POTSHERDS

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 Ca_{10}(PO_4\textsuperscript{3-}, CO_3OH)\textsubscript{6}(OH)\textsubscript{2} or possibly hydroxyl apatite Ca\textsubscript{5}(PO_4)\textsubscript{3}(OH), together with some iron oxide (magnetite, Fe_3O_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, 1768 and 1266 Sample (i), showed the presence of iron oxides (Fe_3O_4 and some Fe_2O_3), quartz (SiO_2) and feldspars, all presumably from the body of the sherds, and a small amount of calcium phosphate.

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.

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APPENDIX 5

THE PETROLOGY OF SOME TONGATAPU POTTERY

Nineteen potsherds from four different archaeological sites were examined, as well as two natural clays from Tongatapu and a mineral concentrate from 'Eua Island. Thin sections were prepared from the sherds and these were examined under the polarising 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 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.

DESCRIPTIONS OF THE MATERIALS

Sherds

To.1/2969: Pit AQ, early period. The sherd is 11.5 mm thick, more oxidised on the outside than the inside, with a centre of unoxidised 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: surface find on the To.2 peninsula. A 4 mm-thick decorated sherd fired red only on the outside half and brown, completely oxidised, 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: surface find on the To.2 peninsula. This 5 mm-thick sherd, evenly fired throughout, is the only sherd which is not oxidised 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.2/surface. The details of this sherd were lost, but its analysis appears in the table.

To.5/237: Horizon I, early period. A decorated sherd fired only on the outside and friable on the inside. This is the only sherd which has a noticeable self-slip on it, and orientated clay as well as orientated feldspar fines.

To.5/258: Horizon I, early period. 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: Horizon II, middle period. A well-fired, 11 mm-thick, decorated sherd with most of its clay orientated parallel to the surface. It contains a high proportion of shell and limonite as filler.

To.5/377: Horizon II, middle period. A 13.5 mm-thick, decorated sherd, oxidised both inside and outside, with a black centre. It contains the highest proportion of pyroxene, 35.8%, and little else.
To.5/738: Horizon III, middle period. A decorated sherd, 11.5 mm thick, badly fired, with only the outside 2 mm oxidised. It contains relatively little fresh pyroxene and feldspar but many fragments of basalt, limonite, clay lumps and 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: Horizon III, middle period. A 12 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: Horizon II, late period. A well-fired 5 mm-thick 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 0.1-1.0 mm and there are few fines.

To.6/1231: Horizon III, late period. A sherd, 6 mm thick and evenly fired throughout, is similar to Sherd To.6/434.

To.6/2154: Horizon III, late period. A 6 mm-thick sherd with only its outside oxidised. It contains a relatively coarse filler, half of which is pyroxene.

To.6/2257: though from a disturbed context, almost certainly late period. 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, the rest being angular fragments of a medium-grained uralatised 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: fill of Pit AM and almost certainly late period. This 6.5 mm-thick, well-fired 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: fill of Pit AN and almost certainly late period. 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: fill of Posthole BM and almost certainly late period. A 5 mm-thick sherd, fired on the outside only. It contains a large proportion of basalt pellets.

To.6/3363: not provenanced in detail, but almost certainly late period. This very thick (19 mm) sherd, fired on the outside, contains very little pyroxene and no fines.

To.6/3366: not provenanced in detail, but almost certainly late period. 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.

Clays

1. 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.

2. The clay from the Ma'ufanga quarry contained only 1% of a similar suite of minerals.

Mineral concentrate

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 oxidised 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 1-2% inclusions, in contrast to a minimum of 10.5% in the sherds.

Tongatapu has no igneous rock outcrops and 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 the 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 she added a filler of pyroxene and probably feldspar. If this is the case, the pottery must have been imported.

The sherd To.6/2257 was almost certainly part of an imported pot, because of the gabbro inclusions. Some sherds from Site To.5 seem to differ from those in Site To.6 in that they carry a higher proportion of pyroxene. We know as a result of Poulsen’s work that To.6 is a later site than To.5.

C.A. Key
1966, Department of Anthropology and Sociology, Research School of Pacific Studies, Australian National University, Canberra
Slight editorial revision
### Tongan Sherds: Point-Count Analysis of Impurities in the Clay Body

<table>
<thead>
<tr>
<th>Sherd no.</th>
<th>Volume % impurities in sherd (P F B L Shell)</th>
<th>Total % (P F B L Shell)</th>
<th>% of total mineral content</th>
<th>Sherd thickness mm</th>
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</thead>
<tbody>
<tr>
<td>T1/2969</td>
<td>14.7 10.8 4.0 1.7 6.9 38.1 P F B L Shell</td>
<td>47.3 34.6 12.8 5.3 0.90</td>
<td>11.5</td>
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<tr>
<td>T2/5237</td>
<td>13.8 10.2 11.5 8.71 0.7 44.9 P F B L Shell</td>
<td>31.1 23.1 26.0 19.7 0.45</td>
<td>4</td>
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<tr>
<td>T2/5365</td>
<td>22.81 14.5 3.5 2.01 - 42.8 P F B L Shell</td>
<td>53.2 34.0 8.2 4.6 1.12</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>T5/surface</td>
<td>24.2 7.1 8.1 1.2 40.6 P F B L Shell</td>
<td>60.0 17.0 20.0 3.0 1.50</td>
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<td></td>
</tr>
<tr>
<td>T5/237</td>
<td>11.8 12.3 3.3 0.8 28.2 P F B L Shell</td>
<td>41.8 43.6 11.8 2.8 0.73</td>
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<tr>
<td>T5/258</td>
<td>27.0 6.1 6.6 0.1 39.7 P F B L Shell</td>
<td>68.1 15.2 16.6 0.1 2.13</td>
<td></td>
<td></td>
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<tr>
<td>T5/314</td>
<td>3.6 9.4 8.4 6.9 4.7 33.0 P F B L Shell</td>
<td>12.8 32.6 30.0 24.6 0.15</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>T5/377</td>
<td>35.8 3.9 2.9 0.1 42.6 P F B L Shell</td>
<td>84.0 9.1 6.8 0.1 5.25</td>
<td>13.5</td>
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<tr>
<td>T5/738</td>
<td>3.8 8.8 6.1 5.61 2.5 26.8 P F B L Shell</td>
<td>15.6 36.2 25.1 23.1 0.18</td>
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<td>T5/739</td>
<td>22.3 9.7 3.7 0.9 - 36.6 P F B L Shell</td>
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<td>12.0</td>
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<tr>
<td>T6/434</td>
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<td>27.0 18.7 34.4 19.9 0.37</td>
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<tr>
<td>T6/1231</td>
<td>3.9 10.0 14.0 2.4 30.3 P F B L Shell</td>
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<td>6</td>
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<tr>
<td>T6/2154</td>
<td>17.3 6.2 8.4 2.7 34.6 P F B L Shell</td>
<td>50.0 17.9 24.3 7.8 1.00</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>T6/2257</td>
<td>- 21.3 [26.4]1 2.2 49.9 P F B L Shell</td>
<td>53% gabbro fragments 21</td>
<td>15</td>
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<tr>
<td>T6/2924</td>
<td>1.8 3.2 2.2 3.2 10.4 P F B L Shell</td>
<td>17.2 30.8 21.2 30.8 0.21</td>
<td>6.5</td>
<td></td>
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<tr>
<td>T6/2990</td>
<td>20.4 6.7 2.3 4.0 33.4 P F B L Shell</td>
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<td>5</td>
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<tr>
<td>T6/3043</td>
<td>11.8 2.2 12.4 0.1 26.4 P F B L Shell</td>
<td>44.6 8.3 47.0 0.1 0.81</td>
<td>5</td>
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</tr>
<tr>
<td>T6/3363</td>
<td>1.4 4.9 8.7 1.8 16.8 P F B L Shell</td>
<td>8.4 29.2 51.7 10.7 0.09</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>T6/3366</td>
<td>7.0 17.0 13.6 0.4 - 38.0 P F B L Shell</td>
<td>18.4 44.6 35.7 1.1 0.26</td>
<td>7</td>
<td></td>
</tr>
</tbody>
</table>

P Pyroxene  
F Feldspar, quartz  
B Basalt, pumice  
L Limonite

1 Some magnetite as well as limonite present  
2 A few grains of hornblende present  
3 Gabbro fragments present
APPENDIX 6

TEMPER SANDS IN SOME TONGAN LAPITA SHERDS

Four sherds with partly whitish paste sent by J. Poulsen from the exclusively early site of To.2 were examined in thin section to discover whether the temper or paste is unusual for Tonga.

The tempers are well sorted and subrounded volcanic sands with the ferromagnesian character typical of the pyroxenic variant of Tongan tempers. Using the notation introduced for such tempers from Tongatapu, Ha’apai and Vava’u (Dickinson 1974:344), the sand in all four unusual sherds falls in the range P_{65-75}F_{20-25}V_{5-15}, with 5-10% opaque iron oxide grains present as well. The proportion of quartz in the quartzo-feldspathic fraction (F) is 0.2-0.5 (implying 5-10% quartz frequency in sands as a whole). Although this proportion is higher than the value of 0.1 or less reported previously (Dickinson 1974:342) for Tongan tempers, careful re-examination of the other sherds reveals that the initial appraisal was not correct in all cases, and that a value in the range 0.2-0.5 is not anomalously high for other ferromagnesian tempers from Tonga. Owing to the low total frequency of quartzo-feldspathic grains in Tongan tempers, quartz frequency does not exceed 5-10% in any case. Such a figure is matched in some other island arc tempers, such as from the Marianas (unpublished data), and does not imply an exotic origin for the whitish sherds or other quartz-bearing sherds from Tonga.

Finely divided mineral grains within the paste appear to comprise the same species as those in the temper.

The whitish colour appears to me to be confined to a thin layer on the insides of the sherds, which have reddish exteriors where the ornamentation occurs. Perhaps the unusual colouration formed in response to local reducing conditions that developed within some pots in certain favourable placements during firing.

As noted by Poulsen, some sherds from Yanuca in Fiji have a similar whitish colour, but the temper sands in them are distinctly different (unpublished data; see also Dickinson 1971). Yanuca sherds contain prominent grains of of felsite (up to 30% by frequency), not present in Tongan sherds, 20-45% quartz grains and typically no more than 25% pyroxene grains. Perhaps their similar appearance stems from similar firing technology, as it apparently does not reflect similar provenance.

W.R. Dickinson
1978, Department of Geology, Stanford University

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APPENDIX 7

PETROGRAPHY OF SOME STONE ADZES FROM TONGATAPU, TONGA GROUP

Stone adzes collected by J. Poulsen from excavations on Tongatapu are chiefly basaltic types. Since three main associations of volcanic rocks are recognised - 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 clinopyroxene and magnetite with an abundance of interstitial brown glass.

Broken pebble

A broken pebble of the type called makahunu, To.6/3177, found in the excavations along with the adzes but of uncertain stratigraphic provenance, 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 excavation. 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.

ROCKS OF THE CALC-ALKALINE SERIES AND RELATED TYPES

Altered 'Andesite or Trachyandesite'

To.1/1914 is typical of a group of fine-grained massive adzes common in the excavations on Tongatapu. They are almost black when polished. The rock contains microphenocrysts of partly altered augite set in a groundmass of feldspar, secondary green-brown phyllosilicates, pale green uralitic hornblende and 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 refers to these dyke rocks as 'fine-grained porphyritic andesite or trachyandesite' and says that they contain 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) has described uralitized gabbro and Alling (1932) 'diabase norite' 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 An45 in the cores to oligoclase (An20) at the margins, according to extinction angle measurements. Independent grains of alkali feldspar were not recognised. 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 Uvea (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 Islands 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. The accompanying map summarises the known distribution of igneous rock associations in the region of Tonga and the most probable sources of hawaiites.

A.J.R. White
1966, Department of Geology, Faculty of Science, Australian National University, Canberra

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Harker, A. 1891 Uralitized gabbro from Eua, Tonga Islands. Geological Magazine 8:172-250

Map of igneous rock associations in the region of Tonga
APPENDIX 8

FAUNAL REMAINS OF SELECTED VERTEBRATES FROM SHELL MIDDENS ON TONGATAPU

INTRODUCTION

The complex history of the faunal collections recovered from the excavations which are the subject of this monograph have been described by Dr Poulsen in Chapter VII. Some of those collections (the so-called miscellaneous bone from Sites To.2, 3, 4, 5 and 6) were sent to Dr Charles Reed, a co-author of this report. Subsequently Mr James Bland, then a graduate student in the Department of Biology, University of Illinois at Chicago Circle, as it was, undertook the work of identification and some of the analyses of the materials sent to Professor Reed, under the latter’s supervision.

This present article, offered as an appendix to Dr Poulsen’s publication, cannot be a finished report. We have not had access to the complete faunal collections and have not seen the reports on the parts we have not seen. Furthermore, since we did not participate in the excavations - indeed, neither of us have ever visited the Tonga Islands - and have only seen small portions of Dr Poulsen’s text, we have decided to leave the chronological interpretations to him, given the complexities involved.

ACKNOWLEDGEMENTS

Our primary thanks are due to Professor Jack Golson and the Australian National University, who loaned us the material upon which we have based this study. Dr Jens Poulsen kindly provided catalogue-listings and designations of sites for his Tongan excavations. Mr Leslie Cram talked with us on problems of Tongan archaeology during a visit in 1973, and additionally placed a copy of his catalogue of human bones at our disposal. Dr John Terrell of the Field Museum of Natural History, Chicago, has been our mentor on matters Polynesian and furnished us with a map indicating the locations of Poulsen’s sites; additionally, he gave a critical reading, correcting many errors, of a previous manuscript we had prepared on our studies. The Department of Anatomy, College of Veterinary Sciences, University of Illinois, prepared several skeletons of pigs of different ages as comparative material for our use. Drs Alice Grandison (British Museum (Natural History)), Richard Etheridge (San Diego State College) and Wilmer Tanner (Brigham Young University) have furnished information on present populations of the lizard, Brachylophus, found on Tongatapu, and additionally Dr Etheridge loaned us a skeleton of this lizard for comparison with bones from the excavations. Dr Rainer Zangerl of the Field Museum of Natural History, Chicago, spent a considerable time with us, identifying the bones of sea-turtles found in the collection. At the University of Illinois at Chicago, the Photographic Laboratory prepared the pictures of artifacts made from lizards’ bone and Mr Ray Brod, of the Cartographic Laboratory of the Department of Geography, prepared the histogram of Figure 4. The catalogues (not published here) and some preliminary (and more voluminous) versions of this manuscript were typed by Patricia Bland. Without the aid of these numerous individuals we could not have functioned.

THE FAUNAL REMAINS

Under optimal conditions, when dealing with vertebrate materials excavated from middens, one expresses the composition of the fauna in terms of numbers of bones of each species, of minimal numbers of individuals of each species, of relative numbers of individuals of each species compared to total numbers of individuals and of the relative amount of meat furnished to the human population by each kind of animal eaten. Unfortunately, we are unable to accomplish these analyses because of the incomplete nature of the collection; additionally, we
THE ARCHAEOLOGICAL SITES

Of the six archaeological sites, only four will be considered here. We have little information about the faunal remains from To.1 and the collection from To.4 consists of a few pieces only. To.2 was the only one of the six near the open sea and here the remains were predominantly those of marine turtles (the green turtle, *Chelonia mydas*, and the loggerhead turtle, *Caretta caretta*). Although broken bones of turtles were found in all the other sites, nowhere else did they occur in such numbers or in such an overwhelming majority as they did at To.2. Our conclusion, as based on these facts, is that To.2 was predominantly a site for butchering marine turtles. Either this area was one where females came ashore to lay their eggs and thus could be caught (we have no evidence for this possibility) or turtles were captured in the open sea and brought to To.2 for butchering.

To.3 has so few bones (only 32 known to us) that probably no significance can be attached to the fact that here remains of birds outnumber those of other animals, particularly as birds were much more numerous at To.2, 4 and 6, yet remained in the minority.

To.5 is one of the most interesting, as here the bones of a tree-climbing iguanid lizard, *Brachylophus brevicephalus*, comprise almost two-thirds of the total, yet remains of these lizards were not found in any of the other archaeological collections examined by us. Something quite special was happening to lizards at To.5. Today, on Tongatapu, these lizards range in size up to a total length of 69 cm, of which some two-thirds to three-quarters is tail; the osteological remains of prehistoric lizards, however, indicate that at the time they were being utilised they were considerably larger - perhaps nearly twice the length with the bodies, at least, considerably chunkier. Lizards of this size would be caught and eaten in some parts of the world, and may have been on ancient Tonga. None of the bones are charred, however, so if they were being eaten they perhaps were not being cooked, although possibly may have been sun-dried, or perhaps they were being dressed at To.5 and taken away to be eaten elsewhere. If they were being eaten elsewhere, however, none of the bones were present in other collections examined by us.

Another possibility is that the lizards were not being caught for food (they are not eaten at present on the island), but to provide the raw material for ornaments, since 29.4% of the iguanid long bones (15 of 51) had been worked or possibly worked. These worked long bones consist of fragments of shafts, or of distal or proximal ends, which had sometimes been polished or scraped.

A brief description follows of each of the eight pieces illustrated (the numbers are Dr Poulsen's):

A. Ends of long bones (Fig.1)
   a. No. 2458. A distal end of a femur. The shaft was cut across in part and then broken; the jagged edges of the broken bone were not smoothed.
   b. No. 2542, the proximal end of a tibia. A shallow notch had been cut all around the shaft, which was then broken smoothly across. Additionally, some minor abrasions appear on the bone.
   c. No. 2463 and no. 2540; each is the proximal end of a humerus. On each the shaft was cut or broken, and the broken surfaces were then smoothed until all traces of the cuts or breaks were eradicated.

B. Shafts of long bones (Figs 2, 3)
   a. No. 1637. Part of the shaft of a small long bone had been broken across unevenly
at each end and these ends were not then smoothed; however, the side of the shaft has been eroded smooth in part.

b. No. 2436, part of the shaft of a small long bone, the smallest in this collection. The piece of shaft had been broken across evenly at each end, with those ends then smoothed in part. The sides of the shaft had not been smoothed.

c. No. 2468. One end of this piece of shaft was broken straight across; the other end shows signs of a cut. These ends were not then artificially smoothed. The surface of the piece is eroded in part.

d. No. 2632. The two ends of this piece of shaft were broken, and the broken surfaces were left rough. The shaft, however, has been whittled in various areas, and some of these areas have been worn smooth.

The pieces of shaft are naturally hollow in the centre, and thus could have been worn as beads; the surface erosion which some of them show indicates the possibility of such use, but prolonged wear should have polished the surfaces more than was shown by any of our specimens. The ends of limb bones (Fig. 1) might be considered to be merely the discards from making beads out of shafts of the bones, but the cut or broken surfaces of some of these end-pieces have been polished, as if they had had a use. What that use might have been we do not know.

If the lizards were being prepared for food at To.5, seemingly the use of fire was not part of that preparation. If, having been so prepared, they were then carried elsewhere to be eaten, we have recovered no bones of lizards in other site collections examined by us to support this possibility. If the lizards were also, or possibly only, being prepared for the purpose of getting bones to make ornaments, why were not any such prepared shafts and ends of long bones present in other collections seen by us? The fact that some bones of other vertebrates were also recovered at To.5 is not, we believe, of any significance in relation to its primary importance as a special area for preparing the carcasses of iguanid lizards, which had probably been caught all over the island and taken to that special area.

To.6 is notable for the numbers of pig bones registered, not only compared with other sites, but also with reference to the other faunal remains from To.6 itself. It is evident that something special relative to pigs was happening at that site, their killing, cooking and eating. The pigs, as discussed below, were young animals, two years old or younger. Since truly wild pigs did not range eastward of Wallace's Line, with the possible exception of those on Flores and Timor (Herre and Röhrs 1977), the pigs of most of Melanesia and all of Polynesia were domestic animals, moved by humans in boats from island to island.

NOTES ON TURTLES, LIZARDS, PIGS AND DOGS

In addition to the information presented above for these animals as pertaining directly to the sites in which they were found, further information of value or interest is here presented.

Marine turtles

Both the green turtle (*Chelonia mydas*) and the loggerhead turtle (*Caretta caretta*) have a world-wide distribution in tropical and semi-tropical seas, so their presence in prehistoric times in the Tonga Islands is not surprising. For those Polynesians who ate turtles (not all did), these large marine reptiles were well worth the effort of catching and butchering; the maximum recorded weight of the green turtle is 386 kg (852 lb), but most specimens probably weigh less than 227 kg (500 lb). The loggerhead turtle (*Caretta caretta*) may grow to even greater size, with some specimens attaining 454 kg (1000 lb) or more, but again probably most of those caught would weigh less than 227 kg. Although To.2 had more pieces of bone (373) of turtles recovered than all of the other sites together, the fact remains that turtle bones were
scattered through the other sites, indicating that possibly some butchering occurred at sites other than To.2, but more probably that pieces of carcasses of convenient size were distributed from the butchering ground to other areas. Additionally, pieces of carapace or pieces of the flat plastron may have been carried to residences for special uses.

During butchering, the carapace and plastron may be broken into several pieces, and this process of breakage continues long after the butchering, as these pieces of 'shell' lie about on the ground and are walked on. Thus, of all bones of turtles, 47.5% were pieces of carapace and 11% were pieces of plastron, which, together with some pieces of 'shell' too small to be otherwise identified, equalled 63.5% of the total, as set out in the accompanying table. Limb bones, always broken, furnished 25.7% of the total, with the remainder of the skeleton (skull and vertebrae) being underrepresented. A relatively few turtles, thus, could produce several hundreds of pieces of carapace and plastron; scattered about through several areas, these would be impossible to reconstruct into any meaningful number of original 'shells', but such large numbers of pieces of 'shell' do not necessarily mean large numbers of original turtles.

A general principle of osteoarchaeology is that probably, lacking evidence to the contrary, the minimum number of individuals (MNI) which can be reconstructed represents far fewer than those which actually contributed to the total number of bones. Indeed, one well-known osteoarchaeologist has stated privately that he believes that the faunal remains from a Neolithic village, for instance, represent almost as many original animals as bones recovered. Under these circumstances we do not place emphasis, or expect others to do so, on the fact that identified limb bones of turtles in our collection could have come from no more than three individuals.

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Total number of fragments = 417

Remains of marine turtles from Tongan middens
Lizards (*Brachylophus*)

These long-tailed, tree-living lizards belong to a family, the Iguanidae, which are South American in origin and generally remain limited in distribution to the Western Hemisphere. One would expect lizards of the Tongan Islands to be related to those of the adjacent Melanesian Islands, as indeed are the skinks and gekkos on the islands (Loveridge 1945), so the presence of iguanids on Tonga and the adjacent Fiji Islands is somewhat of a mystery. The nearest point to Tonga on the Western Hemisphere is the coast of Ecuador, more than 5000 miles (8000 km) away; we must believe that a natural raft or floating tree, bearing at least a pair of differently sexed iguanids, drifted from South America to Tonga long enough in the past for generic differentiation from the ancestral type to have occurred on the islands since the time of the successful colonisation. Later, a further colonisation of the Fiji Islands occurred, again at a time far enough in the past for a distinct species to have evolved on Fiji (Avery and Tanner 1970). The two species are *B. fasciatus* from Fiji and *B. brevicephalus* from the Tonga Islands. The greater size of the prehistoric lizards on Tonga, correlated with larger size of many kinds of lizards on isolated islands in the sub-Recent, will be the topic of a separate publication.

Pigs (*Sus scrofa*)

Wild pigs of the genus *Sus* seemingly never occurred naturally east of Wallace's Line, except possibly on Flores and Timor (Herre and Röhrs 1977:Map 3), but domestic pigs were introduced by man into Melanesia and many parts of Polynesia. Since pigs were present in New Guinea by 5000 years ago (Bellwood 1975), their presence in the first millennium BC on Tongatapu is not surprising.

All bones of pigs were broken, and no two of them could be assigned to the same individual. However, on the basis of the 32 available pieces of mandibles and maxillae and of separate teeth, and of 10 specimens showing stages of fusion of long bones or stage of development of intact cranial vault, 42 individual pieces (not necessarily representing 42 individual pigs) were assigned a presumptive age, using the comparative data from a study of late-maturing races of pigs as determined by Habermehl (1961). On these bases, no pig had been older than 24 months at death, and most had been between 4 and 12 months (Fig.4), so that one infers control of the population and a rational selection of pigs to be killed.

Dog (*Canis familiaris*)

No bone or tooth which we could assign to a dog was present in the material examined by us. A total of four pieces possibly belonging to dog were noted by R.J. Scarlett and C.L. Cram (two pieces each). Even if confirmed, this is a small enough number in a total of something like 3000 bones. We feel the evidence indicates that prior to the visit of the English explorer Captain James Cook in 1773, when he introduced Tahitian dogs to Tongatapu, where none existed at the time, dogs were not present on the Tonga Islands (Titcomb 1969). Dogs were also absent from the adjacent Fiji Islands, in Melanesia, but were present in Samoa and most other Polynesian islands (Titcomb 1969).

**SUMMARY AND CONCLUSIONS**

Present attempts at an analysis of faunal remains from sites excavated on Tongatapu have been seriously hampered by the lack of a comparative collection of vertebrate skeletons from the area, by the incomplete nature of the archaeological collections we studied and by an inadequate acquaintance on our part with the stratigraphy and chronology of the sites.

We found that sites were highly differentiated with regard to faunal remains.
Figure 1  Ends of lizard long bones, showing the shafts purposely cut across

Figure 2  Lateral view of four 'beads' made from the shafts of lizard long bones

Figure 3  End view of 'beads' of Figure 2, arranged in the same order.

Figure 4  Histogram showing ages of pigs at death, To.6
Thus To.5 was the site for the iguanid lizard, *Brachylophus*. The separated ends or pieces of shafts of this animal had been purposely prepared, possibly for making beads and other bodily adornment. These lizards were considerably larger than any known individuals from Tongatapu at present, and furnish an additional case of the phenomena of late Pleistocene or early post-Pleistocene gigantism for certain insular lizards studied in Etheridge (1964, 1965a, b).

The remains of the majority of pigs recovered were concentrated at To.6. These domestic animals had been killed at less than two years of age, and most of them had been killed between the ages of 4 and 12 months.

The site of the greatest accumulation of bones of green turtles (*Chelonia*) and loggerhead turtles (*Caretta*), To.2, was well separated from the cluster of the other five sites and, while still within the lagoon, was near the open sea. We interpret To.2 as a special site for the butchering of these marine turtles.

J.K. Bland  
C.A. Reed  
1978, Department of Biology and Department of Anthropology, respectively, University of Illinois at Chicago  
With approved editorial revisions 1986

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Titcomb, M. 1969 *Dog and Man in the Ancient Pacific with special attention to Hawaii*. Honolulu: Bishop Museum, Special Publication 59
APPENDIX 9

REANALYSIS OF THE HUMAN REMAINS AT TO.1

[edited from a fuller report, Spennemann 1985c - Ed.]

The human remains from Burial Pit AF of Trench III were analysed in the 1960s and some of the data made available in J. Poulsen's dissertation (Poulsen 1967) as Appendix VI (the left femur, by G.C. Schofield) and Appendix VII (jaws and teeth, by R.M.S. Taylor). A skeletal find of the Lapita period, as interpreted by Poulsen, the burial has great interest and value as one of the few with Lapita associations in the Pacific, the others being three burials from Watom Island, New Britain (Specht 1968:124; pers. comm.); one from Natunuku, Viti Levu, Fiji (Pietrusewsky 1985) and two from the Lau Islands, Fiji (Best 1984:100, 101, 534). Of these only the Fijian specimens have been described in detail.

During a study tour in 1985 ahead of archaeological fieldwork in Tonga, I visited the Australian National University and had the opportunity to make a restudy of the burial remains, which are currently housed in the Department of Prehistory, together with the rest of Poulsen's excavated materials.

NATURE OF THE MATERIAL

The remains were found stored in a number of bags, numbered To.1/2149 to To.1/2292, since Poulsen had recorded most of them three-dimensionally either individually or in groups. Each bag represents an entry in Poulsen's catalogue of finds (Poulsen n.d.:43-49a). I unbagged, examined, recorded and rebagged the entire skeletal collection, making amendments to Poulsen's catalogue as necessary (Spennemann 1985a).

The bones are in a good state of preservation. The surface of the compact bone is somewhat rough due to erosion. Spongy bones or spongy areas of bones are generally badly broken. This refers especially to the epiphyses of both humerus and femur and to the vertebrae. The skull, together with other comparatively thin bones, like the ribs, is broken into small pieces, but can be joined so far as the parts are not missing.

The number of individuals represented in the material is at least three and at most seven. There is, however, no reason to assume more than three individuals and subsequent discussion will proceed on this basis. The discovery that more than one individual was present solves a problem which Taylor (1967:XXI-XXIII) grappled with in his original report.

THE INDIVIDUALS PRESENT

Individual 1

This constitutes the real burial [Plates 6, 7 of Vol. I - Ed.]. Present are parts of the head, trunk and upper and lower limbs, as shown in Figure 1. In addition to the bones shown there, both cranial condyles, the petrous portion of both temporal bones and five sesamoid bones are present. A comment has to be made on the ribs and the thoracic and lumbar vertebrae. All are apparently preserved, though rather fragmented. No attempt was made to refit the fragments. Thus it may be that minor parts of these are missing, their absence unnoticed.

The skull

As regards the skull, only a few pieces were present, too few to assemble it, so that the number of cranial measurements that could be taken is rather restricted. As it appears that the cranium was discovered when a test pit was dug ahead of main excavation, it is possible that some fragments were lost during this operation. Certainly some pieces have edges showing
evidence of recent breakage, for which, however, no joining pieces could be located. On the other hand, other fragments show old breakage patterns, so it may be that the skull was little more complete at the time of excavation than it is now.

The skull fragments shown in Figure 1 match in colour and in the state of surface preservation the bones of both Individuals 1 and 2. No duplicate skull fragments could be found to indicate the presence of two crania. It is very likely, though not beyond doubt, that all skull fragments belong to Individual 1. This is somewhat confirmed by the evidence for Paget’s disease on the skull fragments and possibly the femur as well (see Pathology below).

**The right leg**

As can be seen from Figure 1, the major bones of the right leg, i.e. the femur and the tibia, are lacking. This observation led Poulsen to the assumption that the entire leg was missing, as well as the right half of the pelvis (Poulsen 1967:316). A close analysis of all bones, however, revealed that numerous bones belonging to the right foot are present. These are the third and fourth metatarsal (To.1/2232 and 2231 respectively), the first and second phalanges of the first digit (big toe, To.1/2238 and 2237) and a cuneiform bone (To.1/2227 [No.?]). Furthermore there are seven (out of eight possible) first phalanges, not counting those of both big toes.

In addition the right patella (To.1/2185), the distal epiphysis of the right tibia (To.1/?), a medium-sized fragment of the right pelvis (from the greater sciatic notch) (To.1/2252) and parts of the condyle of the right femur (To.1/2250) were encountered.

Though these discoveries finally settle the problem of a possible pre-interment loss of the leg, they raise another. As the preservation of the bones, especially of the long bones, is very good, the right femur and tibia should definitely have been present at the time of excavation. Their absence implies beyond any doubt that the bones were taken out after the body had decomposed and the ligaments no longer existed, since disturbance caused, for example, by rodents could not account for the entire lack of these bones. Such a reopening of the pit would explain some breakage of bones which definitely occurred a considerable time after the death of the individual. This is confirmed by some distinctive breakage patterns - especially clean and non-splintered breakage - and some horizontal flaking of the compact bone near the point of impact.

As no visible evidence for this reopening exists and the photographs taken during the process of excavation show no appropriate intersection of the pit by another [cf. Plates 6, 7 of Vol. 1 - Ed.], it appears that the secondary disturbance took place within the boundary of the former. Pit AH cutting into the NNE edge of the burial pit (AF) does not reach the burial and is furthermore located opposite to the leg bones [cf. Fig.8 of Vol. 1 - Ed.].

**Individual 2**

The entirely different appearance of the upper and lower jaw attributed to what was originally thought to be a single individual caused Taylor (1967:XXII) to speculate on the presence of a second individual. The correctness of his suggestion is shown by the discovery of an additional foot bone (left lateral cuneiform bone) and an additional distal epiphysis of a left ulna, so that the mandible and additional teeth that caused Taylor his worries can be allocated to a second individual, as shown in Figure 2.

Also allocated to Individual 2 in the figure is an additional left humerus, consisting of a large fragment of the mesial and distal shaft with the beginning of the distal epiphysis. It is said to have been found at a lower level than the burial of Individual 1 (Poulsen n.d.:49).

It probably now cannot be determined whether the additional bones constituting Individual 2 are intrusive by chance or by purpose, or whether they belong to a primary burial almost entirely removed during the interment of Individual 1.
Individual 3

This individual can be documented beyond doubt only by one tooth, an upper central incisor.

Other bones

Some fragments belonging to the distal shaft of a right femur (To.1/2278) were found in the profile 36/74-76 [Fig.8 of Vol. I - Ed.], as much as 1 m away from Pit AF (Poulsen n.d.:44). It cannot be ruled out that they belong to Individual 1 and were displaced in later times, for example, during the suggested reopening of the burial pit discussed earlier. They could equally belong to Individuals 2 or 3 or to a different individual altogether.

AGE OF THE INDIVIDUALS

The assessment of the age of the individuals is somewhat complicated.

Individual 1

This individual offers a fair amount of evidence for age determination compared with the other two individuals represented in the sample.

As all epiphyses of the long bones were fused, Individual 1 was a fully grown adult. The arthritic changes which can be observed all over the skeleton, as well as the attrition of the teeth, which is in a very advanced state, indicate that the individual was beyond 30 years of age. This is confirmed by the state of obliteration of the cranial sutures. A more detailed age assessment based on the obliteration of sutures is not very reliable and thus omitted. It has been shown, however, that the intensive onset of endo- and ectocranial ossification all over the sutures cannot be observed among individuals under 40 years of age. Thus it seems safe to assume that this individual was most probably 30 to 35 years of age. An indication of perhaps greater age is the extreme attrition of the teeth, though we lack relevant comparative material to be precise.

Individual 2

The evidence is restricted to the mandible and a few bone fragments. As all epiphyses of the long-bone fragments present were fused and as the third molars had erupted and were already lost a long time prior to death, this individual was a fully grown adult. Arthritic changes in the long bones, together with the state of the alveolar region and the attrition of the teeth, suggest that an age of 30-35 years is a reasonable estimate.

Individual 3

Nothing can be said about the age of this individual beyond stating that the crown of the incisor was only slightly worn and that the root of the tooth was fully developed. This gives a very rough age estimate of 16 to 25 years, and probably older rather than younger.

It should be mentioned, however, that this estimate is based on a comparison with the other teeth from Pit AF, on the assumption that the tooth and the remainder of the bones belong to the same archaeological period. If the dates were radically different, however, we might have to allow for the possibility of different subsistence regimes, which could heavily influence the masticatory function of the frontal teeth (cf. Houghton 1980).
ETHNIC AFFILIATION

A major and to some extent crucial point to be discussed is the ethnic affiliation of the buried individuals: crucial, as the assessment of stature and the metrical assessment of sex relies on factors varying between different ethnic groups.

Individual 1

The issue of ethnic affiliation was raised by Schofield (1967) when he assessed the left femur, on the evidence of the high platymeric and pilastric indices, as probably not Polynesian. He no doubt based his conclusion on results and impressions derived from his study of the New Zealand Maori femur (Schofield 1959), since no data originating from prehistoric Tongan skeletal material were at the time available.

In the meantime, however, the skeletal series from two burial mounds at 'Atele (Davidson 1969) has been published (Pietrusewsky 1969a, b). Thus it seems appropriate to look at Schofield's statement in the light of this recent evidence. As the femoral data series for both platymeric and pilastric indices is large enough, one can restrict oneself to the femora of adult males, thus eliminating the bias of sexual dimorphism.

The platymeric indices of left femora for Tongan males are provided from the 'Atele series by Pietrusewsky (1969b:352). I calculate the mean of the eight values as 81.888 ± 4.223. The platymeric index of the left femur of Individual 1 at To.1 is 80.6: anteroposterior diameter of the upper shaft 25 mm, transverse diameter 31 m (cf. Schofield 1967). This falls well within the range at one standard deviation of the data from the 'Atele mounds.

Pietrusewsky (1969b:351-52) provides pilastric indices for the femora of Tongan males at 'Atele. I calculate the mean of the indices for eight left femora as 113.413 ± 9.934. The pilastric index of the left femur of Individual 1 at To.1 is 122.0: anteroposterior diameter of the mid shaft 30.5 mm, transverse diameter 25 mm (cf. Schofield 1967). This falls within the range at one standard deviation of the data from 'Atele.

By the evidence of the two indices, therefore, Schofield's argument that the burial is probably non-Polynesian does not stand up.

Furthermore, looking at this skeleton for morphological differences between the bones of European and Polynesian populations as outlined by Houghton (1980:34-37), Individual 1 is definitely Polynesian. The evidence is the curvature of the ulna, the subtrochanteric cross-section of the femur, the bowedness of the femoral shaft and the general inclination of the femoral head. As regards this latter, it is true that the distal epiphysis of the left femur is badly broken and some parts are missing, so that it cannot be reconstructed. However, the inclination of the femoral head is beyond doubt. As the femoral shaft is complete down to the popliteal surface, both the anterior and posterior surfaces of the distal shaft can be brought into accordance with the horizontal plane, which would be made up if the distal condyles were present.

Unfortunately, though the head of the femur is almost complete, the femoral fovea, which is a valuable discriminator, is missing. The fragment could not be located within the material, though a thorough search was conducted twice. This is the more annoying as the breakage is a recent, excavation or post-excavation, event.

The evidence adduced is, however, thought to be sufficient to support the view that the buried individual was Polynesian.

Individual 2

The mandible is a typical, though not extreme, Polynesian rocker jaw with a corpus-ramus angle of about 89° (cf. Houghton 1980:43-54). Thus it is extremely likely, though not beyond any doubt, that Individual 2 was a Polynesian as well.
Individual 3

The evidence for this individual, based on a single tooth, is slight. However, the central incisor shows a definite shovelling, which is often said to be an extremely common trait among Polynesians. Recent research indicates, however, that this is not sufficient in itself as a racial indicator (Nichol et al. 1984).

SEX OF THE INDIVIDUALS

Individual 1

The sex of this individual was stated to be male (Poulsen 1967:317). Reassessment of sex proved to be quite straightforward and unproblematic as a part of the pelvis was present. Determination of the sex on pelvic evidence is still the only absolutely reliable method. To judge from the small angle formed by the greater sciatic notch, the male sex is beyond any doubt. This is confirmed by some evidence of the skull, as the inferior temporal line extends over the external auditory meatus, while the overall robusticity and remarkably strong build of the bones indicate a male.

As the discussion on ethnic affiliation has shown the individual to be of Polynesian or proto-Polynesian type, it was of considerable interest to see whether the metrical discriminants worked out for sex in New Zealand Polynesians might apply to this Lapita individual. Thus, in addition to the morphological assessment of sex, a discriminant function analysis based on the length of long bones was performed. The values given by Houghton and de Souza (1975) for Polynesian populations from New Zealand were applied. Though the discriminant function analysis could rely on two measurements only (radius and ulna, function 22), the expected accuracy (EA), as far as populations from New Zealand are concerned, is 91.4%.

The greatest length of the Tongan bones is: radius 245.5 mm, ulna 268.5 mm. The analysis gives a value of 636.449, which is above the sectioning point (SP) at 631. Thus the long bones are those of a male. The same goes for the discriminant functions based on single bones only, i.e. the radius (function 27, value 245.5, SP at 243, EA 91.8%) and the ulna (function 28, value 268.5, SP at 264, EA 87.8%).

By all calculations the sex is male, though the values are always only slightly above the sectioning point. It could be that the body proportions of Tongans varied slightly but distinctly from those known for the New Zealand Maori, as suggested by Houghton et al. (1975:331-32) in their study on stature which is used below.

Individual 2

The assessment of sex for this individual is based almost entirely on the mandible, as the other bones except for the humerus are too fragmented or too small to be useful for the purpose. The latter is as robust and of the same strong build as the corresponding humerus of Individual 1.

This tendency towards the male sex is confirmed by the overall robusticity of the mandible, the form of gnathion and the marking of ligament attachments at gonion.

Individual 3

Based on the single incisor, no sex assessment can be done, as comparative measurements and data on Tongan teeth are not available.
ASSessment of Stature

Individual 1
Assessment of body height for this male relies on the metrical data published by Houghton et al. (1975) for Polynesian populations from New Zealand. Though apparently, as remarked above, there are differences in body proportions between prehistoric New Zealanders and Tongans, the New Zealand data are the only ones currently available. Therefore it has to be stated clearly that the calculation of stature derived from these data has to be read with caution until ratios drawn exclusively from Tongan skeletal material have been recorded.

The calculations are based, as with the metrical assessment of sex, on the greatest length of the radius and the ulna. Due to individual variation, the latter bone especially causes great problems in assessing stature and the data derived from it are to be regarded as problematical, at least as far as European material and experience are any guide.

The results from the left ulna (268.5 mm) and radius (245.5 mm) are: ulna (function 12) an estimate of 1721.9 ± 26.5 mm; radius (function 11) an estimate of 1714.4 ± 20.5 mm; or a mean estimate of 1718 ± 26.5 mm. Though it is likely that these estimates must be corrected for a Tongan formula, they fall well within the range of stature known for Tongan living populations as published by Sullivan (1922). The average standing height of a Tongan male given by him is 1730 ± 52.1 mm (range 1600 to 1880) (Sullivan 1922:239, Table I; 244, Table II).

Individuals 2 and 3
Due to the lack of appropriate bones no estimates can be made.

Status of the Dentition
It was initially intended simply to refer to Taylor’s subtle assessment (Taylor 1967), to which at first glance it appeared nothing could be added. In view of the new evidence brought to light by my restudy of the skeletal remains, however, a thorough reassessment of the dentition seems appropriate.

Except for an upper right incisor labelled To.1/2286, all available teeth were numbered To.1/2292.

Assignments to individuals
Discussing the dental evidence, Taylor found obvious inconsistencies between the general appearance, wear and decay of the teeth of the upper and the lower jaw. He discussed the possibility of a second individual, but because he had no independent evidence for this, he propounded another hypothesis, injury to the incisor area of the face, to explain the different wear of the maxillary teeth (Taylor 1967:XXII-XXIII). As will be discussed below, there is evidence to support this hypothesis, though belonging to Individual 2.

Besides the generally different status of wear, caries and calculus of the teeth of the maxilla in comparison to those of the mandible, a further argument for the dental remains belonging to two individuals is the discoloration of the dentine and secondary dentine which can be observed on the teeth of the maxilla fragment. Their colour is Munsell 10 YR 6.5/3.5, while the colour of all other teeth is 10 YR 9/1.5. If both the mandible and the maxilla belonged to one individual, the discoloration of the dentine should be observable on both parts and should not show such a gross difference. There are additional maxillary teeth, which Taylor (1967:XXIII) could not account for and suggested might have been included by mistake, but they match perfectly as to colour, wear and decay those of the mandible, and there is no reason whatsoever to assume that they do not belong with it.
As the right central upper incisor numbered To.1/2286, which had already been sorted out by Taylor (1967:XXII), shows an entirely different state of wear, it positively does not belong to the same individual as the mandible. The dentine of the cutting edge shows evidence of splintering, which could have occurred either shortly before or, more likely, after death. Fortunately a small area is preserved which allows a secure assessment of the wear. This is the incisor which has been designated as belonging to Individual 3.

The dentition of the three identified individuals is as follows:

- Individual 1 maxilla: C', P^2, M^1 dext.; 1^2, C', P^1, P^2 sin.
- Individual 2 mandible: C\textsubscript{\textasciitilde}, P\textsubscript{1}, P\textsubscript{2}, M\textsubscript{1}, M\textsubscript{2} dext.; C\textsubscript{\textasciitilde}, P\textsubscript{1}, P\textsubscript{2} sin.
- Isolated maxillary teeth: 1^2 dext.; M^2, M^3 sin.
- Individual 3: I^1 dext.

**Wear**

Tables 1 and 2 set out the evidence for the individual teeth. Table 1 gives an assessment of the degree of wear following the ascending eight-point scale developed by Smith (1984:45, Table 2). Table 2 gives a similar assessment, using the system of Molnar (1971:178, Fig.1), an ascending eight-point scale that has been employed in describing the tooth wear of Polynesian populations.

**Caries**

Tables 3-5 record the occurrence of caries on the occlusal surface, the sides of the crown and the root respectively of the individual teeth, using the ascending four-point scale of Taylor (1971a:177) and with 0 recording absence of decay.

**Calculation**

Tables 6-7 give the evidence for the presence and amount of salivary and subgingival calculus, following the ascending three-point scale of Taylor (1971a:177), where 0 means absence of calculus.

**Tooth pathology**

Table 8 summarises the evidence for the individual teeth.

**Individual 1**

For the maxilla of Individual 1 it is sufficient to refer to Taylor’s (1967:XXII) conclusion, that masticatory function was not effective on the left side of the mouth for rather a long time. The wear on the right M^1 enhances this observation. Taylor pointed out that the right temporomandibular joint might have been dislocated to maintain ‘usefulness’ of M^1 and was able to indicate that there is evidence of intensive use in the right glenoid fossa. Though this explanation for the condition of the fossa is plausible, the left glenoid fossa, necessary for cross-checking the observation, is missing. Reliance on the right fossa alone is the more problematical as Individual 1 shows osteoarthritic changes and small pathological alterations all over the skeleton.

**Individual 2**

The mandible of Individual 2 shows the central and lateral incisors to be lacking. All of them had fallen out a considerable time before death, the socket of the right lateral incisor having healed entirely, the sockets of the others being at an advanced stage of healing. There is some evidence that the area I\textsubscript{1} right to I\textsubscript{2} left had been affected by an inflammatory process,
probably a small abscess. A large cavity from an abscess can be observed below the root of the right canine.

The major observation to be made, however, is that the right canine shows unilateral wear towards the side where the teeth are missing. The corresponding second right incisor of the maxilla, normally biting between the lower canine and second incisor, shows the very same abrasion, similarly due to the loss of the lower teeth. As pointed out by Taylor (1967:XXII-XXIII), this loss of the mandibular teeth might have been due to an accident or an intentional assault, but additionally could have resulted from some cultural practice, though the latter seems less likely. This may well have resulted not only in the loss of teeth but in major inflammation of the affected area as well. Taylor describes a similar incidence on other Tongan material, from Site To.6 (Appendix 10 and Taylor 1971b).

As the upper left central incisor is not severely affected, it appears that not all frontal teeth were lost due to this incident, whether assault or accident. However, there must have been some impact on the central upper left incisor as well, as its root shows some irregular surface patterns which indicate the presence of an abscess in the cavity of the (lost) alveolus.

Summary

The graphs below summarise the status of the dentition for each individual and can be read by the following key:

- above the horizontal line the maxilla, below the mandible
- left of the vertical line the right side of the mouth, right of it the left
- \ tooth lost ante mortem, _ probably ante mortem, / post mortem
- () tooth present but socket missing
- c caries

**Individual 1**

```
    7 6 5 4 3 2 1 | 1 2 3 4 5 6
    c
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**Individual 2**

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     8 7 6 5 4 3 2 1 | 1 2 3 4 5 6 7 8
   (2) (1) (7)(8)
    c c
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**Individual 3**

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    (1)
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Table 1  The degree of wear on individual teeth, following the system of Smith (1984). Instead of zeroes, hyphens are used

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Table 2  The degree of wear on individual teeth, following the system of Molnar (1971)

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Table 3  The impact of occlusal caries on individual teeth, following the system of Taylor (1971a)

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Table 4  The impact of interproximal caries on individual teeth, following the system of Taylor (1971a)

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Table 5  The impact of cervical caries on individual teeth, following the system of Taylor (1971a)

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Table 6  Assessment of salivary calculus on individual teeth, following the system of Taylor (1971a)

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HANDEDNESS AND ACTIVITY OF INDIVIDUAL 1

On the evidence of the presence of marked ridges and grooves at the margin of the glenoid fossa (Schulter-Ellis 1980; Stewart 1976), as well as the different state of development of the attachments of the ligaments on both humeri, the individual was right-handed.

The bony evidence of the shoulder joint indicates that the use of the upper right arm was significantly greater than that of the left. Whereas the right fossa (To.1/2272) has built up a deep and clearly visible groove and a parallel ridge, the left one (To.1/2260) has none at all. This very distinctive feature, however, cannot be accounted for solely by one-handedness. It is definitely the result of an excessive use of the right upper arm.

As it seemed likely that such use resulted from regular paddling and canoeing, the evidence of the clavicles was checked as well (cf. Houghton 1980:116-17; Houghton in Best 1984:A81). Both clavicles were broken into fragments (To.1/2292 ‘4th group’ [left specimen] and To.1/2264 [right specimen]), which could not be properly joined due to missing parts. While the sternal end of the right clavicle shows a deep groove where the costoclavicular ligament is attached, the corresponding groove of the left specimen is much less developed. This is well in accord with Houghton's findings (1980:116). Unfortunately, however, the medial part of the clavicle is apparently lost. An assessment of the presence or absence of the so-called ‘first-rib groove’ is thus rendered impossible.

However, use-wear on both scapula and clavicle suggests regular use of paddle and canoe, as with one of the individuals from the two Lau Islands burials dated to Lapita times (Houghton in Best 1984:A81). In contrast to this male individual, however, Individual 1 at To.1 shows clearly defined and strongly developed prominent ridging for the attachment of the flexor tendons, indicating vigorous manual activity as well.

NUTRITIONAL STATUS

During the reanalysis of the bones it was possible to X-ray some of the bones in order to detect Harris lines and other features.

The bones X-rayed were the following:

1. the right humerus (To.1/2268), but the lower shaft fragment only. The broken-off medial part of the shaft was not exposed to X-rays.

2. the left humerus (To.1/2271), but the lower shaft fragment only. The medial part of the shaft was not exposed to X-rays but shielded with lead.

3. the left ulna (To.1/2259), but the lower shaft fragment only. The broken-off medial part of the shaft was not exposed to X-rays.

4. the entire left radius (To.1/2258)

5. the distal fragment of the additional left humerus (To.1/2275), but the lower shaft fragment only. The broken-off medial part of the shaft was not exposed to X-rays.

The X-rays show very slight lines of irregular growth on the proximal ends of the left radius and ulna. Whether they are Harris lines which have almost disappeared with increasing age of the individual or, alternatively, evidence of a small event of illness during childhood is not clear. In view of the fact that the individual is only 30 to 35 years old, the latter is the more likely. We may note that the teeth lack the transverse grooves in the enamel surface (dental hypoplasia), such as are indicative of an inadequate diet during childhood.
Table 7  Assessment of subgingival calculus on individual teeth, following the system of Taylor (1971a)

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<td></td>
<td>M3</td>
<td>M2</td>
<td>M1</td>
<td>P4</td>
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<td>C</td>
<td>I2</td>
<td>I1</td>
<td>I2</td>
<td>C</td>
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<tr>
<td>Individual 1 Maxilla</td>
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<td>Individual 2 Maxilla</td>
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<td>Individual 2 Mandible</td>
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Table 8  Assessment of pathological evidence for individual tooth sockets

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<tr>
<td>Individual 1 Maxilla</td>
<td>0</td>
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<td>Individual 2 Maxilla</td>
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<tr>
<td>Individual 2 Mandible</td>
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<tr>
<td>Individual 3 Maxilla</td>
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P  peridental disease  
A  abscesses  
O  no pathological change  
-  no socket present

Figure 1  Bones of Individual 1, excluding five sesamoid bones  
Figure 2  Bones of Individual 2
PATHOLOGY

The following observations can be made on pathological changes in the skeleton, in addition to the dental pathologies already discussed.

Individual 1

Minor to medium arthritic changes could be observed all over the skeleton and will not be recorded in detail.

Various bones, especially of the vertebral column, however, show evidence of more severe osteoarthritis. This is remarkably severe on the cervical vertebrae, which display an extreme lipping, Schmorls nodules, arthritic changes of the articulate surfaces and, sometimes, complete deformation of the corpus. The freedom of movement of neck and skull must have been rather restricted and most probably rather painful. In contrast to the cervical vertebrae, the impact of arthritis is less on the thoracic vertebrae and almost negligible on the lumbar vertebrae. Taking into account the evidence of the clavicle, it is likely that the arthritis in the cervical vertebrae was due to excessive canoeing leading to greater stress on the neck. Such a distribution of strong impact of arthritis on the cervical vertebrae and much less impact on the lumbar vertebrae Houghton (1980:118) explains as evidence that people transporting material mainly by canoes did not have to carry a lot of weight on their backs, such as would leave rather distinct traces on the lumbar vertebrae.

Generally, osteoarthritic changes in the vertebral column are a common feature of Tongan skeletal material (Pietrusewsky 1969b:321-25; cf. Spennemann 1985b). In Pietrusewsky's graphic presentation of data comparing the osteoarthritic changes of the vertebral column of Tongan males (1969b:324, Diagram 3) and females (325, Diagram 4) from 'Atele, it is obvious that the males show a lot more changes in the neck, with comparatively less or even no change at all in the lumbar vertebrae. In contrast, the females show almost no changes in the neck, but severe changes in the lumbar and thoracic vertebrae. This observation, with respect to the above evidence, leads tentatively to the conclusion that most of the land transport, for example of foodstuffs from the garden to the household, was done by women, while work performed with canoes, such as water transport and fishing, was done by the males.

The inner table of the skull reveals some lesions which may be interpreted either as evidence for some metastatic carcinoma caused by cancer of unknown kind or as the early stage of Paget's disease, as already suggested by Schofield (1967, on the evidence of the femur?). The latter interpretation is confirmed by an enlargement of the diploe (cranial thickness 11.2 mm instead of 7.6), a reduction of the thickness of the inner and outer table and a porous outer surface.

Individuals 2 and 3

No observations can be made on pathological changes beyond those associated with the dentition.

CAUSES OF DEATH

Individual 1

Cause of death could not be determined for this individual on the basis of the skeletal material present. It is unlikely that he died of Paget's disease, as this is not at an advanced stage.
Individuals 2 and 3

Cause of death of these individuals could not be determined on the basis of the skeletal material present.

FISH BONES

A few fish bones were included in bags labelled ‘Sundry human bones’. They have been studied by Dr S. Colley (1985) who recognises Lethrinidae amongst them, probably *Lethrinus*, a species already reported by Poulsen from To.1 [see Chapter VII, section 3.18, of Vol. I - Ed.].

FINAL REMARKS

In general the remains from Pit AF at To.1 are similar to the Tongan individuals known from the burial sites at 'Atele. This observation, however, has no chronological implications, since the Tongan population developed out the Lapita founder population. As yet the data base is too small to allow further and more detailed analyses. In the long run it should be possible to gather sufficient data to analyse the impact of Samoan and later of Fijian gene flow into Tonga, as suggested by historical traditions.

ACKNOWLEDGEMENTS

I am indebted to S. Colley, Department of Archaeology, University of Southampton, who examined the few fish remains in some of the bags containing human skeletal material.

It is thanks to the invaluable assistance of W.R. Ambrose, Department of Prehistory, Research School of Pacific Studies, Australian National University, that some of the human bones were X-rayed.

This report was made possible by J. Poulsen, Institut for Forhistorisk Arkæologi, University of Aarhus, Denmark, who allowed further work on the material excavated by him.

Above all, the author is gratefully indebted to J. Golson, Department of Prehistory, Research School of Pacific Studies, Australian National University, for his permission to work on the material, which is currently housed at his department, and for all the assistance given by him during the author's stay at the Australian National University. Furthermore he read and commented upon an earlier draft of the report. Responsibility for its contents, however, as well as any sins of omission or commission, is entirely the author's.

The research was made possible by a travel grant issued by the Deutscher Akademischer Austauschdienst (Bonn, FRG), Grant No. 315/901/506/5, which is gratefully acknowledged.

D.H.R. Spennemann
1985, Johann Wolfgang Goethe Universität, Seminar für Vor- und Frühgeschichte, Frankfurt-am-Main

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APPENDIX 10

SOME EXCAVATED JAWS AND TEETH FROM TONGA

THE BURIAL AT TO.1

Because of the discovery by D.H.R. Spennemann during his reanalysis of the skeletal remains from Pit AF at To.1 that more than one individual was involved, the section on To.1 which appeared in Taylor's appendix in the original thesis (Poulsen 1967:Appendix VII) has been omitted here. Reference should be had to Spennemann's restudy in Appendix 9, which makes frequent reference to Taylor's assessment of the condition of the dentition. Note that Taylor's concluding discussion of dentition draws on the To.1 material, as well as that from To.5 and To.6, in addition to Davidson's material from the 'Atele burial mounds (Davidson 1969) frequently referred to by Poulsen in his text - Ed.

THE BURIAL FROM TO.5

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:

```
C
i  Right  6 E D X X X

3 4 5
ii  X X C D E  Left

3 4 5
iii  7 6 E D X X X | X X X D E X X  Left
          C      C
```

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 boldface indicates that the tooth had not emerged or erupted to occlusion.

Of the 29 fragments, 21 were identified and included:

1. Almost complete R maxilla, and part of L maxilla (i and ii above)

2. An incomplete mandible, broken through the socket of 6 and the crypt of the unerupted 7 (iii above)

3. R malar bone, and R and L orbital processes of frontal bone

4. Part of sphenoid bone with the great wing of R side and part of great wing of L side, the foramina ovale and rotunda being present on both sides; temporal bone, part of R petrous portion with external and internal auditory meati; glenoid fossa and part of zygomatic and mastoid processes.

5. Where loose teeth were replaced, the graphic chart of the dentition was:

```
5 4 3
Right  7 6 E D C X X | X X C D E  (broken and missing) Left

3 4 5
? 7 6 E D C 2 1 | 1 2 C D E 6 7 8
```

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.
EXAMPLES FROM TO.6

Area 4

1776 1 or 21. A right lower incisor, probably 11. Could be from a young adult, as wear does not seem severe on these Tongan teeth.

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 4111 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 sinususes from long-standing chronic alveolar abscesses, and the socket of 5 presents clear evidence of periodontal disease, the affected area of bone apparently in communication with the sinus over 65.

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’ (Taylor 1963:141; Plate 11).

Area 5

2129-2130, 2146 Fragments of human mandible, left, broken through sockets of 8 and 4 and presenting x x 678. Fully adult, with 8 in occlusion, but degree 1 wear (slight only) on each tooth. Clean roots, normal healthy alveolar borders, no tartar, no caries of teeth. 8 presents long slender roots fused into fine pointed cone curving to buccal.

Ungrouped

2397-2400 Fragment of mandible of an adult person, together with loose teeth which could be certainly replaced to give

Right 3 X - 2 3 4 5 Left

Close examination of this fragment led to the following observations and conclusions:

1. 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 22 might well have followed loss of 11 and the facet on 2 mesial could have arisen from an adjacent 1. 11

2. The missing portions of the cusp tip of 3 and incisal edge of 2 are not from wear but from fracture which could have taken place in life.

3. The teeth 23 are elevated above the occlusal line of the other remaining teeth, which suggests that they had no antagonists in the upper jaw. Tooth 31 is worn by function, but the occlusal facets on 45 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