THROUGH A GLASS DARKLY:
present and past land-use systems of Papuan sagopalm users

by

James W. Rhoads

This work is a thesis submitted for the
Degree of Doctor of Philosophy in the
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This thesis is the product of the author's research. In the analysis of some data the help of specialists in various disciplines has been sought and is acknowledged. Except for these instances the thesis is my own original work.

J.W. Rhoads

J.W. Rhoads.
This study concerns the application of ethnographic information to the understanding of prehistoric peoples. The ethnography of contemporary sago-using peoples, who inhabit the foothill margin of the deltaic swamps of the Papuan Gulf, and the archaeological evidence recovered from a series of excavated open and rock shelter sites serve as the basis for this work.

The Kairi living at Waira Village, who are the focus of my ethnographic research, follow a dual residence system: permanent villages along large rivers and temporary encampments sited near the interior margin of a broad alluvial plain. Their primary subsistence pursuits: sago-making, fishing and hunting follow traditional modes; however, European tools have contributed to some recent alterations.

The contemporary Kairi land-use strategy, as interpreted from a time-and-motion study of the Waira community, is oriented from the location of sagopalm stands, instead of the village site. Taking this information and the observed seasonal fluctuations in subsistence and settlement strategies into account I construct a model of contemporary land-use. This analogue and that derived for the contact period are expressed in a series of working and test hypotheses which relate the modelled behavioural patterns to their archaeological reflections.

Before considering the archaeological evidence I derive a further set of alternative models from an analysis of other Melanesian sago-using groups. The usefulness of this expanded view of the application of ethnographic analogues — namely the projection of possible prehistoric systems for which there is no evidence in the area today — is demonstrated through model testing.
The second part of the thesis considers the archaeological evidence and an assessment against the suite of test hypotheses is made. The results suggest that the occupation of the Waira region extends over approximately the last 3000 years. Subsistence strategies appear to have changed little during that time from what is noted today. Settlement patterns have, however, altered between 1500-1200 BP and from just before European contact to today. This change is marked by the siting of villages along major waterways, repeated use of temporary encampments near the karst escarpment and occurrence of large amounts of exotic commodities.

A consideration of the mechanisms of trade and exchange whereby exotic goods reached the Kairi area concludes this thesis. From this analysis I hypothesize that the times when the regional settlement pattern was altered represent intense periods of coastal trade linking sago-producing peoples of the Papuan Gulf with more easterly sited pottery-making communities.
ACKNOWLEDGEMENTS

After completing a document of this size one becomes humbled with the realisation that its production would have been impossible without the sensitive co-operation of others. I may in this statement of thanks omit the names of some; therefore, to the entire community of friends and colleagues who fostered this work I offer my most sincere gratitude.

This work was sponsored by the Australian National University and sanctioned by the Papua New Guinea Government. I am appreciative of the opportunity which they offered me.

The debt of friendship I owe to the people of Waira Village is too great to be repaid adequately. My knowledge of man and land grew out of my deep association with apa John Tovi, who patiently tutored my perception and bore incessant questioning with the skill and kindness of a father. I also thank Ume Kirokae for assisting with the digs; as an excavator he is surpassed by only a few.

At numerous times during the course of my analysis I ran-up against problems which required the help of experts, each of whom gave generously of their time and efforts. They appear as follows: Geoff Hope and Doug Yen (ethnobotany); Geoff Pickup, John McAlpine and Marjorie Sullivan (hydrology); Joe Jennings, Colin Pain and Phil Hughes (geomorphology); Phil Coleman, Roley McKay, John Calaby, Jerry Van Tets and Jeannette Hope (faunal identification); Reg Barrett and Allan Haines (animal ecology); Alan Thorne and Peter Brown (physical anthropology); and last but definitely not least Doug Mackenzie and Alastair Lamb (sourcing analysis).

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The thesis as it greets the reader is largely the product of the skill and untiring efforts of two very good friends. In typing the manuscript and tables, Jill Johnston has not only clearly demonstrated her professional abilities but also her fortitude to bear up against my idiosyncratic habits and last minute changes. In co-ordinating the illustrations and producing the majority of them, Win Mumford has had to weather the storm of my excessive imagination. Dragi Markovic's talents to turn lack-lustre field photographs into an artful display is gratefully appreciated.

In last place here but certainly not in my heart, I thank the members of the Department of Prehistory who thoughtfully extended me every consideration during my bad as well as good moments. Betty Meehan and Jim Allen read and critiqued this thesis in its entirety and I am "greatly beholdin'" to them for their fortitude, constructive insight and "learnin' me proper English". The friendship of my fellow students provided an intellectual and social environment without which the development of my ideas would have been impossible. I thank, in particular, Ian Johnson and Klim Gollan for their interjection of thoughts to my mind and a smile on my face at times when the weight of it all was just too great.

Over the past six years there have been many sign posts along the road. The point at which I gratefully am today is largely the product of the guidance of four very close friends and colleagues. Therefore I extend my most heartfelt gratitude and inscribe this thesis to:

Gene for first sending me to New Guinea,
Ole for introducing me to the bush,
Ian for the lessons in bushwalking and survival, and
Jack for his peripatetic and long-term training in New Guinea prehistory.
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# Glossary of Linguistic Abbreviations

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CHAPTER 1

INTRODUCTION

In 1948 Sauer hypothesized that the antecedents of plant domestication in Southeast Asia lay in the development of riparian-based cultures. The diverse plant communities living along tropical waterways and the abundant supply of riverine fauna provided a benevolent environment within which man's subsistence and material culture requirements were easily met. The technology required for the use of plant resources need not have been complicated. The "crushing or macerating of plant parts and their washing" (p. 266) enabled a variety of tree fruit and wild tubers, including poisonous varieties, to enter the inventory of food plants. Similar methods also produced fibrous cloth and cord, as well as the poisons used for fishing, hunting and medicine. Subsumed within this single "cultural complex" (p. 267) was the exploitation of palm starch and on this basis Sauer postulated it to be "a trait of high antiquity" (ibid.). Although this and his later theories were judged "completely untestable" (Mangelsdorf 1954), it is from the stimulus of Sauer's ideas that the following research was conceived.

SAGOPALM BOTANY AND HABITAT

Since the Cretaceous the hapaxanthic sagopalms have been an element of the floristic communities living either side of the Wallace Line. From their origin along swampy waterways, the various genera expanded their range through adaptation to marginal environments, as well as filling familiar habitats which appeared on newly developed landforms (cf. Corner 1966). Today five genera of palms are known to have been exploited for starch in widely separated areas of Asia and Melanesia (cf. Ruddle, et al. 1978: 1-7, 42-50 for further discussion). Eugeissona spp., limited to the uplands of the island of Borneo and West Malaysia, is now only occasionally used for food by the Punan living in the remote interior of Sarawak. Arenga spp. occurs throughout the region and is classed as a dryland palm, as it reaches optimum growth potential at altitudes between 500 and 1200 metres (Dransfield
While only rarely exploited for starch, the *Arenga* palm gains notoriety from the potent toddy fermented from its fruit. *Caryota* spp. and *Corypha* spp. are also typed by Dransfield as montane palms, but this may be a debatable point since information on their primary habitat is extremely scarce. Unlike other sagopalms the distribution of these genera includes northern Australia, as well as the tropical region from India to Island Melanesia. With the possible exception of groups living on Mindanao and in the Indian region, the *Caryota* and *Corphya* palms rarely supply more than an infrequent source of food.

*Metroxylon* spp., the only true lowlands sagopalm, is the most important source of palm starch for peoples living from West Malaysia to the Solomon Islands. Since it forms the primary focus for this work its botany and habitat are considered in greater detail. The *Metroxylon* palm has only one reproductive phase which follows seven to fifteen years of vegetative growth. As the plant matures carbohydrates produced in the leaves are sedimented in the stem tissue. These reserves remain untapped until flowering, at which time the starch is converted into sugar to sustain the production of seeds. After flowering, clonal suckers begin to develop around the base of the stem (Paijmans 1976: 43). It is this dual reproductive cycle of *Metroxylon* that ensures a hearty regeneration of the genus.

In considering the optimum environment for the natural occurrence of *Metroxylon*, three preconditions are relevant. In order to inhibit the encroachment of high canopied rain forest competitors which could prohibit sunlight from reaching the plant, the water-table must be high. The palm also requires a regular inflow of nutrient-enriched fresh water. Permanent inundation or repetitive exposure to brackish or salt water impedes normal growth (cf. Flach 1973; Flach *et al.* 1977). Lastly *Metroxylon* shows a marked preference for mineral soils as opposed to more acid peat soils, as Sim and Ahmed (1977) demonstrate in starch yield studies. From these factors one may conclude that the alluvial freshwater swamps located inland from the mouths of large rivers represent the natural habitat of *Metroxylon* spp.

THE PREHISTORY OF NEW GUINEA SAGOPALM EXPLOITATION: RESEARCH DESIGNS AND FIELD STRATEGY.

Nowhere within the distribution of all sagopalms is the
incidence of human use greater than on the island of New Guinea. Virtually all people living below 1000 metres rely upon the starch processed from *Metroxylon* spp. to supply some portion of their carbohydrate intake. In Papua New Guinea alone this accounts for 10 percent of the total population (Brookfield with Hart 1971: 86). The starch extraction techniques throughout New Guinea are similar, differing primarily in the selection of tools to pulverise the pith. While Sauer argues that the wide distribution of such a rudimentary procedure satisfies a claim of great antiquity, the early use of palm starch in New Guinea may be inferred on other grounds.

The earliest archaeological remains on the island date from 26,000 BP (White *et al.* 1970). Therefore, irrespective of the time of initial arrival distances of at least 50 to 100 km of open water remained to be crossed (Jennings 1971; Chappell and Thom 1977). Although the early travellers need not have had a prior knowledge of coastal or riverine environments, intuitive reasoning promotes the conclusion that populations with such knowledge would have more likely made the journey than other groups, whether accidentally or intentionally. Assuming that these coastal peoples departed from Sundaland they noted little change in the faunal resources and edible plant taxa, including the sagopalm. As a working hypothesis it may therefore be posited that the first settlers in New Guinea were sagopalm users.

To examine the antiquity of sago exploitation an archaeological marker must first be identified in the material culture. Considering the nature of tropical environments, the recovery of plant remains in sites cannot be anticipated, with the exception of those found in dry cave or peat deposits. Clay pots used for the cooking or storage of palm starch are noted ethnographically in three areas of New Guinea (Lewis 1923; Groves 1960; Tuckson 1966), but the reconstruction of the broken sherds usually found by archaeologists poses obvious problems. Even if vessels could be restored there is no certainty that the form of clay pots would enable the discrimination of people who process palm starch from those who consume sago (evidence the Motu of Port Moresby who obtain palm starch through trade).

Numerous observers (e.g. Malinowski 1915; Lewis 1923) have noted the use of morphologically distinct stone tools in direct association with the process of sago extraction. However, it was not
until Crosby (1973) collated information on a wide range of Melanesian sago using societies that the unique character of these tools became apparent. The implements she describes are categorised into two functional types: palm fellers and pith choppers. The first tool type is indistinguishable on the basis of hafting from local varieties of tree-felling or wood-working implements. In many instances only the blunting or absence of a working edge on typical stone axes supports the classification of a tool as a sagopalm feller. Crosby does, however, record several examples of morphologically distinct felling implements, which are all hammer-dressed into an elongated ovoid form from igneous rock. Many "worn-out" stone axe blades are also used as pith choppers. Several specialised pith choppers, either fashioned from siliceous rocks or ground from another material, are noted as well. Generally conical in plan and circular in cross-section, these implements have a concave to flat working face, which interestingly is usually the case with non-stone choppers. Whereas the felling tools exhibit little or no definable use-wear patterns, the working face of all stone pith choppers is overlaid with a highly reflective silica gloss, which "seem[s] to be largely caused by a chemical bonding mechanism" acting between the siliceous structure of the stone and the opaline silica found in the plant cells (Kamminga 1977b: 13). Although the question of preservation of the use polish in archaeological sites is raised (Crosby 1976), there can be little doubt that a very significant indicator of prehistoric sago exploitation has been documented.

Armed with the hypothesis that the utilisation of palm starch in New Guinea has a significant antiquity which could be demonstrated from the material culture remains in archaeological sites, I began my fieldwork in February 1976 in the Kikori District of the Gulf Province, Papua New Guinea (Fig. II-1). There were a number of reasons for choosing this area for research. The vast fresh water swamps inland from the coast in this region provide optimal conditions for the occurrence of natural stands of sago. Sea level and climatic fluctuations throughout the Pleistocene probably have altered the land forms in this area only marginally (cf. Powell 1976: 177; Nix and Kalma 1972; Chappell and Thom 1977). In a number of localities karst landforms, which are more extensive further inland, abut the swamp and thus
juxtapose potential cave and rock shelter sites and sagopalm stands. The limestone regions nearby to the north also afford the possibility of siliceous stone resources. Lastly, chipped stone sago choppers have been recently noted in use in the area, although well inland at Lake Kutubu (White 1967).

Prior to the initiation of my field research, Bowdler conducted a brief archaeological reconnaissance of Aird Hills and the area along the Veiru Creek in 1971. As her findings suggested little, if any, direct evidence of sago exploitation (Bowdler 1976: pers. comm.), my initial field strategy was to interview members of numerous communities throughout the area during their visits to the government station at Kikori. My enquiries focused upon current sago processing technologies, the types of habitation sites directly associated with sagopalm exploitation and the occurrence of caves and rock shelters in different localities. Although, as I later learned, this methodology elicits very imprecise information, three areas were eventually nominated for examination. At the first two localities visited, the Siligi Valley (Pepeke Census Division) and Kaim Village (Ikobe-Kairi C.D.), the contemporary populations still used chipped stone sago choppers, which they either made themselves or obtained in trade. For logistical reasons these areas were judged inappropriate for extended field research. The Kikori-Kairi C.D., neighbouring the junction of the Kikori and Sirebi Rivers, fulfilled the primary requirements for research and was situated within easy access to the government station.

In April I began an intensive survey of the karst country in the Kikori-Kairi area. Twenty-nine caves and rock shelters were visited. Of these only four had cultural deposits of more than 20 cm depth. In all of the sites subsistence debris, shell and animal bone, was the primary evidence of human occupation; sherd fragments, shell ornaments and stone artefacts also occurred but always in very small numbers. In the present-day village of Kopi, an open site was discovered. Where the ground was disturbed around and under the village houses, chert tools, flakes and cores, as well as pottery, were found in large numbers. A chipped stone sago chopper, with use-polish, was recovered from the wall of a house drain, still in situ. The site was tested and the association of the stone tools and pottery was confirmed.
The results of the initial field survey offered little support for my conjectures concerning the antiquity of palm starch utilisation and the settlement pattern concomitant with exploitation. The site at Kopi Village could be reasonably dated to no more than 1500 BP, based on the comparison of the ceramic style present with pottery recovered further east at Yule Island (Vanderwal 1973: 191-92, 196-97). The pottery recovered from the rock shelter sites suggested a similar age for their habitation, but the archaeological remains in these sites did not corroborate their use as base camps for sagopalm exploitation.

The ethnographic observations made over the six weeks I lived with the Kairi of Waira Village depicted a situation inconsistent with my expectations, as derived from the ethnographic literature I had read. Pieces of evidence, such as:

1. the juxtaposition of recent and current village sites and large stands of sagopals;
2. village-based sagopalm exploitation;
3. the Kairi claim that they not only plant sagopalm suckers but also fell virgin rain forest prior to cultivation; and
4. Porokae's off-handed comment while we walked through a mature rain forest: "Bipo saksak sanap i stap long hir, tasol mipela lusim pinis". (Sago grew here before, but we stopped using it.)

all implied a highly sophisticated relationship between man and palm. Whereas ethnography was not an integral part of the original research design, it now assumed a decisive role in understanding the subsistence and settlement pattern present in the area.

My response to this new set of data was a substantial re-orientation of the research project. Rather than questioning how long man has exploited palm starch in New Guinea, the problem became a consideration of the natural and cultural factors governing the land-use strategies of sago users living in the area near the confluence of the Kikori and Sirebi Rivers. Although a wide range of variables is relevant, the research focus was refined and addressed
the complementary issue of comprehending the subsistence strategy of the Kairi and the extent to which contemporary subsistence and settlement patterns are relevant to those practised by the area's prehistoric inhabitants.

In October 1976, I returned to the Kikori District and initiated an investigation of present and past man-land relationships. Waira Village was again selected for my base of operations. The relative absence of commercial goods in the people's diet afforded the best approximation of a subsistence-based economy in the research area. The small size of the village also facilitated detailed observations of an entire community. To assess the attributes of land-use it was necessary to examine several specific topics.

**Sagopalm Cultivation** In a situation, such as that at Waira Village, where a community's sagopalm resources are substantial, direct observations of palm cultivation cannot be anticipated. Therefore, other means needed to be found in order to distinguish between natural and husbanded sagopalm stands. My investigations were directed at documenting the exploitation history of specific stands and describing the vegetation pattern within them by means of survey transects.

**Contemporary subsistence strategies** Several variables were considered, including the distribution of resources, contemporary and traditional technology, exploitation strategies and seasonal influences on procurement patterns. Particular concern was given to the use of temporary habitation sites in order to identify their function, their physical relationship to resource areas and the range of shelters utilised.

**Non-subsistence resource areas** Since the research area has no stone suitable for the manufacture of stone tools, it was necessary to locate potential quarry sites and determine the contemporary and traditional means of acquisition.
Chronology of traditional Kairi settlements. Although oral history was judged to be of only tentative value in absence of an in-depth study, the collation of historical information and informant testimony was seen as a useful measure in assessing village site selection and recent settlement patterns, particularly with respect to the habitation of areas along the major waterways as opposed to inland sites.

Since the archaeology of the research area had only been briefly tested a more thorough examination was necessary. The location of new sites, particularly open sites, was seen as a major problem. To define a restricted area for intensive survey I conducted a site reconnaissance of the southern portion of the Kairi landholdings, an area lying north of the Ivi River between Anu Creek and the Kikori River (Fig. II-5). Caves and rock shelters were again the focus of my survey. Since the archaeological remains of the sites tested were insubstantial, further investigations concentrated on the area sampled during the first field season.

Although a number of subsidiary questions arose during the course of archaeological investigations, the problems which guided the subsequent survey and excavations were:

1. Description of the regional settlement

Of main importance here was the discovery and excavation of open sites. At the time of intensive European contact during the early twentieth century the Kairi lived well away from the major waterways in very inaccessible and easily defended locations. Local informants claim this to be the result of frequent head-hunting raids by coastal peoples. However, it may also be the case that the contact settlement pattern reflects a single component of a long-term land-use strategy, which subsumes other settlement modes. To examine this problem the distribution of open sites and the degree of sedentism suggested by each were considered.

2. Characterisation of the range of items comprising the material culture

As the time available forced certain economies, excavations focused on recovering what was intuitively judged to be a representative
sample of the range of material culture items present. Subsistence debris, shell and animal bone, received special attention.

3. Interpretation of the nature of rock shelter occupation

Relying on the findings of the first season reconnaissance, three rock shelter sites with substantial deposits were selected for excavation. The major questions directed at each site were the duration and periodicity of habitation and the range of subsistence resources exploited. In order to describe these factors and to link the shelter sites with the occupation of open sites in the region, the excavation of a major portion of each site was essayed.

METHOD OF ANALYSIS AND PRESENTATION

The procedure by which the prehistoric indices of human behaviour are assessed could not simply be a recourse to direct historical or ethnographic analogues for two compelling reasons. Firstly, oral history suggests the Kairi migrated into the region from further inland. Without a detailed series of genealogies the time period of this event cannot be estimated; therefore, to conclude the Kairi are direct descendents of the prehistoric inhabitants of the area is inappropriate. Secondly, 60 years of pacification, the introduction of government services and mission activity have affected traditional behaviour and land-use patterns to an as yet unspecified degree. If these factors have in fact played a major role in influencing local history, the direct application of ethnography to archaeology is seriously undermined.

However, these restrictions do not negate the relevance of ethnography to an understanding of prehistoric land-use patterns in the research area. Each set of data is in its own right an expression of the range of resources chosen for exploitation, the procurement technology and the spatial relationship between human settlement and resource localities. By studying the ways in which subsistence strategies and settlement patterns interact within contemporary societies, pertinent components of the natural and human environment which influence human behaviour can be delineated. With this understanding
the possible range of land-use strategies practised by prehistoric peoples may be defined using a suite of abstract models. A projection of each model's archaeological manifestation, expressed in a series of testable hypotheses then provides the basis against which the prehistoric evidence of the region may be assessed. Thus the relevance of present to past subsistence systems based upon the exploitation of palm starch is evaluated by questioning whether or not the factors influencing contemporary land-use strategies elicited similar responses from temporally distinct populations. If an affirmative conclusion is reached, an objective specification of the limitations on human settlement in the area will have been established. If, on the other hand, the archaeology reveals radically different patterns, the significance of unforeseen variables which effect historical development will be identified and alternative explanations can be sought.

This thesis is organised into two major parts: ethnography and archaeology. The first concentrates on the components of contemporary Kairi land-use, noting its natural and cultural setting (Chapter 2) and the present-day subsistence and settlement strategies of Waira villagers (Chapter 3). Chapter 4 presents an analysis of contemporary land-use and the derivation of abstract land-use models for present-day and contact Kairi populations. This section of the thesis closes, in Chapter 5, with an analysis of the variation in land-use systems involving the exploitation of palm starch, as exhibited by a wide range of Melanesian societies. Based upon this study five alternative land-use strategies which are applicable to the Kairi environment are set forth.

The findings of my archaeological investigations and artefact analyses are discussed in the second part of this thesis. Chapter 6 focuses solely upon the Kulupuari open site, whose material culture remains form the nexus of my interpretation of the archaeology of the research area. Chapter 7 describes the remaining open sites I excavated and Chapter 8 presents an analysis of three rock shelters.

The interpretation of the archaeological data base and its assessment against the proposed hypotheses follow in Chapter 9.
The final chapter reviews the import of my findings with regard to the development of communities along the Papuan coast.
Part I

Ethnography
CHAPTER 2

ENVIRONMENTAL SETTING

The context in which people live is a composite of natural and man-determined elements. Just as the physical environment delimits a series of factors which facilitate and constrain human activities, the succession of historical events affects the range of options at one's disposal. Often, as in the case of climatic change or human modification of the landscape, these elements of the environment function as an integrated feedback system of enormous complexity. In this investigation such extreme conditions are not relevant. During the last 3,000 years, a time span that encompasses the following study, the climatic and vegetational patterns have changed little (Nix and Kalma 1972). The impact of human activities upon the natural landscape has only recently become substantial. Historical processes resulting from pacification and the management of public affairs by the Australian government may, however, have had a major influence on the area during the past 100 years.

The aim of this chapter is to familiarise the reader with the research area and to set forth major factors which influence present-day subsistence and settlement patterns. I describe the natural setting, the Kairi people and their history.

PHYSICAL ENVIRONMENT

The south coast of New Guinea between 136° and 145°E longitude is a vast mosaic of verdant swamps and plains transected by the muddy waters of rivers draining the central cordillera. At the eastern end of this region two of the most extensive river systems, the Kikori and Purari Rivers, flow into an impressive landscape of deltaic islands separated by a dense array of interconnected channels. Along the northwestern fringe lie the karst foothills of the Papuan Geosyncline (Thompson and Fisher 1965), which is the homeland of the Kairi (Fig. II-1).
Topography and Vegetation

After beginning the hour long boat ride from Kikori Station to Waira, the swampland and waterways lined with nipa palms are soon left behind and one is immediately thrust into a striking karst landscape. Low, cone-shaped hills rise abruptly from the water's edge and throughout the narrow alluvial plain. Occurring as solitaires or in small clusters these degraded limestone remnants of an uplifted, Miocene seabed are only a modest introduction to the almost impenetrable karst plateau and sinkhole country lying just inland. Equally notable is the change in the vegetation pattern. Vast areas of low canopy and uniform delta species suddenly give way to a highly diverse lowlands rain forest. The canopy height increases and the understory flora varies in density.

South of Waira the karst hills recede inland. A broad plain forms on either side of the Kikori River and continues upstream for nearly 100 kilometres (Löffler 1977:57). The rich alluvial soils support a lush lowlands rain forest with a three storied structure (cf. Paijmans 1976:49-52). The upper stratum attains a height of 30-35 metres with widely spaced emergents reaching 50 metres or more and common tree species include Alstonia scholaris, Ficus spp., Pterocarpus spp., Terminalia spp. and Intsia bijuga (Grey 1959). The second story is more open and contains fewer mature trees. The slender boles of young saplings are omnipresent and sometimes form dense isolated clusters. At localities where the upper canopy is scarce and the water-table is high small groups of Metroxylon palms occur. The shrub layer is dense with numerous small palms, pandanus and thorned lianes. While pleasing to the eye, the rich vegetation of the alluvial plain greatly impedes movement of all but the most experienced bush travellers.

The eastern portion of the Kairi territory, which the people infrequently visit, presents yet another landscape. Here lie the southern reaches of Plio-Pleistocene lava flows originating from Mt. Faveng and Mt. Duau. The entire region is heavily dissected by the creeks and rivers forming the headwaters of the Sirebi River. Upstream from Victory Junction these waters become fast flowing and numerous rapids and gravel banks appear.
Climate

The coastal and inland region at the head of the Gulf of Papua lies within the wet tropical climatic zone (Thornthwaite 1931). Year-round the weather is characteristically hot, humid and, with the exception of occasional respite, rainy.

Annual temperature variation (Fig. II-2) is minimal. Mean monthly high and low fluctuations are only of an order of one to three degrees centigrade from their yearly average (McAlpine et al. 1975:127). The relative humidity is always high with an annual mean of 90 percent and mean monthly variations of no more than five percent (Ibid.:144).

The most dramatic feature of the area's climate is its rainfall (Fig. II-3). With a mean annual total of 5772 mm (Ibid.:27) it ranks among the wettest regions of Papua New Guinea. In contrast to the late-December through late-March seasonal high of mean monthly rainfall throughout most of the tropical southwest Pacific (cf. Brookfield and Hart 1966), the Kikori/Purari delta and inland region receives more than 50 percent of its annual rainfall between mid-May and late-September. This difference is generally attributed to the long trajectory of the southeasterly trade winds over the warm waters of the Coral Sea and their rapid rise against the mountain chain running through the centre of the island (Nix and Kalma 1972:65). The regionally high precipitation during the remainder of the year results from the stagnation of moist air masses along the southern face of the central cordillera (Brookfield and Hart 1966:9). Brief doldrums occur between the wet and dry seasons, with the most lengthy period at the beginning of the southeasterly trade winds.

The difference in rainfall patterns between seasons is significant (Table II-1, 2). During the wet season long periods of incessant rain are only sporadically broken by brief spells of clear weather, rarely lasting more than three days. Daily clearing is infrequent; however, rainless periods of a few hours may occur. In the dry season rain during daylight hours is restricted to noon or late afternoon showers. Night-time precipitation is regular and accounts for the major proportion of rainfall totals for this season.
Flooding

As might be expected from the low topography and high rainfall of the region, overbank flows of river waters are a regular yearly event. Precise information describing the flood patterns in the area near Waira Village is unavailable. However, with the assistance of several geographers familiar with the New Guinea climate and the hydrology of the island's rivers I have developed a model which illustrates the general order of magnitude of wet season flooding in the research area. I discuss the procedures followed and my findings in Appendix 1. I must point out that I incorporate within the model a number of assumptions whose applicability to the environment discussed remains unresolved; therefore, the flood patterns predicted represent a rough estimate.

Figure II-4 illustrates the depth of weekly wet season overbank flows which could ensue from an annual, 5 year, 10 year and 50 year flood. The height of flood waters resulting from predictably common events, the annual and 5 year floods, most generally vary between 0.7 and 2.0 m. The peak discharge of stored rain-water during the first weeks of the dry season results in 1.5 - 3.8 m floods. Infrequent and dramatic overbank flows of 10 and 50 year flood events are catastrophic.

Although these findings are very provocative I hesitate to derive any but very general conclusions. I suggest that during most years wet season overbank flows are of sufficient magnitude to alter the landscape significantly. The level of flood waters throughout most of the alluvial plain would impede ready access to the area and possibly effect the subsistence activities conducted here. My own field observations suggest that even modest overbank flows serve to deter trips to the alluvial plain. Informants report using canoes to travel to lucrative hunting localities in the area during wet season floods. Furthermore, an early government patrol to the Pinini Creek region of the plain (Chinnery 1916a) records September flood waters varying from the officer's knees to his shoulder in depth.
CULTURAL ENVIRONMENT

The Kairi People

Today there are approximately 535 Kairi (Kikori Station Census Files 1975) living in eight villages (Fig. II-5). The area claimed by members of this group is roughly bounded on the north by a line extending from the headwaters of the Sire Creek to the middle reaches of the Pinini Creek. The southern border runs from the Tale Creek to the headwaters of the Veiru Creek. The Kairi subdivide themselves into five groups: Morere, Irimuku, Mati, Utiti and Sirebi Kairi. The area inhabited by the last three groups serves as the focus of this study.

Language

The Kairi speak a Non-Austronesian or Papuan language (Wurm 1975) belonging to the Turama-Kikorian Stock (Franklin 1973). Other members of the same group include the Mena, Omati and Ikobe peoples who live between the headwaters of the Turama and Omati Rivers. The mutual intelligibility of these languages and the high percentage of shared vocabulary cognates suggests a family-level relationship; however, Kairi evidences some linguistic distance from them and is currently assigned the status of a family-level isolate (Ibid.).

Beyond its stock-level associates Kairi demonstrates a close linguistic relationship with the Teheran language family which is situated immediately to the north (McDonald 1973). Based only on the inventories of cultural items Kairi shows a high level of affinity with all its neighbours. This is presumably a result of considerable cultural contact through exchange and the use of Kairi as a trade language among people living between the sea and Mt. Murray (Franklin 1973).

Oral History

The Kairi trace their origin to localities well inland from the coast. Sirebi Kairi report Sikitaripare Hill, near the headwaters of Wao Creek, to be the site of their founding village (Fig. II-6).
Utiti Kairi claim an ancestry originating at Mopi Hill, a volcanic formation situated near the present-day village of Baina. Following the sundering of the hill by Aiparu, the Kairi myth hero, a large portion of the people were transported on a broken segment downriver to Neuri Mountain (Aird Hills). The Kairi lived here until Aiparu and his brother Amau (Hito—cf. Austen 1931-32) quarrelled over a transgression by Amau's wife. Fearing reprisal Aiparu and the Kairi fled to the Huri Creek. From here the people migrated to the Omati and Veiru Rivers and the Mati Creek to the west, to the Sirebi River to the north, and to the Uwowe (Me'epa) and Era Rivers to the east. (A fair rendition of this story is reported by Woodward (1917c)).

The period between the mythological dispersal and traditionally remembered settlements is a lacuna of unknown duration. The Sirebi Kairi claim to be the descendents of the Sikitaripare Hill inhabitants who were left behind in the hinterland. After migrating to the headwaters of the Sire Creek, they moved in small numbers to Ibira and Yamurupo, near the mouth of the Sirebi River. From these villages the inhabitants moved inland to Nodoro and Pekematu just prior to initial European contact.

The Mati Kairi recognise Bageima as their first village site after dispersal. Following its abandonment they moved well inland to the plateau karst regions before returning to live near the headwaters of Mati Creek. By the time of European contact the Mati Kairi had relocated their settlements along Mati Creek.

The Utiti Kairi relate a more complex history of traditional settlement. They say that after leaving the Huri Creek they lived at Oheika near the headwaters of the Veiru Creek. Later they migrated to the karst hills north and west of the Utiti Creek. At this time the Ikobe reportedly shared the settlement at Komaiu. As a result of conflict between the two groups the Utiti Kairi established three new villages—Aeyapo, Kaepa and Kuruma—perched on limestone hills adjacent to the upper reaches of Arae Creek. Sometime before contact they moved to six village sites along the Utiti Creek, and for a brief time one segment lived on a limestone hill near the confluence of the Utiti Creek and Kikori River.
Documented History

The twenty-fifth of March, 1887 marks the terminus ad quem of Kairi prehistory.

From Barnett Junction the river wound round low hills for a distance of four miles, when, at a somewhat abrupt bend, two native houses on the summit of volcanic cones came into view. It was soon evident that the strange apparition of the steamer [Victory] gliding into these fastnesses was visible from the shore, as the mellow sound of the conch-shell was heard warning the inhabitants of the scattered village of danger. Slowly the steamer approached, and when abreast of the village, and opposite a creek, some canoes full of natives were seen paddling off in adjet terror ...

Seeing that the steamer had stopped, the natives of Tumu (as the hill-village was called) approached in their canoes, but very warily. As they neared the steamer, it was perceived that so pronounced were their friendly feelings that they had dressed their own persons with green boughs as well as their canoes. ... The next step was to bend a slip of Turkey-red cloth, a piece of sharpened hoop-iron, and one or two trifles on to a wooden batten, and let it drift with the current down-stream .... By such means confidence was promoted, and taking with me two men, I drifted slowly down in the boat towards the natives, and after overcoming their natural shyness, obtained bone-tipped arrows in barter, and taught the Tumuans to shake hands. (Bevan 1890: 190-91)

Ten days later, after exploring the headwaters of the "Philp" (Sirebi) River, Bevan returned to visit Tumu (Ru in Kairi oral tradition) Village. Unfortunately, his stay was short and his description of the people and their village is brief. Bevan passed by the village again later in the same year but did not stop as "there was no time now to be lost ....." (Ibid.:220) from his new discoveries.

Except for W. MacGregor's abortive attempt to explore the area five years afterwards (MacGregor 1893:44-45), contact between the Kairi and Europeans lapsed until Hubert Murray's visit in 1910 (Murray 1910: 3-9). The government station at Kikori was established two years later and no respite from contact has since ensued.
In order to reconstruct pre-European Kairi culture it is necessary to turn to the accounts of the early Australian administrators of the region. The "pacification" of the Kairi was swift and thorough. By 1917 government patrols had successfully reconnoitred all but the most inaccessible areas of Kairi settlement. By 1919 segments of the Kairi population had established residence along or near the major rivers.

Prior to this government-induced resettlement, the Kairi lived near or along inland creeks (Fig. II-7). At least some portion of Kairi villages were situated either on top of cone karst hills or nestled in the karst escarpment. These settlements consisted of two types of structures. Both were raised on stilts and in general resembled coastal housing styles (Murray 1910: 4). The men's house or *dubu daimu* (Ker) ranged from approximately 30 to 100 metres in length (Bevan 1890: 220; Murray 1910: 9; Chinnery 1916b). Informants report that it accommodated all post-pubescent males. Internally the *dubu* was divided into a series of sleeping platforms separated by fire hearths, which lined both sides of the central passageway. Flanking the men's house or either one or both sides was a line of smaller, women's houses, *moto* (Ker). Although not always internally partitioned, the women's houses were separated into cooking and sleeping areas. In contrast to these informant reports, Woodward (1917b) observed women also living in small cubicles underneath the *dubu* in one early Kairi village.

To the chagrin of government officials (Woodward 1919a) the Kairi, like many other Gulf peoples, spent much of their time away from the village. Temporary encampments or *kombati* (Ker) consisted only of rough shelters whose construction was hurriedly completed. When located near a village site *kombati* residence is reported to have been associated with fishing and gardening (Saunders 1921), but as they were never directly observed in use by government officials their existence is an unsubstantiated aspect of Kairi settlement.

Kairi *kombati* occurring well away from villages were seen on several occasions. Murray (1910) and Johnson (1920) report meeting groups of Utiti and Sirebi Kairi fishing and hunting along the Kuru Creek. Woodward (1919b) encountered Sirebi Kairi on a hunting expedition near the junction of the To Creek and the Sirebi River. Johnson (1921)
visited a fishing camp of the same people just north of the previously cited location. Of particular note is Chinnery's narrative (1916b). He reports finding Morere Village almost abandoned due reportedly to the collecting of turtle eggs near the headwaters of the Siribbi River.

Documentary evidence, with few exceptions, provides little information of Kairi food-getting techniques. There is no direct account of Kairi sago-making, no doubt because the event was so common. A number of observers (e.g. Chinnery 1916a; Johnson 1919; Zimmer 1925) attributed the small number of people met in villages to the processing of palm starch. Sagopals were seen growing in great numbers (Anon. 1916) and near villages (Murray 1910; Chinnery 1916d) in the Kairi region. These accounts when considered in light of those describing modest Kairi gardens (Bevan 1890: 194; Bastard 1923) suggest no major difference between traditional Kairi horticultural practices and those of today.

The Kairi both hunted and fished. Their use of canoes to exploit diverse and sometimes distant resource localities is frequently noted.

The Kairi appear to have been on relatively good terms with all their neighbours. MacGregor (1893: 44) and Murray (1919: 8) met small groups of Goaribari, the Kairi's nearest coastal neighbours, in the vicinity of Mati Creek. Ryan (1912a) observed eight separate instances of Goaribari en route to Kairi villages during the first four months of European residence at Kikori Station. By carefully noting these movements to and from Kairi villages Ryan confirmed the peaceful intent of the Goaribari to barter mangrove crab for tobacco (1912b). Friendly relations between the Kairi and their northern neighbours, the "Bara", are reported in the narratives of Kirby (1916), Brown (1919) and Austen (1930). The last observer proposed that the "Bara Villages ..... at present [are] a great trading site for Okani (Samberigi) people who come down and trade with the Siribbi and Ututi peoples" (Ibid.). West of the Kairi were the Omati and Ikobe people with whom the Kairi intermarried (Anon. 1916).

Cordial relations did of course breakdown from time to time, as was the case in the reported attack by Bagema villagers upon two Goaribari canoes (Thompson 1913). The frequency of such occurrences is impossible to determine. However, it is instructive to note the use of
"watch towers" by some villages (Anon. 1916; Chinnery 1916c; Woodward 1917) and the "magnificent view of the surrounding country" obtained from atop cone karst hills (Ibid.).

Extant Kairi villages in 1925 are indicated in Fig. II-8. By this time the government's resettlement programme had successfully persuaded the Kairi to locate all their villages within easy access of Kikori Station. The people continued to build separate men's and women's houses but now, at the government's insistence, enclosed the entire landward side of the village in a sturdy fence (Leonard 1922). Also under the direction of patrol officers the Kairi stopped their practice of "depositing a lot of rubbish close to houses ...." (Johnson 1919) and began throwing their refuse into the rivers. Census figures for 1923-24 (Bastard 1923; Chance 1924) record a total of 322 Kairi: 115 Sirebi Kairi, 195 Utiti Kairi, 100 Mati Kairi and 42 Kairi living at Irimuku. Of particular note for this study, the predecessors of the people now living at Wairi village moved from Nodoro to Poialaviti during the last months of 1918.

Between 1926 and the early 1960's only a few minor alterations occurred in the Kairi settlement pattern (Fig. II-9). In 1929 (Blyth 1929) the people at Kiginu resettled with other Utiti Kairi villages. Short-lived villages such as Hori (Hall 1933) and Waisiwi (Ethell 1939) appeared but were soon abandoned on orders of the Kikori Resident Magistrate (Chance 1941). The one new village to gain government sanction was Oboro. This settlement was established in 1941 (Ibid.) and, from my informant reports, consisted of Utiti and Omati Kairi.

During this period the population structure of the Kairi villages changed dramatically. Village absenteeism increased from three in 1927 (Chance 1927) to 100 in 1965 (Kikori Station Census File 1965). In the majority of cases this was due to young men leaving their villages to take up government or plantation employment.

SUMMARY

While the contemporary subsistence and settlement modes of the Kairi bear little evidence of over 100 years of European contact and administration, there have been notable changes in three areas: material culture, village residence patterns and the geographical focus of primary settlement sites. The full extent of these alterations will
be discussed in the chapter which follows; however, they are worthy of mention here to preface the detailed discussion of contemporary and contact land-use systems (Chapter 4).

The contemporary material culture is replete with the products of Western society. Most items are utilitarian and serve only as a convenient alternative which increases leisure. Metal pots appear in most village kitchens but their use in the storage of drinking water and the preparation of meals is rarely preferred to traditional bamboo containers. All Kairi men own steel axes and knives and pay careful attention to their upkeep. There has certainly been a decrease in the amount of time devoted to the felling of trees, construction of canoes and manufacture and repair of wooden implements, but the time gained is infrequently used for additional work projects. As will be discussed later in more detail (see pp.36,42), the shot-gun and nylon net have expanded the available resource areas and the periods during which game and fish may be captured. However, the incorporation of these items into the material culture has not replaced items belonging to the traditional technology. Finally, the recent introduction of outboard motors greatly facilitates travel to and from Kikori station and to distant resource areas near the headwaters of the Sirebi River.

The traditional village pattern of separate men's and women's houses has today been replaced by moderate-sized family dwellings. The extent to which this reflects changes in the structure and conduct of traditional social relationships cannot be directly assessed. However, the absence of traditional ceremonies, for example the "Burugu" (Woodward 1918), and the carving of "ancestral boards" (MacFadzean 1977: pers. comm.) denote a modification of the social system which is perhaps paralleled in the change in residence patterns.

The geographical reorientation of village sites from the area near the karst escarpment to localities along the major rivers is, with respect to this study, a significant point of distinction between traditional and contemporary Kairi land-use patterns. The closure of resource areas on the alluvial plain during wet season flooding would not have seriously disrupted the acquisition of animal foods for people living near the karst margin. The movement of pigs, wallabies and other game animals to inland areas during this time of the year affords a substitute for inaccessible riverine resources. The remoteness of traditional villages provided some margin of protection from sudden attacks by hostile groups and from catastrophic floods.
CHAPTER 3

WAIRA VILLAGE ETHNOGRAPHY

The structural components of contemporary Kairi land-use, the people's subsistence techniques and their modes of settlement, are discussed in this chapter with special reference to Waira Village. This analysis aims to describe the present-day subsistence technology, to identify the range of exploitation and settlement strategies applied to each mode of food procurement and to note aspects of the natural environment which effect the availability or accessibility of specific food resources.

WAIRA VILLAGE AND ITS PEOPLE

Waira Village is situated along a low-lying river levee just upstream from the junction of the Sirebi and Kikori Rivers (Fig. II-1). With the establishment of Poialaviti Village on the opposite bank of the Sirebi River (see Chapter 2), this area served as an occasional site for village gardens. Prompted in part by a strongly propagandized government policy to initiate cash-cropping projects Tovi Aupoae, a Poialaviti villager, cleared a large area of high ground lying inland from the gardened area and planted a grove of coconut palms. At the same time he felled a portion of the rain forest in the adjacent lowlying area and transplanted sagopalm suckers from the Poialaviti stand. Early in 1961 Tovi persuaded his fellow villagers to relocate their settlement at Waira. Members of Oboro Village (see Chapter 2) moved to Waira a few months later after purchasing a strip of land extending from near the Sirebi/Kikori river junction to the middle of the current village grounds. Subsequently two households from Tutugi Village set up residence at Waira, but they acquired no land in the village or surrounding area.

The residential units forming the present-day village (Fig. III-1, Table III-1) still reflect the social groupings associated with Waira's settlement history. The Poialaviti community lives in the northeastern segment of the village and consists of nine nuclear families. Each of
these is interrelated on the basis of extended kinship ties. Within the Poialaviti group no clear distinction is made between family unit and house of residence. For example, affinal and cross-generation ties establish the kin relationships of the residents of House 1 (Table III-1), with the exception of Ket and Eri (BDa). Also, houses of residence are not fixed, as shown by the continuous flux in the composition of House 4 during my stay in the field. Therefore, food producing and consumption units are not necessarily equateable in the Poialaviti community. Although there is no structured pooling and redistribution of food resources, the fare of morning and evening meals is usually shared by all members of the community.

The Oboro community occupying the southwestern portion of the village is made up of two family units related consanguinely. Also one unmarried male of an unknown relationship was on an extended visit at Waira from his job in Port Moresby. Each family maintains a separate residence. Although members of both sometimes share work tasks, each group operates as an independent production/consumption unit, unless one suffers shortage or enjoys surplus.

The two households originally from Tutugl Village live separately and function independently of one another. Arising primarily from his position as a local government officer, Porokae has usufruct rights to garden land owned by both the Oboro and Poialaviti communities. His family may also process starch from palms adjacent to Waira Village owned by the Poialaviti group. With the exception of prestations Porokae's family does not participate in food sharing with other Waira communities.

Peter's household is, on the other hand, closely integrated by affinal ties with the Poialaviti and Oboro communities. His first wife Umona is a distant relative of members of the Poialaviti group. Through this kin relationship Peter has obtained access to hunting tracts near his land holdings at Waemau. Peter's ties with the Oboro community are much closer because his second wife Ape is a direct descendent of the original inhabitants of Oboro Village. His family therefore has unquestioned rights to process sago from the palm stand near the old village site. Peter's household is a frequent benefactor and beneficiary of the other two village communities in respect to surplus fish and game.
MODES OF FOOD PROCUREMENT

The following discussion of contemporary subsistence techniques and strategies among the Kairi is founded solely upon informant testimony. This method was the only technique available to an observer whose daily work schedule included archaeological excavations at sites well away from Waira and the most frequented work localities of the people. To minimize the distortions of hyperbole or misinterpretation numerous interviews were conducted on both informal and formal bases with men and women living in Waira and Kopi Villages. Informants from Waira who demonstrated consistency in their statements during follow-up discussions were frequently approached throughout the study period for casual, late evening talks. Although lacking the structure of formal interview such discussions greatly clarified my understanding of Kairi land-use as they generally dealt with day-to-day activities and thus the nuances of the Kairi subsistence-settlement strategies.

Plant Use

The Kairi practise three forms of horticulture: sagopalm cultivation, swidden gardening and rudimentary silviculture. The scale of each of these subsistence modes varies directly with the site selected and perceived dietary requirements. Initially attention centres on edaphic conditions and their potential to meet the nutrient and ground moisture requirements of particular crops. However, since these prerequisites occur at numerous localities within an individual group's landholdings, the distribution of cultivated plant resources is a unique indicator of a series of decisions regarding subsistence needs and how they are met.

Sagopalm cultivation and exploitation

The alluvial plain surrounding Waira Village affords all but one of the environmental preconditions necessary for the healthy growth of Metroxylon palms. Although the water-table is on a yearly average high, it is insufficient to inhibit the establishment of a climax lowlands rain forest. Hence sagopals only appear naturally
as a minor component of the lower tree strata. In order to promote a dense stand of *Metroxylon* palms the local environment must be altered to favour the growth of the palm (see Appendix 2).

The pioneering of a sagopalm stand demands a significant input of labour before any subsistence returns can be realised. Rainforest on the selected site is first felled. When a large portion of the canopy is removed palm suckers from an established or natural stand are transported to the site and planted in deep holes made with a wooden dibble, without any preparation of the soil. Over the first four years, during which time the palm's bole develops, all natural regrowth is conscientiously cleared from the area. After this, until individual palms reach maturity some three to eleven years later, the "weeding" process need not be as rigorous. When starch exploitation begins the natural regeneration of palm suckers is ensured simply through the felling of a palm nominated for processing and the clearing of undergrowth from around the work site. Some individuals continue clearing around the base of palms on a casual basis after the initial harvest. However, the long term integrity of the stand demands regular felling of immature, high-canopy tree species.

Five sagopalm stands (Fig. IV-1) are utilised by the people of Waira Village. The Oboro community only exploits a 17.5 ha. stand which was established approximately 35 years ago adjacent to their prior settlement site. Peter's household processes starch from two stands, the Oboro stand and a small grove comprising only a few hectares and situated at a site named Waemau. The Poialaviti community has the greatest holdings of sagopalms. The 18.6 ha. stand adjacent to Waira Village is regularly exploited for starch. Since the Waira palm plantation was established in the late 1950's it represents the most recent instance of pioneering a sago stand. The 16.7 and 14.9 ha. sago stands at Poialaviti and Nodoro are only utilised occasionally for starch - the latter one so infrequently that the rain forest has almost regenerated.

Hereditary group ownership of individual palm stands is followed at Waira and is probably sustained by the excess of readily available palms. The decision to fell a particular palm for starch production or the cultivation of sago grubs normally resides with
an individual producer. However, persons may insist upon the privilege to nominate how certain sagopalms may be used, as in the case of one man's prohibiting the exploitation of a palm planted by his deceased father. If palms are planted outside the bounds of the primary stand, at garden sites or in the vicinity of distant, family hunting tracts, exploitation rights remain with the individual who planted the palm and his or her descendants.

Two implements are used during the exploitation of starch from sagopalms. The first is a steel axe which is used to fell the palm. Before European contact a ground stone blade obtained by trade with the North Kairi living along the Iehi Creek or the Aurai to the east was employed instead. The traditional stone axe was hafted in a wooden socket which was placed in a hole cut through the bulbous end of the handle, moto (K) (Plate III-21).

The second is a pith chopping implement (Plate III-9) which is manufactured for this task alone. The tool's handle, which has a branch fork at one end, is lashed with plant fibre (Gnetum gnemon) to the wooden arm bearing the stone tool. A tension cord is bound to the ends of both. The chipped stone tool, which is secured in its haft with rattan bindings, is still manufactured by men of the village from river cobbles found near the headwaters of the Sire Creek (Fig. II-5). The tool's production (Plates III-1 - III-8) begins with the bifurcation of the core with a sharp percussive blow. The freshly exposed surface is then used as the platform for the removal of lateral trimming flakes. If the desired conical tool form is not achieved, the lateral margins are further reduced by light percussive blows struck at roughly right angles to the tool's length. The production sequence ends with light step flake removal along the entire edge of the implement's working face.

Occasionally a black chert chopper is purchased from the inhabitants of Baina Village during visits to the government station at Kikori. Although many sago users in the Gulf area have now replaced their wooden or stone sago chopping implements with a short length of steel pipe, the women of Waira stubbornly maintain the stone chopper is of superior quality.
Starch production typically commences when the terminal inflorescence nears flowering. Exceptions arising from immediate starch needs occur, particularly with small groups living away from the village, but the Kairi prefer to wait until "the trunk is full of sago". Starch yield studies conducted on the *Metroxylon* palm by Sim and Ahmed (1977) support this informant observation. Another pertinent factor for exploiting only mature palms may be that sucker development does not begin until this time (Paijmans 1976: 43), but informant testimony does not refer to this notion.

Men or women fell the palm. Prior to felling, young suckers around the palm's base are indiscriminantly cut back to allow direct access to one side of the bole. The palm is felled (Plate III-11) at a point roughly 75 cm up the bole. A small platform of sago leaf stems is often constructed near the base to allow a purchase from which to strike the palm. Once the resilient bark is breached a portion of the exposed pith is removed and sampled. If it is judged "too watery" another palm is selected for exploitation.

After the palm is felled women perform all the tasks. Work groups usually consist of two people: a married or widowed woman and her adolescent or pre-adolescent daughter, or two unmarried women in their late teens who are either sisters or members of the same generation of an extended lineage. Although this is the general case exceptions do occur. As well, the membership of the group initiating exploitation is sometimes changed and sometimes the group itself may be completely replaced by another.

Before starch processing is begun a work area is prepared. The area surrounding the fallen palm is cleared of undergrowth so that free movement around the bole is possible. The women then remove a number of sago leaf petioles, stems, and fronds from the fallen palm's crown. The fronds are used to erect a small lean-to which provides shelter from the rain. The stems and leaf petioles are carried to the nearby starch washing site and used to construct a processing platform (Plate III-12, III-13).

The lower portion of the washing stand is formed by placing two leaf petioles or stems parallel to one another approximately one metre apart. On top of these two leaf stems are laid at right
angles to the base material. Next, a woman embeds four parallel rows of short sticks in line with the bottom petioles. Two black palm (*Areca* spp.) leaf sheaths are wedged between the rows of sticks thus forming the starch settling troughs. Finally, two sections of sago leaf stems are placed close together on top of the petiole lattice. When the washing platform is completed the women turn their attention to digging a shallow well in the forest floor to provide the water necessary to wash the starch from the pith. By working steadily the women can easily prepare the work area in about three-quarters of an hour.

Starch production starts with the delineation of a section of the bole (beginning at the base) from which starch will be extracted during the work day. The spiny leaf scars, if present, are cut away from the trunk. The bark is split with an axe to the desired length and prised back with a sharpened stick. Along the side where the women work the bark is propped up with cut lengths of mature saplings. This bark seat provides a comfortable and elevated position from which to chop the pith (Plate III-14).

Sitting facing the palm's trunk, a woman chops the pith with steady, rhythmic strokes ending with a sharp flick of the wrists. The pith is scraped away with the outer edge of the stone acting as the focus of impact. After a large pile of minced pith accumulates at the woman's feet she further pulverises the fibres with the chopper's concave face. The pith is then loaded into an all-purpose bag plaited from bark, e.g. *Broussnetia papyrifera*, and transported to the washing platform (Plate III-15).

Differing from the majority of New Guinea sago users the Kairi process starch from the pith using only the carrying bag as the washing vessel and pith strainer. The crushed plant fibres are first saturated with water carried from the well in a baler fashioned from a black palm leaf sheath. Standing atop the washing platform the woman presses her foot firmly on the bag and using a rocking motion, squeezes the starch-laden water into the settling troughs below (Plate III-16). This process is repeated a number of times until the water from the bag runs clear. The depleted pith is then cast away to one side of the platform. Several times during the day a portion of the water in the troughs is drained off so that the freshly processed water will not spill over the sides before
the starch has sufficient time to precipitate. At the end of the day's work all the water is emptied from the troughs and the white, pasty starch is scooped into the carrying bag for transport back to the village (Plate III-17). If the starch has not had sufficient time to settle or the women choose not to carry it back to the village, palm fronds are placed over the platform to shelter the sago from rain. Alternatively a woman may put the starch in an oblong container fashioned from *Metroxylon* fronds and store it on a loft constructed nearby or in a garden hut (Plate III-18).

The processing of sago involves a full eight hour work day, including canoeing and/or walking to and from the work site, as well as a number of rest periods. It is not unusual for other, short term work tasks to be performed as well during the day, such as harvesting garden produce, the fetching and carrying of water in bamboo segments and the collection of firewood.

No direct observations of palm productivity or processing efficiency were made. Relevant information was collected by monitoring the sago larders of three households (one control group and two selected randomly). For six five-day periods throughout my stay at Waira the starch reserves of all three households were weighed morning and night. During this study it became evident that the weights recorded were biased because they did not account for the sago left in the settling troughs before or after each period or for the starch stored away from the village. The figures listed in Tables III-2 and III-3 are therefore, minimum values of the actual yield.

The starch content for eight boles for which an estimate could be made ranges between 62 and 303 kg, with a mean of 221 kg. The rate of sago production recorded for village women varied from 15.5 to 40.0 kg per work day (Table III-3).

Assuming an eight hour work day and making no allowance for travel time, rest periods or other activities, a woman produces on an average of 2.6 kg of starch per hour. Using Hale and Williams' conversion ratio of 362 Kcal (1,513 Kjoule) per 100 g of palm starch (1977: Table A.1.4) this production figure is equivalent to over 34,000 Kjoules per hour.
Plate III-1  General view of a Sire Creek quarry site

Plate III-2  Sago chopper manufacture sequence:
Initiating core reduction
Plate III-3  Sago chopper manufacture sequence:
Second attempt to bifurcate core after an initial mishit

Plate III-4  Sago chopper manufacture sequence:
Initiating reduction of lateral margins
Plate III-5  Sago chopper manufacture sequence:
Removal of a side trimming flake

Plate III-6  Sago chopper manufacture sequence:
Continuing to modify the lateral margins
Plate III-7  Sago chopper manufacture sequence:
Initiating retouch of the platform edge

Plate III-8  Sago chopper manufacture sequence:
Completing the retouch
Plate III-9  Contemporary sago chopping implement from Waira Village
Plate III-10: Starch production sequence: *Metroxylon* palm with inflorescence just appearing

Plate III-11: Starch production sequence: Palm felling
Plate III-12  Starch production sequence:  
Construction of the trampling platform

Plate III-13  Starch production sequence:  
Completed platform and water carrying container
Plate III-14  Starch production sequence:
Pith chopping

Plate III-15  Starch production sequence:
Collection of minced pith for washing
Plate III-16  Starch production sequence:
Removing the starch from the pith

Plate III-17  Starch production sequence:
Collecting the processed starch
Plate III-18  Starch storage rack in the Oboro sagopalm stand
Gardening and Silviculture

At first glance Kairi gardening practices may strike the Western observer as casual and *ad hoc*. Within broadly defined lineage groups rarely is there any consideration given to rigidly delineating the location of swidden gardens or specific, family plots in a single garden. A strict adherence to following is not necessarily followed as gardens still being harvested are cleared of invading weeds and replanted. Moreover, the range of crops cultivated at any site varies greatly and the content of gardens represents a strong preference for a diverse diet and not a dependence on any one plant species. The role gardens play in the economic (subsistence and non-subsistence) structure of the people and their geographical placement evidences a sophisticated management of resources.

The Kairi distinguish two types of gardens, "village" or primary gardens and "bush" gardens. In construction, maintenance and composition they may differ very little, although bush gardens typically receive less attention and concomitantly less labour input. As implied by their titles, the distribution of each garden type is distinct. Village gardens are generally situated within a half of a kilometre of Waira, bush gardens at a distance greater than 1.5 km along or near a track to other resource areas, such as sago stands or favoured fishing locales.

In selecting a garden site a Kairi man or woman first makes a general assessment of soil fertility. The evaluation procedures are rarely complex. Memories of the productivity of past gardens or the maturation rate of tree crops provide the key criteria. Occasionally the ground surface below the leaf litter is examined to ensure the desired mixture of humus and sand is present. The Kairi do not attempt to promote soil fertility through planting soil-enriching tree species, as is the case in other areas of Papua New Guinea (cf. Brookfield and Brown 1963: 50-51). However, the mixture of leaf detritus and soil from bush hen nests is infrequently spread over the garden surface prior to planting to provide temporary soil enrichment. Similarly, large trees (primarily *Ficus* spp.) are felled at projected sites for bush gardens and allowed to decompose before planting is initiated.
Both men and women participate in all gardening activities and except in the rare instance when large communal gardens are constructed, the nuclear family or household is the primary labour and ownership unit involved in garden construction. Men fell only small-girthed trees, except that sometimes large trees are felled to promote colonisation by grubs. The women clear the site of vines and undergrowth vegetation. During the dry season all cleared litter is left in place and burned (Plate III-19). In the rainy season it is merely deposited along the garden margin.

As the Kairi do not fence their gardens all that remains is planting. A wide variety of crops is cultivated (Table III-4). Men and women assist in planting with no apparent concern about the plant types each may cultivate. Although the primary purpose of garden crops is fulfilling short term subsistence needs, the Kairi plant a number of trees whose crops will be eaten well in the future. Prominent among these are pandanus (*Pandanus conoideus*), breadfruit (*Artocarpus altilis*), okari (*Terminalia* spp.) and Malay apple (*Syzygium malaccense*). Non-subsistence plants are also cultivated in gardens, the most familiar of which are *Derris* spp. for fish poison, *yaemi* (K) for canoe logs, *Broussonetia papyrifera* for plaited carrying bags, *Areca catechu* for stimulants, *Nicotiana tabacum* for smoking, *Bambusa* spp. for cooking and water storage vessels and *Areca* spp. for bows and house flooring.

Until the harvesting of the first crop of leaf greens (*Amaranthus* spp., etc.) gardens are carefully weeded. Thereafter, only sporadic attention is given to the removal of regrowth vegetation (Plate III-20). With the harvest of the "fourth crop of bananas" all maintenance ceases. One exception is the upkeep of a few bush gardens which are located in frequently visited areas or whose crop of okari fruit is nearing maturation; in such cases maintenance is continued for several years.

In 1976-77 the people of Waira cultivated approximately 0.8 ha. in village and bush gardens (Table III-5). Village gardens were the primary source of garden produce, crops from bush gardens infrequently formed a part of meals consumed at the village. Bush gardens did, however, provide a regular component of the diet during non-village residence. Since virgin land suitable for
cultivation is in ample supply near Waira there is no indication that gardens have ever been concentrated only in the vicinity of the village. Only a drastic reorientation in the diet toward garden produce would precipitate a change in the present-day gardening pattern. Thus, the village garden/bush garden dichotomy appears to be real and an integral part of the village/temporary encampment settlement pattern of the Kairi.

Like many other groups in New Guinea the Kairi promote the growth of a number of tree species. Much of the time this simply takes the form of allowing economically important plants to remain at sites designated for other uses, such as gardens and sago plantations. However, the Kairi encourage the regeneration as well as the extended distribution of selected species which always includes the okari, betel nut palm and tulip tree. When replanting occurs the most favoured sites are along frequented trails or near canoe moorings.

In summary, the Kairi exhibit a great deal of flexibility in their economic demands on gardened resources. Lacking the constraints accompanying a nearly total reliance on garden produce to furnish primary subsistence requirements, the people achieve considerable flexibility in utilising their environment to meet short and long term needs.

Gathering

The gathering of wild plants occupies only a minor role in Kairi subsistence activities. Except for the leaves of Gnetum gnemon and Hibiscus manihot, both of which occur in cultivated and semi-cultivated states, few wild plants (Table III-6) are consumed. Such food items rarely appear in village meals.

Animal Husbandry

Domesticated animals play a minor role in the Kairi diet. Pigs, chickens and to a lesser degree cassowaries are eaten only at important feasts, which occur sporadically. Allowed to roam at will through the village, chickens and cassowaries feed on food scraps
the exploitation of fish in the major rivers. For the most part the Waira villagers select the junction of the Sirebi and Kikori Rivers to set their nets. While I was in the field the people expressed great consternation concerning the unreliability and small size of fish yields and new sites further up the Sirebi River were increasingly used.

It is difficult to judge whether or not the indecision about the selection of net sites reflects unfamiliarity with a new resource zone or the failure of a perceived technological advantage to meet expectations. However, the participation of women in nylon net fishing possibly supports the former explanation because traditional fishing does exhibit a sexual dichotomy in the types of fishing implements employed.

The fishing patterns of women have changed more radically in the post-contact period than those of men. In the past, women fished only during the dry season and in groups of between four and six individuals. Across small creeks they constructed two "fences" of closely spaced sagopalm leaf stems. The water ponded between was bailed out using large sagopalm leaf petioles until it reached a depth of 30-50 centimetres. The trapped fish, eels, turtles and crayfish were simply gathered by hand. If the haul was insufficient (i.e. "all the women's bags were not full") the procedure was repeated.

Today, women fish using only nylon line and steel fish hooks. Although they still exploit the small creeks, the primary focus of their fishing activities has now become the major rivers. Usually alone, but occasionally in the company of a female relative or age-mate or husband, women spend up to four or five hours at a time fishing along the river banks. Individual women demonstrate a marked preference for specific fishing sites. Earthworms, grasshoppers, tree grubs and prawns are said to be used as bait, but it was difficult to monitor in what frequency.

Until now the discussion has focused on sexually distinct and primarily individual or small group fishing patterns. Three important examples of communal fishing remain to be described. The first is focused at the large doline ponds found in isolated localities on the alluvial plain or concentrated along the karst escarpment (Plate III-24). As these ponds are continually restocked
by river inundation or the migration of fish up the small creeks which drain them, they are important resource sites. The technology available for their exploitation is limited and only effective during the dry season, when the water-level is low. At this time large groups of men and women visit the ponds, sometimes for a number of days. Using only fish poison they catch large quantities of fish, eels and turtles. Individual ponds may also be exploited more than once if the pond is big enough or subject to frequent flooding.

The large creeks forming the headwaters of the Sirebi River are the other areal focus for communal fishing. At the beginning of the wet season, from late May to early July, large numbers of mullet congregate in these waters to spawn. Attracted by this resource and the abundance of terrestrial fauna which remain accessible throughout the wet season (see following discussion on hunting), a lineage group and invited guests numbering up to 25 individuals camp in the area for upwards of six to eight weeks at a time.

Traditional dry season exploitation of the same resource area also included communal fishing. Large river boulders were used to construct a dam across a moderate-sized waterway just downstream from its junction with another similar-sized creek. The upstream side of the stone wall was also covered with the large leaves of the opona (K) tree. When the water-level in the channel below the dam dropped significantly fish poison was cast into the water. The stunned fish and turtles were then collected by hand.

**Hunting**

Kairi men are the sole providers of hunted game. Armed with a shot-gun and the traditional hunting equipment, a black palm bow and an assortment of arrow types, individual men range at irregular intervals through their lineage reserves. Hunting is an extremely generalised activity which is rarely designed to capture or kill a single animal species and is often associated with fishing. Successful forays into the rain forest are usually the result of prior assessments of the game potential of a specific area arising from repeated observations of possible feeding and watering sites, game trails and dens or wallows. As well as skill and acumen, a great deal of tenacity is required of the hunter, particularly during
the rainy season. Although it is improper to assign the titles of hunter or fisherman to individuals, many Kairi men avoid hunting and rely heavily upon fishing to supply their family's protein requirements.

The Kairi recognise 37 ethnozoological species of hunted game (Table III-7). Since the general environment is homogeneous and thus lacking any clear-cut ecozones, the hunted resources are distributed evenly throughout the rain forest surrounding the village. Despite this, the entire inventory of game is not accessible year-round. The hunting technology and seasonal floods provide a number of constraints causing modifications of hunting strategies.

In order to portray these variations the following discussion employs an arbitrary grouping of game into classes defined mostly by where they are found by hunters within the vertical zones of the rain forest - ground, low canopy, high canopy and stream bank-dwelling animals.

Ground dwelling

Terrestrial fauna supply the major portion of hunted game, with pig and cassowary being the most eagerly sought. On most occasions the heat of pig and cassowary scats and the presence of water in their spoors alert the hunter to the relative proximity of his prey. Since pigs are judged to feed in a consistent and repetitive manner, the content of scats and a knowledge of the distribution of the plant food in them form the primary basis from which a hunter establishes a pig hunting strategy (Table III-8). The haphazard feeding pattern of cassowaries, on the other hand, precludes the application of such information. After long rainless periods in the dry season the demise of most watering sites in the rain forest lures both pig and cassowary to small, year-round creeks. Kairi men claim kills to be more prevalent at this time because the hunting range becomes more restricted.

The strategy applied to hunting pig and cassowary generally reflects a close juxtaposition of hunter and prey. The density of vegetation in the rain forest limits effective hunting with bow and arrow or shotgun to distances of roughly 20-25 metres. The possibility of losing a wounded animal in the bush as well as the chance that it might attack men and women travelling through the area demand a high
expectation of success before a kill is attempted. Sometimes a hunter lures a pig to a specific location by exposing the pith of a recently felled sagopalm. By returning to the site a few days afterwards and waiting patiently behind a blind constructed of palm fronds for a number of hours, the hunter is normally rewarded with a kill.

Until recently, dead falls and snare traps were employed as an alternative to stalking pig and cassowary. The construction of a dead fall, *keipai* (K) to kill pig was a laborious process involving the co-operation of a group of men. Using a felled sagopalm as bait the men positioned a large tree trunk overhead, resting one end on a moveable support. One end of a vine rope was secured to a wooden peg embedded half-way along the palm's bole and the other was tied to the log support. Once the construction was completed the area was cleared of refuse to restore a pristine appearance. The men then abandoned the site for several days. The trap was sprung when pigs rooting through the pith removed the peg and thus released the tension on the vine cord. This caused the support brace to fall and the log descended on the prey below. Informants claimed the *keipai* to be quite useful as several pigs were often killed at a time.

The noose snare, *ipuwau* (K), was used only in capturing cassowary. Hung from a branch above a trail indicating recent use by cassowary, the *ipuwau* was simply a lasso formed on the end of a vine which tightened with tension. The noose snare has long been out of use; therefore, informants were uncertain as to its success rate.

The other types of hunted terrestrial game are the wallaby, bandicoot, *keipu* (K) - ?*Dactylopsila* sp., and the various species of bush hens and megapodes. In hunting wallaby and *keipu* a man relies on fortuitous sightings during feeding periods to make a kill. Bandicoots are usually trapped in their dens and dispatched by prodding the interior with a sharpened stick. Very rarely a man constructs a smaller version of the dead fall trap, *kei hano* (K), baited with a sago grub and places it near a bandicoot feeding site. Ground-dwelling fowl appear to be more actively sought than any other animal except pig and cassowary. Potential feeding sites and the mounded nests of megapodes are regularly investigated for evidence of recent activity. Often men construct palm leaf blinds near these sites or at localities
in the sago stands where palms are currently being exploited or where a palm has been felled for a pig lure. Lizards, rats, frogs and small cave-dwelling bats are reportedly hunted. Some men even construct a small version of the kei hano baited with sago pith to trap rats (Plate III-22). General observations made during field research suggest that the occurrence of such game in the Kairi diet is rare and extremely haphazard.

In contrast to the above, the Kairi report the occurrence of communal hunting specifically in the wet season. During periods of prolonged and extensive flooding of the alluvial plain pigs, cassowaries and wallabies seek refuge from the rising water on small isolated knolls which are present throughout the area. Before the waters fall, groups of men and women canoe to these localities to exploit the reportedly large congregations of game. A human wall is formed around the hill and slowly tightened until the game is closely grouped and easily killed. The animals fleeing down the slope are caught by hand and/or killed with a wooden club or axe. Incredible as it may seem, informants claim that pig and cassowary are not permitted easy escape through the line and individuals prohibit such by grasping a pig's ears or a cassawary's neck until they can be clubbed or shot.

If shotguns are used during communal hunts, the group size may decrease to several well-armed men who assault rather than surround the game. Alternatively, the line is shortened to encompass only half of the hill and the game is driven past a group of armed men on the opposite slope.

**Lower canopy**

Phalangers and snakes comprise the two classes of lower canopy fauna exploited by the Kairi. Usually, all four ethnozoological species of phalangers are hunted during twilight periods when their movement as they feed attracts the hunter's attention. Since these animals remain immobile for most of the daylight hours, only chance spottings result in a kill. Prior to the introduction of the shotgun, the only effective means to kill phalangers was by bow and arrow as they fed among the lower tree branches or to fell the tree in which they slept and then club them to death. Snakes are no longer eaten
by the people of Waira and such has been the case since before
contact. Traditionally, however, men climbed the tree in which a
snake was observed sleeping and killed it with an axe or club.

**High canopy**

The exploitation of flying foxes and birds living in the
high canopy posed special problems which have greatly diminished with
the introduction of the shot-gun. Today the hunter need only sight
the game and fire. Before contact procurement techniques were more
complex. Flying foxes were only accessible during the rainy season
"when their sleep is deeper" and they were unaware of men felling
the tree in which they roosted. I was somewhat sceptical about such
a practice until it was twice attempted during my stay at Waira.
Both efforts proved unproductive and immediately after the second
occurrence the two participants returned to the village to fetch
shot-guns before they assailed another well-stocked tree.

To hunt the hornbill, cockatoo, pigeon and large parrots an
igloo-shaped blind, *kaimi* (K), was constructed from palm fronds in
the upper portion of a *maki* (HM) tree (*Ficus* spp.) or in another tree
adjacent to a *maki* or a *Caryota* palm. While these birds fed on the
fruit of these trees, the hunters lying in wait in the blind would
shoot them with arrows fired through sighting holes in the wall. The
bird of paradise and one type of large parrot, *kamo* (K), were also
hunted in the same manner, the only difference being that the blind
was situated adjacent to a fruiting pandanus.

**Stream banks**

This hunting resource zone is of little important for the
acquisition of game. Crocodiles, lizards and water rats are the only
animals which occur exclusively in this habitat and Kairi men show
very little interest hunting them. Crocodiles are scarce in the
area near Waira Village and trips to the headwaters of the Sirebi
River, where they are more plentiful, are concerned with the procurement
of other subsistence resources (see p. 38) as well as the hunting of
crocodiles for their skins. Lizards appear sporadically in the diet,
but they are usually killed during fishing rather than hunting
expeditions. Water rats were never noted in the inventory of kills,
for the village.
The possibility that women will capture game should not be overlooked, particularly with respect to animals they encounter while working in the sago plantations or fishing along bush creeks. I have little doubt that if an opportunity is seen it will be pursued. Such captures will probably be eaten in the bush and therefore not be included in the game returns consumed in the village. However, the incidence of women providing hunted game was never observed and the possibility of it occurring never arose in conversations. Perhaps in a setting where riverine resources are so plentiful, unlike that studied by Morren (1974: 285-86), minor game resources which might be procured by women play an insignificant role in the diet of the people.

Collecting

The collection of animal food is most usually characterised by short but intense periods of activity and performed by women and young children. Small seasonal creeks, sagopalm stands and gardens are the major foci of this subsistence activity.

Small Creeks

Crayfish, prawns and fresh-water shellfish are the fauna collected, mainly during the dry season, in this resource area. As the water-level falls in the small bush creeks large stretches of their banks are exposed and the nesting grounds belonging to these species become available for profitable exploitation. Working only a few hours in the early morning, women walk along the stream course collecting individual shells, crayfish and prawns by hand and storing them in their carrying bags. The task is laborious, but the returns are substantial and, as delicacies, supply a pleasant variation to the diet. During the rainy season only two types of gastropods, *kipiri* (K) and *towoi* (K), and prawns are easily found and a catch comparable to that of dry season gathering is possible only by a significant lengthening of the work period.

Sagopalm stands and gardens

Individual palms are felled or unworked portions of processed palms are nominated for the curation of sago grubs. After remaining
untouched for a few weeks the bole is split open and the beetle larvae inside collected. Another species of grub is obtained in a similar fashion from trees felled during garden construction. The importance of sago grubs in the Kairi diet appears to be minimal in terms of the frequency of collection. However, their importance to the people is indicated by the fact that the misappropriation of sago grubs is cited in the oral history as the source of intra-village feuds, which in one story resulted in the resettlement of a portion of one village's inhabitants.

In exception to these examples, men and women form collecting parties most years to exploit the eggs laid by salt-water turtles in the sand banks along the large creeks which flow into the upper reaches of the Sirebi River. Today, these groups vary greatly in size and are often comprised of members representing several landholding groups and possibly different villages. The period during which the eggs are collected lasts from September to early November. Groups stay in the area for a few days to over a month.

ASPECTS OF KAIRI SETTLEMENT

Today all Kairi villages have adopted a more European style of housing with the omission of the men's house and a pronounced emphasis on family-sized units, which are divided into living, cooking and sleeping rooms. With the exception of Kopi Village the population of each Kairi village remains equivalent to the range of from 15 to 60 people observed at contact (cf. Woodward 1918). The presence of the mission station and a government aid post has resulted in the amalgamation of all the Utiti Creek villages at Kopi, which in the 1975 census had a residence population of 173 people (adults and children).

With regard to function the permanent village serves as the primary focus of all social activities and with the increasing acceptance of copra production has become the centre of all cash cropping. More importantly, the village is the primary staging point for all subsistence activities. As will be illustrated below in more detail (Chapter 4), in 92 percent of all man-days (over a sample
period of 98 days) were devoted to food-getting activities that began and ended at the village.

Essentially ephemeral but certainly no less important, the kombati is an often used alternative to village habitation. The size and social structure of groups using temporary camps vary greatly; however, based on site function kombati roughly fall into two groups. The first may be termed as generalised land-use. Group size is typically small, rarely exceeding the members of a nuclear family. Site selection need not be areally specific within a group's landholdings, although habitable rock shelters are reused. Also temporary camps tend to be situated at a distance exceeding 2.5 - 3.0 kilometres from the village. The shelters constructed at kombati lack any semblance of permanence as they are hurriedly erected lean-tos or open-sided huts (Plate III-25, III-26). The purpose of this type of kombati may be the exploitation of a seasonally lucrative resource locality, but informants stress that the fear of pollution in the village due to sorcery or the desire to "just go bush" are strong determinants of extra-village settlement as well. Although never mentioned by the people one may conclude a closer position to game is certainly an important aspect of kombati use.

Due to the flooding of the alluvial plain near Waira, small-scale kombati are relevant only to dry season exploitation strategies. An important exception does occur with regard to sago processing. If available palm stands are situated at some distance from the village and daily travel would, therefore, involve a considerable amount of exposure to the elements, semi-permanent structures are inhabited for short but intensive periods of starch production.

The other form of kombati is task specific and usually involves a sizeable number of individuals, not necessarily members of a single lineage. The purpose of communal kombati is in most cases the exploitation of seasonally available resources. Within the area near the village this usually consists of dry season fishing at large doline ponds. During the rainy season the communal kombati focuses on mullet fishing or collecting turtle eggs near the headwaters of the Sire Creek. Occasionally the building of a canoe, particularly in the later stages of construction and transport to the river, necessitates the gathering together of large numbers of people and the formation of a communal kombati.
Plate III-25  Hevere *kombati* near Herekuna rock shelter, April 1977

Plate III-26  Sire Creek *kombati*, October 1976
The manner in which the various subsistence techniques and the settlement pattern function in relation to one another to create a co-ordinated pattern of land-use is the concern of this chapter. The aims are to:

1. define the subsistence strategy of the people of Waira,
2. demonstrate how the wide range of diverse resource localities are integrated in the successful implementation of that strategy, and
3. describe the archaeological analogues of the contemporary and contact land-use systems.

In the first section of this chapter the interrelation between subsistence and settlement patterns is elucidated by reference to illustrative example. The data supporting this analysis were collected by monitoring the daily work activities of all adults and adolescents living in Waira Village. The sampling period covered 98 days from 1 March to 15 June, 1977; the days from 23 April - 1 May, during which time I was away from the village, are not included. Each day the following information was recorded:

1. work activity,
2. location of work,
3. group composition,
4. time spent away from village,
5. materials brought back.
Non-subsistence activities (e.g. canoe construction, fetching and carrying, and cash cropping) were also recorded, but as they are not of immediate concern here they are omitted from the record. The reader is directed to Appendix 3 for a discussion of these activities.

Methodological Aspects of Analysis

As a result of the method employed in recording information (see p. 25) bias and lacunae are inherent in this study. Therefore, with respect to most classes of data a number of conventions is used.

Work activities

Sago processing, gardening, fishing, hunting, gathering and hunting/fishing comprise the different work categories. The subsistence activity assigned to each work group represents the class of work in which the most time was spent. This was determined by direct questioning and the documentation of goods carried back to the village. For example, on 4 March Niruramae and her daughter Muna, members of the Poialaviti group, spent the entire day processing palm starch. When they returned to Waira late in the afternoon, they left the worked sago in the settling troughs but arrived at the village with Gnetum gnenom leaves and sections of bamboo gathered at a garden along the way. Since sago processing, and not gardening, was the work task to which the most time was devoted, sago processing is the activity assigned.

A special hunting/fishing category is used since there are many instances where these tasks are indistinguishable. For example, while walking through the alluvial plain men who have "gone hunting" frequently encounter fishing localities and sometimes exploit the resources found in bush creeks. On 14 March Kororu and Aiseri went hunting in the rain forest inland from the old Oboro Village site. Each man carried his bow and arrows. As well, Kororu took along his shot-gun. When they returned to Waira around noon they had three fish which they caught in a small bush creek. Since it was impossible to determine how much time was spent in each activity a hunting/fishing work category is used to characterise their subsistence efforts.
It is also impossible to distinguish hunting and fishing in instances where groups of men and women venture into the rain forest in search of animal resources. On 15 March John's entire family went to the Tenu resource locality. While John and his young son Ani hunted, the women fished along a bush creek in the area. Two fish were caught and eaten in the bush. The crocodile and pig John killed were carried back to the village. As with the example above a hunting/fishing work category best describes the subsistence pursuits of this group.

**Location of work**

Except for areally restricted sites, sagopalm stands and gardens, work localities are rarely specific. The resource area ascribed to a particular activity represents a prominent land-mark near which the activity was conducted. Therefore, no determination is made of the size of resource areas. Also, this practice does not draw immediate attention to other resource areas lying between the village and the assigned work site and at which work activities may have occurred. Thus the assumption employed in this study is that subsistence resources were not obtained at localities beyond the work site but might have been in the "transit area" *en route* to it.

**Time at work**

No attempt was made to record the "clock time" for the departure and return of work groups to the village. Instead the day was divided into the following relative time sequence:

"tulait" (early morning: 0500-0800), "morning" (morning: 0800-1000), "moning i go lik lik" (mid-morning: 1000-1200), "belo kaikai" (noon: 1200-1400), "apinun" (mid-afternoon: 1400-1600), "belo bek" (late afternoon: 1600-1800), "tudak pinis" (dusk: 1800-2000), "long nait" (night: 2000-2400).

Each division was determined by the daily time sequence expressed in *Melanesian Pidgin* the language used during my fieldwork. The notation in parentheses is an approximate translation into English and 24 hour clock time.
For purposes of analysis each division expresses a single unit of work ("work units" in the following discussion). Although each unit is roughly equivalent to two man-hours of work the relative time figures are not translated into actual minutes and hours. To standardise work units further I do not differentiate "actual" time at work from time spent travelling, resting, talking and so forth.

Materials brought back

The listing of goods carried back to Waira by each work group is inventorial and serves to indicate the general quality of the people's diet. Because of the limitations of research time and the interference it might have caused to village life I did not attempt to quantify subsistence items in terms of flesh or plant weight. However, a record was made of the number of fish and game animals caught or killed and is used as a measure of the relative success of these activities. (See Appendix 5 for a further discussion on diet).

Resource Areas

In order to acquaint the reader with the land-use localities, a brief discussion follows describing the areal distribution of the resource areas and the activities conducted at each by the village landholding groups.

Exclusive of the Sire Creek area (Fig. II-1), the 25 resource localities exploited by the people of Waira lie no further than seven kilometres from the village (Fig. IV-1). Table IV-1 indicates that most landholding groups have access to and conduct the majority of their subsistence activities within two kilometres of Waira, a distance which encompasses two-thirds of the defined exploitation sites. The zone beyond generally includes only those localities where the people hunt and fish, primarily during the dry season and where they establish kombati. An important exception to this is Waemamu. Here all garden and a portion of the sago resources of Peter's household are centred.
The Sire Creek resource area provides an important component of the villagers' wet season diet. All landholding groups possess title or usufruct rights to hunting and fishing sites in this area.

**Individual Group Land-use Patterns**

The fundamental problem encountered in interpreting subsistence behaviour rests in defining individual units for analysis. In anthropology such studies (eg. Dornstreich 1973; Morren 1974; Rappaport 1968) initially focus upon the individual and then generalise for an entire group. Since this study centres upon land-use patterns for geographically distinct resource areas, an alternative methodology is necessary.

Single household units are ideal analytical units, but in a subsistence-based society where residence, production and consumption units do not necessarily coincide, difficulties arise. Similarly land ownership patterns influence the distribution of cultivated resources and the accessibility of highly advantageous areas of natural resources. Existing kinship systems and their maintenance contribute additional variables which further camouflage primary subsistence strategies.

In the following discussion land-access is the primary criterion for defining mutually exclusive, analytical units. This term is preferable to land ownership because many individuals cannot support ownership claims to specific tracts of land but have access to exploit them as they wish through extended kin relationships.

In Waira Village there are four land-access groups. The Poialaviti and Oboro groups contain multiple residential units and a general title relating to their pre-Waira settlement sites is used to distinguish them. The others, Peter and Porokae, consist of single households and are named for the male head of the family. Except where noted below, Porokae's household is omitted from analysis. Since Porokae is the councillor responsible for Waira, Kabarau, Lalau and Ario Villages, he maintains dual residence in Waira and Kabarau Villages. During the sample period he spent much of his time performing administrative duties away from Waira. Thus his entire household appears in the study on only 32 days. This portion of the total sample is judged insufficient for comparative purposes.
**Peter's household**

Over the sample period group composition remained stable and household activities were monitored on all but six man-days (Table IV-2). One non-resident, Iokae's sister Mimari, was a visitor for seven days during the Easter holidays.

The distribution of labour among the various subsistence activities is illustrated in Figure IV-2a. Non-subsistence activities account for an additional 21 work units (see Appendix 3) and 66 man-days were spent in extra-village encampment. Almost as much time was involved in plant food-getting activities as in those centred upon animal resources. Gardening registers more than twice the amount of time spent in sago processing. This largely results from the household's constructing a new garden at Waeamu, a task which comprised 77 percent of all garden-focused work and necessitated a high proportion of mixed work group labour.

Fishing dominates animal food-getting activities. Women individually or in groups account for over 60 percent of the labour expended in household fishing, and women participated in another 30 percent of work devoted to fishing. Time spent in hunting or hunting/fishing is only a minor component of household subsistence pursuits.

An important aspect of this unit's subsistence activities is its use of *kombati*. On 26 percent of the man-days observed household members lived away from the village. Just over half of these occurrences are subsistence-oriented, and half of this half are in conjunction with members of other land-access groups. As a result of non-village residence it may be assumed that some food procurement tasks, certain to include sago processing, do not appear in the record.

Figures IV-3 – IV-7 portray the areal distribution of household subsistence activities. Eighty percent of all subsistence work units are focused in the immediate vicinity of the two sago stands utilised by the household. At Waeamu all categories of food-getting were conducted and 60 percent of all work units occur here and at the nearby Sirebi upstream resource locality. Sagopalm exploitation and fishing are the only subsistence tasks associated with the Oboro sagopalm stand and the work units expended here represent the efforts of Peter's second wife Ape. Because of the
probable omission from the record of the household's sago production while in *kombati* at Waeamu, the strong emphasis on the Oboro sagopalm stand as a sago resource locality (78 per cent of sago processing work units) is somewhat artificial. The area surrounding the Oboro sagopalm stand does, however, gain further distinction with the occurrence of 39 percent of all fishing work units within 1 km of the stand.

On 14 percent of subsistence-oriented work is directed outside these two areas; however, as this encompasses the majority of time spent in hunting and hunting/fishing, these outlying areas cannot be considered unimportant. Furthermore, 44 percent of *kombati* man-days occurred at these distant resource sites.

Since fishing alone can take place in two distinct environmental settings, major rivers and bush creeks/ponds, a brief discussion of household fishing patterns is necessary. The instances of riverine fishing are eleven times more frequent than those inland. With respect to work units the ratio drops to 6:1. In part this reflects the high percentage of fishing performed by women and the increasing reliance by both men and women on a fish hook technology. However, it more accurately demonstrates the paucity of inland fishing sites within the unit's land holdings, with one significant exception.

The Pote resource area situated along the northern face of the karst escarpment has a number of doline ponds, the largest of which gives the area its name. During late March/early April (Fig. IV-8) Peter's entire household, along with most of the Oboro community and three unmarried males from the Poialaviti group, camped at the Pote pond and exploited its fish resources. This communal function followed a long period of little or no rain (Fig. IV-9). The use of fish poison to capture the fish was particularly successful as demonstrated by the large number of bamboo containers filled with cooked fish carried back to Waira at the end of *kombati*.

The patterning of subsistence activities throughout the study period (Fig. IV-8) portrays few discernible regularities with regard to the cyclical or repetitive interspacing of individual work categories. The pattern displayed mirrors the work pattern illustrated in Table IV-2. However, a comparison of the rainfall pattern (Fig. IV-9) with specific activities, as illustrated by the above reference to doline pond fishing, reveals that particular subsistence activities have temporal
As noted above, the Oboro unit infrequently used temporary encampment during the period subsistence activities were recorded. With one exception all *kombati* occurrences were in conjunction with Peter's household and were sited at the Pote resource locality. The other two involved mullet fishing along the Sire Creek. The single instance of a family *kombati* was on May 19-20 during which time Lanagae's household procured a large quantity of fish in preparation for a feast celebrating the birth of his granddaughter. More frequent use of the family *kombati* may however have occurred during the next rainy season. This was indicated by Kororu's household constructing a substantial rain shelter near the Oboro sagopalm stand.

Figure IV-15 illustrates the patterning of work groups for each subsistence activity over the study period. Sago processing reflects the most regular ordering of any work task. Even though members of both households worked together on only seven occasions, there is a remarkable consistency in their patterning of sago exploitation. The other major regularity portrayed concerns hunting/fishing. In the later part of the period this work activity ceased altogether. Although unclear in the diagram, it was effectively replaced by an increase in men fishing along the major rivers. In most instances they used only nylon net which they left in place and visited each morning and night to collect the catch. By referring to the rainfall chart (Fig. IV-9) it is clear that the change over in these tasks took place with the beginning of the wet season.

**Poialaviti**

Over the study period the constitution of this group was roughly stable. Just after recording started two young men returned to Waira after two years at work as contract labourers on a copra plantation. Two unmarried women also resided in the village for a portion of the time before moving back to Kikori to live. Activities of the Poialaviti group were recorded on 93 percent of the possible man-days and of those only four percent were spent in *kombati* (Table IV-4). The bulk of my archaeological work force, in particular my field informant John Tovi, was drawn from this group. Within the context of John's household his absence from subsistence activities on 68 days must have resulted in an alteration of the family's food-getting pattern; however, in considerations of the entire unit this factor and the employment of other unit members is not viewed as significant.
The division of time spent in the acquisition of plant and animal resources (Fig. IV-2c) is roughly equivalent. Sago processing and fishing comprise almost three-quarters of all work units and 70 percent of the individual occurrences of subsistence activities. Furthermore both of these are female-dominated work tasks - sago: 99% of work units, 99% of individual instances; fishing: 61% of work units, 55% of individual instances. Hunting and hunting/fishing are minor components of the subsistence strategy, with the former an individual male activity and the latter a mixed group task. Unlike the other two land-access groups, the Poialaviti group expended a small percentage of their subsistence pursuits on the gathering of fauna.

Nineteen resource localities were utilised by the Poialaviti community over the sample period (Fig. IV-16 - IV-20). Over three-quarters of labour expenditure is sited in the 13 localities situated within 2 km of Waira. This includes all sago processing and gathering activities and 92% of gardening, 64% of fishing and 50% of hunting work units. Beyond this area only the Tenu and Pinini resource localities are important. Both are dry season foci for the exploitation of game and fish.

For the entire recording period fishing activities are nearly equally distributed by time between riverine and inland sites. However, the time spent in March capturing fish from poisoned ponds accounts for over one-third of all fishing work units for the month. Contrary to the other groups, the Poialaviti women demonstrate a greater preference for inland sites than do the men. Although not as marked as with the Oboro group, a slight preference for riverine fishing occurred at the beginning of the wet season.

The Poialaviti group made less use of kombati settlement than the other groups. With one exception all were subsistence-oriented. On two occasions temporary encampment was for a single night and associated with sago processing at the Poialaviti stand and a hunting/fishing expedition near Tenu. Longer absences occurred at Pote and Nodoro. The former involved three unmarried males joining members of the other two groups to fish at the Pote doline pond and the latter resulted from my excavations at the Herekuna rock shelter. At the end of the sample period members of the Poialaviti group briefly visited the Sire Creek area to fish for mullet.
Figure IV-21 illustrates the pattern of subsistence activities for the Poialaviti group. Sago processing occurred at roughly cyclical intervals. This suggests that women with access to a common palm stand prefer to process starch from several boles at the same time. Although the frequency of fishing is regular and generally intense, there was a slight trend from bush to riverine resource areas between March and June. The increase in gardening activities during May represents the weeding and replanting of currently productive gardens. As was the case with Peter's household, this occurred just before the wet season commenced (Fig. IV-9).

**Intergroup Comparison**

Up to this point it has been assumed that the groups are viable, mutually exclusive units sufficient for purposes of comparison. Since objections may be raised, some evidence to support this conclusion is not appropriate.

**Group Size**

While the first two groups discussed, Peter and Oboro, have a similar-sized residential core, the Poialaviti unit is substantially larger. One might, therefore, expect that the Poialaviti community would exploit a larger area to support their subsistence demands. By comparing Figures IV-7, IV-14 and IV-20 this is demonstrated. However, these illustrations also show that all groups focus their subsistence activities within a comparable core area. This arises from a reliance on sago and fish to meet dietary needs. The Kairi's management of sagopalms permits a group of any size to establish a stand at most localities and ensures a density of palms which will fulfil all of a group's carbohydrate requirements. This is well illustrated by the fact that although the Poialaviti unit has greater holdings of sagopalms, the majority of the starch processed by this group comes from the Waira sagopalm stand, which is roughly equal to the size of stands exploited by the other two groups.
Group solidarity

A second point of possible contention concerns the correctness of regarding each group as an independent production/consumption unit. Evidence supporting this is to be found by comparing Figures IV-8, IV-15 and IV-21. Each of these demonstrates a clear trend toward intra-group work group composition in daily subsistence activities. Patterns of food sharing among the households (see p. 24) further demonstrates the independent nature of each land-access unit.

Availability of resources

The structure and composition of natural resources within each unit's landholdings is different and thus influences the patterning of work tasks. Although the environment does not grossly change between group territories, the occurrence or distribution of resources is not the same. Highly productive resource localities are not present within some landholdings. For example, Peter's household and the Oboro group do not have immediate access, respectively, to bush creeks and doline ponds. This does not need to concern us here, however, because the study of activity patterning over an area centres on the decisions made and not those which never come to mind.

The intention of this inter-group comparison is the delineation of common land-use patterns among the inhabitants of Waira Village. The subsistence techniques reviewed in Chapter 3 gain substantial illumination from the above analysis. By inspecting the distributional maps for the subsistence activities of each group it is illustrated that:

1. sagopalsms are areally restricted;
2. starch exploitation is segregated along lines of group ownership;
3. the harvesting of garden produce centres on the area near the village;
4. fishing activities are widely distributed;
5. hunting, although sporadic, has a predictable range;
6. gathering occurs infrequently and is most usually sited along small bush creeks where gathered animals appear in the greatest density.
Furthermore, the histograms in Figure IV-2 reveal very clearly that subsistence activities other than sago processing and fishing are secondary work tasks.

When reference is made to Figures IV-7, IV-14 and IV-20 a more fundamental pattern of resource exploitation becomes apparent. In each diagram a clustering of all subsistence activities appears in the vicinity of sago stands. As well, the figures in Appendix 3 demonstrate a high proportion of non-subsistence activities occurring in the same areas. If in following this lead the line graphs in these figures are altered so that the sago stand instead of the village serves as a datum*, this observation gains further significance (Fig. IV-22). The diminution of labour expenditure through the first kilometre is considerable for each group. Up to 2.5 km each graph differs, but the variations in the rises and falls are to a degree misleading. This is primarily due to the closeness of resource localities and the occurrence of "transit areas" (see p. 49) within this zone. Despite the dissimilarities between graphs, the overwhelming majority of subsistence labour is expended by each group within the 2.5 km area: 95% (Peter), 92% (Oboro) and 80% (Poialaviti). Virtually no subsistence activities occur outward for either of the first two landholding units, with the exception of those at the Sire Creek locality (not included in the diagrams). The two prominent peaks in the Poialaviti graph represent the Tenu (5.5 km) and Pinini (6.5 km) resource localities. Both are area specific resource sites and the travel routes to them are best viewed as a corridor beyond 2.5 km.

* Since the Poialaviti group's stand is at the village site this unit's graph remains unchanged. With respect to the utilisation of two palm stands by Peter's household, two reference points are taken and equated with the zero point on the new graph. The first only applies to Ape as she is the only member of the household to exploit the Oboro stand; all work units attributable to her are calculated from the Oboro stand. The second reference is the Waeamu stand, from which the remainder of the household's work activities is computed.
Section Summary

From this study of intra-village subsistence strategies a number of trends within the general pattern of land-use are identifiable. The most important of these is that a sagopalm stand is the geographical locus from which the majority of a group's subsistence activities are oriented. Moreover, during most of the year people rarely travel more than 2.5 km away from the sago stand in the course of their subsistence pursuits.

Exception to this rule occurs in four instances.

Initiation of wet season

The first concerns mullet fishing in May-June. During these months this species of fish spawns in the small rivers forming the headwaters of the Sirebi River, for example the Sire River. At the same time the Southeasterlies begin and the flooding of the alluvial plain becomes more frequent. The loss of a principal resource area and the enhancement of another promotes the focusing of subsistence activities well beyond a 2.5 km exploitation range.

The period of kombati for such expeditions is likely to be a function of group size. Informants claimed that Sire Creek kombati were lengthy and always occupied by a large group consisting of several households. The cases noted toward the end of the study period (Fig.IV-8, IV-15 and IV-21) were all groups of from four to six people spending two to three days away from Waira. Since all the observed occurrences involved travel by outboard motor, perhaps contemporary Sire Creek kombati represents a change in the exploitation strategy associated with this resource area. However, one may posit that before motorised transport large groups usually visited the Sire Creek and stayed away from the village for a long period of time, perhaps from six to eight weeks.

Seasonally available resources

Another case for the exploitation of "distant" resource localities relates to the seasonal availability of a specific food item. The most important examples of this concern the exploitation of doline ponds and turtle eggs. Doline pond fishing is stimulated more by an increase in the usefulness of a particular subsistence technique,
poisoning fish, rather than by the abundance of a specific resource. Rainfall patterns (Table II-1, II-2) which bring about a lowering of the water-level of bush ponds occur primarily in November and December. The case study described above illustrates fish poisoning techniques being used later in the dry season. This subsistence technique may, therefore, be applicable several times during a single season. Perhaps, however, its use is governed by the occurrence of high overbank flows which greatly assist the restocking of inland waterways.

A *kombati* directed only at the exploitation of a doline pond lasts a few days.

Turtle eggs are available from mid-September until late-December. While some turtles lay eggs in the narrow sand banks in and along the Sirebi River near Waira, the greatest quantity of eggs is found along the banks of large creeks which drain into the upper reaches of the Sirebi River (e.g. Sire, Wao and Kuru Creeks). Turtle egg collecting I noted while in the field was directed to both of these areas. The exploitation of Sirebi River egg resources involved one or two men who stayed away from Waira for no more than a few hours. The exploitation of the Sire Creek was conducted by one group of eight adults and another of approximately 20. The smaller group camped for five days and the larger for almost six weeks. Both used motorised transport.

**Distant landholdings**

The land tenure system followed by the people of Waira only restricts regular access to resource localities in cases where consanguineal or affinal kinship cannot be established between individual households. Land ownership can be altered immutably through purchase, as occurred when Oboro villagers established residence at Waira. Usufruct rights to garden land or individual economic resources (e.g. canoe trees, game killed during a hunt or fish captured during the exploitation of a bush pond) are granted but only for a set duration of time. The daily acquisition of subsistence resources for any household, therefore, falls within a geographical range largely the product of traditional land rights.

Instances where a group's landholdings lie beyond a village's 2.5 km core exploitation zone do occur. For example, even though the subsistence strategy of Peter's household has been altered by his marrying
into the Oboro community, the Waeamu resource locality and those nearby form this group's resource base. To compensate, in part, for the distance lying between Waira and this area Peter's household is more strongly oriented toward *kombati* residence than any other in the village.

This situation may be transitional, particularly if the household consolidates its relationship with the Oboro group. However, this does not diminish the importance of its occurrence as an alternative to a village-based subsistence strategy.

**Intra- or inter-village conflict**

The last exception to a subsistence pattern of "core area" exploitation concerns reasons other than purely those of diet. The threat of physical violence or sorcery against any individual or group of people was reported by informants to be sufficient grounds for a temporary or long term absence from the village. In early contact times and before, conflict between Kairi villages or headhunting raids by neighbouring tribes initiated a partial or complete abandonment of a village. Today, as in the past, fear of sorcery directed from within or without the village may prompt a family to establish *kombati* in a distant area of its landholdings. One instance of sorcery occurred while I was in Waira. After reneging on a bride-price transaction involving his ward Alice and a man living in Kikori, Peter became seriously ill and lost the use of his legs. In order to avoid his opponent's sorcery, as well as a court summons, Peter shifted his family to Pote on 6 April (Figure IV-8). Except for brief visits Peter's household did not re-establish residence in Waira until a month later.

In summary, the land-use strategy of Waira villagers exemplifies a highly sedentary mode of living. The subsistence needs for all but recent immigrants are met by resources found near the permanent habitation site. The most predictable alterations in the subsistence strategy occur in connection with an increase in the accessibility of riverine resources. This results either from a seasonal concentration of a specific resource (e.g. mullet while spawning or the eggs laid by turtles) or from the lowering of the water-level in inland creeks and ponds.
ARCHAEOLOGICAL ANALOGUES OF KAIRI LAND-USE PATTERNS

In this section the historical and ethnographic evidence detailed above is used to describe the contemporary and pre-contact land-use strategies of the Kairi in terms of a general model and to deduce their archaeological analogues. In practice, this analysis depicts the most predictable structure of the two land-use systems but does not attempt to infer human activity patterns from generalised "laws" of behaviour. In principle, I undertake only the characterisation of temporally static models and not the creation of a hypothetical cultural sequence for the research area.

The models I derive focus upon elements of the settlement pattern. This change in emphasis away from subsistence strategies is made for two reasons. Firstly, the localities from which subsistence techniques are directed form discrete units representative of a specific range of activities which may be isolated for independent analysis. Secondly, settlement sites are in most instances directly analogous to archaeological sites.

In this analysis only "vertical" or "organisational components" of each settlement pattern are assessed (Garner 1967:306ff). The inclusion of "horizontal" or spatial attributes of settlement, as exemplified in locational models based on central place theory (Losch 1954), is not supported in the ethnographic data or anticipated in the archaeological data. While the study of Waira Village land-use strategies reveals regularities in the minimum distance between village and kombatī, the observations of habitation site selection are insufficient in number to permit an analysis of their spatial arrangement. Moreover, ethnographic evidence suggests that temporary encampments are not as a rule established at previously used localities. Likewise, the archaeological data cannot be expected to demonstrate precise temporal conjunction between sites or the habitation of sites by members of the same population.

The organisational components of a settlement site considered below include group size, length and time of occupation, range of subsistence pursuits directed from a site, proximity to specific resource localities and work tasks conducted at the site. The last attribute primarily accounts for non-subsistence activities which may have occurred at settlement sites. The reader is directed, therefore, to Appendix 3 for a discussion of my field observations concerning such
activities. All vertical components are described by reference only to their individual qualitative characteristics.

**Analytical method**

The derivation of the archaeological analogues for each Kairi settlement pattern follows three procedural steps. Firstly, the attributes and general structure of each land-use strategy are summarised. This process collates the ethnographic and historical information concerning Kairi land-use and allows its resolution to an abstraction or model. Secondly, the model is described by means of a series of "working hypotheses". These assumptions posit a set of conditions whose occurrence is sufficient to result in the modelled land-use strategy but which are not the necessary, or causal, conditions which must be met for the model to obtain. Lastly, each working hypothesis is in turn reduced to a set of test hypotheses. These assertions specify the material culture, or archaeological, products of the proposed behavioural patterns.

This hierarchy of model and hypotheses closely follows Kaplan (1968: 88-89) and Watson et al. (1971: 7-9). An exception does occur with reference to the latter's derivation of "test implications", which are procedurally equivalent to my test hypotheses. Watson et al. deduce their material cultural correlates from "hypothetical laws" which assume general propositions of behaviour. Examples of this are assumptions of cultural continuity (e.g. Hill 1968) and the least effort postulates of site catchment analysis (Vita-Finzi and Higgs 1970). As an alternative method I have chosen to generate test hypotheses from ethnographic information. I believe no logical impurity is introduced. Test assertions form only the methodological linkage between the hypothetical speculation stated in the working hypotheses and the archaeological data to be processed. I make no assumption as to the causal factors influencing behaviour; to do such I would forcibly impute meaning to archaeological phenomena. Therefore, in using the ethnographic correlation of behaviour and its material expression I am asserting one empirical solution which allows the hypotheses to be assessed in a rigorous manner. The identification of alternative solutions would at the least suggest an inaccurate correlation or at the most delineate factors other than those explicated in the working hypotheses for consideration.
Contemporary Settlement Model

The present-day land-use strategy of the Kairi revolves about a nuclear village/kombati settlement pattern. Village sites are located along the major rivers and inhabited by a large population throughout most of the year. All modes of food procurement are conducted from the village site. With few exceptions sagopalm stands, village gardens and small creeks are the primary resource localities situated near the village.

Kombati residence is established along or near an inland body of water, which serves as the most dependable source of food. Kombati occur most frequently during the dry season, October-April, and the length of site occupation is no more than a few days. Group size varies from a family-sized unit to a community of people representing several households. The family kombati is multi-purpose and the site is one from which a wide range of hunting and fishing techniques are directed. Communal kombati result from the exploitation of a specific resource locality, usually doline ponds. Temporary encampments for long periods of from six to eight weeks occur at the beginning and end of the wet season. The Sire Creek and its adjacent waterways serve as the site for these kombati. Several factors would seem to encourage the habitation of Sire Creek kombati. These include the seasonal availability of large supplies of aquatic resources and the accessibility of terrestrial game, which is no longer easily obtained near the primary village because the flooding of the alluvial plain causes their dispersal further inland. Despite this, it is impossible to determine from ethnographic evidence whether or not Sire Creek kombati take place regularly each year. Therefore, temporary encampments of this type lack predictability and are thus omitted from the model.

Figure IV-23 depicts the contemporary settlement pattern in diagrammatic form. This style of illustration is used again in this chapter, and the next as well; therefore, a brief explanation is necessary. While two dimensional in form, this illustration is not designed to portray real distance. Instead, it represents the configuration of settlement sites and resource localities as they would appear in an abstraction of the Kairi landscape. Specific locations of food resources are depicted by the symbols for gardens and sagopalm stands. They are also implied in the use of geomorphic symbols. For example major rivers and bush creeks are fish resource areas; the
karst escarpment is the site of numerous doline ponds. Although imprecise in portraying the "real situation", illustrations of this kind are accurate qualitative characterisations of the settlement pattern. Moreover, these symbolic representations closely comply with the modelling procedures used herein.

From this model of the contemporary Kairi settlement two working hypotheses can be derived.

Hypothesis I:

If during the year a large percentage of a group lives at a permanent village site, then
A. houses are substantial structures which allow for periodic overbank flows;
B. the manufacture, maintenance and repair of material culture items frequently occurs in the daily repertoire of work activities;
C. the exploitation of seasonally available resources is not a dominant characteristic of subsistence activities directed from the village.

Houses

Contemporary Kairi houses are always raised from 50-175 cm above ground level. The stilt supports are long sections of hardwood trees of substantial girth. The floor space of a house varies generally in proportion to the number of adult occupants, but no consistent ratio between the two was observed. However, the total amount of floor space in a village suggests the relative population size of the village.

The archaeological representation of a contemporary Kairi village is a patterned array of post holes, whose depth and width are consistently large. The sum of the area enclosed within each cluster of postmoulds serves as a guide to the comparative size of the population inhabiting the site.
Non-subsistence work activities

As illustrated in Appendix 3 a portion of the work activities, particularly of men, are spent in the construction of canoes and the maintenance of repair of houses. As well, men devote some of their time during the day to the care of work implements. They may even set aside an entire day for the production of bows, arrows, fish weirs, axe handles or sago chopping tools. While a hurried sharpening of tools occurs away from the village at garden clearings, canoe construction sites and kombati, non-subsistence activities of this type most consistently take place at a village.

Archaeologically this appears as obsolete steel and stone tools, assuming no one consciously disposes of a tool before securing its replacement. It is also revealed in the discarded portions of rattan and wood resulting from the construction and repair of material culture items.

Subsistence debris

The riverine and forest resources procured as a result of their seasonal availability or their increased accessibility are reflected no differently from the food obtained throughout the year, with the exception of turtle eggs and some shellfish species. Therefore, the subsistence debris in an archaeological Kairi village is not indicative of special aspects of the general subsistence pattern.

Hypothesis II:

If kombati residence is established within a day's walk from the village, then

A. its occurrence is during the dry season;

B. the length of site occupation is short;
C. the number of occupants is a direct function of the categories of work performed at the site.

**Period of site occupation**

Kairi exploitation of food resources situated within a 7 km radius of the village occurs throughout the year and primarily involves the acquisition of faunal resources. While the wet season subsistence strategy includes the procurement of fish and game from this region, it is only on exceptional occasions (e.g. sago processing) that *kombati* residence is taken up. The subsistence debris at temporary encampments is therefore biased toward dry season resources. This is represented archaeologically in the appearance of an excess of one food resource (e.g. fish collected from doline ponds) or the presence of resources only available seasonally (e.g. shellfish including *Batissa violacea*, *Hyaydella* spp., *Melanoides* spp. and species of Vivaparidae).

**Site habitation**

The primary motivation for establishing *kombati* residence is either the initiation of the wet season, the appearance of seasonally available resources, the exploitation of distant landholdings or the fear of conflict. As discussed in the general description of this model, the first of these is not considered here. Since the last two stimuli are predictably random they are also omitted. Therefore, *kombati* residence prompted by the seasonal availability of resources characterises the settlement mode of this model. These temporary encampments last no more than a few days. The depth of the total accumulation of artefacts is not great. Also, subsistence debris comprises the bulk of the deposits.
Group size

Field observations of *kombati* use suggest that the number and/or size of shelters constructed at a temporary encampment increases as the group's composition includes more members of different households. An areally discrete cluster of artefacts thus represents a small group, possibly limited to the members of a single landholding unit. A highly expanded scatter denotes a larger group, probably including members of several landholding groups. A determination of group size may also provide a useful index of site function, if regularities in the size of sites and types of artefact clusters can be determined in the archaeological record. For example, a temporary encampment oriented about canoe construction could have an extensive scattering of debris consisting of subsistence remains which lack a clear seasonal focus and a high percentage of steel and stone tools, as well as the products of tool repair.

Contact Settlement Model

No detailed account of the Kairi exists for this time period. The settlement pattern model described below is, therefore, a reconstruction. Information used to derive this model appears in the discussion of the Kairi contact period (see Chapter 2). Also a consideration of the impact of Western technology provides useful clues. Lastly, this reconstruction includes the oral testimony of my informants concerning their past.

The Kairi settlement pattern observed during the first fifty years of European contact is largely a replica of today's. Village sites were permanent and occupied by approximately the same number of individuals. House structures differed notably in size and general plan but maintained the same raised floor. The geographical focus of village sites was, however, significantly different. As they were most
usually situated away from the major rivers and near the karst escarpment/alluvial plain margin, villages were not easily reached by water transport alone. Also, the flooding of resource localities on the alluvial plain during the wet season probably did not hinder subsistence activities to the same degree as today.

Kombati residence was also a major feature of the settlement pattern. Since government officials rarely stayed overnight in a village, there is no information on temporary encampments near primary habitation sites, but their use is generally implied. Observations of Kairi in kombati near the headwaters of the Sirebi River confirm this region as an important area for faunal resources, including turtle eggs. However, it is not clear whether or not these kombati were seasonal in focus.

Although direct information is scanty, there is no evidence supporting a major alteration in the dietary pattern of the Kairi during this time period. The two narratives in which gardening is mentioned (Bevan 1890: 194; Bastard 1923) do not provide evidence which suggests that gardened tubers, rather than sagopalms, were the staple source of carbohydrates. The acquisition of fauna by hunting and fishing is noted, but the techniques employed and the relative proportion of terrestrial and riverine resources in the diet are not reported. Despite such omissions it is reasonable to posit no major differences in the strategy of animal food procurement from that of today, with the exception of changes in the technology.

Lacking the advantage of nylon nets and steel hooks, Kairi fishing techniques were most effective if directed at inland bodies of water. The fish resources of the primary rivers were not accessible by any technique other than bow and arrow fishing along the banks. Also, I surmise fishing by women alone to have been a more important component of the overall subsistence strategy. Evidence supporting this is the ready adoption and successful use of fish hooks by women and their participation, at Waira, in more than 50 percent of all fishing expeditions. If the traditional fishing techniques of women have not changed drastically since contact, then small bush creeks were an important resource locality.

As discussed above, the introduction of the shot-gun has not altered hunting strategies, with the exception of those centred on high canopy food resources. If in fact the use of a shot-gun ensures a
higher probability of a successful kill then Kairi men of contact times may have been obliged to expend more time to acquire hunted game. On the other hand, the positioning of village sites nearer to the karst escarpment placed the hunter at a more favourable location from which to initiate hunting. This is substantiated by the fact that the forests of the karst uplands and slopes are the year-round habitat for wallaby and the wet season refuge for pig and cassowary.

From this evidence the following settlement model is reconstructed.

Kairi land-use strategies for the contact period centred upon a nuclear village/kombati settlement pattern (Fig. IV-24). Village sites were permanent locations well removed from the major waterways. Sagopalm stands and bush creeks, which carried water for either most or all of the year, were the primary resource localities in the village area. Gardens were probably also nearby. The size of the village group varied. The ratio of time spent in village residence to that in kombati may have fluctuated more, possibly as a result of head-hunting.

The use of dry season kombati during the contact period differed little from that described for the contemporary situation. The factors which prompt the establishment of these temporary encampments are not for the Kairi practices greatly influenced by Western contact. The occurrence of wet season kombati may have changed. The inference of wet season encampments arises primarily from the positioning of village sites nearer to the karst interior. Since the movement of pig, wallaby and cassowary is restricted by flooding, the area immediately bordering the karst escarpment becomes the habitat frequently occupied by these animal species. Therefore, game was prevalent within a day's walk from the village and this created a situation of resource accessibility analogous to the exploitation of doline ponds. A wet season kombati directed at the seasonal exploitation of game may have, therefore, been a feature of the contact subsistence strategy.

It is important to note that the exploitation of the Sirebi River headwaters is reported at contact. This suggests that subsistence resources well away from the village played some role in the Kairi strategy of food procurement. However, this type of kombati is again omitted from the model presented.

From this model of the Kairi land-use pattern at contact three working hypotheses are derived.
Hypothesis I:

*If* villages are a permanent component of the settlement pattern, *then*

A. village houses are substantial structures;

B. the manufacture, maintenance and repair of material culture items occurs in the daily repertoire of work activities;

C. the exploitation of all food resources, regardless of their seasonal availability or accessibility, is directed from the village.

By and large these hypothetical propositions mirror those of Hypothesis I for the previous model. However, the material culture relevant to the contact period necessitates some alteration in the test hypotheses proposed.

*Houses*

All contact villages were observed to have at least one large structure and in most instances several smaller houses. The similarity between Kairi and Goaribari houses structures is commented on by Murray (1910: 4) and subsequent reports always describe Kairi houses by reference to Goaribari names, *dubu* (men's houses) and *moto* (woman's house). Therefore, a conjecture of the structural components of Kairi houses can be made using those of the Goaribari as a template.

The floor and superstructure of a *dubu* are massive. The stilt supports used are numerous and often large in girth. The weight of the thatched roof and its steep pitch also necessitate additional support. The walls,
constructed of sago leaf stems or plaited strips of plant fibre covering short and haphazardly occurring studs, are not designed to carry the weight of the roof or to counter the swaying motion set up by storm winds. These tasks are performed by column supports running from the roof beams into deeply dug holes. These long sections of mature trees often occur in association with floor supports. The women's houses resemble present-day Kairi housing.

The archaeological representation of a Kairi village at contact is a lengthy array of large post holes which appear as a discrete unit in the entire village area. "Double postmoulds" representing the concurrence of floor and roof supports are also present. Arrays of post holes representing smaller structures occur as isolates in the remainder of the site area.

Non-subsistence work activities

Supportive evidence for this class of activities at village sites is discussed in the previous model. Alterations in the archaeological manifestation of this behaviour pattern include the occurrence of obsolete stone axe blades and chipped stone tools, as well as fragments of both denoting tool manufacture, repair and use.

Subsistence debris

The positioning of villages near to the alluvial plain/karst escarpment ecotone closely juxtaposed the village population to a greater number of more diverse resource localities. Bush creeks carrying water for most of the year are more prevalent and Kairi subsistence techniques are applicable to the exploitation of this resource locality year-round. During the dry
season weir fishing by women, bow and arrow fishing by men, the use of fish poison and the collecting of shellfish and crayfish were particularly effective. The weir nets employed by men provided access to fish resources during the wet season. The karst escarpment lying nearby had many productive sites for hunting during both seasons.

The subsistence debris at an archaeological site representing a village of the contact period evidences no seasonality.

Hypothesis II:

If *kombati* residence is established during the dry season, then

A. the habitation site frequently occurs in the alluvial plain;

B. several individuals are in residence there.

Residence Locality

During the dry season there are no natural constraints influencing the placement of temporary encampments on the alluvial plain, in contrast to the conditions resulting from wet season floods. The accessibility of aquatic resources occurring in the small bush creeks which frequent the alluvial plain increases greatly as a result of seasonal droughts. Together these factors encourage short-term, dry season exploitation of this ecozone. This occurrence is represented archaeologically in the presence of fish and shellfish subsistence debris at sites well within the bounds of wet season flooding. And, by corollary, few indicators of dry season resource exploitation should occur at camp sites well away from the alluvial plain.
Group size

Two factors are important determinants of the number of people living at a dry season kombati. First, a portion of the male members of the group may have been relegated to sentry duties. Contact between people in kombati and a head-hunting party was always possible. Moreover, the aggressiveness of the attackers would have been greatly enhanced by a small group of defenders. Secondly, the faunal resources available on the alluvial plain during the dry season are sufficient to support groups of varying sizes.

As noted in the description of test hypotheses for Hypothesis II for the previous model, a dispersed scattering of artefacts over a kombati site denotes its use by a larger than family-sized group.

Hypothesis III:

If kombati residence is established within a day’s walk of a village and during the rainy season, then

A. the habitation site is located near the karst escarpment;

B. a variable-sized group lives at the site.

Residence Locality

Habitable sites rarely appear on the alluvial plain during the rainy season and riverine resources found here are not generally accessible due to flooding. Therefore, wet season kombati occur near the karst escarpment.

The obverse of the archaeological evidence for dry season kombati, just cited, serves to characterise kombati residence during the wet season.
Group size

Again, a large-sized group is an effective deterrent to the hostile raiding parties, but the remoteness of the karst area may have also diminished the frequency of contact between unfriendly groups. Therefore, family and communal kombati are predictable occurrences during the wet season.

The archaeological correlates for group size are discussed in Hypothesis II for the contemporary land-use model.

Section Summary

The two discernible patterns of Kairi land-use have been described and expressed as archaeological phenomena. The most crucial difference between them is the location of village sites. For purposes of future reference it is important to note that the range and number of resource localities increases in proportion to distance away from major rivers in the absence of Western technology.
CHAPTER 5

DERIVATION OF ALTERNATIVE LAND-USE MODELS

The corpus of historical and ethnographic data presented above (Chapters 2-4) provides a starting point from which to assess the prehistory of the research area. However, it would be contrary to reason to presume that either the contemporary or contact land-use models is a replica of prehistoric subsistence-settlement strategies. In other words, we cannot assume that the Kairi are the descendants of the prehistoric inhabitants; indeed given what is known of Kairi history we should anticipate the presence of different peoples and different land-use systems. Furthermore, even if the Kairi occupation of the area is represented in archaeological sites it would be misleading to expect a continuity of behaviour from the present back into the past. This chapter therefore presents a series of hypothetical models of other land-use systems which could operate within the environmental setting of the research area. The purpose of these models is to provide a range of possible land-use patterns against which to test the archaeological data described in the next part of this thesis.

In the first portion of this chapter I describe the range of diversity evidenced in the traditional subsistence strategies and land-use systems which involve sagopalm exploitation. This study focuses only upon societies living in New Guinea and Bougainville, an area which I shall henceforth call Melanesia, and serves as the basis from which all hypothetical land-use models are derived. I do not attempt to discuss all the detailed factors promoting variation, such as the availability and/or acquisition of non-subsistence resources and social organisation. The inclusion of such variables in the construction of models would exceed my objective, the characterisation of localised land-use systems, and would introduce a level of refinement into the models which exceeds archaeological verification within the research area.
To describe the variation in subsistence strategies among Melanesian sagopalm users I consider the following topics:

1. the management and processing of sagopalms and the techniques for storing palm starch;
2. the cultivation and storage of starch resources other than that processed from sago palms;
3. the gathering of wild or semi-wild plant foods;
4. the dietary role of major plant foods;
5. the techniques and strategies practised in the acquisition of animal protein;
6. the contribution made to the diet by flesh obtained by fishing, hunting and collecting.

The first portion of the chapter ends with a discussion of the types of settlement patterns exhibited among Melanesian sagopalm users and an assessment of the ways in which subsistence and settlement patterns are co-ordinated to produce variable land-use strategies.

Drawing upon this analysis I conclude this chapter by outlining a series of hypothetical land-use models which could be viable in the environmental setting of the research area. It must be stressed that the procedure followed does not involve the transplanting of the behavioural patterns of groups into the Kairi environment. Rather, it assumes that land-use systems other than those observed in the area today could have been successful in the past. In constructing the models I emphasise the subsistence pursuits organised from particular habitation sites and the temporal components of site occupancy. The assumptions implicit in each model are then used to define the likely archaeological reflections of each analogue in testable hypotheses.

CROSS-CULTURAL VARIABILITY AMONG MELANESIAN SAGO USERS

No attempt is made here to describe all sagopalm using groups in Melanesia. The ethnographic case studies I have selected for analysis conform to three criteria. Firstly, I examine only those people who traditionally exploit *Mextroxylon* palm stands, as opposed to groups
which obtain palm starch through trade or exchange. Secondly, while I have tried to examine literature on all areas where sago exploitation is reported (Ruddle, et al. 1978: Table 2; Townsend 1977) or where a region's physical geography suggests it may occur, I use only those studies available in English. Lastly, while many anthropological investigations (e.g. Thurnwald 1916; Fortune 1932; Bateson 1936) mention subsistence strategies and settlement patterns that are associated with sagopalm utilisation, I refer only to those studies that focus particular attention to these issues, although useful observations are not ignored. Table V-1 lists the groups surveyed; Figure V-1 displays their geographical distribution.

Sagopalm Utilisation

Palm management

The distribution of *Metroxylon* palms throughout the Melanesian lowlands attests not only to the vitality of the species but also to the interdependence of people and palm. As discussed above (p. 2) optimum conditions for a *Metroxylon* - dominated, sub-climax forest occur primarily in the lowland fresh water swamps lying inland from the mouths of rivers. In the inter-tidal swamps along the coast (e.g. the Kikori/Purari Delta) the high level of water salinity inhibits the fullness of palm maturation and reproduction (Paijmans 1977: 43). Stunted palm boles and debilitated rhizome development afford little competition against salt-tolerant species such as mangroves and nipa palm. In inland regions where the frequency of river inundations is on an average low, *Metroxylon* palms are forced to concede ground to higher canopied rain forest trees. Thus in many areas of Melanesia a reliance on palm sago by at least a semi-sedentary group of people necessarily involves human manipulation of the species.

The present-day occurrence of *Metroxylon* palm stands outside their most favoured environment is thus predictably an artefact of both prehistoric and contemporary exploitation (see Appendix 2). While it is difficult to produce conclusive data to support this view concerning initial introduction by man, the question of the maintenance of sagopalm stands is relevant at this point.
Most ethnographies of Melanesian sago users identify the exploitation of either natural or planted (= ? "cultivated") palm stands (Fig. V-2). Although an important component of palm use, few observers consider the effect which the processing of palm starch has for the species itself (but cf. van der Veer as quoted in Held 1957: 348). The reproduction potential of individual *Metroxylon* palms is enhanced by the felling of a bole and the haphazard clearing of a sago processing work site. Firstly, the removal of the canopy of the parent plant exposes the young shoots to previously unavailable quantities of light. Growth is stimulated and the success of at least one of the suckers is assured. Secondly, the hindrance caused to the growth of nearby plant species by the falling palm and humans constructing a work site allows suckers to achieve some advantage over their plant competitors. The repetitive exploitation of a palm stand for even a moderate time period results in the maintenance of the stand as a plant community.

Man further assists *Metroxylon* sp. by planting palm suckers or nurturing and replanting palm seedlings. This level of sagopalm management I term horticulture. Evidence for the planting of palm suckers exists throughout Melanesia amongst the Marind-anim (Verschueren 1970: 44, 45), Siwai (Connell 1977: 15), Orokaiva (Williams 1930: 16), Orokolo (Holmes 1924: 250), Etoro (Schieffelin 1975: 27, fn. 8) and Keraki (Williams 1936: 220). The planting of *Metroxylon* palm seedlings is rare, or possibly poorly documented, and is only reported for the Kairi, Kiwai (Landtman 1927: 101) and Ningerum (R. Jackson 1977: pers. com.).

The most intensive form of sagopalm management is palm cultivation. This occurs among the Kairi, Daribi, Nimboram and Anggor. Among all these groups palm suckers are not only planted but the environment in which palm stands are cultivated is altered significantly to promote the growth of palms. The Daribi practice two forms of environmental management.

Groups of men ... plant their sago in plots, which are subdivided for individual men. Nearby trees are ring-barked to clear a place. Holes one foot deep are dug with a stick, about ten feet apart, and a piece of rotten wood is put into each, after which a sago shoot is inserted. If it thrives, the ground is cleared around it and the rotten vegetable matter heaped around the young plant. (Wagner 1967: 15).
As well, streams are dammed to form an artificial swamp in which palm suckers are planted (Ibid.) and in such cases palms are felled and the pith exposed for use as domesticated pig feed (Hughes 1970). The Nimboram also flood tracts of land in which individual families cultivate sagopalms for household consumption (Kouwenhoven 1956: 16, 17). The Anggor clear garden land upslope from the ravines and valleys in which planted *Metroxylon* palm stands occur in order "to encourage greatly the growth of sago stands formerly shaded by the forest" (Huber 1978: 165). These examples plus that of the Kairi, attest to the practice of a sophisticated level of sagopalm management formerly masked by the distinction made between wild and planted palm stands.

It should be pointed out these observations may very well be fortuitous. In other words, more reports of palm cultivation would have possibly been made if students of sagopalm using communities had been present when new stands were established. However, since casual observations cannot deduce the cultivation history of well-established stands, the distinction between horticultured and cultivated sagopalm stands may only be discernible if vegetation patterns are analysed.

**Starch production**

While aspects of the techniques used to process *Metroxylon* palm starch vary throughout Melanesia, the basic method is the same. The pith is chopped using a variety of implements whose working face is made of wood, bamboo or stone (Lewis 1923; Crosby 1978). In all but a few cases (e.g. Misima - L. Kidd 1977: pers com.) the surface fashioned to chop the pith is concave to flat in section with a sharp outer edge. Despite the fact that the durability of materials used to make sago chopping implements differs, the efficiency of each to mince the pith to a state suitable for starch removal appears to be about the same.

The majority of Melanesian sago users process the pith in a trough which is constructed from the petiole of a sago leaf. Starch is extracted by beating the macerated pith with a stick and/or kneading it by hand (Lea 1964: 121; Townsend 1969: 30-32). The Kairi method of trampling the pith in a bag is less usual but has been reported for the Kongara (Connell 1977: 21), the Keraki, Wirum and Setari of the Trans-Fly (Williams 1936: 38, 41) and is used by the Pepike (personal observation).
Table V-2 lists information on *Metroxylon* palm yields for six Melanesian societies. The productivity of individual boles fluctuates greatly, from 28-401 kg. The density of processed starch in a palm ranges from 48 to 245 kg/m$^3$. Variability in palm productivity is explained by varietal differentiation within *Metroxylon* spp. (Townsend 1969: 40), soil conditions (Sim and Ahmed 1977) and the degree of palm husbandry practised (Ruddle et al. 1978: 61).

Further analysis of the data in Table V-2 does, however, reveal a degree of consistency in the starch production rates among the groups noted. The figures reported for the Gidra, Kairi and Sanio-Hiowe differ by roughly one-third of their individual values. Dornstreich's observations for the Gadio-Enga and those of Lea for the Abelam exclude time spent resting and walking to and from the processing site. If, as Townsend (1969: 38) found, these activities account for 16 percent of the actual time involved in processing starch the adjusted production rate for these groups become 2.59 and 1.91 kg per man-hour, respectively, thus placing these rates within the range of the others.

The production rate for the Siwai is exceptionally low. As well, the starch density of palms exploited by this group is 66 percent below the other reported figures. This evidence lends support to Connell and Hamnett's suggestion (1978: 36-37) of a real difference between *Metroxylon bougainvillense*, which Barrau (1959: 154) identifies as the only *Metroxylon* species on Bougainville, and *Metroxylon sagu*, which occurs westwards in New Guinea and Insular Southeast Asia.

All of these groups, except the Siwai, exhibit comparable starch production rates despite the fact that their methods for starch removal differ. I therefore suggest that this evidence generally negates processing technologies as a criterion for identifying variation among Melanesian sago users.

**Consumption of unprocessed palm pith**

There are only two reported observations of Melanesians eating the unprocessed pith of *Metroxylon* palms. According to Wollaston:

> Very often the natives of the Mimika eat the crude sago, that is to say, the pith simply as it is cut out of the tree, without having been washed or pounded. The stuff is roasted in the usual way and the separation of the sago is done in the mouth of the eater, who spits out the uneatable fibre. (1912: 91)
Malinowski (1915: 550) notes that the Mailu islanders occasionally eat raw sago pith without any further discussion. Among the Kairi, as well as other peoples living in the Kikori/Purari Delta (I. Davey 1977: pers. comm.), the pith of sagopalm, which have completed fruiting, is eaten raw. The pith is extremely sweet and tastier than sugar cane.

Since Wollaston and Malinowski do not describe the palms from which the unprocessed pith was taken, it is difficult to assess the compatibility of their observations with mine. However, the consumption of unprocessed pith which no longer contains a substantial quantity of starch must be taken into account when positing the exploitation of sagopalms prior to the development of a starch removal technology (cf. Watanabe as quoted in Ohtsuka 1977a: 483).

Storage of palm starch

Unlike most other traditional Melanesian starch resources, palm sago can be stored. Palm starch is often accrued for purposes of exchange by the Wogeo (Hogbin 1938-39: 129), Waropen (Held 1957: 232), Orokolo (Williams 1940: 99) and Kwoma (Whiting and Read 1938-39: 188) and for ceremonial feasting by the Waf (Oosterwal 1961: 238) and Kiwai (Landtman 1927: 351). Where sago palms are plentiful and immediate food requirements not excessive, starch obtained from processing a single bole is stored and this becomes the food supply for the near future.

Four methods of palm sago storage are practised in Melanesia (Table V-3). The most common form is 'dry' storage, where the starch is placed in a clay pot or container made from leaves and kept in the house or some other shelter. Among the Kairi, I have observed sago to be stored in this fashion for up to two months. Palm starch is also packed in a leaf-covered bundle and either buried in swampy ground or left exposed out-of-doors. Schieffelin (1975: 27) notes that the Kaluli keep sago stored in this way for up to a year. The partial cooking of sago usually occurs as an adjunct to either of these methods and is an effective means of extending the storage of sago for even longer periods (Ruddle et al. 1977: 27). The most unusual technique for storing sago is practised by the Kiwai:
When a sago palm has attained maturity, a man climbs up it with the aid of a tall bamboo pole propped up against the tree and cuts off the bud at the top. In this way the inflorescence is prevented from developing. The people do not want 'that milk inside the tree to go where egg (the fruit)[sic]'. After that operation, ... the tree ceases to grow, but remains alive. It is left standing for a few months, sometimes longer (before it is felled for starch processing).

(Landtman 1927: 102)

Gardening

All Melanesian sago using people supplement their diet with garden produce, but in notably varying degrees. Inhabitants of swampy alluvial plains or river deltas possess little arable land and thus do not systematically raise garden crops. Kitchen gardens in and around the village, small plots on isolated patches of high ground in the swamp forest and, in the case of the Waropen (Held 1957: 350), trade with adjacent groups serve as the primary sources of vegetable foods other than palm starch. Banana is usually the most important garden crop in these circumstances. Sago users in other environments cultivate a wide range of plant foods in mixed gardens (but cf. Landtman 1927: 127, figures 52, 53); the major crops grown include yam, banana, taro and sweet potato.

Gardening technologies among sago users are similar to those used in swidden gardening throughout Melanesia. Since comprehensive studies of gardening appear elsewhere, I forego reiteration and direct the reader to the excellent accounts of Dornstreich (1973: 181-204), Lea (1964: 70-99) and Schieffelin (1975).

The gardening practices of the Kiwai and Marind-anim, which are remarkably similar to those of some New Guinea Highlands peoples, differ somewhat from gardening methods employed by most traditional sago users. The Kiwai (Landtman 1927: 67) criss-cross (? some of — cf. Fig. 52) their gardens with shallow ditches which intersect with larger drains located at the garden's margin. Prior to intensive European contact, the Marind-anim established gardens or "long prismatic ridges [raised beds] set out in parallel rows and divided by deep draining ditches" (Barrau 1955: 23). Taro, yam, banana and *Piper methysticum* were planted in these garden plots. Taro and yam were
grown "to produce spectacular displays during feasts" (Verschueren 1970: 46), banana for daily consumption and *P. methysticum* for making kava (van Baal 1966: 20).

Yam is the only garden produce which is regularly stored. Among several groups (e.g. Abelam – Lea 1964: 111, 117, 146-148) yams are accumulated during a single harvest to display personal wealth and to gain prestige through food redistribution during feasting. Seed-yams are also stored for the next season's planting. The period of yam storage is relatively short. In both cases yams differ from palm starch because once stored they are normally no longer available to meet immediate subsistence needs.

**Gathering Plant Foods**

The gathering of wild or semi-cultivated plants is generally poorly documented, usually appearing as an inventorial aside. Exceptions do, however, occur and these reports concern the harvesting of palm and tree crops such as coconut, breadfruit, pandanus, tulip and *canarium* almonds which are planted in groves or at garden sites (Connell 1977: 11; Dornstreich 1973: 222; Huber 1978).

The omission of detailed information on gathered plant foods hinders comparative analysis because such items form an important source of protein and vitamins (Dornstreich 1977: 256). Furthermore, my observations of the Kairi (see Appendix 5), those of the Gadio Enga (Dornstreich 1977: Table III) and those of the Waina-Sowanda (Gell 1975: 16-17) illustrate the regularity with which gathered plant foods appear in people's diet. However, I am led to assume that the paucity of information indicates the minor role played by such foods in the organisation of food-procuring strategies.

**Major Plant Foods in the Total Diet**

The contribution made by starch resources to the diets of Melanesian sago users is rarely documented beyond saying that individual food items are a "staple crop" or a "supplementary resource". While these labels prohibit assessment of the quantitative and nutritional aspects of diet, they do provide a basis for identifying dietary preferences and for understanding land-use patterns which reflect the
availability of arable land and the interplay of appetite, subsistence and ceremonial imperatives.

Figure V-3 indicates staple starch resources utilised by the sago using groups reviewed in this study. The second most important source of carbohydrates in daily meals is also shown where relevant as is the seasonal orientation for the exploitation of both categories.

The most widespread pattern of plant food exploitation is sago palm serving as the carbohydrate staple with banana following as the next most used crop. The greatest number of exceptions appear in the Sepik River Region. The people living in the foothills north of the river and in the Middle Sepik River area rely heavily upon yam to meet subsistence needs, specifically during the dry season. While sagopalm starch may, in some cases, be a staple resource, its exploitation takes place during the wet season, when harvesting of yam is impossible. In the southern and western catchments of the Sepik River, taro is the most important garden crop and since the rainfall regime here permits taro to be harvested year-round there is no seasonal focus associated with the exploitation of either taro or sagopalms. Among the Gadio Enga (Dornstreich 1977: Table IV) living in one of the most southern reaches of the Sepik River drainage area and the Tangu (Burridge 1969: 40-41) who occupy the area north of the Ramu River catchment, sagopalms and garden crops, particularly taro, are complementary starch resources. Palm starch exploitation by the Tangu does, however, become important during the wet season.

There are four other exceptions of note. The Orokaiva subsist upon sagopalm resources only during the dry season (Williams 1930: 16, 58; Waddell and Krinks 1968: 170). At this time the produce obtained from taro gardens is low and palm starch supplements the inventory of available plant foods, thus becoming important as a "famine" resource. Among the Wogeo, palm starch is consumed only at feasts (Hogbin 1938-39: 129). The Siwai eat sago at feasts, but they also rely upon sagopalms to provide a supplementary plant food when the production of taro or, more recently, sweet potato gardens is low and when natural disasters destroy garden resources (Connell 1977: 15; Connell and Hamnett 1978). The Daribi are the only group of sagopalm users surveyed to have reoriented the subsistence base of their diet.
Prior to the acquisition of steel axes the size of sweet potato gardens is reported to have been small, and based upon this evidence Wagner posits a decrease in the exploitation of sagopalsms since European contact.

Table V-5 lists the findings of dietary studies conducted among Melanesian sago users. This sample represents the full range of dependence upon palm starch in Melanesia. The figures indicate the qualitative distinctions described above, although no assumption is made that they replicate the dietary components of other groups in the survey. The Abelam data accounts for a strictly seasonal reliance upon sago thus exemplifying the situation in which palm starch is either a seasonal or famine resource.

Acquisition of animal protein

Fishing

The Anggor and Miyanmin are the only sago using peoples included in my survey who are not reported to fish. Groups residing away from the coast or major rivers only procure small catches unless favourable climatic events are conducive to the use of poisoning and damming techniques. Thus, for some sago using people, fishing is an unreliable subsistence pursuit providing only small quantities of animal protein to their diet.

Traditional fishing technology employed by Melanesian sago users (Fig. V-4) differs from that described for the Kairi in two major respects: the use of harpoons and of fibre nets. The Waropen (Held 1957: 343), Asmat (Eyrde 1967: 19) and Kiwai (Landtman 1927: 124-25) employ harpoons to catch turtle, dugong and large fish. The Waropen and Asmat use this technique in the shallow waters of tidal swamps; the Kiwai employ it on the coral reefs which lie offshore from the mouth of the Fly River. Only among the Kiwai is harpoon fishing a common technique in the acquisition of aquatic resources.

Net fishing is more widespread. Hand or dip nets of varying sizes are used when fishing in shallow water, such as along beaches and in small streams. Men or women stand with their back to the flow of the current holding the net underwater until a catch is made. Large fibre nets are more limited in their distribution and are most commonly
used as hand-held barriers by people standing in water. Fish captured by this method are either driven toward the net or carried into it by the current. Unlike other groups the Waropen employ stationary nets to impound fish stranded by the falling tide (Held 1957: 342).

In considering the applicability of harpoon and net fishing to the Kairi environment, it must be noted that these techniques are not commonly employed in other than shallow water. The swift, muddy flow of the Kikori and Sirebi Rivers inhibits the successful implementation of harpoon fishing. The steep fall of the major river banks renders traditional methods of net fishing impossible. Therefore, if either of these techniques were used in the Kairi environment they would be most effective in the shallow streams and pools, sites at which the Kairi employ traditional fishing techniques.

**Hunting**

The following discussion focuses on the exploitation of hunted rather than domestic animals. The special importance of the latter is not questioned, though because the consumption of domesticated animals is usually restricted to ceremonial occasions their significance in the total diet and the time devoted to the acquisition of animal foods is minimal.

As one might expect, reliance on hunted game occurs predominantly among those sago users with impoverished fish resources (see Table V-5). The Marind-anim, Gadio Enga, Etoro and perhaps people living in the catchment of the Tor River (cf. Oosterwal 1961: 62, 77) are anomalous in this respect. The first group inhabits an exceptionally rich and varied environment in which large waterways dissect savanna grassland and lowlands rain forest. Faunal resources are abundant within this region and can be procured with a wide range of techniques, some of which - for example, fire drives and the use of fish poison, are particularly successful because of the pronounced dry season occurring in the area. The remaining groups place equal importance upon fishing, hunting and the collection of animal food.

Individual hunting is practised by most Melanesian sago users. While the stalking of game is common, men frequently employ a wide range of other techniques. Dogs are used to bring pig or cassowary to
bay, to flush ground-dwelling marsupials from concealment or to tree phalangers. Pig, cassowary and rat are captured from ambush at feeding sites or lured with sagopalm pith to hunters waiting behind a screen made from palm fronds or tree branches. Bush and water fowl are captured by the same methods, but birds living in the high canopy are usually shot from behind blinds which are constructed in trees. Lizards, snakes, frogs and bats, game of lesser importance, are usually captured by improvisation.

A number of groups practise communal hunting and drives toward nets or a line of hunters, sometimes with the assistance of dogs, are commonly employed. This technique is effective in capturing pig, cassowary and wallaby. Such drives only occur during the dry season and occasionally as a prelude to ceremonial feasting. In regions of savanna, fire drives are used and pig, wallaby, bandicoot, pythons and rats are frequently caught this way. In areas where seasonal floods are extreme, hunters surround isolated patches of high ground and capture the pigs, wallabies and cassowaries which have sought refuge there.

Melanesian sago users employ a wide variety of traps and snares to bag game. Dead falls, often baited with felled sagopalms, and pit falls are used by many groups to capture pigs. Some hunters kill pig by constructing snares or implanting a row of sharp-pointed sticks in gaps left in garden fences. A noose snare is often used to trap cassowary. Wallabies, bandicoots and rats are caught by dead fall, pit fall and noose traps. Lizards, birds and bats are also trapped, but only by a few groups.

Collecting Animal Food

All Melanesian sago users supplement their diet with collected animal foods (Table V-6), such as sago grubs, shellfish, bush fowl eggs, crabs and crayfish. The "cultivation" of grubs in the unprocessed portions of felled sagopalms has gained renown as an important means of converting palm starch into animal protein. However, this view arises from a fixation upon the deficiency of protein in the sagopalm and thus ignores the dietary significance of sago grubs as a probably more important source of fat (but cf. Townsend 1968: 54). Shellfish and crabs appear almost daily in the meals of sago users living near
the coast. Further inland riverine resources are haphazardly
collected, but in a few instances these items and bush fowl eggs
assume importance as seasonal resources. Snails, insects, turtle
eggs, frogs and prawns complete the reported inventory of animal
foods collected by sago users.

Variations in subsistence patterns

The ethnographic data presented above suggests that three
fundamental factors underlie the variation in the subsistence
patterns observed among Melanesian sago users:

1. natural distribution of food resources;

2. artificial distribution of plant foods
   created by the purposeful management of these
   resources;

3. hunting techniques and strategies.

Distribution of natural resources

Although wild plants are an important element in the diet of
sago using peoples, their exploitation rarely occupies a dominant
role in subsistence activities, apart from sagopalm exploitation.
Groups inhabiting all the major lowland and highlands fringe environ-
ments process starch from reportedly wild palm stands. The distribution
and density of wild palm stands differ little from those of other
wild plant foods favoured by human exploitation. Stands of wild
sagopalms that occur outside freshwater swamps are generally restricted
to areas bordering natural drainage routes or to isolated depressions
having a high soil moisture content. Such stands are typically small,
scattered clumps of palms. *Metroxylon*'s slow maturation rate and
the strong preference shown by people to exploit only those palms
which are inflorescing limit the capacity of most wild sagopalm
stands to support large sedentary groups.
Townsend (1969: 177) suggests the distribution of wild animal food, particularly riverine resources, is the critical factor influencing the "population density, settlement pattern, and total cultural adaptation" of New Guinea sago using peoples. From the evidence I have reviewed I would argue that the degree of sagopalm management is an equally important factor in this equation, but it is nevertheless true that the natural density and distribution of exploited fauna govern the resource potential of specific regions.

The availability of littoral and riverine animal foods is an important distinction amongst sago-using peoples. Groups such as the Koriki (Williams 1924: 12-13), Waropen (Held 1957: 12, 42, 342-45) and Asmat (Eyde 1967: 18-23, 25), who live in regions where fish, shellfish and crabs are abundant, devote a significant amount of time to the procurement of these resources. Further inland or in environments such as that inhabited by the Gidra (Ohtsuka 1977b) fish and shellfish are smaller and less abundant (Dornstreich 1973: 145; present study, Appendix 16). In these regions people exploit these resources sporadically. On those occasions when they decide to fish the methods employed involve large groups of people and take place during drier seasons of the year when yields are higher (e.g. see Oosterwal 1961: 14, 67-68 for the Mandar and Waf; Konwenhoven 1956: 16 for the Nimboran; Schieffelin 1976: 31, 144-46 for the Kaluli).

The natural distribution of favoured game species does not differ markedly throughout the area inhabited by Melanesian sago users. Different species of cassowary and phalanger occur, but this does not seem to affect hunting strategies or the orientation of subsistence activities. Of the macropodids, *Thylogale* sp. and *Dorcopsis* sp. are found in most areas; *Dendrologus* sp. is limited to the highlands fringe region. *Macropus agilis* occurs only in savanna environments and the fact that this animal species is the focus of intensive, seasonal hunting expeditions (e.g. see Verschueren 1970: 47 for the Marind-Anim; Williams 1930: 46 for the Orokaiva) singles it out as an important exception for which the natural distribution of game does affect land-use strategies. This level of human response to the increased accessibility of game is also mirrored in Morren's observations of the Miyanmin (1974: 328, 371) who congregate yearly to take advantage of the seasonal movements of pigs.
Artificial distribution of plant foods

The distribution of sagopalms and garden crops are intensively manipulated by humans. Within certain limits dictated by soil fertility and moisture content, ground slope and the salinity of invasive water these plant foods may be cultivated anywhere in the areas inhabited by sago users. Given this, it is surprising that most groups which subsist largely upon palm starch and live in areas where extensive, natural stands of sagopalms do not occur (e.g. Waf-Oosterwal 1961: 57-58; Gadio Enga - Dornstreich 1973: 197-98, 205; Kaluli-Schieffelin 1977: 31-32; Gidra-Ohtsuka 1977a, 1977b) do not actively husband or cultivate sagopalms. In contrast, the majority of people for whom palm sago is supplementary food exploit stands of planted palms (see Figures V-2, V-3). Perhaps dietary preferences, historical pressures from outside groups to acquire land or inadequate faunal resources encourage mobility amongst some peoples and sagopalm cultivation is, therefore, not desirable. Still, the variation in sagopalm management is a key factor which differentiates sago-using peoples.

Where garden produce is the carbohydrate staple, access to fertile land is crucial. Since soil enriching cultivation techniques are not practised among Melanesian sago users, garden sites must undergo long fallow periods before being replanted. Group mobility or large land holdings are the most common methods used to secure an adequate supply of arable land for gardening.

Exploitation of hunted game

The equipment used by Melanesian sago users for hunting varies only slightly. The use of nets or fences during game drives is a notable exception but the distribution of such items is very limited (see Table V-5). Methods of trapping game differ and groups usually distinguish themselves on the basis of the particular type of traps employed to catch different animals.

Hunting techniques, however, vary considerably and communal game drives are the single most important strategy serving to set apart individual communities of sago users. Fire drives are restricted to savanna environments; human-dog drives have a limited distribution
which includes all environments inhabited by sago-using peoples. The infrequent use of dogs in hunting is surprising and it is difficult to understand why this seemingly productive hunting technique is not more widely employed.

The organisation of hunting activities also differ to a large degree. For some groups (e.g. Kaluli-Schieffelin 1977: 30-31; Foi-Langlas 1974: 24, 31), success in hunting is fortuitous; for others (e.g. Mandar-Oosterwal 1961: 65-66; Orokolo-Williams 1940: 15) it is the result of intense effort directed towards acquiring food for ceremonial feasting. However, when animal movements or seasonal events enhance the applicability of specific hunting techniques, such as ambush at garden sites, drives or surrounds, hunters always pursue their advantage.

Summary

In discussing the major factors denoting variation in the subsistence strategies of Melanesian sago users a number of key indices have been identified. With regard to plant foods, the degree to which groups consciously influence the distribution and density of sagopalm is the most decisive. Differences in the procurement of animal foods are best represented by the availability of a stable supply of aquatic resources and by the systematic implementation of communal hunting strategies.

Land-use Patterns

As illustrated for the Kairi, the primary indices of land-use are a community's settlement pattern and the manner in which people organise subsistence activities from different locations. While subsistence activities are easily defined, the variability of settlement patterns defies typological classification. In the following discussion I make use of several general terms to characterise the range of settlement patterns observed among sago users (see Table V-7). These settlement categories may gloss over some important distinctions between groups, but further refinement is unnecessary. The ethnographic literature surveyed frequently contains inadequate information about the areal distribution of habitation sites, the size of residence groups and the amount of time sites were occupied. In many cases the
information included in reports was too general to be of any use. For these reasons the classifications I derive are meant to describe settlement patterns, not to define types.

**Settlement categories**

Primary modes of settlement documented include nuclear village, hamlet cluster and dispersed hamlet. These distinctions account for regional concentrations of a population, regardless of size. In a settlement pattern centred upon a nuclear village the population gravitates toward a specific locality; in hamlet cluster small groups settle in close proximity to each other; in dispersed hamlet small groups live at some distance from one another. Variations within the primary settlement mode also occur. It is necessary to draw attention to these alterations because their existence emphasizes intra-group subsistence strategies which are an integral part of land-use patterns. Temporary encampment (the *kombati* of the Kairi) is the only variant of the nuclear village and hamlet cluster patterns; these small camps are used regularly, occasionally and seasonally. Alterations in the dispersed hamlet pattern are seasonal nucleation, infrequent nucleation and residential flux. The last is characterised by nuclear families continually occupying different hamlets.

**Variation in land-use strategies**

I now describe the three land-use strategies identified for contemporary sago users by dividing each according to its primary settlement mode.

1. The most common form of land-use among the cultures surveyed is best described as extensive resource exploitation.

**Nuclear settlements**

The Asmat, Koriki and Mandar live in nuclear villages but subsist largely on food, particularly palm starch, obtained while residing at *kombati*. From these foci men occasionally hunt, but game is not a regular component of the total diet of these groups. The Wania-Sawanda, who live in hamlet clusters, follow a similar pattern, but the cultivation and harvesting of garden crops while at *kombati* is more emphasized.
The Gidra resemble the Asmat in their settlement pattern and use of *kombati* to process palm starch. However, they regularly move their village site as the number of harvestable sagopalms in the area proves inadequate to meet subsistence needs.

**Dispersed hamlet**

The Kaluli, Mimika, Pawaia, Siwai, and Waf exhibit the same type of land-use strategy, but this is more function of their dispersed hamlet settlement pattern. Members of these groups rarely congregate at a single locality. If they do it is usually on ceremonial occasions. Hamlet site and sago palm stand are usually contiguous, with the exception of the Siwai and possibly the Kaluli who rely more heavily upon garden crops. The Kaluli, Pawaia and Waf all live in lean resource areas and regularly move their hamlets to adjacent regions when palm stands and/or garden land becomes depleted. The Mimika inhabit a rich environment and range within such a limited territory that they can be considered virtually sedentary, despite the fact that they constantly move from sagopalm stands in the freshwater swamps to fishing grounds in the tidal swamp.

The Sanio and Gadio Enga stand apart from the other groups which practise an extensive land-use strategy and live in dispersed hamlets. Among these groups the composition of any one hamlet constantly changes as family units move from their "primary" residence to join neighbouring groups. This settlement pattern, which I term residence flux, is unique among Melanesian sago users as it provides an extraordinarily large resource base. The Gadio Enga occasionally use temporary encampments when exploiting food resources located at some distance from their hamlets or when establishing new gardens. However, extended residence at *kombati* resulting in substantial quantities of food being exploited on site is contrary to food sharing principles and usually only occurs in situations where the demand on hamlet food supplies exceeds local production.

2. The second land-use strategy identified is seasonal resource exploitation. In all groups exhibiting this pattern, the increased accessibility of animal food during the dry season is a primary factor influencing the re-orientation of settlement.
Nuclear village

With the lowering of the water-level of creeks in the freshwater swamp, the Marind-anim move to temporary encampments dispersed throughout inland sagopalm swamps. Communal fishing with weir "nets" and communal fire drive hunting in the nearby savanna dominate the subsistence activities during this period. Palm starch is also regularly processed.

The Keraki also abandon their villages and retire to seasonal kombati, which are situated near yam gardens. The harvesting of last season's crop and the planting of yams for the next is a major activity during kombati residence. The Keraki also capture large quantities of game by using fire drives.

The seasonal re-orientation of the Etoro settlement pattern is not as marked as that of the Marind-anim and Keraki because it involves only small groups of men hunting bush wallabies. Men drive game through the rain forest toward a line of "picket fences". Between each section of fencing a dead fall trap is constructed to capture the stampeded wallabies. The hunters live at the "lodge" until a substantial supply of smoked meat has accumulated.

Dispersed hamlet

The Miyanmin differ from the other groups which practise a land-use strategy based on seasonal exploitation. Throughout much of the year people live in dispersed hamlets near mature gardens, but during the dry season a large segment of the population congregates along the margin of the primary and secondary forests. At this time, large groups of pigs are attracted to the primary forest by the fruiting trees; therefore, hunting becomes more localised and the yield higher.

3. The third land-use pattern is localised resource exploitation. Groups using this strategy subsist substantially on food obtained within close proximity of their nuclear settlements. The Foi, Daribi, Tangu and Orokaiva all employ this strategy. The occasional hunting expedition and gardening, for the Tangu and Orokaiva, are the subsistence activities conducted from temporary encampments. With the exception of the Daribi, all these groups appear to be very sedentary.
ALTERNATIVE LAND-USE MODELS

Each of the societies in the foregoing study of Melanesian sago users has been examined with regard to three major components of land-use: technology, subsistence strategy and settlement pattern. This assessment of the range of variation to be found amongst living communities now serves as the basis from which I now propose five hypothetical land-use models for the Kairi environment.

It must be made clear at the outset that my use of discrete ethnographic examples in the course of model building is not an attempt to transpose in a wholesale fashion these systems into the middle Kikori region. The reasons why this is not an appropriate strategy are obvious. Firstly, my study of land-use strategies has paid little attention to differences in the social organisation of the groups concerned and therefore the effects of social structures on land-use and vice versa. Secondly, contemporary societies are the product of unique historical developments in particular environmental circumstances. To regard either of these factors unimportant undermines the use of analogy because there are generic and functional differences between all societies.

In short the ethnographic systems are used only to assist in defining the range of land-use strategies which are applicable to the Kairi area and against which the archaeological record may be fully tested. It must be conceded that I may not have exhausted all the possible strategies. But, given the environmental and technological constraints which are known to exist I am satisfied that any additional models would only vary from the ones presented here in minor details.

To preface my description of the models I review the basic assumptions upon which they are predicated.

Natural environment

The history of climatic change modelled by Nix and Kalma (1972) and the reconstruction of Holocene vegetation patterns in New Guinea by Powell (1976) support the conclusion that the natural environment in the research area has remained substantially unchanged over the past 6000 years. Therefore, it is assumed that the present-day environment accurately portrays the natural context within which the prehistoric peoples, who are considered in this study, lived. As
demonstrated above (Chapters 3 and 4), the restricted distribution and density of sagopalms and seasonal flooding are major components of the natural environment which effect the structuring of land-use systems.

**Technology**

In discussions describing the various subsistence techniques practised by Melanesian sago users, it is apparent that the technology associated with most subsistence pursuits is roughly equivalent between societies. The use of fish nets and harpoons by a few groups (see Fig. V-4) is a notable exception. However, prehistoric peoples living in the research area would gain no appreciable advantage by the possession of these implements because nets and harpoons are used only in shallow water. This suggests that the exploitation of resources in large rivers would not be possible even if such implements were a part of the prehistoric fishing technology. Therefore, in constructing the following land-use models I also make the assumption that technological variation does not increase the range of resource localities beyond that achieved by traditional Kairi subsistence techniques.

I now describe five hypothetical land-use models and their archaeological analogues. The procedures employed in their derivation and the method of presentation is the same as that used in Chapter 4.

**Vagabond Model**

This model proposes a situation in which palm starch is the staple plant food and only naturally occurring stands are exploited. The population inhabiting the area is small and the people live in isolated hamlets near palm stands. The number of harvestable palms puts limits on the amount of time the region is occupied. However, the processing of immature sagopalms, the planting of a few garden crops and an intensive exploitation of additional wild plant foods could lengthen the stay, but only marginally.

Figure V-5 is a graphic representation of this model. Hamlet sites situated on the alluvial plain are inhabited only in the dry season. At this time the people perform all the major subsistence
activities, with the possible exception of gardening. Hamlets nearer to the karst escarpment accommodate year-round occupancy. Gardens, if constructed, occur near such sites. If population size is sufficiently low, individual groups can move from wet to dry season hamlets, with hunting being the primary method of capturing animal food at the former. This situation also allows a longer residence in the area. If, however, the population size is large, the period over which the area is inhabited is short because of the limited supply of palm starch resources. In this case a full year's residence may not be possible and either wet or dry season settlements are not used.

This land-use model assumes that the population may range freely throughout a large area without the constraints imposed by other groups competing for the available subsistence resources.

For this model I propose three working hypotheses.

**Hypothesis I:**

*If* primary settlement sites are impermanent over a span of years, *then*

A. the structures erected at habitation sites are not substantial;

B. the accumulation of cultural debris in the area of the habitation site is not great.

**Houses**

The frequent shift of settlement sites to areas adjacent to unexploited sagopalm stands would remove the need for structures whose use would encompass more than a few years. Temporary buildings, such as those documented for the Keraki (Williams 1936: 12-15), would be the most suitable housing because:

1. there is no need to devote a great deal of time to major construction projects and

2. the replacement of thatch would probably be the only maintenance required over the period the site was occupied.
This would be represented in the archaeological record by the occurrence of only small post holes, probably appearing in discrete groups.

**Cultural debris**

Although the use of previously exploited palm stands may lead to the re-use of old habitation sites, the midden resulting from any one particular period of site occupation would not be great, considering the short time involved. It is also highly likely that renewed occupation of an area would not involve settlement on exactly the same spot.

**Hypothesis II:**

*If* habitation sites are used throughout the year, *then*

A. they are located near the alluvial plain/karst margin or on the levees of inland creeks;

B. a wide range of activities occur at the site.

**Residence locality**

Wet season flooding would prevent year-round settlement of the alluvial plain. However, the reliance upon palm starch as the carbohydrate staple would prompt the establishment of settlements in the general vicinity of sagopalm stands. As well, the inhabitants would need to have ready access to localities not normally flooded, where game and riverine resources could be procured. These factors would, therefore, favour the siting of year-round settlements either near the maximum extent of annual floods or on river levees adjacent to perennial creeks.

The occurrence of open sites at locations meeting these requirements would provide archaeological confirmation of this aspect of the hypothesis.
Work activities

The use of a single habitation site throughout the year results in the full range of subsistence and non-subsistence activities being performed at or near a specific locality. Subsistence activities would include processing sago, fishing, hunting, the gathering of wild plants and animals and possibly gardening. Small-scale construction projects and the manufacture and repair of implements are likely to comprise the major non-subsistence activities.

Archaeologically, this would be represented by a variety of subsistence and artefactual debris. Food items would reveal no seasonal bias, for example the occurrence of fish or game only available on the alluvial plain. Assuming the availability of raw materials for the manufacture of stone tools, artefacts representing the complete stone reduction sequence (i.e. debitage, non-utilised cores, tool blanks and fully fashioned implements) and the repair of implements (i.e. retouch flakes) would appear in the site deposits. Specialised tool forms, such as sago choppers and axe-adze blades, would assist in further documenting the range of subsistence and non-subsistence activities.

Hypothesis III:

If there is a seasonal alteration in the siting of settlements, then

A. dry season habitation sites are located on the alluvial plain;

B. localities near the alluvial plain/karst margin or on the levees of inland creeks are inhabited during the wet season.
**Dry season**

Natural sagopalm stands most frequently occur within the area subject to annual flooding. As they are normally unavailable for exploitation during a portion of the year, these stands would promote the establishment of dry season settlements at nearby locations.

The accessibility of riverine resource localities and game movements during this season would be another advantageous feature of the alluvial plain.

Archaeological sites situated within the area subject to annual flooding and indicating some bias toward riverine resources would exemplify this mode of land-use.

**Wet season**

The siting of wet season habitations is largely dictated by the natural distribution of sagopalms and flood levels. As the subsistence activities conducted from these settlements have a more restricted range, a limited number of resource localities would be available for exploitation.

This would be reflected in the archaeological record by the occurrence of sites outside the range of annual flooding or on the levees of perennial creeks. The subsistence debris would be limited to game occurring along the karst escarpment and to fish inhabiting the headwaters of small tributary creeks and streams and shallow flood waters covering the alluvial plain. Since game populations congregate in restricted areas during this season, the remains of hunted fauna may be a dominant component of the subsistence debris.
Gardener Model

In this model, garden crops, rather than palm sago, provide the starch base of the diet. Localities in the Kairi region suitable for gardening include elevated areas of the alluvial plain, river bank levees and isolated localities along the lower slopes of the karst escarpment, where soil accumulation is greatest. Low-lying areas of the alluvial plain are inundated yearly and a gardening technology lacking drainage systems would not allow sufficient time for crops to mature. Sites on the karst plateau are unsuitable because of the shallow depth of soils occurring there.

Given the climatic conditions taro and bau would probably be the primary crops. Small isolated stands of sagopalms on the alluvial plain would provide a supplementary starch resource while garden crops matured or during feasts. Palm starch resources would not be readily renewed, even if *Metroxylon* suckers were replanted. This is assumed because the time needed for palms to mature would exceed the period during which arable land in the area would be suitable for raising crops. Therefore, the population would have relocated itself in a different area by the time sagopalm resources were again available for exploitation.

Fishing techniques need not necessarily differ from those of the contemporary Kairi. The increased number of functioning and abandoned gardens may serve to attract pigs and thus greatly localise their movements. Ambush would then be a most effective means to kill pigs at any time during the year. If communal drives or surrounds were used, they would generally take place during the change-over from dry to wet seasons, when the karst regions become more attractive to game due to the increase in flooding and the fruiting of plants (see Table III-8). High overbank flow during the wet season, which limits the distribution of game to isolated areas of high ground in the alluvial plain, would certainly prompt communal hunting, if these events were monitored by people living near to the flood plain.

I suggest the settlement pattern would not include permanent villages. Settlements would more likely shift seasonally and different settlement modes, such as dispersed and clustered hamlets, might appear. During the wet season plant and animal resources would be unobtainable on the alluvial plain and people would move to sites
near the karst escarpment or to river levees along perennial creeks. In the dry season there would be a tendency for the population to disperse and settle on the flood plain.

Figure V-6 is a diagrammatic portrayal of the Gardener Model, illustrating the seasonal orientation of habitation sites. Dry season settlements are dispersed throughout the alluvial plain and directly associated with gardens planted during the previous dry season. Sagopalm stands occurring nearby serve as a resource buffer while new gardens undergo initial construction. Animal food acquired through hunting, fishing and collecting regularly enters the diet. Climatic factors and labour requirements for the different phases of garden construction and for sago processing strongly influence the timing and types of animal food procured. Wet season settlements are situated nearer to the karst areas. Gardening and hunting are the major subsistence activities during this season. Palm starch is processed if *Metroxylon* stands are situated nearby. The exploitation of fish resources only occurs at the upper reaches of permanent streams having an outfall into the major rivers and perhaps along the fringe of the alluvial plain.

This model presumes that the group is a pioneering population, with the ability to occupy adjacent areas at will and return eventually to an area previously inhabited. From this land-use model I derive the following working hypotheses.

**Hypothesis I:**

*If* sites on the alluvial plain are gardened, *then*

A. dry season encampments are located near gardens;

B. encampments are probably occupied over several seasons;

C. the population inhabiting the area does not aggregate in specific areas;

D. a wide range of activities is conducted from habitation sites.
Residence locality

The timing of the habitation of the alluvial plain directly follows from consideration of annual flood patterns. The location of settlements adjacent to gardens arises from the need to protect garden crops from wild pig predation. The construction of habitation sites contiguous to gardens is a pattern followed by many New Guinea shifting horticulturalists (e.g. see Dornstreich 1973: 199; Townsend 1969: 56). However, in most instances further protection is afforded by the fencing of garden plots. This need not be the case for gardens located on the alluvial plain. Yearly flood patterns deter pig movement into this area and, as well, most garden sites would be isolated islands during the wet season (e.g. cf. van Baal 1966: 19).

The occurrence of open sites adjacent to or on elevated areas on the alluvial plain would be the archaeological representation of this settlement mode.

Length of site use

The luxuriant vegetation covering the alluvial plain attests to the fecundity of the soils present here (for further description see Chapter 2; Paijmans 1976: 49-52). It is therefore highly probable that garden sites may be used for more than a single planting of crops, as the Kairi do today.

Archaeologically this would appear as open sites having either

1. a dense and isolated deposition of cultural debris, possibly separated by a stratum of alluvium, or

2. dispersed cultural deposits falling within a discrete area.
Group size

Arable land occurring above the maximum height of annual floods most usually appears as small isolated knolls. The extent of gardens is restricted and this would presumably limit individual harvests. I posit that family-sized groups usually occupy settlements situated on the alluvial plain. Dispersed hamlets would, therefore, be the settlement mode during the dry season. Discrete arrays of post holes which are indicative of a limited number of structures and which appear at several localities throughout the alluvial plain would be the archaeological representation of this settlement pattern.

Work activities

A full range of subsistence activities would occur during the dry season. Work associated with gardening is most prominent, but the processing of sago also takes place. The increased accessibility of riverine fauna probably results in an emphasis on fishing and collecting shellfish rather than the hunting of game.

Evidence of the manufacture and repair of implements used in gardening figures greatly in the archaeological deposits at such sites. This is also true with respect to sago processing tools, which are more likely to occur at dry than wet season sites. Subsistence debris is primarily comprised of riverine resources.

Hypothesis II:

If localities outside the area affected by flooding are used for gardening, then
A. settlements are either a single large or a cluster of smaller hamlets;
B. habitation sites are occupied primarily during the wet season and only over a few years;
C. the range of work activities is restricted.
**Settlement mode**

The presence of pigs in this area throughout the year would necessitate the fencing of garden plots. Since potential garden sites are possibly larger but more dispersed in the area of the karst escarpment than on the alluvial plain, it is probable that large communal gardens would be frequently constructed. This would promote the aggregation of the population in the general vicinity of garden sites.

Ethnographic examples of the use of communal gardens are reported for several groups, for example: Marind-anim (Verschueren 1970: 47), Keraki (Williams 1936: 213), Orokaiva (Williams 1930: 42) and Orokolo (Williams 1940:13). However, the motivation for this practice is not stated. My interpretation of such reports supports the notion that economy of effort plays some role and this is the basis for the above postulation.

The archaeological reflection of this type of settlement would be a number of discrete arrays of post moulds occurring at a single open site or at several sites not too distant from one another. The distribution of cultural deposits would be more extensive than those occurring at sites in other environmental settings. Also, there would probably be a number of separate middens.

**Period of habitation**

The postulation of wet season habitation of such sites arises as a corollary to evidence supporting the dry season habitation of the alluvial plain. Settlements near the karst escarpment would have a shorter total period of use because the fertility of limestone-derived soils would not support recurrent cropping and the number of arable plots would be small in number.

The cultural debris deposited at these sites would be shallow.
Work activities

The reduced accessibility of most riverine resources and sagopalm stands would generally result in a marked decline in these activities. Hunting would increase in response to the clustering of game in the area along the karst escarpment or on isolated patches of high ground on the alluvial plain. The organisation of communal drives or surrounds would be facilitated by the close proximity of groups of hunters (e.g. Miyanmin-Morren 1979: 10). There would in most cases be little variation in the types or extent of non-subsistence activities from those conducted in or near settlements established elsewhere.

A strong contribution of hunted game to the subsistence debris and the absence of evidence for the repair of stone implements associated with the exploitation of palm starch are the primary archaeological representations of these behavioural patterns.

The models presented to this point have focused upon divergent subsistence systems. Now we consider models based upon the same subsistence base, but where the strategy of resource acquisition and the associated settlement pattern differ. An assumption implicit in each model is that in the past the natural distribution of sagopalms has been extended through palm husbandry or new stands have been deliberately cultivated.

Residence Flux Model

Here the settlement pattern accommodates a frequent change in the composition of people living at specific locations and presumes the regional population density to be low. Palm sago is the staple starch resource and palm stands are cultivated. Mixed crop gardens are the rule and they are most usually associated with habitation sites. The settlement pattern consists of dispersed hamlets situated near ephemeral streams adjacent to the karst escarpment or along
perennial creeks close to the inland margin of the flood plain. Temporary encampments are unnecessary because seasonal variations in the distribution of the population need not involve the establishment of new quarters.

Figure V-7 illustrates this model in schematic form. All habitation sites are located either outside the immediate area subject to annual floods or at localities, such as river levees, where predictable overbank flows rarely occur. All subsistence activities are conducted from the hamlets, regardless of the seasonal accessibility of animal resources. If settlements near the karst margin are favoured during the wet season, subsistence activities will be more strongly oriented toward hunting.

An assumption inherent in this model is that the movement of people into, through and possibly out of the region progresses at a slow rate. This is based upon the length of time it takes to establish a cultivated palm stand and the reluctance of people to abandon an area in which a staple resource exists before it is replaced elsewhere.

I derive three working hypotheses from this model.

Hypothesis I:

*If* the permanent population of a hamlet is small throughout most of the year, *then*

A. hamlet sites are never inundated by flood waters and are usually located near creeks or streams;

B. a wide range of activities occurs at settlement sites;

C. a variety of permanent and temporary structures is constructed at hamlet sites.

The first two propositions of this hypothesis are identical to those set forth in Hypothesis II of the Vagabond Model (see pp. 100-02). Thus the description of the relevant test hypotheses given there also pertains here.
Houses

The types of structures used by a small resident population may include a number of small, family-sized dwellings (e.g. Waf - Oosterwal 1961: 32), a single moderately sized house (e.g. Pawaia - Woodward 1922) or a combination of the two (e.g. Daribi - Wagner 1967: 17-21). However, the accommodation requirements of visitors, whose numbers vary considerably throughout the year, results in a wide range of temporary and permanent structures occurring at habitation sites (e.g. Sanio - Townsend 1969: 6, 8, 157). Post holes of variable shapes and sizes appearing at an open site is the archaeological representation of this settlement mode.

Hypothesis II:

If the population seasonally inhabits specific hamlets, then

A. localities on or adjacent to the alluvial plain are favoured during the dry season;

B. localities near the karst escarpment are preferred during the wet season;

C. the size of hamlets is very much the same.

Dry season

The inclination toward settling areas near and possibly within the range of annual flooding arises as a result of the large number and diversity of riverine resource localities which seasonally appear in this area. The movement of some game animals back to the alluvial plain also suggests that such sites are most desirable for habitation.

The occurrence of open sites at such locations and possibly a high proportion of riverine fauna represented in the subsistence debris there are archaeological markers of a seasonal shift in residence patterns.
**Wet season**

This proposition of preferred wet season habitation near the karst escarpment follows as a corollary to the above. Its archaeological manifestation is the occurrence of a high proportion of game animals among the subsistence remains in habitation sites located beyond the range of annual floods.

**Settlement size**

It is proposed that the population of hamlets settled during specific seasons does not vary significantly from year to year. For example, groups such as the Keraki (Williams 1936: 3-6, 12, 13) and Marind-anim (Verschueren 1970: 45, 47, 50, 51) change settlement sites between wet and dry seasons, but the size of groups living at dry season kombati is always small and that at wet season villages is always large. Although the character of wet and dry season settlements in the research area cannot be easily predicted for people practising a residence flux settlement pattern, it is probable that the size of hamlets occupied during the same season does not necessarily vary.

In the archaeological record this is portrayed by a repetition of the areal extent of sites undergoing use during the same season.

**Hypothesis III:**

*If* the number of people living at a hamlet fluctuates irrespective of season *then*

A. a wide range of subsistence activities are conducted from all hamlet sites;

B. the areal extent of hamlets varies.

**Subsistence activities**

In the absence of a seasonal preference for specific hamlets, any habitation site may serve as the base from which people pursue the full range
of subsistence activities. Therefore, the food remains at archaeological sites reflecting this settlement pattern exhibit no bias for a particular resource or suite of resources.

Settlement size

The premise of variation in hamlet size suggests the antithesis to the argument of Hypothesis II. The occurrence of habitation sites in similar localities but of varying sizes serves as the archaeological correlate of this settlement pattern.

Ecotone Model

This model proposes a situation where settlement sites and group composition are static. Large curated stands of sagopalms supply the staple carbohydrate resource. Small mixed crop gardens are situated near hamlet sites, which cluster in an area.

Figure V-8 depicts this model diagrammatically. Hamlet sites are located near stands of sagopalms and along the middle reaches of small creeks or streams. From such locations the rise and fall of flood waters and the seasonal movement of game within the region are easily monitored. The accessibility of all animal foods is therefore predictable and subsistence activities directed toward their procurement are only conducted from permanent habitation sites. Communal hunting and fishing expeditions occur regularly throughout the year.

The following working hypothesis is derived from this model.

Hypothesis

*If* people live in clustered hamlets which are inhabited year-round, *then*

A. settlements occur only in the area between the maximum extent of annual floods and the karst escarpment;

B. houses are durable structures;
C. all subsistence activities are conducted from habitation sites;
D. the manufacture, maintenance and repair of material culture items occur in the daily repertoire of hamlet work activities.

Residence locality

Factors inhibiting the permanent habitation of the alluvial plain are detailed in previous models. The establishment of hamlet settlements in the karst plateau seems unlikely for a number of reasons, not the least of which is the paucity of riverine resources. The zone between these two environments is ideal for permanent settlement and the siting of hamlets along waterways is favoured because movement within the region is facilitated by such positioning and riverine resources are near at hand.

The archaeological manifestation of this settlement pattern is that all open sites occur within the prescribed zone.

Houses

Although a variety of house styles may be used, they will all be constructed so as to last for a number of years. Taking the local climate into account, it is most probable that structures with raised floors would be used.

A patterned array of post holes, whose width and depth are consistently large, is the archaeological reflection of such structures. Assuming clustered hamlets to be the settlement mode, such arrays will be limited in number.

Subsistence activities

Since temporary encampments are not a component in this model, the refuse of most food items is deposited at or near the hamlet. In the archaeological
record this appears as highly diverse and substantial midden deposits. It is most probable that seasonal exploitation patterns will not be recognised.

*Non-subsistence activities*

This aspect is discussed in the description of the Contact Model (p. 73).

**Wet Season Dispersal Model**

This model closely parallels that described for the Kairi during the Contact Period. It differs in its proposal of an intra-regional dispersal of the population during the rainy season. The flooding of the alluvial plain makes fish resources inaccessible because no technique is continuously appropriate in such conditions. The rising waters on the plains also restrict the movement of most terrestrial animals to high ground near the karst plateau. People are thus motivated to move from permanent village sites situated on rises in the alluvial plain to small, possibly family-sized hamlets near the karst escarpment in the wet season, for hunting and perhaps fishing.

Figure V-9 illustrates this model. The large sagopalm stands adjacent to the village and the smaller one close to *kombati* sites, both of which are cultivated, supply the major source of carbohydrates year-round. Small mixed gardens are situated near the primary habitation site and perhaps near temporary camps. In the dry season the full range of subsistence activities is conducted from the village; in the wet season hunting and sago processing predominate.

From this model I derive the following hypotheses.

**Hypothesis I:**

*If* the population resides in villages only during the dry season, *then*

A. village sites are usually situated on the alluvial plain;

B. a number of durable structures are erected at a habitation site;
C. the manufacture, maintenance and repair of material culture items frequently occur in the daily repertoire of work activities;

D. the exploitation of riverine resources is a major subsistence activity, although a wide range of subsistence pursuits is conducted from the village.

**Residence locality**

The arguments supporting this proposition are reviewed in the land-use models above where settlements shift seasonally. Archaeological evidence representative of this aspect of the hypothesis is the occurrence of large open sites on the alluvial plain alone.

**Houses and non-subsistence activities**

The reader is directed to the Contact Model (pp. 72-73) for a discussion of these components of the hypothesis.

**Subsistence activities**

Since the full range of resource localities is accessible in the dry season, their exploitation is certain. However, an emphasis upon the procurement of riverine resources is expected because all fishing and collecting techniques are appropriate during this season. A predominance of fish and shellfish remains at an open site would support this proposition.

**Hypothesis II:**

*If* the population disperses during the wet season, *then*

A. habitation sites occur near the karst escarpment;

B. small-sized groups usually occupy a single site;

C. the acquisition of animal foods is oriented toward hunting.
Residence locality

The restricted distribution of accessible faunal resources promotes the occupation of the region near the karst escarpment during the wet season. The limited occurrence of sites in this area characterised by the features proposed below provides archaeological substantiation of this premise.

Group size

The significant reduction in the number of resources within the exploitation range of temporary settlement sites and unfavourable fishing conditions suggest that only small groups would occupy a single site. Furthermore, family-size *kombati* is a dominant aspect of the settlement pattern of people who reside in permanent villages during a large portion of the year (e.g. Mandar - Oosterwal 1961: 31-33; Koriki - Williams 1924: 10). This is represented in the archaeological record by a limited scatter of cultural debris and possibly the occurrence of post holes indicative of only a few structures.

Subsistence activities

An emphasis upon hunting activities follows from the contraction of game movements and the difficulties in procuring riverine resources during the wet season. This is portrayed archaeologically in the high incidence of terrestrial fauna occurring in the food remains at sites.

Summary

In this and the previous chapter I have described the structural components and associated test hypotheses for seven land-use models. By comparing the proposed strategies (see Table V-8) it is apparent that several share similar hypotheses for testing against the archaeological evidence. However, the geographical location of
habitation sites and the scheduling of their use form major points of distinction between models. Also in anticipating the assessment of these models against the archaeological record, it must be stressed that the confirmation of any one hypothesis belonging to a specific model serves only to suggest that there is sufficient reason to posit the use of the appropriate land-use strategy. It does not, however, necessarily follow that the model obtains because the full range of factors influencing land-use, such as intergroup and intragroup relations, are not incorporated into model construction.
Part II
Archaeology

The central objective of this section is to describe the archaeology of the area situated near the present-day villages of Waira and Kopi and to establish a baseline for the explication of prehistoric land-use patterns. With respect to much artefactual material I report only the findings of detailed analyses which appear in Appendices 8, 12, 14 and 15. This method of presentation is chosen as the most satisfactory approach to address specific issues of land-use and the application of ethnographic models to prehistory, both of which form the central theme of this thesis. It is also the most reasonable in terms of the material itself. While a substantial quantity of artefacts was recovered, distinct classes of artefact types are numerically poorly represented. Thus a purely typological study lacks justification.

The discussion of the region's archaeology is divided into three chapters. Chapter 6 reports the findings of excavations conducted at the major open site discovered in the study area, Kulupuari. Chapter 7 describes the results and analyses of archaeological investigations directed at a number of other open sites. Chapter 8 concerns the interpretation of research focused upon three rock shelters.

The reader is also directed to consult a number of appendices, 6-15 and 17, where supporting information for discussions appearing in the text of this thesis may be found.
CHAPTER 6

KULUPUARI

The Kulupuari open site (Fig. VI-1, VI-2; Plate VI-1, VI-2) is situated along an old river terrace overlooking the junction of the Utiti Creek and the Kikori River (7°17'S, 144°11'E). Northward on the opposite bank of the Utiti is the present-day village of Kopi. The site extends for approximately 120 m along the upstream bank of the Utiti and roughly 75 m along the Kikori. Its inland boundary corresponds with the base of a large cone karst hill.

Secondary forest regrowth in varying stages of development covers the site. Betel nut and coconut palms, as well as banana, occur frequently over it. Primary rain forest and mature secondary regrowth border Kulupuari on most of its inland margin.

The first explorers and government patrols to the Kairi make no mention of the site area. In late April 1917, Woodward noted that a portion of the Utiti Kairi had recently established the village of "Hicinu" near the mouth of the Utiti (1917b). The rough sketch map, which accompanies his report, places the village in the general vicinity of Kulupuari. In a later report that same year Woodward changed the spelling of the village to "Higinu". The Kairi census of 1918 records one dubu and four moto at "Higiniu" and a village population of 29 people (Woodward 1918). Five years later Bastard notes the construction of an additional dubu at "Kiginu" (1923). This village continues to appear in reports through to the end of 1929 (Blyth 1929). Afterwards it is never mentioned and I presume it was abandoned.

In conversation with the man claiming ownership of the site, I learned that the site has two names: Kikiniu and Kulupuari. The first is given to the ground surface and the latter to the soil horizons below. He further stated that there had been a post-contact village at Kulupuari, but he did not remember its name or where it had been located.
Plate VI-1  Confluence of the Utiti Creek and Kikori River: Kulupuari open site (left), Kopi Village (right)

Plate VI-2  Kulupuari: Excavation Area 2; Pit 5NOE appears in the foreground and the grave site in the background
The area has been heavily gardened in recent times, as evidenced by the presence of several large patches of herbaceous regrowth. During the time I excavated the site there was only one garden at Kulupuari and it was situated along the extreme western margin of the site. A few months before I first visited Kulupuari the site's owner buried one of his sons in a grave near the centre of the site.

DISCOVERY AND EXCAVATION

The site was first brought to my attention in December 1976 by a young man who was constructing a garden along the southern bank of the Utiti Creek. I visited Kulupuari a few days after receiving the report and found potsherds, chipped stone flakes and shellfish littering the ground surface in the general vicinity of the grave. I excavated two 50 x 50 cm test pits (Test Pits 1 and 2), the first near the grave and the other approximately 20 m to the east. The artefacts recovered from the top 20 cm of Test Pit 1 were for the most part pottery fragments. At 30 cm I found three large, red-slipped bowl rims which directly joined with one another to form a considerable portion of the original vessel rim. A ground stone axe was also discovered in direct association with the rim sherds. The pit was excavated to a depth of 50 cm before the upper soil matrix of brown-coloured clay noticeably changed to very compact greyish-brown clay, which bore artefacts only to a depth of 53 cm. I observed a change in the texture of the upper soil horizon, from reworked humic clays to dense silty clay, but the changeover occurred between 20 and 35 cm and was not noticeable as a break in stratigraphy.

I returned to the site in January 1977 and over the next four months conducted a major excavation of the area. The density of economic plants growing on the site limited large scale excavations to only two areas, north of the grave and 50 m to the west. The last area was chosen because it appeared to be the least disturbed. Before beginning my excavations I embedded a large piece of sawn timber with a 6 in. nail hammered into one end in the area to serve as the primary datum. It was located 3.25 m at a heading of 153° from grid location ONOE. (N.B. all pits and trenches identified by a grid reference are labelled by the location occurring at their south-west corner). With the help of D. Bell, an honours student in prehistory at the
University of Sydney, I began excavating two 3 x 3 m pits, ONOE and 6NOE. As the stratigraphic evidence of the test pits suggested no clear breaks in the natural soil horizon containing cultural debris, I elected to excavate using 10 cm spits. The artefact density disallowed the use of spades; therefore, only trowels were used during all excavations.

Pit ONOE

This excavation yielded a rich assortment of artefacts. Pottery fragments and small rim sherds were ubiquitous in the first 10 cm. At approximately 15 cm large pot sherds began to appear, often in association with other sherds with which a direct join could be made. This trend continued to roughly 45 cm after which the number and size of sherds decreased sharply until the cultural material stopped at 63-64 cm below the surface. Chipped stone artefacts were present throughout the cultural horizon, but they seemed to be denser near the bottom. Three sago choppers were recovered from the sieved material in Spit 1; two more were found at 36 cm and 48 cm below ground surface.

Complete or fragmentary ground stone artefacts occurred in all excavation units. A few post moulds were identified in the brown clay matrix; however, it was not until the greyish brown clay was reached that these features were confirmed as postholes, not tree root disturbances. Changes in the soil horizon were again observed. They seemed more marked than in Test Pit 1, but no clear boundaries were observed.

Pit 6NOE

This excavation followed much the same pattern as Pit ONOE. However, artefacts were not as dense. An increase in pot sherd size was again noted at a depth of approximately 15-20 cm. Chipped stone artefacts were found in all spits, but no increase in their number appeared at greater depths. Sago choppers and ground stone artefacts were also recovered. As the northern portion of the pit sloped downward following the natural contour of the river terrace, the greyish brown clay soil horizon was encountered at a shallower depth.
below the ground surface. Post moulds, some of which were quite large, were identified from Spit 2 onwards.

**Trench 9NOE**

During the later stages of work on Pit 6NOE I excavated Trench 9NOE, a 1 x 5 m trench which included the upper and middle areas of the terrace face. Artefact numbers recovered from all spits were small and generally concentrated in the upper soil horizon overlying the first 2-2½ m of the trench (i.e. from 9-11.5 m north of zero north).

**Pit 3N3W**

After completing work on all of the above mentioned pits I excavated another 3 x 3 m pit, 3N3W. By this time a long section across the site had been exposed and it seemed clear that discrete units had now been identified within the upper soil horizon. Therefore, I changed my excavation strategy and began excavating "natural" stratigraphic units. Horizon I was defined as the area of root disturbance, Horizon II as the humic/reworked clay soil, Horizon III as the compact brown to grey-coloured silty soil, Horizon IV as the compact grey clay with no silt and Horizon V as the compact greyish brown clay with extensive iron-oxide staining. To foreshadow discussions appearing below, Horizons I-III are indistinguishable on the basis of particle-size analysis and the same is true for Horizons IV and V. The appearance of large rims was again noted at 15-20 cm below the surface. Chipped stone artefacts appeared to decrease in number through the first 30 cm, but then became quite dense in the remainder of the cultural horizon. Post moulds occurred in all but Horizon I. A large pit, first defined at roughly 20-25 cm, was found in the northern portion of the excavated area. I continued to have difficulty in determining changes in the natural stratigraphy and the solving of this problem was greatly impaired by a partial reverse in the stratigraphy resulting from the infilling of the pit feature after its use.
Trench 5S0E and Pit 11S0E

To extend my section through this area of the site, I excavated two additional localities. Trench 5S0E was a 1 x 5 m trench. The cultural horizon was shallow, but a considerable number of potsherds, mostly small fragments, was recovered. Pit 11S0E was a 1 x 2 m pit. It contained no artefacts.

Final Test Pits

Before ending my work at Kulupuari I excavated a 1 x 2 m pit, 5NOE, near the grave site and eight more test pits, most of which were 2 m² in area. The test pits were situated at an ever increasing radius away from where cultural deposits had been recovered and were used to establish the areal extent of the site. I also collected 10 column samples using sections of bamboo and one bulk soil sample before backfilling my excavations.

STRATIGRAPHY

For most areas of the site I noted only two distinct, natural stratigraphic horizons. The uppermost was a dark brown clay (10YR 3/3) whose texture graded downward from reworked soil aggregates to compact clay. The diminution of the humic content of the soil followed the textural changes. The bottom horizon was a very compact greyish brown clay (10YR 5/2) devoid of cultural material except in its top 2-5 cm.

In the primary excavation area and adjacent localities I observed an additional stratigraphic component in each horizon (Fig. VI-3). The lower portion of the first unit gradually altered its appearance to a grey silty clay. This material felt notably crisp when troweled and could be peeled off in laminae. The upper portion of the bottom horizon was differentiated by its light grey colour and the absence of silt. I was only able to define the precise margins between the four units in section; therefore, during my excavations intuitive impressions of changes in colour or soil texture served as the basis for establishing the boundaries between the four units.
Unclear as to whether the natural stratigraphic units I defined during excavations were in fact unique depositional events, I first conducted an analysis of the sand-sized particles included in samples from each horizon. Under the guidance of C. Pain (then Department of Geography, University of Papua New Guinea) specimens were assayed by X-ray defraction and microscopic analysis. The results of the first test are presented in Appendix 9. From these analyses it was concluded that each horizon generally has a common volcanic source contributing to its sediments.

I next submitted samples from each horizon to P. Hughes (Department of Prehistory, ANU) for particle-size analysis. The method he followed is described in Appendix 9. Figure VI-4 is a graphic portrayal of his results. The two uppermost natural horizons, II and III, have a similar particle size distribution and are characterised as sandy clayey coarse silt. The remaining two units differ only with regard to the amount of sand-size particles. Horizon IV is a sandy silty clay with modes of medium silt and fine clay; Horizon V is a silty clay with modes of medium silt and fine clay. From these results I conclude that there are only two distinct natural horizons which grade into one another in Horizon IV. The difference I noted between Horizons II and III relates to a greater incorporation of humus into the upper portion of the unit. This most probably occurred during recent habitation of the site and contemporary gardening in the area.

DATING

All radiocarbon determinations appearing in this thesis were conducted by the ANU laboratory (Department of Prehistory, RSPacS) and I gratefully acknowledge the patient assistance of the staff, in particularly H. Polach and J. Head. The calculation of all dates followed the procedures outlined by Stuiver and Polach (1977) and were made using a C-14 half-life of 5570 years.

All determination made on carbonised material are reported in radiocarbon years. Shell dates were calculated by applying an environmental correction factor of 2900 ± 150 C-14 years. This date was derived from a modern shell sample collected from a riverine
environment in the research area (cf. Appendix 10). Following Stuiver and Polach \textit{(ibid.)} environmentally corrected dates are designated with an asterisk (e.g. ANU-2232: 1160 ± 170 BP*).

Seven carbon samples from Kulupuari were submitted to the ANU laboratory for dating (Fig. VI-3).

\textbf{ANU-1964 : 100.0 ± 1.3\% Modern (AD 1850-1890 or AD 1950)}

This date refers to a 13.0 g of charred wood (which was identified by my field informants as \textit{marawa}, \textit{Pterocarpus indicus} — cf. Appendix 2: Table 2.1) collected from Feature 12, Pit 3N3W (Fig. VI-5). When excavated the plant fibres of each piece of wood ran in the same direction as the post mould; therefore, I conclude the specimen to be a burned house post. The sample evidenced no "atom bomb" or "Suess" effects (cf. Polach and Golson 1966: 10 for further discussion); therefore, two calendrical ages may be assigned to the sample (H. Polach 1979: pers. comm.).

Although each calendrical age corresponds with a period for which historical documentation is available, there is no clear evidence in support of either. Bevan (1890: 190-92, 194-95, 219-20, 234) makes no mention of structures along the Utiti Creek during his visit in 1887 and 1888. Information in government patrol reports suggests that the area was only used as a village between 1917 and 1930.

There seem to be two plausible interpretations of the dates for this sample. Firstly, either calendrical age may be correct if the structure represented by the post mould were only a garden shelter. Evidence in support of this conjecture is:

1. Bevan's report (1890: 194) of gardens near the bank of the Utiti Creek;
2. the large area of the site today which is covered by secondary regrowth;
3. the probable omission of garden huts, which occurred near villages, in historical documents; and
4. the contemporary use of garden shelters very near to Waira Village.
The second interpretation is that the post mould was dug during the construction of Kikiniu Village, but the timber used was the post of a structure at an earlier village. Evidence in support of this interpretation is:

1. the wood from which the sample was taken is exceptionally durable and highly prized today by the Kairi;
2. the reuse of old building materials is practised today and reportedly was done in the past; and
3. the width of the post mould is 28 cm wide and a minimum of 25 cm deep, which probably suggest that it held a post of substantial size.

While either interpretation may be correct, intuition leads me to posit that this sample represents an early contact use of the site.

ANU-1965 : 280 ± 70 BP

This date was obtained from a 12.3 g sample of charred wood (Pterocarpus indicus) found in Feature 15, Pit 3N3W (Fig. VI-5) and was deposited in the same manner as the sample discussed above. Originally I submitted this material as a check sample for ANU-1964 because both features were encountered at the same level below datum during my excavations. The disparity between the two dates is distinct and two periods of site use must be assumed. The depth of the post mould containing this sample is uncommonly shallow; therefore, I suspect that there has been some erosion of the surface from which this post hole was dug during the most recent phase of the site occupancy.

The occurrence of historically documented items of European manufacture at Kulupuari (see pp.148ff) requires further clarification of this sample with regard to its calendrical age. Recognizing C-14 variation in nature affects calendrical correlation of C-14 ages BP (cf. Olssen 1970) the 280 ± 70 BP age can be said to be representative of a calendrical date between AD 1700 and AD 1460 (Stuiver 1978: Fig. 1). The significance of this date range for the interpretation of European artefacts is discussed below.
ANU-2173 : 1390 ± 105 BP
This comes from a 6.0 g sample of a charcoal concentration situated approximately 10 cm below the level of ANU-1965 in Spit 2, Pit ONOE. It lay 5-7 cm above the interface between what I defined as stratigraphic Horizons II and III and was submitted to help with clarifying a stratigraphically undifferentiated section of the depositional event which I subsequently term the early phase of site occupation.

ANU-2063 : 1590 ± 340 BP
The 0.9 g of charcoal from which this date was derived lay just above the interface between Horizons II and III in the north-west quadrant of Pit 3N3W. At the time of its submission for dating I believed the deposition of Horizon III may have been a separate depositional event, based upon my impressions during excavations.

ANU-2064 : 1210 ± 210 BP
This date resulted from a 1 g sample of dispersed charcoal recovered from the south-east quadrant of Pit 3N3W. The material was situated in the middle levels of Horizon III. It was submitted with the previously mentioned sample in hopes of establishing a maximum date for the end of the deposition of Horizon III.

ANU-1962 : 1360 ± 100 BP
This date was obtained from a 44.5 g sample of charcoal which was excavated as a discrete unit. The material was found in Spit 4, Pit 6NOE, and was situated above the interface of Horizons IV and V. It was submitted in conjunction with ANU-1963 and was intended to assist in bracketing the beginning of the deposition of Horizon IV.

ANU-1963 : 1480 ± 80 BP
This date refers to a 194.0 g sample of charcoal recovered from the bottom 16 cm of fill from Feature 80, Pit ONOE (Fig. IV-6). As this post hole had been excavated from the top of Horizon V, this age represents the minimum date for the earliest occupation of the site.
Based on these dates I posit a minimum of three occupations of Kulupuari. The most recent is the historically documented village of Kikiniu. The next occurred during or just prior to the initial period of intensive European contact with the Papuan coast in the seventeenth and early eighteenth centuries. In discussions which follow I term these two periods of site habitation the recent phase. To define the earliest occupation further analysis is required.

The sequence of the five remaining dates does not match their stratigraphic deposition. However, since the mean dates for the upper and lowermost samples differ by only 90 years, there is reason to assume no significant difference between any of these dates. To test this hypothesis I compare the dates with one another using the analytical method proposed by Polach and Golson (1966: 19-20). Briefly, this technique assesses the significance of the difference between: (i) the arithmetic difference of the two mean dates and (ii) the square root of the sum of the squares of each standard deviation. If the first calculation is less than or equal to the second, then the two dates are not significantly different. If, however, the first is more than twice the second, then the two dates differ significantly.

Table VI-1 presents the test values. Only two dates, ANU-1963 and ANU-2064, can be interpreted by this test to be different. The test results, therefore, suggest that the five dates represent the same or a roughly contemporary event. Since there is a probable difference between two dates I propose that the lower depositional unit of the site was laid down at different but closely successive ages. At one standard deviation the five dates generally overlap between 1285 and 1460 years ago (490-665 AD). The early period of site occupation occurred during this period.

FEATURES

A total of 120 cultural features were found during the excavation of Kulupuari. The vast majority of these are post holes, but I also noted one earth oven and three holes definitely dug for the planting of coconut palm seedlings.
Figure VI-5 illustrates the distribution of features in the major excavation area relating to the recent phase of site occupation. All features contain an earthy brown-to-black-coloured fill. The patterning of these post moulds does not readily indicate the structures erected in this area. However, the removal of a portion of Feature 20 by the digging of Feature 18 provides some support for the notion that there were two periods of building construction, as already suggested by the C-14 dates.

Figure VI-7 is a graph of the maximum width and depth of post moulds belonging to the recent phase. Most features are from 18–30 cm wide and greater than 25 cm in depth. There are two general groupings of post holes worthy of note. The first are those with a width-depth ratio in excess of 0.67. These long, narrow post holes comprise 48% of all recent features and are most usually 18–30 cm wide and greater than 34 cm deep. The second grouping consists of four wide and deep post moulds. The largest of these, Feature 19, has two distinct bases, the lower of which is considerably smaller (Fig. VI-9a). Assuming that post hole size correlates with the size of the post it held, I suggest that the first grouping represents roof supports and the second stilt supports for a floor of considerable weight.

Features belonging to the early phase of occupation (Fig. VI-6) are more than twice as numerous. Two or possibly three distinct types of fill occur in these features. There are seven instances in which the construction of early phase features truncates previous features. This supports the notion of a minimum of two periods of site construction during this phase. If the earth oven, Feature 69, is associated with a distinct period of site habitation, there would have been three separate times when structures were erected during the early phase. Evidence substantiating this is:

1. Feature 83 is truncated by Feature 69;
2. the fill of Feature 82 is overlain with spoil from Feature 69 (Fig. VI-9b);
3. Feature 69 is cut by Features 56 and 63.

There is no clear patterning of post holes.

The maximum width and depth of most early phase post moulds are presented in Figure VI-8. Those post holes whose form is disturbed
by more recent features have been omitted. Unlike recent phase features, those belonging to the early phase of occupation do not appear in discrete groups. Post holes with a maximum width of less than 30 cm are most prevalent, but the range of depths is roughly continuous between 15 and 48 cm. The width/depth ratios also vary considerably. Following the criteria used to group post holes during the recent phase, long and narrow posts and large posts are identifiable for the early phase, but neither appear with the same frequency as previously noted. I therefore refrain from positing the function of posts which may be represented by specific post holes. It is, however, clear from the presence of these two classes of post moulds that structures with raised floors were present at some time(s) during the early phase.

Feature 69 is defined as earth oven on the basis of the large number of cooking stones found at or near its base. Its maximum width is 2 m and it is 40 cm deep (Fig. VI-9c). Silty grey clay lined its base; therefore, I suggest it was dug after the initial occupation of Kulupuari.

Another 34 cultural features are present elsewhere at the site (Table VI-2). Test Pit 3 has the greatest number of post holes found in all test pits. From the type of material filling the features and the depth at which they first appear I assign three of the long and narrow post moulds to the recent phase and the fourth to the early phase. The four post holes of this type in Test Pit 8 and Pit 5NOE are recent phase features.

Large post holes occur in Test Pits 4 and 5. In Test 4 one belongs to the recent period of site occupation. The other relates to the early phase and its tiered base possibly represents its containing two posts. The large post hole in Test 5 is an early phase feature.

Holes with fragments of coconut shell in the fill appear in Test Pits 5 and 6. None of the plant material is carbonized; therefore, considering the poor preservation characteristics of the Kulupuari site I conclude they represent very recent events. The earthy black clay matrix found in association supports this deduction. These holes range from 25-30 cm in depth below ground surface.
Five categories of vessels appear in the Kulupuari assemblage. The two jar classes, everted and straight, are distinguished on the basis of rim form. Bowls exhibiting a shoulder are termed composite bowls (following Vanderwal 1973: 72) and the simple and complex divisions occurring within this category are defined by the presence of one or two rim (orientation) angles, respectively. The last vessel category, direct bowls, includes bowl forms having no shoulder.

Before describing the pottery collection from Kulupuari, consideration must be given to the possibility of dealing with different types of pottery through the depositional sequence. A simple visual determination is impossible because potsherds recovered from the upper levels are badly weathered, thus obscuring their decoration. Clearly, the best information available to resolve this problem is the quantitative measurements made on rim sherds (see Appendix 7).

In carrying out this analysis I draw my sample from the rim sherds recovered from Pits ONOE, 3N3W and 6NOE. The total number of specimens for each of the most prevalent vessel categories (everted jar, straight jar and simple composite bowl) found in these units is sufficient to permit comparison of upper and lower stratigraphic assemblages. Based upon the radiocarbon dates and the stratigraphic distribution of pottery which I noted while excavating it is preferrable to establish the boundary between the upper and lower samples at 20 cm below the ground surface. However, there is no direct correspondence between this level and the floor of any spit or horizon. Using the nearest approximation the upper sample includes Spits 1 and 2 of Pit ONOE, Horizons 1 and 2 of Pit 3N3W, and Spits 1 and 2 of Pit 6NOE; the mean floor level of the lowest excavation unit belonging to the upper stratigraphic unit of each pit is 24, 33 and 18 cm respectively. Rim sherds recovered in the remainder of the excavation units form the lower stratigraphic assemblages.

Table VI-3 lists the descriptive statistics for each quantitative attribute by vessel category. The difference in sample size within each grouping of rim sherds arises from the inclusion of small rim sherds in sampled populations. For many individual sherds the full complement of quantitative measurements could not be made.
To test the null hypothesis that both samples are drawn from the same population, I first applied an F-test to each set of data. This measure determines whether or not the variance of the two samples is equal. Failure to meet this criterion undermines a fundamental assumption upon which the subsequent t-tests are predicted (cf. Simpson, Roe and Lewentin 1960: 183-84 for further discussion). Table VI-4 presents the results of the F-tests. With the exception of the orientation angle of straight jar vessels, there is no basis upon which to assume a difference in the variance of the stratigraphic samples.

I next conducted a Student's t-test to determine if the difference between the means is sufficient to reject the null hypothesis. Table VI-5 lists the t-test values. The general trend between the two samples is one of no difference; in other words, the majority of rim sherds from these pits is derived from the same population.

Since all the pottery is judged to belong to a single group, commonsense dictates that the pottery found in the 300 years BP and modern periods of site occupation must be derived from the original phase of site habitation, when the pottery was originally deposited. Support for this conclusion is found in Figure VI-10 which illustrates a 28 percent decrease in the average size of sherds recovered from the upper excavation units of the three major pits. Also, the reconstruction of vessel rims prior to analysis suggests a notably low dispersion of rim sherds among all excavation units. Therefore, it is reasonable to assume that the pottery excavated from the most recent stratigraphic units represents the upward redeposition of pottery originally laid down during the last period of early phase site occupancy. The erosion of previously deposited material during recent site occupancy, the excavation of post holes, the contemporary clearing of garden sites and the planting of crops are processes which probably resulted in the redeposition of pottery.

**Clay fabric**

Appendix 11 presents D. Mackenzie's thin section analysis of the clay minerals found in the paste. The specimens sectioned are 21 weathered body sherds recovered from Pit ONOE, Spits 2 and 4,
which represent both recent and early phases of site habitation. This analysis was initiated to determine if the clay used in the manufacture of pottery excavated at Kulupuari was collected from sources within the study area. Mackenzie's findings conclusively assign the clay sources to an area well removed from the Gulf region. Therefore, I am led to assume that the pottery at Kulupuari was transported to the site from its place of manufacture, some 250 - 400 kms east along the coast.

Summary of pottery collection

The collection of rim sherds excavated at Kulupuari exhibits a remarkable consistency of form and decoration within each major vessel category. Jar forms, which comprise 75 percent of all rim sherds, are only divisible on the basis of rim form, straight or everted, and the closely associated rim orientation and inclination angles (see Appendix 8). The majority of jar rims are short, rarely exceeding 2 cm. Most rims have a straight rim course, but very convex rims also occur (Fig. VI-11). Lips are most usually rounded. All jars are decorated and painting is clearly the most prominent decorative technique (Fig. VI-12, VI-14). Narrow horizontal bands of paint appear on the interior rim, lip and shoulder of jars. Sometimes a solid zone of paint is applied to the exterior rim, neck and upper shoulder areas. Tool decoration, which is rare, occurs on painted surfaces and normally covers more than one discrete area of the exterior surface. Only straight jars have tool decorations on the lip. Incised parallel lines immediately followed by triangular figures are the most common motif used.

Simple composite bowl forms comprise 87 percent of all excavated bowl rims. Rims are either straight or concave and generally have a parallel profile and rounded lip. Form measurements (see Appendix 8) suggest only minor variability within this vessel category. Bowls are decorated both with colouring and tooled designs (Fig. VI-15, VI-16). The slipping of the interior surface is one of their major characteristics. The exterior surface is often slipped, but the painting of only the exterior rim is also common. Tool decorations appear on coloured surfaces only and are usually restricted to the exterior rim. Designs are very complex; straight line and triangular figures occur frequently.
Comparative analysis of the Kulupuari pottery collection

To date there have been four major studies of pottery collections from the South Coast of Papua: Allen (1972), Vanderwal (1973), Irwin (1977) and Bulmer (1978). The first three have been available to me for lengthy and detailed examination. Based upon her earlier publications (Bulmer 1971, 1975) I am appraised of Bulmer's discoveries of pottery in the Port Moresby area which is without doubt comparable to the Kulupuari collection. Because our theses have been produced at the same time, neither of us has had access to the detailed analysis of each other's research. Thus I am unable to include her findings in this comparative analysis. I have examined Irwin's study in considerable detail and concur with his findings (1977: 309) that the Mailu pottery belonging to the time period under consideration bears no resemblance to collections found further west along the Papuan coast. Therefore, all that remains are the studies of Allen and Vanderwal.

Before beginning this analysis I bring to the reader's attention that both Allen (1972: 99) and Vanderwal (1973: 107; 1978: 425) postulate on-site manufacture of pottery. Pot sherds deposited at Kulupuari are unquestionably derived from vessels fashioned a considerable distance away from the site (Appendix 11). Taking Balfet's studies (1965) into account one may suspect that there may be distinct differences between collections representing locally manufactured pottery and that acquired through exchange (but cf. O. Rye, in press).

Nebira 4

Even taking into consideration Allen's objections to his most recent date at Nebira 4 (1972: 121) his sequence easily brackets the dates for pottery deposition at Kulupuari. The most recent pottery at Allen's site exhibits a wide range of distinct and intricately fashioned motifs on bowl rims. Among the most common are multiple parallel lines and inverted hatched triangles formed by the removal of a slipped surface (pp. 103, 105, 108). Painted pottery (? jar rims) also occurs frequently during this period (Table 4). These factors alone suggest a great deal of similarity between the
most recent pottery assemblage from Nebira 4 and that from Kulupuari. As Allen offers no quantitative data regarding vessel form, I am hard pressed to relate his data further with mine (see Appendix 8). However, shell-impressed decoration and body grooving are the most diagnostic ceramic attributes of the early and middle ages respectively, at Nebira 4 (p. 108). These never appear in the Kulupuari collection; therefore, Allen's most recent pottery collection corresponds best with that I excavated.

There are a number of differences between Allen's Horizon I and the Kulupuari pottery collection. The occurrence of each vessel type is very dissimilar. Bowl forms comprise 89 percent of all rims at Nebira 4, as compared to 25 percent at Kulupuari. Furthermore, bowl rim sherds in Allen's sample most often have a thickened rim form and generally lack a pronounced shoulder, which I interpret as indicative of a high percentage of direct bowl rims. Nebira 4 jar rims have a heavily rolled and horizontal form. This rim shape appears infrequently at Kulupuari. However, it is difficult to assess the significance of this variation as the Nebira 4 sample contains only 6 jar rims.

Two additional aspects of dissimilarity concern the occurrence of decoration. Allen reports that only 1.5 percent of all excavated sherds are decorated, but suggests this to be a function of the small size of sherds recovered at Nebira 4 (p. 103). Regardless of the exact percentage of plain vessels represented at his site, the fact that there is every reason to assume that all pottery occurring at Kulupuari was decorated, prior to post-depositional weathering, stands as a major feature by which the two collections may be differentiated. The absence of interior surface colouring on Nebira 4 bowl rims (Ibid.) is another point of dissimilarity.

Oposisi

During his archaeological research in the Hall Sound area, Vanderwal excavated or made surface collections at 13 sites whose radiometric age determinations range from approximately 4,000 to 700 years ago. At Oposisi he discovered his longest pottery sequence approximately dating from 1900 years ago (the earliest ceramic horizon
in the area) to 1,000 years ago (Vanderwal 1973: 48-50). I limit my comparative analysis to this site since the date range easily accommodates the period during which pottery was deposited at Kulupuari and also because Vanderwal uses the Oposisi material as his type sample.

Vanderwal reports a number of diagnostic changes in the pottery assemblages occurring in successive archaeological horizons. After an initial analysis of jar rims he identifies rim form as the single most important attribute upon which to categorise different types (p. 71). For vessels he terms "cooking pots" the pattern of change from the lower to upper stratigraphic levels is as follows (using my terminology).

1. straight rim course with a parallel or thinning profile;

2. convex to very convex rim course with a parallel profile. Allen (1972: 102) and Vanderwal (1973: 103) term this a "rolled rim";

3. convex to very convex rim course with a thinning profile. Such rims are very short and have a highly curved interior surface, thus giving this rim form a rounded appearance;

4. straight rim course with a thinning or parallel profile and a thickened lip (Vanderwal 1973: Figures V-5, VI-3).

Vanderwal also notes a gradual increase in jar wall angles (comparable but not equal to my inclination angle) through the sequence and suggests a change to more globular vessel forms (p. 71). While the rim form of "cooking jars" alters with decreasing age, these changes represent a trend rather than discrete temporal markers. Only the forms listed in numbers 1 and 4 are restricted stratigraphically (pp. 95-96).
Vanderwal distinguishes another class of jar rims, "water jar", on the basis of a small orifice diameter and a very large wall angle. The rim form of such vessels does not change dramatically through the sequence. These rims are segregated according to lip form, with rounded lips and flattened lips distinguishing low and upper assemblages respectively.

In his analysis of bowl rims Vanderwal discriminates between direct and composite vessel forms. Among sherds representative of the first he initially proposes the segregation of types on the basis of wall inclination and surface alteration, with rim form added for two groupings (pp. 76-77). Composite bowl rims are first isolated by surface alteration and decorative technique (p. 77). The groupings are then refined by testing a number of quantitative attributes (pp. 78-79).

Next, Vanderwal assesses the stratigraphic distribution of decorative techniques and decorative motifs (in my terminology, decorative elements). He defines three types of techniques: etching or gouging, incising and impressing (pp. 79-80). Each of these he relates to discrete periods of site occupation (1973: Fig. V-4).

After my own inspection of the Oposisi type collection, housed in the Department of Prehistory, ANU, I have one major objection to his conclusions. While, as Allen found at Nebira 4 (1972: 105, 108), etching or gouging is a distinct marker of pottery appearing 1,000 to 1,200 years ago, it is an oversight for Vanderwal to exclude incising as a major decorative technique appearing in this assemblage. A cursory inspection of his illustrations of pottery types T and W, the most prominent classes found in the uppermost levels at Oposisi (cf. Vanderwal's Fig. VI-10), reveals incised lines on each specimen.

Table VI-6 replicates Vanderwal's Table VI-8 describing the distribution of decorative elements by "stratigraphic zone or site". Figure VI-18 is a seriation graph of similar information but derived from Vanderwal's Table VI-3. The discrepancy between the two is explained by positing "artefact migration and excavator's error" (p. 92). The latter I cannot assess. The former may, however, be examined.

The question of artefact migration at Oposisi is not relevant to the lower stratigraphic units, with the exception of Zone IIC for which Vanderwal illustrates only a 4 cm zone of disturbance (Vanderwal: Fig. IV-4). For Zones IB-IIB he states that "continuous dumping kept
the depositional surfaces stable" (pp. 32-33). Vanderwal describes the uppermost cultural layer, Zone IA, as "a mass of lenses and minor recent disturbances, the latter presumably the result of burrowing animals" \textsuperscript{ibid}. In his Figure IV-4 (1973: following page 30) Vanderwal illustrates a surface feature in Trench 1 which, although unidentified, appears to be the type of disturbance caused by bandicoots as they feed. Since this feature extends only into the upper portion of Zone IA, it does not, in itself, account for the redeposition of earlier material. Of course, there may have been other, deeper disturbances, but Vanderwal provides no information to assist in their assessment.

Recent gardening activity may have also affected the stratigraphic redeposition of material. However, in his discussion of site stratigraphy (pp. 32-34) Vanderwal only identifies the up-slope portion of the site as a gardening area. Since his ceramic analysis does not include material from this area (Vanderwal: Tables VI-2, VI-6), this factor is irrelevant to present considerations.

Slope erosion is another possible contributor to artefact migration. Vanderwal notes that shellfish are the most common remains at Oposisi and in Zone IA of Trench I shell debris was quite dense (p. 29). Ambrose's experiments (1973) on weathering rates at Oposisi indicate that there is no significant loss in the weight of shellfish remains appearing in this stratigraphic unit over the period since site abandonment. Therefore, the incorporation of early cultural material originally deposited on the higher portions of the site into more recent cultural deposits downslope seems unlikely to have occurred as a result of midden deflation.

This reassessment of Vanderwal's stratigraphic interpretations is not intended to question his entire sequence. On the contrary, I believe that his stratigraphic units are depositionally secure. Vanderwal's observations concerning the stratigraphic occurrence of body grooving and the distinctive gouging decorative techniques, as well as the change in everted jar rim forms, all parallel the findings of Allen at Nebira 4. However, in attempting to define types Vanderwal artificially restricts the distribution of decorative elements by postulating artefact migration. While some decorative attributes dominate certain stratigraphic units, the danger implicit in Vanderwal's analysis is that of making a specific motif denote a particular age.
I now turn to the comparison of Oposisi and Kulupuari pottery assemblages. The absence of body grooving and shell-impressed pottery at Kulupuari again suggests that Vanderwal's Zone I pottery assemblage is potentially comparable to the Kulupuari collection. As with the Nebira 4 Horizon I assemblage, the large number of undecorated vessels and direct bowl rims in Oposisi Zone I (Vanderwal 1973: Tables VI-7, VI-9) immediately establishes a major point of distinction with the Kulupuari pottery. Bowl and jar rim forms appear in roughly the same proportions in the uppermost zone at Oposisi. At Kulupuari the ratio is 1:3.

In his pottery analysis Vanderwal describes individual rim forms as a single unit and neglects to present the range of ceramic attributes as they occur in a single stratigraphic unit. Therefore, detailed comparison must be limited to those rim forms recovered only from Zone I. These include Vanderwal's jar forms XXII, XXIII and XXV and bowl forms XXI and XXIV. Vanderwal combines jar forms XXII and XXIII into a single category, type S (p. 106). The most distinctive attribute of these vessel forms is a heavily rounded rim. This rim form corresponds to Kulupuari jar rims with a very convex rim course and thinning profile (Fig. VI-11), which appear on 11 percent of jar rims. At Oposisi this is the dominant jar rim form in Zone I.

Vanderwal reports a mean aperture radius for form XXII of 7.7 cm, with a standard deviation of 1.4; for form XXIII this figure is 10.2, with a standard deviation of 2.4 (Vanderwal 1973: Table V-2). These values generally fall within the range noted for the orifice diameter for Kulupuari everted jar rims (see Appendix 8: Table 8.2).

Jar form XXV comprises a single pottery type, T, and its most diagnostic attribute is a flat thickened lip (p. 107). This lip form is rare at Kulupuari. The mean aperture radius for this jar form is identical to form XXII (Vanderwal 1973: Table V-2) and therefore conforms to the range recorded at Kulupuari.

Vanderwal notes that vessel forms XXIII and XXV usually have slip applied to the exterior surface (pp. 106, 107); form XXII is never decorated. This observation is not so for jar forms at Kulupuari where exterior slip is either rare or non-existent. Tool decoration of these Oposisi jar forms is uncommon, but when present triangular and hatched parallel line motifs are among the most popular
(Vanderwal 1973: Table VI-4). This is similar to Kulupuari jar rims, except with regard to the frequent incised parallel line motif on Kulupuari rims.

Both bowl forms are composite bowls. The only information Vanderwal provides for form XXI is the total number of specimens, their weight, a "ghost" profile and an identification of the decoration on the sherds (Vanderwal 1973: Table VI-7; Figures VI-3 and VI-4). As there are only 10 specimens with an average weight of 18.5 g (!) perhaps this is permissible. I do not, however, understand why he isolated a unique vessel form (unfortunately not illustrated), which he then assigns with direct bowls to Type R on the basis of decorative elements alone (1973: 96, Table VI-9).

Bowl form XXIV is assigned to a single pottery type, W (Vanderwal 1973: Table VI-9). This category includes both simple and complex bowl forms, in my terminology. Rim forms are straight, concave and convex; rim profiles include parallel and thinning forms; lips are round, flat and thickened flat (Vanderwal 1973: Fig. VI-10). The mean aperture radius is 17.2 cm with a standard deviation of 3.8 (Vanderwal 1973: Table V-24). The mean rim length is 3.6 cm (Vanderwal 1973: Table V-25a). All of these qualitative and quantitative attributes of form are comparable to the Kulupuari assemblage (see Appendix 8: A.45ff, A.52ff).

Surface colouring of Vanderwal's type W vessels always appears on the interior surface; exterior surfaces have either paint on the exterior rim or slip covering the entire exterior surface (p. 107). Triangular figures and hatched parallel lines are the most prominent decorative motifs (Vanderwal 1973: Figure II-4). Based on his illustrations of rims of this type (Vanderwal 1973: Fig. VI-10), I suggest that from the evidence presented Vanderwal's type W best characterises the bowl rims at Kulupuari. However, decorative elements which Vanderwal identifies for other vessel forms also appear on composite bowl rims from Kulupuari (Fig. VI-15e, VI-16b, VI-17b). Among these are Vanderwal's decorative attributes 24B, 31, 32 and 33 (cf. Vanderwal 1973: Fig. VI-7 - VI-9) which he associates with the Ravao complex, an early to middle phase "culture" in the Hall Sound area (Vanderwal 1973: 168ff; Table VI-9).
Chronological comparisons

To conclude this comparative analysis I comment on the chronological appearance of Allen's Horizon I, Vanderwal's Zone I and the Kulupuari pottery assemblages. Allen's date for the termination of his most recent ceramic horizon is 880 ± 250 years ago (1972: 99). Vanderwal reports a minimum date of 1180 ± 200 BP for the initial deposition of Zone I and proposes a date of 1,000 years ago for its close (1973: 50). Based upon a series of five radiocarbon determinations I conclude that the Kulupuari assemblage dates from 1285 to 1460 years ago; however, to foreshadow discussions appearing later p.186) I revise the more recent date to 1,200 BP.

The discrepancy between the dates for the beginning of the ceramic sequence is not extreme because Vanderwal's date is a minimum age. However, the terminal date of approximately 1,000 years ago suggested by Allen (1972: 121) and Vanderwal (1973: 50) is not sustained by my findings which strongly support a date 200 years older. The data in this thesis cannot solve this predicament. Obviously a reappraisal of all relevant information and the excavation of additional sites along the Papuan coast will have to be undertaken some time in the future.

CHIPPED STONE ARTEFACTS

The majority of chipped stone material occurring at Kulupuari is derived from two distinct source areas (see Appendix 8: Tables 8.16, 8.18, 8.21, 8.23 and 8.26). Cherts found in limestone formations near the headwaters of the Omati River (Fig. II-1) comprise the largest proportion of identified chipped stone material in the collection. The other source area lies in the volcanic region drained by the eastern headwaters of the Sirebi River (Fig. II-1). For convenience I identify material derived from the former as limestone cherts and from the latter volcanic cherts. A small percentage of chipped stone artefacts are fashioned from a distinctive black chert, \(\text{wasa}(K)\), which is reported to be quarried from a limestone cave situated west of the present-day village of Baina (Fig. II-1; see Appendix 7: A.32 for a further discussion).
Unmodified stone

This category contains all chipped stone flakes and cores which lack retouch or edge alteration. The distribution of debitage recovered from the three major excavations (Fig. VI-19) shows a decline in this artefact class to an average depth of 24 cm; this is immediately followed by a marked increase in the lower excavation units. This evidence corresponds well with the trend toward an increase in average sherd size (Fig. VI-10) and the stratigraphic position of radiocarbon samples which denote recent and early phases of site occupation (Fig. VI-3). There may have been some redeposition of early phase chipped stone artefacts during more recent periods of site use. However, the near break in the deposition of debitage and the differences between flaked implements recovered from upper and lower stratigraphic units (see Appendix 8:A.56ff for a detailed discussion) support the occurrence of at least two periods of chipped stone deposition, which correspond to the major habitation phases.

The analysis of modified stone (see Appendix 8:A.57ff) reveals two important characteristics of the chipped stone collection, which are relevant to both phases of site occupation. Firstly, 30 percent (recent phase) and 42 (early phase) of these artefacts exhibit cortex covering a minimum of 10 percent of their surface. Therefore, whole cores were probably transported to Kulupuari. Secondly, this category comprises no less than 70 percent by weight of the collection associated with each occupational phase (Table VI-7). It seems most likely that core reduction and utilised flake and core modification occurred at the site.

Altered flakes

Flake implements identified as scrapers (see Appendix 8:A.58 for the criteria used) comprise the majority of altered flakes belonging to both depositional phases at Kulupuari (Appendix 8: Table 8.24). The analysis of the two stratigraphic assemblages of edge-altered flakes (Appendix 8:A.57ff) demonstrates notable differences between samples. Recent phase implements (Fig. VI-20) are small, thin and "blade-like" in form and edge modification is characteristically restricted to microscopic alteration. Also, the majority of specimens are side-
altered implements (Appendix 8: Table 8.24). Early phase edge-altered flakes (Fig. VI-21) are chunky and toward square in plan; their average weight is more than 100 percent greater than recent phase flake implements (Appendix 8: Table 8.20). The early phase assemblage evidences a relatively even occurrence of side, end and multiple-edge implements.

A small percentage of recent and early phase flake implements exhibit special forms of edge alteration. The rounding of the distal tip (vertex) accompanied by unifacial alteration of the dorsal crest immediately adjacent (Fig. VI-20b) suggests that some implements were used as drill points. Use-polish occurs along the edge and adjacent surfaces of some flakes (e.g. Fig. VI-20d; VI-21b,d), thus denoting their use in the working of soft wood, bamboo, rattan or palm wood (Kamminga 1977a).

The comparative analysis of the early phase assemblage with those from Nebira 4 (Allen 1972) and Oposisi (Vanderwal 1972: 122-25) indicates little correspondence between collections (see Appendix 8: for a detailed discussion). Nebira 4 and Oposisi flake implements are characteristically small, weighing on average between 1.5-3.5 g (Allen 1972: Table 6; Vanderwal 1973: Table VII-2). Allen notes a wide range of tool forms in the Nebira 4 assemblage, including awls, fabricators, drill points and burins (1972: 116-16). Since these specialised tool categories comprise more than 21 percent of the flake implements associated with any of Allen's archaeological horizons (1972: Table 7), the Nebira 4 collection significantly differs from the Kulupuari assemblage. Furthermore, the absence of fabricators at Kulupuari suggests some technological disparity between the two collections.

Edge-altered cores

The Kulupuari chipped stone assemblage contains very few specimens of this artefact category (Table VI-7); therefore, a comparative analysis between early and recent phase edge-altered cores cannot be made. Most specimens are moderately large, chunky and square in plan (see Appendix 8: A.60ff for a further discussion). Their altered edges, which are usually acute, often exhibit unifacial retouch.
**Sago choppers**

This category of chipped stone artefacts includes implements whose pattern of wear demonstrates their use in the processing of palm pith, specimens which are fully fashioned but exhibit no use-polish and artefacts that are identified as representing the various stages of tool manufacture and repair.

All sago choppers recovered from Kulupuari have a conical form and resemble a blade core (Fig. VI-22). They are not, however, true blade cores because the removal of flakes during manufacture is never initiated from a single platform and all flake scars attest to the desire of the knapper to produce a tapered implement rather than blades.

Differences exist between sago choppers recovered from upper (recent phase) and lower (early phase) excavation units, but it is difficult to assess the significance of these factors because of the small size of each sample (Table VI-8). Choppers from the early phase tend to be stubbier in appearance. However, the area of the working face and the length of the utilised edge are comparable for both groups.

Sago processing implements from both occupational horizons exhibit retouch of the working face and adjacent lateral margins (Fig. VI-22a,b). Presumably this represents attempts to rejuvenate implements by removing areas where the phytolith polish has dulled the working edge. Further support for this conclusion come from the small number of flakes with use polish covering most of their dorsal surface, found in both upper and lower stratigraphic unit.

Two other artefacts belonging to this chipped stone category appear in the collection. One of these is a sago chopper "rough out" (Fig. VI-22d). Its length is approximately 100% greater than the mean value for sago chopping implements proper, which also occur in the upper stratigraphic sample. Most of its lateral surface is covered with limestone cortex and only the area immediately adjacent to the working edge exhibits extensive secondary retouch. The other artefact, which cannot be assigned to a specific phase of occupation is a large flake with phytolith polish appearing on the entire platform area. Presumably it represents the removal of a major portion of a sago chopper.
The presence of sago choppers with phytolith polish in each stratigraphic unit confirms the processing of sagopalm pith. The modification of the working face and lateral margins of sago choppers and the occurrence of small flakes with use-polish covering most of the dorsal surface indicate that these implements were retouched at the site.

Other chipped stone artefacts

Three of the four artefacts assigned to this category occur in an early phase provenance; the last is in an ambiguous context.

The first of the early phase artefacts is a retouched flake implement (Fig. VI-23a; see Appendix 8:A.61ff for further discussion). Extensive macroscopic edge alteration is restricted to the left margin and consists primarily of large, hinge-terminated flakes. Small step flake alteration occurs along the distal end. Both flake margins exhibit microscopic edge battering. Most of the flake surface, including retouch flake scars, is heavily patinated. Since all of the associated chipped stone artefacts, with the exception of the one I next describe, have no patina, it seems likely that this artefact was not manufactured during the early occupation phase and is probably an ancient implement which has been redeposited at Kulupuari. This artefact is unique to Papuan chipped stone assemblages, including that recovered from the pre-ceramic occupation of Kukubu Cave (Vanderwal 1973: 122-24, Table VII-2).

The second artefact (Fig. VI-23c) is a thin bifacially modified core, whose surface is heavily patinated (see Appendix 8: for further discussion). Delicately struck hinge and feather flakes occur along the entire margin. Bifacial edge alteration has not been reported for any other Papuan chipped stone assemblage (Allen 1972; Vanderwal 1973: 122-27; Irwin 1977: 312); therefore, this artefact and the technology it represents set it clearly apart.

The remaining artefact associated with the early phase is a multiple platform core exhibiting heavy macroscopic battering at one end of its longest axis. This form of surface alteration may result from an irregularly directed percussive force thus suggesting that this specimen is a hammerstone.

The last chipped stone artefact (Fig. VI-23e; see Appendix 8:A.62 for further discussion) is a core tool found in the intermediate levels
of Pit 5NOE and cannot be assigned to either occupation horizon. It is roughly trapezoidal in plan and unifacially retouched at one end. In form it resembles an axe. This artefact has no surface patination and is therefore assumed to relate to one of the major occupations at Kulupuari. No other item reported from Papuan collections is comparable to this specimen.

GROUND STONE ARTEFACTS

A total of 72 ground stone artefacts were recovered from Kulupuari (Table VI-9). Specimens fashioned from meta-volcanic stone occur in all depositional layers; none appears on the surface. Artefacts of other metamorphic material are generally restricted to the upper 10 cm of deposits and the surface, but some chips do occur as deep as 21 cm below the ground surface. One axe-adze, discovered 3 cm below the surface in Pit ONOE, was made from sedimentary rock (cf. Appendix 11). The poll of another axe-adze of similar material was found in a comparable deposit in Trench 5S0E.

Only 5 complete axe-adzes were found (Fig. VI-24). Table VI-10 lists the measurements taken on these specimens, as well as a summary of quantitative attributes for incomplete excavated specimens. In Table VI-11 measurements are collated for 4 form attributes of whole and incomplete axe-adzes and the percentage distribution of two qualitative form attributes is also presented. The early and recent phase assemblages may be characterised by referring to the information in these tables. The axe-adzes associated with the pottery deposition are generally lenticular or hemispherical in cross-section and their cutting edge is usually asymmetrically bevelled. These artefacts taper sharply in plan from the cutting edge to the butt. Two specimens in this grouping have phytolith polish covering their cutting edges and adjacent faces for approximately 2 cm (Fig. VI-24b,d). Recent phase axe-adzes appear to be slightly shorter in length and their width narrows only between the area of maximum thickness and the butt. Their cross-sections are generally elliptical and their cutting edges are often symmetrical. Although both samples are small, it is reasonable to conclude that the two assemblages are distinct from one another.
The thin-section analysis of 11 meta-volcanic axe-adzes confirms a common source area located in the western region of the Owen Stanley Range, an area which lies approximately 120 km north-north-west from Port Moresby, for all but one specimen (cf. Appendix 11). Four of the axe-adzes are from the recent phase of site occupation, 5 from the early phase and 2 from an uncertain, but probably early, context. Since the pottery was transported to Kulupuari from an area well away to the south-east, the early phase axe-adzes most probably arrived by similar means. Some of the recent phase axe-adzes may have been discovered in archaeological deposits, refashioned and reused. However, these artefacts are generally wider at the girth and butt and have a distinctly different form in both plan and cross-section. This evidence leads me to conclude that more recent axe-adzes were transported to the site as well.

The 4 remaining, incomplete axe-adzes were surface finds. Three of the specimens are planilateral in cross-section. The material from which they were fashioned occurs only in the Central Highlands. I. Hughes and Chappell concur that one is from the Abiamp quarry (Fig. VI-25a) and another from one of the Jimi River quarry sites (cf. Chappell 1966 for further discussion). Another specimen is a poor quality metamorphosed stone which has a wide distribution. The other surface find (Fig. VI-25c) is ovoid in cross-section a form which is very comparable to Eastern Highlands axes (Chappell and Hughes 1979: pers. comm.). This artefact is made from a metamorphosed hornfels tuff similar to that found in the Kafetu quarry (cf. Chappell 1966), but Chappell judges the material to be distinct from that most characteristic of this quarry.

The distribution of the two major stone types at Kulupuari (Tables VI-9) and the distinct form changes of the axe-adzes suggest two possible depositional sequences. The earliest component of each includes only hemispherical and lenticular edge-bevelled implements made from meta-volcanic stone. In one possible ordering of events this would be quickly followed by axe-adzes of the same type of stone but with a distinctly different form, an elliptical cross-section and a symmetrical cutting edge. If this were so, then a large portion of
the specimens I assign to the recent phase at Kulupuari must necessarily
be reallocated to the early phase. However, this postulation
necessitates me to conclude that 70 percent of the axe-adzes in a
recent context were redeposited. The next deposition, which would
correspond to the recent occupation phase, consists primarily of
planilateral axe-adze forms of Highlands stone. These artefacts would
relate to either or both of the recent settlements at Kulupuari.

The second depositional sequence accepts the two meta-volcanic
axe-adze samples to be temporally distinct assemblages relating to
the early and protohistoric periods of site occupation. Planilateral
forms may have been present during the recent pre-contact period, but
their primary deposition occurred while people lived at the post­
contact village of Kikiniu. I contend that this sequence is the most
probable as I am unwilling to concede a major redeposition of a
distinct group of axe-adzes which putatively may have been a portion
of the early phase collection.

Comparative analysis

Vanderwal segregates his collection of 26 "adzes" into two
groups. The first comprises specimens whose cross-section is trapezoidal
or triangular and is restricted to the earliest ceramic horizon for
the area (Vanderwal 1973: 133). The second group includes the
remaining specimens, whose archaeological provenances span the first
millennium A.D. (1973: 49, 52); Table VII-11). As "high-backed adzes"
do not occur at Kulupuari, only the second group is considered for
comparison. The average length, width and thickness values of the
Oposisi specimens (Vanderwal 1973: Table VI-11) generally correspond to
those noted for the early phase assemblage at Kulupuari (Tables VI-10,
VI-11). All of the Oposisi artefacts are asymmetrically bevelled
(p. 127), as are most of the early Kulupuari axe-adzes. Notable
differences in the Oposisi assemblage include a greater diversity of
cross-sectional forms (1973: Fig. VII-5), no marked tapering between
the cutting edge and butt (1973: Table VII-12) and a less refined
surface grinding (pp. 133-34).

Irwin assigns the majority of his "adze" specimens to the
eyear period of area habitation (1977: 296), a time span which generally
precedes the initial occupation phase at Kulupuari. His most common
adze form has an asymmetrically bevelled cutting edge and a "flattish" (elliptical in my terminology) cross-section. In plan these artefacts are widest at the cutting edge and generally taper only between the firth and the butt (p. 298). Adzes with a lenticular or plano-convex cross-section occur in only three instances. Irwin provides no listing of the quantitative attributes for his specimens; therefore, comparison is limited to general form characteristics. On the bases of artefact cross-section and plan the Kulupuari and Mailu early assemblages bear little similarity. The most recent adzes from Mailu are at least 10 cm in length, lenticular in cross-section and generally elliptical in plan (pp. 298, 299, 300a). They are, therefore, distinct from recent Kulupuari axe-adzes.

At Nebira 4 Allen found only 2 small axe-adze chips in his excavations (1972: Table 8). Among his surface finds he reports the presence of 2 "high-backed adzes" (p. 116). This information is insufficient for detailed comparison.

While some similarities do appear, Kulupuari axe-adze assemblages are, on the whole, different from other Papuan collections. Furthermore, axe-adzes fashioned from Highlands stone has not been previously reported for the south coast.

Miscellaneous stone artefacts

Three additional categories of stone artefacts were found at Kulupuari. They include cooking stones and their heat spalls, iron stone and pumice. Table VI-12 lists the distribution of these items throughout the site. The cooking stones are water-worn volcanic lavas and tuffs (M. Worthing 1977: pers. comm.), material which occurs in gravel banks a minimum of 30 km from Kulupuari (see Appendix 7:A.39). Cooking stones frequently appear in deposits relating to both occupation phases. The functional significance of iron stone and pumice is not discernible; however, they have undoubtedly been transported to Kulupuari from elsewhere.

Artefacts of European manufacture

Table VI-13 describes the distribution of European artefacts discovered at Kulupuari. The area of the site represented by Test Pit 8 evidences the greatest concentration of such items. However, it
would be unwise to suggest that this locality is the locus of the post-contact village of Kikiniu because of the presence of blue and yellow-coloured plastic beads and a fragment of green glass, which strikingly resembles glass from a South Pacific beer bottle. With the exception of a single dating sample (ANU-1964) I excavated no material which clearly locates the Kukiniu settlement.

The most significant European artefact found is a Murano glass bead (Plate VI-3a), whose most probable date of manufacture is AD 1650-1750 (see Appendix 12). It was recovered at a depth of 10 cm below ground surface in an area of the site well removal from the dating samples and lay in association with a small white glass bead. Historical evidence suggests that the most likely date for the introduction of the Murano bead by Europeans into New Guinea and adjacent regions is near the beginning of the eighteenth century (see Appendix 12). Since the proto-historic occupation of Kulupuari dates from AD 1700 at the latest, this evidence suggests that it was deposited at the site during the occupation of Kikiniu Village (see p. 21). However, this conclusion is possibly contradicted by the close positioning of the Murano and white glass bead in the site's deposits.

The white bead differs little from those found at the Ibira open site whose calendrical date is from AD 1520-1360 (see p. 165ff). If the Ibira C-14 accurately dates the deposition of the white beads at this site, and I judge this to be the case, then it may also be possible that the Murano bead was transported to the New Guinea region by non-European traders living in the Moluccas. Therefore, the bead's deposition at Kulupuari may date from the proto-historic period of site occupancy.

Based on present evidence, I cannot suggest which of the recent periods of site habitation corresponds with the deposition of the Murano bead. Its recovery from the site, however, supports the existence of an extension of the Torres Strait/Kiwai Island exchange system (cf. Landtman 1927: 214-16) into the Gulf region because historical evidence excludes the possibility of Europeans introducing the bead directly into villages along the Papuan Gulf.
Plate VI-3   Excavated glass artefacts

  a. Kulupuari: Murano bead
  b. Kulupuari: White glass bead
  c. Rupo: Glass imitation of a dog tooth
  d. Rupo: White glass bead
  e. Rupo: White glass bead
  f. Rupo: Blue glass bead
  f. Herekuna: Red glass bead
SUBSISTENCE DEBRIS

Shellfish

Table VI-14 describes the distribution of shellfish remains at Kulupuari. Below a depth of 10 cm the occurrence of shellfish is slight with the exception of Test Pit 8 which is situated at a midden. In his analysis of the animal skeletal remains (cf. Appendix 13), Aplin reports the omission of catfish (Ariidae) otoliths in the collection, despite the presence of a large number of head plates belonging to individuals of this family. Based on this and other supporting evidence he posits differential preservation affecting the faunal remains at this site. If such is the case, the shellfish remains probably depict only recent subsistence activities.

Shells and presumably shell fragments of a single species of bivalve, *Batissa violacea*, constitute 88 percent of all shellfish debris. This species inhabits the banks of small creeks and large rivers. Informants from Kopi Village confirm this distribution for the local environment; however, they report this mollusc to be most plentiful along small waterways draining the alluvial plain. Either habitat lies only a short distance from Kulupuari. Gastropods comprise the remainder of the sample and specimens of the genus *Neritina* are most predominant. Camaenidae are land snails whose habitat includes the local environment of the site. The two specimens from Kulupuari may, therefore, have been naturally incorporated into the deposits.

Animal Skeletal Remains

A wide range of animals appears in the faunal collection recovered from Kulupuari (Table VI-15). In the analysis which follows I segregate the material into recent and early assemblages in the same manner as I have done for the different artefact classes. I further separate the faunal remains occurring in Horizon I, Test Pit 8 because the absence of pottery and the discovery of recent European artefacts in this excavation unit set it apart from deposits found elsewhere at Kulupuari.
Pig and probable pig bone constitute 65 percent by weight of this assemblage. Based upon dentition the age of individual pigs varies from 6-12 months, with some specimens exceeding 18 months (see Appendix 13 for Aplin's discussion of aging techniques). One species of macropod (*Dorcopsis veterum*), two species of phalanger (*Phalanger gymnotis* and *P. maculatus*) and one unidentified form of bandicoot also occur among the mammal remains, but their total weight is less than two percent of that of the total assemblage. A single specimen of murid rat also appears.

Aquatic fauna comprises only 19 percent by weight. Fish specimens include individuals belonging to two genera and five families. Ariid catfish remains are three times more numerous than all other identified fish bone. With the exception of a single *Lutjanus argentimaculatus* premaxilla indicative of a large individual, only small to medium-sized fish appear in the assemblage (see Appendix 13 for Aplin's discussion of size determination procedures). Likewise, chelid turtle skeletal remains are generally representative of small individuals.

Three families of lizard and two snake families are included among the identified faunal material. The size of individuals represented by these specimens varies widely, with the exception of varanids which are mostly large. A cassowary phalanx also appears.

Pig and probable pig bone comprise 83 percent by weight of this assemblage. Based upon dentition most individuals range in age from either 10-20 months or 24 months and greater. Remains of two pigs whose ages are 2-4 months and approximately 6 months also appear. Other identified mammal bone, which constitutes less than one present, includes two species of macropod (*Dorcopsis veterum* and *Dendrologus cf. goodfellowi*), two species of phalanger (*Phalanger gymnotis* and *P. maculatus*), one unidentified form of bandicoot and murid rat.

Aquatic fauna makes up nine percent by weight and includes one genus and four families of fish, chelid turtle and crocodile. Ariid catfish bones are four times as numerous as all other identified fish
remains. Only small to medium-sized fish are represented and this also is the case with chelid turtle.

Boid snake and varanid lizard appear. A cassowary phalanx is also present.

**Recent Historic Phase**

Fifty-two percent (by weight) of the faunal remains from Horizon I, Test Pit 8, are pig or probable pig bone. A minimum number of two individuals is present and the right humerus of one belongs to a juvenile pig. Other identified mammal bone comprise seven percent by weight and include two wallabies (*Thylogale bruni* and either *Dorcopsis* sp. or *Thylogale* sp.), one tree kangaroo (*Dendrologus cf. goodfellowi*), one bandicoot and one murid rat.

Two cassowary tibiotarsi, which account for 34 percent of the assemblage weight, bear deeply etched cut marks made by a steel implement.

Identified aquatic fauna includes one genus and one family of fish, chelid turtle and crab chela. Fish remains constitute less than one percent by weight and there is a minimum number of two fish. One is a large *Lutjanus argentimaculatus* and the other a medium-sized *Acanthopagrus berda*.

This assemblage also contains a single specimen of a large snake.

**Other Animal Bones**

The percentage distribution of animal remains whose provenance cannot be assigned to a specific period of site occupation closely parallels that noted for the recent phase. The range of identified animals is also similar, with the exception of *Carrettochelys insculpta*. The age of individual pigs and the size range of fish and turtles shows no difference from that noted elsewhere at Kulupuari.
Summary

The early and recent phase faunal assemblages compare well on a number of points:

1. age range of pigs,
2. size distribution of fish and turtle,
3. contribution of identified mammals, other than pig, to the total assemblage and
4. variety and repetition of identified animals.

The major differences between the two are:

1. density of skeletal remains,
2. contribution of aquatic fauna and
3. proportion of pig and probable pig bone.

The probable deterioration of faunal remains in recent and early phase deposits (cf. Appendix 13) inhibits comparison between these assemblages and that of the recent historic phase. However, fish bone occurring in the latter demonstrates differences which may be important. Whereas a wide range of fish families appear in recent and early assemblages, the recent historic material evidences a limited number and it also has no arid catfish bone, which constitutes the majority of identified fish in earlier deposits. The contribution of fish to the recent historic assemblage and the size range present are also different, but this may be the result of a more limited sample.

HUMAN SKELETAL REMAINS

The occurrence of human remains is restricted to the most recent phase of site use. Since this material is not immediately germane to the present discussion, I omit their description and analysis from the text. The reader is directed to Appendix 17 for A. Thorne's listing and description of human skeletal remains.
SITE SUMMARY

Artefactual and radiometric evidence indicate that Kulupuari was inhabited during two ages. The first occurs over a period ranging from approximately 1,250-1,500 BP and is probably represented by more than one instance of site use. Large and moderate-sized structures, probably with raised floors, were erected at the site. The most prominent characteristic of the artefactual material is that all items were imported to the site from distant source areas, either as raw material or finished products.

Pottery and stone axe-adze blades arrived at Kulupuari after transport from sites situated at least 300 km to the south-east. Raw material for chipped stone artefacts was imported from three source areas: headwaters of the Sirebi River, approximately 30 km to the east; headwaters of the Omoti River, 45 km to the west-north-west; the Baina quarry, 80 km to the north-west. Cooking stones were also acquired from their source localities along the headwaters of the Sirebi River or the middle reaches of the Kikori River.

A wide range of subsistence activities were conducted by the early phase occupants of Kulupuari. These include the exploitation of sagopalms, hunting terrestrial and arboreal fauna, fishing and, as I shall later argue (Chapter 9), the raising of domesticated pigs. Non-subsistence activities consisted of the manufacture and repair of stone and probably wooden implements.

The second phase of site use spans the proto-historic and historic period from roughly sometime in the sixteenth century until near the present-day. During this time there are probably three distinct periods of site use: proto-historic, historic and recent historic. Structures belonging to either one or both of the earliest periods includes large and moderate-sized houses, probably with raised floors. There are no post holes associated with recent historic deposits.

The artefacts for this phase are again foreign imports. Stone axe-adzes continue to arrive from the same general source area as the early phase, but similar implements also begin to come from Highlands stone sources. Raw material for chipped stone artefacts is also obtained from the same source areas. European trade beads made of glass are introduced into the research area probably during the proto-historic period. Although not noted in the ceramic analysis,
evidence from the Bageima open site suggests that pottery arrived in 
the area around the time of European contact (see p. 171). Therefore,
a small proportion of the potsherds occurring in the recent phase 
deposits at Kulupuari may be related to the early historic period 
of site use. The absence of chipped stone artefacts in Horizon I, Test 
Pit 6, and the occurrence of steel implement cut marks on animal bones 
in these deposits suggest that the use of most stone tools ceased by the 
recent historic period of site use.

Subsistence and non-subsistence activities during the proto-
historic and early historic periods probably differ little from those 
of the early phase. Since the recent historic faunal material may be 
poorly sampled, it is difficult to assess the differences between this 
and earlier assemblages. However, the evidence supports the occurrence 
of fishing, hunting and collecting shellfish.
CHAPTER 7

OTHER EXCAVATED OPEN SITES

MAMPAIU

The Mampaiu open site (Fig. VI-1, Plate VII-1) lies along a high river levee in the southern portion of Kopi Village, overlooking the junction of the Utiti Creek and the Kikori River (7°17'S, 144°11'E). The site extends along the terrace for roughly 100 m from a large limestone outcrop which marks its easternmost limits. The site continues inland for no more than 10 m and downslope toward the creek edge for roughly 5-10 m. Most of the site is covered by contemporary dwellings.

No historical account records the use of the site prior to the settlement of Kopi Village in early 1960 (Kikori Census Report, July 1960). Haimegeau or Aimakeau Village was established in 1923 approximately 0.5 km northward along the Kikori (Bastard 1923) and was abandoned when Kopi Village was settled. Villagers from Aimakeau probably built gardens at Mampaiu or at localities nearby.

Discovery and Excavation

The site was first brought to my attention in May 1976 by one of my field assistants who stubbed his toe on a large piece of chipped stone, while out late one night buying betel nut from a friend living at Kopi. The discovery took me by surprise as I had been living at Kopi for two days while surveying caves and rock shelters in the region. The disturbed area under and around the village houses was surveyed the following morning. Pottery and chipped stone artefacts were found in reasonable numbers in only the southern village area. Adjacent to houses forming the western margin of Kopi a light scatter of cultural debris was observed and no artefacts were noted in the eastern and northern portions of the village. A sago chopper was discovered weathering out of the wall of a house rain-water drain, situated 15 m away from the house in which I slept. It lay in situ approximately 10 cm below ground surface and a dense layer of use-polish covered its working face. I excavated three test pits at this time.
Plate VII-1  Kopi Village: Mampaiu open site appears in the lower right (excavation areas denoted with a white dot)
In December 1976, during my second field season, three days were spent testing the site further. Five 1 x 1m test pits were excavated. Test Pit 4 was located at the southwestern end of the levee, Test Pit 7 approximately 15 m to the north-west at the edge of the village green and Test Pits 5, 6 and 8 along the low river terrace to the south and west of Test Pit 4. Significant amounts of cultural debris were recovered only from Test Pits 4 and 7.

During this period I discovered the Kulupuari site. As this site appeared to yield a greater depth of deposits in a less disturbed setting, work ceased at Mampaiu and was focused on Kulupuari.

**Stratigraphy**

Only two natural soil horizons occur along the high levee. The first is a black humic clay which grades into the second, a greyish brown compact clay. These units appear along the lower terrace, but a high percentage of silt and sand is also included in the soil horizons.

Figure VII-1 is a sketch of the east wall section of Test Pit 1. Although the stratigraphic units in this excavation pit are roughly twice the depth of those found elsewhere along the terrace, I have chosen this example because Test Pit 1 has the greatest depth of cultural material. The deposits are also the least disturbed by recent house construction.

Black humic clay with a great amount of root penetration extended to a depth of 10-15 cm below ground surface. The sod layer, which mantled this horizon, contained a rusted metal bolt. Small pot sherds began to appear just below the root matting at an average depth of 5 cm. Toward the bottom of the black humic clay unit the average size of sherds increased notably. Chipped stone artefacts and cooking stones were also found in this horizon.

A light brown soil matrix occurred next and continued to a depth of 38-42 cm. This horizon, which I interpret as a transitional zone, was defined by the absence of humic staining and extensive root penetration. Large pot sherds, including rim sherds, were generally restricted to this stratigraphic unit. Stone artefacts were infrequently found. Compact greyish brown clay with extensive iron-oxide staining appeared throughout the remainder of the pit to a depth of 1 m below the ground surface. Cultural material, primarily pot sherds, occurred in only the top 12-17 cm of this horizon.
Dating

One carbon sample was submitted to the ANU laboratory for radiometric dating.

ANU-1832 : 310 ± 250 BP

This date was obtained from a 0.7 g sample of scattered charcoal recovered from Test Pit 3, at a depth of 12-15 cm and at the interface of the black humic clay and light brown clay.

The high error factor for this sample accommodates both a historic and a proto-historic period of site occupancy. If the Polach-Golson test is applied to this date and ANU-1965 from Kulupuari (p.125) and ANU-2181 from Ibira (p.166), no significant difference is apparent. On this evidence it seems likely that there was a recent, but pre-contact, period of site use, which possibly parallels the use of Kulupuari and Mampaiu during the ceramic phase.

The close stratigraphic juxtaposition of this sample and the appearance of large sherds in Test Pit 1 (see Appendix 14: Table 14.1) does not necessarily confirm their association. The dating sample was collected from an area of the site well removed from the highest concentration of artefacts and in a locality where the transition zone between the two major stratigraphic units is exceptionally shallow. Therefore, there is sufficient evidence to believe that the dating sample represents a period of site use distinct from the age at which the pottery was deposited.

Features

Ten cultural features were noted during excavations at Mampaiu. The seven post holes found average 15 cm in diameter, with a range of 7-16 cm. Their average depth is 22 cm and they vary between 11-30 cm deep. These features are clearly smaller than those found during any phase at Kulupuari.

Two possible pit features appear at Mampaiu. One is 15 cm wide and 10 cm deep, the other 30 cm wide and 13 cm deep. The form of another feature suggests no notion concerning its possible use. It is ovoid in plan with a maximum length of 23 cm and width of 8 cm. Its depth varies from 20-30 cm.
Artefacts

Pottery

Sherd fragments and badly weathered body sherds comprise 90 percent (by weight) of the excavated pottery collection (Appendix 14: Table 14.1). The analysis of sherds for which ceramic attributes may be clearly noted (see Appendix 14 for further discussion) reveals no discontinuities between the Kulupuari and excavated Mampaiu collections. The repetition of rim form attributes and styles of surface colouring is especially prominent.

Of the four rim sherds found during the surface survey only one is not badly weathered. This sherd (Fig. VII-2a) is a portion of a simple composite bowl rim with a distinctive rolled shoulder. Its quantitative attributes are: orifice diameter: 31 cm, orientation angle: 0°, inclination angle: 215°, rim length: 2.07 cm, rim thickness A: 1.35 cm, rim thickness B: 0.95 cm. The last two measurements are of interest because they fall outside two standard deviations of the mean recorded for similar rims in the Kulupuari assemblage (Appendix 8: Table 8.4). The rim length compares with only a small proportion of Kulupuari bowl rims. The absence of surface colouring and the restriction of tool decoration, which consists of parallel gash incisions, to the shoulder further denote the uniqueness of this specimen. This sherd closely resembles Motuan sherds reported by Bulmer (1971: Fig. 5) and those I have examined in archaeological and ethnographic collections from the Port Moresby and Gulf regions. Since its surface is unweathered I suspect that it has only recently been deposited at the site.

Chipped Stone

Twenty-eight specimens representing four classes of chipped stone artefact were recovered from Mampaiu (Table VII-1). Since the number of items comprising each class is small, assemblages belonging to the different periods of site occupation cannot be identified and the analysis of chipped stone artefacts evaluates each class as a single sample population (see Appendix 14 for a full discussion).
Chipped stone debitage and cores comprise 79 percent (by number) of the collection. All stone sources are represented in the debitage assemblage the majority of these specimen has little or no cortex present (Appendix 14: Table 14.2).

Side, end and multiple edge-altered flakes appear in the collection. These artefacts are usually small, thin and roughly square in plan (Appendix 14: Table 14.3). Macroscopic edge alteration occurs on most specimens (Appendix 14: Table 14.4). In general these flake implements are similar to specimens from both phases at Kulupuari.

Two sago chopper artefacts are present in the collection. The only excavated specimen is a small flake with phytolith polish covering 50 percent of its dorsal surface. This artefact is most probably a sago chopper retouch flake. The other specimen is the sago chopper discovered during my initial survey of Mampaiu (Fig. VI-22e). Its measurements are as follows:

- length: 4.05 cm
- width 1: 3.00 cm
- width 2: 1.30 cm
- taper index: 4.20
- area of working fact: 284 mm²
- length of working edge: 9.70 cm
- edge angle: 85°
- depth of edge retouch: 1.45 cm

The entire working face is covered with phytolith polish, but there are a few flake scars present which suggest a prior retouch of the working face. The surface polish continues down the implement's sides to a depth of 0.95 cm. This specimen compares closely with those from Kulupuari (Table VI-8).

**Ground Stone**

With the exception of two chips, all ground stone artefacts were discovered during the surface survey or were later presented to me by residents of Kopi, who reportedly found the items "under my house" (see Table VII-2). The most distinctive specimen is probably the only clear adze form in all my collection (Fig. VI-25d). In terms of Pacific adze terminology it is of rounded triangular cross-section apex to the front (cf. Duff 1959: 137, type 4). Its measures are as follows:
maximum length: 11.80 cm  
length from cutting edge to girth: 7.40 cm  
width at cutting edge: 1.85 cm  
width at girth: 2.55 cm  
width at butt: 1.10 cm  
maximum thickness: 2.30 cm  
weight: 115.5 g

Its cutting edge is asymmetrically bevelled with a chin angle of 70° and a dorsal surface bevel of 62°.

While the specimen's age cannot be fixed it seems likely that it belongs to the prehistoric period. Kopi Village is the only historic settlement recorded for the Mampaiu site area and it was established long after the introduction of steel axes into the area. The meta-volcanic material from which this artefact was fashioned is consistent with that of the prehistoric ground stone artefacts found at Kulupuari (see p. 145). Of course this artefact may be a recently discarded relic of the past, but this does not detract from evidence supporting its prehistoric origin.

Vanderwal reports similar implements from his excavations with their occurrence restricted to the earliest ceramic period which dates about 2,000 BP (1973: 50, 129-131, 133; 1978: 417). The measurements made on the Mampaiu specimen fall within the range for that collection (1973: Table VII-11); however, the length and width values correspond more closely to those he documents for the Oldham collection (1973: Table VII-14). The probable age difference between our collections cannot be resolved except to note the occurrence of two specimens in Horizon IA at Oposisi which Vanderwal claims are redeposited from earlier levels (p. 131). Since the issue of site disturbance at Oposisi is not resolved (see p.136ff), the IA specimens could be in situ, in which case there would be no appreciable age difference, unless the Mampaiu specimen was originally deposited during the "proto-historic" period. Allen reports the recovery of two similar specimens from the surface of Nebira 4 (1972: 116) and this possibly lends support to the notion that the Mampaiu specimen was deposited at the same time as the pottery.

One other ground stone artefact made of meta-volcanic stone is worthy of mention. It is a portion of a larger straight-sided implement which is elliptical in cross-section (Fig. VI-25b). One end is rounded
and phytolith polish covers this area and continues down the body for approximately 3 cm. Although an accurate identification of this tool's use cannot be made, its form and the presence of use-polish suggest it may be a sagopalm felling implement.

A complete axe-adze is also included in the collection of ground stone artefacts. Its cross-section is elliptical and its sides are asymmetrical (see Appendix 14: for further discussion). The stone from which it was fashioned is a metamorphic material closely resembling that found in Highlands quarries. Since one of the two excavated ground stone chips of similar rock type occurred in the top 5 cm of Test Pit 4, I suspect that the deposition of the axe-adze occurred after the ceramic phase of site occupation. The distribution of ground stone artefacts of similar material at Kulupuari adds support to this conclusion (see pp. [465]).

Miscellaneous Artefacts

Cooking stones and their heat spalls occur most frequently in the top 30 cm of the site (Table VII-3). They are also generally restricted to the area along or immediately adjacent to the high levee.

Finds of European artefacts are also listed in Table VII-3. With the exception of a small portion of a rusty nail, weighing 2 g, all of these artefacts were recovered from the upper 10 cm of the site.

Animal Skeletal Remains

The collection of animal bones from Mampaiu generally consists of poorly preserved specimens, 21 percent of which (by number) are identified. Based upon the distribution of pottery (see p.160; Appendix 14: Table 14.1), the faunal remains may be divided into early (including only Test Pit 1, Spits 2 and 3 and Test Pit 7, Spits 2-6) and recent phase assemblages. Animal bone assigned to the latter probably relate to the proto-historic period of site occupation because:

1. the poor state of preservation compares well with collections of similar age from Kulupuari and Ibira (pp.125, 166), and
2. since the establishment of Australian administration in the region, Kairi villagers have been strongly encouraged to dispose rubbish in rivers (see p. 21).
Pig and chelid turtle are the only animals identified in the early phase assemblage, which comprises 75 percent by weight of the total faunal collection (Table VII-4). Pig bone and unidentified but probable pig bone include 71 and 27 percent, respectively, of the early phase faunal remains. Based upon dentition there is a minimum number of 3 pigs in the assemblage. The age of two individuals exceeds 2 years; that of the third is between one and two years (see Appendix 13 for Aplin's discussion of aging procedures).

The recent phase assemblage is small and pig remains comprise 31 percent (Table VII-4) of the sample. A single specimen of a fruit bat, Pteropus neohibernicus, is also present.

Site Summary

The Mampaiu open site was used during two periods, which are most probably contemporaneous with the ceramic and proto-historic habitations of Kulupuari. Based upon the occurrence and nature of the post holes small-sized structures were erected at the site at least once, but at an uncertain age. The artefacts associated with the early phase suggest that:

1. exotic materials, such as pottery and stone, were being transported into the area,
2. sagopalmst were exploited, and
3. the repair and possibly manufacture of stone artefacts occurred at the site.

The poor state of preservation of faunal remains prohibits an assessment of the range of animal foods deposited at the site.

The artefacts recovered from recent phase deposits are insufficient in number and diversity of items to suggest the nature of the site's use. The occurrence of ground stone implements made from Highlands material in the upper deposits and on the site's surface corresponds with the evidence from Kulupuari. This supports the conclusion that it is appropriate to assign a proto-historic phase of occupation, as suggested by the C-14 determination and its comparison with estimates from other sites. From this evidence I also conclude that some order of contact took place between the inhabitants of Mampaiu and peoples who lived to the north and had indirect access to Highlands ground stone artefacts.
The Ibira open site (Fig. VI-1) is located approximately 70 m inland from the southern bank of the Sirebi River across from Waira Village (7°14'S, 144°12'E). The area of high ground upon which the site occurs is bounded by the river levee to the north and Poiala Creek to the south. The vegetation in the site area includes a number of high canopy trees, some of which (e.g. *Terminalia* spp. and *Artocarpus altillus*) are reported to have been planted during the site's habitation. The lower tree story is dense and luxuriant as the upper canopy is generally open. Ground cover consists primarily of Araceae, ferns and vines.

The site is reported to have been occupied immediately prior to Nodoro Village (see p. 21). At initial contact the Ibira locality was uninhabited. Poialaviti Village was constructed in 1918 in an area adjacent to the site (Woodward 1918) and inhabited until 1961 when the villagers resettled at Waira.

John Tovi first reported the site to me during my second field season. In April 1977 we visited Ibira and excavated four 1 x 1 m test pits by natural stratigraphic units. Test Pit 1 was located at a shell midden and Test Pit 2 approximately 20 m to the west, in an area which John had been told was the village green. Test Pit 3 was situated 40 m west of Test Pit 1 near the edge of the drop-off to the river terrace and Test Pit 4 20 m to the north of Test Pit 3.

**Stratigraphy and Dating**

With the exception of Test Pit 1, there was no well defined humic layer in any of the excavations. The upper soil horizon was viscous dark brown-grey clay which appeared to a depth of from 10-15 cm. Artefacts were generally restricted to this zone. The layer below was very compact light grey clay which extended to a depth of at least 50 cm, the maximum extent of any excavation. In Test Pit 1 black humic clay occurred to a depth of 8-10 cm, dark brown-grey to 15 cm and a sterile light grey clay below.
One carbon sample was submitted to the ANU laboratory for dating.

ANU-2181 : 410 ± 80 BP

This date was obtained from a 15.3 g sample taken from a large piece of wood (*Pterocarpus indicus*) which my field assistant identified as a section of a house post. The specimen was found lying horizontally in Test Pit 1 at a depth of roughly 10 cm and at the bottom of the primary deposition of the shell midden. Using the calibration curve suggested by Clark (1975: Fig. 1, Table 8) this radiocarbon determination corresponds to the calendrical date range of AD 1530-1350, at one standard deviation. Since this age is well before the settlement of Poialaviti Village, a prehistoric phase of site use must be posited.

**Artefacts**

Excluding subsistence debris all test pits contained few artefacts. The rusted handle of a small implement, perhaps a knife, and 4 g of metal fragments were found in the upper portion of the midden in Test Pit 1. A small piece of clear glass occurred near the surface of Test Pit 2. At approximately 5-10 cm in the same excavation a number of small, white glass beads was found. The exact number is unknown because only one specimen survived the accidental processing of the sample bag by my crew of artefact "washers".

The occurrence of European artefacts (e.g. knife handle), whose manufacture probably dates to the early historic occupation of the research area, is in contradiction to the dating result. The C-14 sample may have been collected from the remnants of a house post which has been reused at different village sites, as is possibly the case with ANU-1965 for Kulupuari (p. 125). However, this seems unlikely because even at two standard deviations the most recent calendrical date, AD 1620, requires the post to have been used over a period of 300 years. Unless I am in error concerning the date at which some of the European artefacts were manufactured, there must be either the incorporation of recent items into an earlier deposit or some use of the site during the early historic period as well. The close proximity of the Poialaviti Village site and the recovery of the knife handle from the shell dump suggest the latter to be the case.
The date for the deposition of the glass beads is not clear; however, there is some evidence to suggest that they belong to the earliest period of site use. The beads lay together in situ a few centimetres above the lowermost soil horizon, which is roughly the same stratigraphic position of the dating sample collected from a pit 20 m away. The fragment of clear glass recovered from the same excavation unit appeared near the ground surface amid a light scatter of shell. This evidence compares with the context for the occurrence of the knife handle and lends further support to two periods of site use. Furthermore, the rate of soil accumulation at the Kulupuari open site (and from my impressions all open sites I excavated) could not have been great, as demonstrated by the stratigraphic position of C-14 samples and the density of artefacts. To conclude, the balance of the evidence is consistent with the postulation that the beads were deposited at Ibira well before direct European contact with the research area. As this assumption may be correct, consideration must be given to the means by which they were introduced into the region.

Hughes (1977: 18-22) reports the distribution of glass ornaments by Portuguese, Spanish and, possibly, Chinese ships along the north, north-west and west New Guinea coast during the time Ibira was first occupied. If such agents introduced the Ibira beads into New Guinea, then indigenous coastal trading systems linking west New Guinea with the Papuan Gulf must be assumed. However, there is another possible explanation.

Meilink-Roelofsz (1962: 62, 85, 95, 99, 100, 103) documents Malayans trading glass beads into the Moluccas during the early sixteenth century. In his detailed discussion of local trading systems in this region, Ellen (1979: 56-57) notes that by the beginning of the sixteenth century exotic trade items had become established as important items in local trade and ceremonial exchange in the Moluccas and New Guinea. Therefore, it is probable that Moluccan traders transported beads, such as those recovered at Ibira, to localities along the south coast of New Guinea. There has been little research into documenting this trading system, so it is impossible to determine the geographical extend of Moluccan voyages. However, it seems likely that an exchange system between the Torres Strait and the south-central New Guinea coast was the primary mechanism for the introduction of the Ibira beads into the Papuan Gulf.
Subsistence Debris

Shellfish

Small shellfish fragments weighing only a few grams were found in most excavation pits. Test Pit 1, however, had weathered, but substantial, remains. *Batissa violacea* is the only bivalve species identified in the midden debris and it appears in a density of 31 kg/m$^3$. Gastropod shell belonging to *Neritina* spp. is the only other shell material present and its density is 0.9 kg/m$^3$. *Batissa violacea* is present along local waterways. *Neritina* spp. is primarily restricted to large creeks heavily influenced by tidal fluctuations (P. Coleman 1978: pers. comm.). According to local informants living in Waira this gastropod's nearest occurrence is along the banks of the Anu Creek, which is located approximately 16 km to the south-east across the karst plateau.

Animal Skeletal Remains

Only chelid turtle carapace weighing a total of 7.5 g is included among the finds from Ibira. This material, which was recovered from the humic clay horizon of the shell dump in Test Pit 1, is very badly corroded. Aplin (Appendix 13) suggests that this indicates a lengthy period of deposition, so the turtle remains probably date from the earliest phase of site use.

Site Summary

The Ibira open site was initially occupied around 400 BP and subsequently used during the historic occupation of Poialaviti Village. The length of time for first use was probably brief, based upon the depth of deposits.

The artefact remains provide few clues concerning the nature of site use. The most significant find is the group of glass beads, whose presence possibly supports a coastal exchange network linking the research area and the Torres Strait region. The sparse amount of subsistence debris suggests the exploitation of only riverine resources, most of which may have been captured from waterways located close to Ibira.
BAGEIMA

The Bageima open site (Fig. VI-1, VII-3) lies along a high river terrace of the Kikori River approximately 1.5 km south-south-east of Kopi Village (7°18'S, 144°11'E). The eastern and western site margins are roughly delimited by two seasonal creeks. The site extends from the edge of the terrace inland for 35 m. Primary rain forest vegetation covers the site. The ground surface is relatively free of undergrowth.

Bageima is reported by local informants to be site of the Mati Kairi's place of origin. Historical documents make no mention of a settlement occurring in the site area.

Site Discovery and Excavation

The site first came to my attention in May 1977 during a conversation with an elder from Mati Village. I visited Bageima a few days afterwards and surveyed the site. Shell debris littered the ground surface and a few discrete midden areas were noted. Several small pot sherds were also found in two test pits.

Bageima is the only traditionally remembered habitation site I examined which contained pottery. Its discovery posed an interesting question concerning the possible introduction of prehistoric ceramics into the research area at a date other than that at Kulupuari.

As Bageima was discovered at the end of my final field season, large open area excavations were not possible. I instead tested Bageima extensively by using a 1 m grid pattern. Ten test pits were excavated along the cardinal axes to delimit the areal extent of the site and to define any distributional variation of cultural deposits within the site. One additional pit was situated in a shell midden and another two near the terrace edge, where a large number of pot sherds was found during the initial testing of the site. Each pit was excavated as a single excavation unit because the cultural debris occurred only in humic or humic-stained soils and because there was no discernible break in the deposition of artefacts.
Stratigraphy and Dating

A black humic layer appeared first in all excavations and varied in depth from 2-12 cm. In pits with a high concentration of shell debris the humic horizon extended to as much as 24 cm below the ground surface. A dark brown-black transitional horizon followed. At 20-24 cm the soil matrix in all excavations was a very compact light grey-brown clay which continued to at least 50 cm, the maximum depth of any pit. Artefacts were generally restricted to the top 15-20 cm.

One carbon sample was submitted to the ANU laboratory for dating.

ANU-2182 : \(100.41 \pm 0.8\) Modern (AD 1950 or AD 1890-1850)

The 6.3 g of charcoal from which this result comes was recovered from the fill of a post hole, Feature 1, in Pit 9N6W. The sample evidenced no "atom bomb" and no "Suess" effects (cf. Polach and Golson 1966: 10 for a further discussion) and this is the basis for assigning the calendrical dates. The archaeological evidence presented below does not clearly specify which age best approximates the period of site occupation but does suggest, when compared to historical data, that the earlier age is the more likely.

Features

Four post molds were found during excavation, three in Pit 9N6W and another in Pit 19N22W. All were 20-24 cm in diameter and their maximum depth ranged between 31-61 cm. Black humic clay comprised the fill of all post holes.

Artefacts

Excepting subsistence debris the vast majority of cultural artefacts was found in the site's northwestern quadrant. Cultural deposits did not occur in Pit ON20E.
Pottery

The small size of the Bageima pottery collection and the weathered and fragmentary nature of individual sherds (see Appendix 14 for further discussion) prohibit a detailed comparison with other assemblages.

The western limit of *hiri* trading voyages, during which the Motu of the Port Moresby area traded pottery for sago, included only the Koriki villages near the mouth of the Purari River (cf. Chalmers 1895: 74-92; Barton 1910 for further discussion); however, early reports (Papuan Annual Report 1908; Grimshaw 1911: 231) document the movement of Motuan pottery to villages situated further west in the Kikori/Purari River Delta. Murray notes seeing a Motuan pot in a Kairi (? and Goaribari) village during the government's first extensive patrol to the Gulf region (1910). Also my excavation of the Old Mati Village site (not reported in this thesis), which was occupied in 1918 (Woodward 1918), recovered Motuan pot sherds. While not conclusive, this evidence suggests that sherds found at Bageima are for the most part derived from Motu pottery. The absence of Motuan pottery in recent Kairi villages and the decline of the *hiri* trading system over the period of Australian administration give support to the habitation of Bageima between AD 1850-1890.

Chipped stone

Only four "volcanic" chert chipped stone artefacts were recovered from excavations at Bageima (Table VII-5). The most notable specimen is a large fragment of a sago chopper. A portion of the implement's lateral margin and the entire butt are removed. Phytolith polish covers the entire working face and continues down the tool's side for approximately 1 cm. Two small sago chopper retouch flakes with use-polish appearing on most of their dorsal face were also found.

Ground stone

Both ground stone artefacts (Table VII-5) are axe-adze fragments of metamorphosed mudstone or hornfels. The largest specimen is the butt end of a planilateral axe-adze.
Cooking stone

Twenty-five heat spalls and one whole cooking stone were found at Bageima. The stone type of all specimens is identical to that noted at Kulupuari.

Subsistence Debris

Shellfish

Two genera of shellfish are present at Bageima (Table VII-6). *Batissa violacea* comprises 98 percent of all shellfish remains. This species occurs in waterways in the general vicinity of the site, but residents of the area report it to be most plentiful along the middle and upper reaches of the Mati Creek, whose mouth is located approximately 2.5-3.0 km from Bageima. Shell of *Neritina* spp., which is primarily found along creeks situated a minimum of 10 km from Bageima, appears infrequently in the deposits.

Animal Skeletal Remains

Specimens representing four genera and five families of animals are included among the site's faunal remains (Table VII-7). Identified pig bone constitutes 40 percent (by weight) of the total collection. Based upon dentition there are a minimum number of five individuals whose ages are 12-16 months and greater than 25 months. A minimum number of three individuals are represented in the post-cranial material. *Macropodidae* (two individuals) and phalanger (one individual) are possibly the only hunted game identified in the collection. A small fragment of a cassowary eggshell also appears in the assemblage.

The second most prominent animal remain is chelid turtle carapace, which comprises 27 percent of the total collection weight. Several fragments are representative of large-sized turtles. Fish skeletal material constitutes 10 percent of the assemblage. Among the identified specimens there are portions of eight individuals: five medium-sized sparids, one arid of similar size, one large *Lutjanus* sp. and one barramundi (*Lates* sp.) of indeterminant size.
Site Summary

Bageima was occupied briefly, but intensively, during the early historic period. A few, modest-sized structures were probably built on the site. While living in the area, the inhabitants exploited local and not too distant riverine resource localities for turtle, fish and shellfish and they probably also processed palm starch. The pig remains suggest that portions of several medium to large-sized individuals were consumed at the site. Taking into account that pig may have been a domesticate, hunting was probably only a minor activity conducted from Bageima.

The representation of stone artefacts in the site's deposits is meagre; therefore, the manufacture or repair of stone implements rarely occurred. The presence of ground stone artefacts fashioned from Highlands stone supports contact with groups living to the north. Historical evidence suggests that the pottery was probably obtained from people inhabiting the deltaic region to the south.

WAIRA

The Waira open site (Fig. VI-1, VII-4) is situated on the crest of a high knoll located in the northeastern portion of Waira Village and overlooking the junction of Napara No. 1 Creek with the Sirebi River (7°14'S, 144°12'E). The hill falls sharply toward the north and east. Its slope is more gradual in other directions. Short grass covers the entire site area.

Local informants report that the Waira site was inhabited while people lived at Ibira and abandoned when Nodoro Village was established. There is no mention in historical documents of the site being used prior to the founding of Waira in 1961 (Kikori Census Report 1961). John Tovi said that his father, the founder of Waira Village, may have built a temporary shelter in the area when he began work on the coconut palm plantation, which is situated to the west of the site.
Plate VII-2  Foreground: Waira open site;  Background: Ket's house (left) and John's house (right)
Site Discovery and Excavation

The Waira site first came to my attention in November 1976 via several reports from villagers of finds made while digging post holes, particularly in the general area of the knoll. Late in the month I surveyed the site area by excavating a series of small test pits which radiated away from the small hill. I also tested other areas in the village using the same method. All finds were restricted to the general area of the knoll, with the exception of a few flakes and an axe-adze fragment which were recovered from 1 test pit located on another small hill lying in the middle of the coconut plantation.

Before returning to Port Moresby for Christmas 1976 I excavated three 2 x 2 m pits and one 2 x 4 m pit on the crest and eastern slope of the knoll using 10 cm spits. In January I dug two additional 2 x 2 m pits with the assistance of David Bell. Further excavations were not attempted because recent disturbance increased significantly with increasing distance away from Pit ONOE.

Stratigraphy and Dating

Only one soil horizon with light humic staining near the surface was noted during excavations at Waira. The light greyish brown soil appearing at the site contained heavy root infiltration and humic discolouration in the top 10 cm. Within this zone there was also a high percentage of sand and silt. Below 10-15 cm the soil matrix was very compact. Small gravel inclusions of chert, quartzite and metamorphosed stone and sediments, plus large clay conglomerates, occurred throughout the soil layer. Their presence often made it difficult to distinguish chipped stone from naturally fractured stone. Artefacts were generally restricted to the top 10-20 cm of the site.

One carbon sample was submitted to the ANU laboratory for dating.

ANU-2062 : 106.2 ± 1.1% Modern (AD 1957/58)

This estimation was obtained from a 3.8 g sample of charred wood lying in the southeast quadrant of Pit ONOE and approximately 4 cm below ground surface. The sample showed evidence of the "atomic bomb" effect. The calendrical date is an estimate based upon the percentage of this contaminant present (H. Polach 1979: pers. comm.).
This age corresponds well with my personal estimate for John Tovi's father beginning the construction of the coconut plantation and the Waira sagopalm stand. I do not believe, however, that this date corresponds with the deposition of non-European artefacts at Waira. I will provide some substantiation for this conclusion later in this section.

Features

Five post holes were discovered at Waira (Fig. VII-2). All were dug at a depth of from 10-20 cm below the present ground surface. Their maximum widths range from 18-31 cm with an average diameter of 23 cm. They were from 27-40 cm deep, averaging 36 cm. Following the criteria established for the features at Kulupuari the post molds at Waira may all be categorised as long and narrow post holes.

Artefacts

Most cultural material occurred in the upper 10-20 cm of the site. In the absence of natural stratigraphic markers, artefact analysis must proceed by considering each artefact grouping as a single assemblage.

Chipped stone

This category contains the majority of finds from Waira (Table VII-8). The only stone type represented in the collection is "volcanic" chert. Chipped stone debitage is recorded for each excavation unit. Flake size averages 4 g and most specimens retain little or no original cortex. Thirty-six non-utilised cores are also included in the collection. Two cores evidence no flake removal, while the majority of the remaining specimens consists of multiple platform cores.

The 13 edge-altered flakes recovered from Waira are characteristically short, relatively high-backed and close to square in plan (Table VII-9). A large percentage of the flakes is retouched and 83 percent of the altered edges exhibit no microscopic alteration. These characteristics and more specifically the average weight of the
implements closely approximate the observations made for the early chipped stone assemblage at Kulupuari (see p. 141ff; Appendix 8: Table 8.20).

Most flakes are side-altered implements (Table VII-10). Flakes with an edge angle in excess of 80°, steep edge implements, are also numerous. A comparison of this information with that noted for the Kulupuari assemblages (Appendix 8: Table 8.24) reveals some similarities with the recent phase chipped stone implements.

The absence of pottery among the finds from Waira prevents the assignment of the Waira chipped stone assemblage to an age compatible with its most comparable counterpart at Kulupuari, the early phase. However, I believe the evidence does substantiate an occupation of the Waira site during a period prior to that evidenced by the site's C-14 result (ANU-2062). The fact that the Kairi readily adopted steel implements, which superseded their equivalent fashioned from stone, lends support to this conclusion.

One complete sago chopper was found at a depth of 4 cm in Pit 4N2E. Its measurements are as follows:

- length: 4.30 cm
- width 1: 3.10 cm
- width 2: 1.00 cm
- taper index: 4.88
- area of working face: 282 mm²
- length of working edge: 9.60 cm
- edge angle: 88°
- depth of edge retouch: 1.00 cm

Less than 10 percent of the working face exhibits use-polish. The presence of retouch flake scars suggests that most of the polished surface has been removed. Use polish continues down only a small portion of the lateral margins to a depth of 1 cm. Because of the level at which this implement was recovered, its deposition is most probably recent.


Ground stone

Excavated ground stone artefacts include only two axe-adze fragments which were discovered during the initial test survey at Waira. The first, which appeared 10 cm below the surface in the coconut palm plantation, is the cutting edge of a symmetrically bevelled axe-adze fashioned from meta-volcanic stone. Its cross-section form is lenticular. The second specimen, which was found 20 cm below the surface near the southern margin of the knoll, is the butt of a planilateral implement. It is made from a light grey-coloured metamorphosed material similar to that originating in Highlands quarry sites. If extrapolation from the stone axe-adze sequence at Kulupuari is in order (see p. 146ff), then a recent prehistoric occupation of Waira is suggested.

The three remaining axe-adze artefacts are finds made by local informants and said to come from Waira Village. Each specimen is planilateral in cross-section and fashioned from Highlands stone. One complete specimen (175/2) has an asymmetrically bevelled cutting edge and straight sides (Table VII-11). The other complete specimen (175/3) has a symmetrical cutting edge. One of its sides is straight and the other convex.

Miscellaneous stone artefacts

The distribution of the four categories of miscellaneous stone artefacts is described in Table VII-12. The ironstone and pumice specimens are comparable in size to the gravel inclusions in the soil and may have been naturally transported to the site. The volcanic cooking stones, however, have been carried to Waira by other means.

European artefacts

Table VII-13 presents the distribution of European artefacts found at Waira. With one exception, the stratigraphic deposition of these artefacts is limited to the uppermost 5-7 cm of the site. The concentration of European artefacts in Pit 2S4W reflects my placing this pit in an area where my field informant's house once stood.
Subsistence Debris

Shellfish

Four genera of shellfish appear in the excavated shell debris (Table VII-14). Specimens of *Batissa violacea* comprise 81 percent of the total sample. With the exception of *Neritina* spp. all of the genera are today found along waterways near Waira. According to local informants *Neritina* snails occur only near large creeks draining the southern portion of the karst plateau, some 11-20 km south-east of Waira.

Animal Skeletal Remains

The faunal assemblage recovered from Waira consists of only mammal remains. Identified pig bone comprises 81 percent (by weight) of the collection. A single specimen of a phalanger is also present.

Site Summary

The Waira open site was briefly occupied prior to European contact. Based upon the presence of chipped stone artefacts and stone artefacts fashioned from Highlands and Papuan stone sources an age relating to the proto-historic period is suggested. Possibly only a single small to moderate-sized structure was erected at the site.

The occurrence of large amounts of debitage and non-utilised cores suggests that stone knapping was a major activity during site use. However, as the source area for the raw material is situated at a considerable distance from Waira, the intent underlying site habitation is unclear. The paucity of subsistence debris definitely associated with the proto-historic period provides no further evidence of the nature of site use.

CONCLUSION

The open sites discussed in this chapter were, with the exception of Mampaiu, only inhabited during the period represented by the recent phase of occupation at Kulupuari. The density and distribution of artefacts at these sites suggests that they were briefly used. The
post holes noted are representative of small to medium-sized structures. Since this evidence is distinct from that observed at Kulupuari, I conclude that the small open sites illustrate a different aspect of the settlement pattern for this period.

The artefact assemblages of these sites collectively reflect the range of items found at Kulupuari during a comparable age. The occurrence of pottery at Bageima, which is most probably Motuan, suggests that a small proportion of the pot sherds in the upper stratum of Kulupuari may be of a similar origin. Bageima and Waira chipped stone artefacts are made from only "volcanic" cherts and this possibly reflects a greater reliance upon stone sources situated near the headwaters of the Sirebi River during more recent times. Although not certain, it is likely that Highlands stone axes, as well as those obtained through exchange systems linking the Gulf region with area further east, arrive in the research area during the proto-historic period. The recovery of European glass beads at Mampaiu and Ibira supports the pre-contact introduction of these items into the Gulf region and possibly the presence of indirect trade relations with the Torres Strait area.

The range of subsistence debris occurring during the recent phase at Kulupuari is not represented in any of the other open sites. From this evidence I conclude that subsistence activities at the smaller open sites were probably more limited in scope.
Chapter 8

ROCK SHELTER SITES

Up until this chapter the archaeology section of the thesis has concentrated upon a discussion of open sites, most of which I discovered during my second field season. I now describe my archaeological findings of three rock shelter sites. With the exception of the Emehemate rock shelter (not discussed in this thesis), these are the only sites of this class in which I recovered substantial cultural deposits.

RUPO

The Rupo rock shelter (Fig. VI-1; Plate VIII-1) is a small cavity in the north-west face of a cone karst hill situated near the headwaters of the Utiti Creek (7°15'S, 144°12'E) and roughly 40 minutes by canoe from Kopi Village. The site lies 30 m up a steep slope directly overlooking the creek. The area sheltered is about 8.5 m² and the maximum dimensions are 6.5 x 7.5 m. A small platform extends less than a metre outside the dripline, which is 50 cm outside the entrance; beyond this point the ground surface falls very sharply to the creek edge.

The karst hill is isolated from the adjacent plateau by the Utiti Creek. A broad alluvial plain, which continues to the Kikori River, lies to the north and east. The vegetation in the area is dense rain forest.

Discovery and excavation

I was first guided to Rupo in May 1976 by Kuiauru Latto, the site owner. I found 17 human skulls lying in the centre of the sheltered area and a large number of long bones piled in a small cavity in the western wall. European artefacts were also present on the surface. During conversations with Kuiauru I learned that the site had been used as an ossuary by his forefathers, but these funerary
Plate VIII-1  Front view of Rupo rock shelter

Plate VIII-4  Front view of Ouloubomoto cave
customs ceased not long after the beginning of European administration of the area, when government officials rigidly enforced the burial of dead. In recent times the site has served as a rain shelter.

During my first visit to the site I excavated two hand tests. These confirmed that the site contained substantial cultural deposits, including pottery. I returned to Rupo a few days later and excavated a 0.5 x 1.0 m pit, Test Pit 3. Artefacts were recovered from five of the six 10 cm spits and shell fragments continued to a depth of 1 m in a 25 x 25 cm test excavated in the pit's south-west corner.

My major work at Rupo began in November 1976. Three 1 x 1 m pits (Fig. VIII-1) were excavated to a depth ranging from 20-50 cm by 5 cm spits. All of the spoil was processed by water flotation. Work at Rupo was halted while I conducted excavations at Kulupuari. When I returned less than a month was remaining in my second field season; therefore, I hastened the work by excavating in spits of 10 cm or more and by dry sieving the spoil.

Pit A was excavated to a depth of 80 cm; cultural debris did not occur below 75 cm. A 50 x 50 cm test in the north-east corner of Pit A was taken down to 120 cm. The soil matrix did not change and no artefacts were found.

Pit B was excavated to a depth of 60 cm by spits. Below 30 cm only friable shell was present and by 40 cm the western portion of the pit was sterile. At approximately the same depth a large limestone boulder appeared bisecting the pit along a north to south axis. A 25 x 50 cm pit was next excavated in the north-west corner of the pit to test for additional cultural horizons. Approximately 80 cm below the surface human skeletal material was discovered. The overburden in the remainder of the western portion of the pit was carefully removed. Skeletal material continued to appear along a gradual slope upwards. A human skull and mandible were uncovered near the south-west corner at 63 cm. After removing the skeletal remains I continued excavating for another 10-20 cm. With the exception of a few snail shell fragments at 90 cm in the north-west corner the pit produced nothing further.

Pit C was also excavated to a depth of 60 cm. Cultural material was restricted to the uppermost 45-50 cm. A 50 x 50 cm test was excavated in the pit's south-west corner. At 90 cm a solid limestone floor was found. The soil matrix did not change from that noted in Spit 10 (50-60 cm) and no artefacts were found.
After concluding my excavations I cored the deposits of one wall section of each pit with a length of bamboo.

Stratigraphy

Three major stratigraphic units were identified during excavations. Two areally discrete strata were also noted (Fig. VIII-2, VIII-3). Soil texture and slight variations in colour served as the only criteria for defining distinct units. With the exception of Horizon IA, the transition between strata was gradual.

The top unit was a loose greyish brown clay (10 YR 3/2). Large roots, which generally covered the surface of the site, occurred throughout this soil zone, particularly in Pits A and C. A filament root matting covered the upper 3-5 cm and humic staining was generally restricted to this area. Limestone roof-fall of a medium to coarse gravel size was prevalent in the lower portion of this stratum. The maximum depth of Horizon I ranged from 25-45 cm.

A discrete layer of powdery, light brown to white coloured clay (10 YR 5/2) was found in the lower levels of Horizon I in Pit A and the northern one-third of Pit B. This stratum was identified as Horizon IA. While excavating I noted a large number of very fine gravel-sized limestone fragments in it and on this evidence I concluded that this matrix represented an intense and localised weathering of the limestone roof-fall found elsewhere toward the bottom of Horizon I.

The next major stratigraphic unit was a compact dark brown clay (10 YR 4/3). Large roots continued to appear, but much more infrequently than in Horizon I. Limestone roof-fall maintained the same density. This layer varied in depth from 3-30 cm and appeared to thicken along a north-south axis.

The lowest soil horizon was a very compact yellowish brown clay (10 YR 5/6), which was limited to the eastern portion of the site. West of the large limestone boulder, which occupied the centre of Pits A and B, it was replaced by a reddish brown clay (10 YR 5/4) which I labelled Horizon IV. In the poor light of the site it was impossible to distinguish a clear boundary between Horizons III and IV. My field interpretation was that the differences between these were post-depositional.
Since my impressions while excavating the site provided few clues as to the depositional and post-depositional characteristics of the stratigraphic units, I elected to analyse the sediments contained in the three core samples. Under the guidance of P. Hughes (Department of Prehistory, ANU) and J. Jennings (Department of Biogeography and Geomorphology, ANU), I conducted several analyses of the sediments at Rupo. The procedures followed and the quantitative results of these analyses are presented in Appendix 9. The information obtained from these analyses suggests that there are considerable differences in textural composition and calcium carbonate content between Horizon I and Horizons II and III. Gravel-sized particles of limestone, which comprise a modest proportion of the upper soil matrix, are rare in Horizons II and III (Fig. VIII-4). The percentage of calcium carbonate in the less than 2 mm fraction of the lower horizons is approximately one-tenth of the values for Horizon I (Fig. VIII-5). Initially this evidence suggested to me that the surface of Horizon II had remained stable over a considerable period of time while the soil deposits weathered \textit{in situ} and lost carbonate in solution. However, the presence of shell debris in Horizons II and III contradicts this supposition.

I next considered the possibility that the upper and lower units were derived from different sources. I postulated that the material comprising Horizons II and III were washed into the site from an external source. For example clay soils which developed on the ground surface of the karst hill in which the site occurs may have been transported by rain-water through fissures in the hill to the site and deposited there. In contrast, I postulated that the material included in Horizon I resulted from the weathering of the limestone which forms the roof and walls of the cave.

To test this hypothesis six samples of roof-fall found in the Horizon I sediments of the column samples were examined to determine the insoluble fraction (i.e. non-calcareous material) included within the limestone (see Appendix 9). Since all samples contained one percent or less insoluble material Horizon I could not have been derived from localised weathering and roof-fall alone. Therefore, the sediment found within the site must have been carried there, most probably suspended in ground water. Until further analysis of the
sediments proves otherwise, I must also assume that the natural deposition of material at the site is continuous because the process by which sand, silt and clay were deposited remains unchanged throughout the site's history.

On the basis of the present analysis I suggest that the differences noted between Horizon I and Horizons II and III result more from human than natural agencies. Two lines of evidence support this conclusion.

As noted in Appendix 9 the analysis of the percentage of calcium carbonate in the less than 2 mm fraction does not differentiate the contributions made by limestone and shell to the deposits. Therefore, the decrease in calcium carbonate may be attributable to a decrease in the shell content of different horizons. Figure VIII-6 illustrates the percentage loss of shell and calcium carbonate between stratigraphically adjacent samples in each excavation pit. It should be noted that in the graph I compare only the weight of shell which is greater than 3 mm in size (i.e. the shell which is retained in a one-eighth inch sieve) and the calcium carbonate appearing in two 2 mg samples for each collection unit. Also, the orientation points of the graph are not centred on a particular stratigraphic zone but rather between zones. This technique is followed to compare the values between two units.

The only clear indication of co-variation between the two calcareous materials occurs in Pit B and C. This evidence provides considerable support for the view that differences in shell content between Horizon I and Horizons II and III contribute to the noticeable variation in the calcium carbonate content of these two units. The relative absence of limestone gravel in the lower stratigraphic units probably also contributes to such differences, but as I presently argue this may be a product of human rather than natural effects.

The textural differences between Horizon I and Horizons II and III (Fig. VIII-4) may explain the lack of correspondence in the variation between measured calcium carbonate content and the amount of shell present (Fig. VIII-6). The majority of gravel-sized particles in Horizon I is limestone. Although weathered limestone is not the primary source for the silt and clay components of the matrix, this material must be a contribution to the calcium carbonate content of the fine fraction.
The increase in weathered limestone gravel noted in Horizon I is possibly the result of increased human use of the site. The radiocarbon dates for Rupo (see below; Fig. VIII-2) suggest that the rate of deposition of Horizon I is approximately 1 cm in 10 years, as compared to roughly 1 cm in 40 years for Horizon II. Further, P. Hughes (1978: 41) in his study of Australian sandstone rock shelter sites concludes that the weathering rate of stone surfaces forming the roof and walls of such sites increases greatly during intensive site use. He attributes this to the following three factors:

1. knocking down of any pre-existing layer of weathered rock;
2. maintaining of the roof and walls in a clean state through physical contact and hence exposing the rock to further weathering;
3. influencing the shelter environments through changes in temperature and humidity, particularly by the lighting of fires.

I draw the following conclusions from this analysis of the sediments at Rupo. Throughout site history the silt and clay fraction of the sediments has been transported by water to the site. Since Rupo lies well above the maximum flood level of the Utiti Creek, I must assume that this material has been carried through fissures which join the hill's upslope surface to the tunnel which extends into the centre of the hill from the rear of the site. Prior to the deposition of Horizon I human occupation of the site was infrequent and the only alteration in the natural stratigraphy resulted from the deposition of food remains. Site habitation indicated by the deposition of Horizon I was relatively brief but intense.

Dating

During the first field season excavations at Rupo yielded little or no charcoal. After consulting with Henry Polach and John Head (ANU C-14 laboratory) a shell dating programme was initiated to establish a constant correction factor for shell date estimates (see Appendix 10). All discussions appearing in the text of this thesis
consider only the corrected results and these are denoted by an asterisk.

Three shell samples from Rupo were submitted to the ANU laboratory for dating.

ANU-2232: 910 ± 170 BP*

This date was obtained from a 46.5 g sample of *Batissa violacea* shell collected from Spit 4 (10-15 cm) in Pit C (Fig. VIII-2). The greatest concentration of pottery at the site occurs in this excavation unit (Fig. VIII-7); therefore, this sample was submitted to establish the maximum age for the end of the pottery deposition.

ANU-2233: 1160 ± 170 BP*

This date resulted from a 45.5 g sample of *Batissa violacea* shell recovered from Spit 8 (30-35 cm) in Pit C (Fig. VIII-2). This material was processed in order to obtain a minimum date for the initial deposition of pottery at Rupo.

ANU-2234: 2160 ± 180 BP*

This date was derived from a 50.4 g sample of *Batissa violacea* shell recovered from Spit 11 (50-70 cm) in Pit A (Fig. VIII-2). This excavation unit was the only one in the lower stratigraphic levels of the site with a sufficient amount of shell for dating. It was submitted to obtain a minimum date for the initial occupation of Rupo.

Table VIII-1 presents the results of a Polach and Golson test of similarity (see p. 127) for the dates from Rupo and for two dates from Kulupuari. This evidence demonstrates that the result denoting the minimum age for the use of Rupo (ANU-2234) represents a distinctly different event from that marking the pottery deposition at both sites, which is indicated by the remaining C-14 estimates listed. The test results comparing the estimates for the beginning and end of pottery deposition at each site suggests that the accumulation of these deposits continued over time. However, only the results marking the end of pottery deposition at Kulupuari (ANU-2064) and its beginning at Rupo (ANU-2233) are contemporaneous events. From this analysis
I infer that

1. the initial use of Rupo represents a pre-ceramic occupation of the research area and denotes activities of some antiquity;

2. the ceramic phases for the two sites are partially contemporaneous; and

3. the use and discard of pottery in the research area continues over a period of at least 600 years.

Artefacts

Pottery

The stratigraphic occurrence of pottery at Rupo is generally limited to the top 30 cm of deposits, with the greatest density between 5-20 cm (Table VIII-2). The appearance of potsherds at lower levels in Pit C and Test Pit 3 corresponds with the eastward thickening of the uppermost soil horizon (Fig. VIII-3) and is, therefore, compatible with the deposition of pottery elsewhere at the site.

The pottery collection includes four straight jar rim sherds and one reconstructed simple composite bowl rim. Three jar rims have a straight rim course, parallel profile and a round lip. The remaining rim has a convex rim course, thinning profile and round lip. Most of these rim sherds are small and the full complement of quantitative attributes is not present on any sherd. The measurements which were taken correspond well with those described for the Kulupuari assemblage (Appendix 8: Table 8.3). The jar rims are badly weathered and any decoration which may have appeared is obscured.

The two portions of the reconstructed bowl rim were found in adjacent pits and spit levels. The sherd (Fig. VII-2b) has a concave rim course, thinning profile and round lip. Its rim length is 1.75 cm and the rim and body thickness measurements are 0.65 and 0.59 cm respectively. These values fall within the range noted for simple composite bowls at Kulupuari (Appendix 8: Table 8.4), but the first two measurements are considerably smaller than the average figures. The two angle measurements compare well with Kulupuari bowl rim sherds.
The Rupo bowl rim is decorated with interior and exterior slipping, while incised and gash incised rectangular figures appear on its exterior rim.

Twenty-six plain or weathered body sherds are also included in the Rupo pottery collection. The average thickness of these sherds is 0.59 cm with a standard deviation of 0.14 cm. These values correspond well with those observed in the Kulupuari assemblage (see Appendix 8: A.55ff).

**Chipped stone**

Twelve chipped stone artefacts comprise the collection excavated at Rupo (Table VIII-3). Since all material is in direct association with pottery, I confidently suggest that the entire assemblage may be assigned to the ceramic phase of occupation. The debitage consists of very small flakes and each of the major source areas for stone material is represented in the collection. Of particular note is the presence of a wasa flake. The only core has a single platform and is a "volcanic" chert.

Table VIII-4 describes the quantitative attributes for the altered flakes. The mean values for most measurements are smaller than those calculated for both early and late groupings at Kulupuari (Appendix 8: Table 8.20). The variation among values for Rupo flake implements generally corresponds with the lower distributional range for Kulupuari edge-altered flakes.

The percentage distribution of qualitative attributes is presented in Table VIII-5. Macroscopic alteration appears on 50 percent of modified edges and is most usually characterised by hinge flake removal. Considering the angle of percussive force needed to produce these large flake scars, it is reasonable to assume that macroscopic edge alteration is more a product of edge retouch than use. Microscopic alteration occurs on the majority of altered edges and along more than 50 percent of their length. This information probably means that the Rupo flake implements were frequently used for light tasks and their edges were modified by retouch to increase the life of the implements. If this is so, then the repeated "resharpening" and reuse of flake implements deposited at Rupo may explain their small size and, therefore, the difference between Kulupuari and Rupo assemblages. This is
further supported by the fact that stone resources for the production of implements was more readily available at Kulupuari.

**Shell and bone artefacts**

With two exceptions, all specimens appearing in this category (e.g. see Plate VIII-2, VIII-3) are modified in such a way as to suggest they were either strung as beads or pendants or possibly sewn onto fabric. The apex of *Oliva* shells is neatly removed at right angles to the shell's length. *Nassa* and *Cypraea* shells are modified by the removal of the dorsal crest. As well, a hole is drilled through the ventral surface of *Nassa* shells directly opposite the aperture. *Conus* shells exhibit two forms of alteration. A single specimen in the form of an annulus has been shaped by cutting away the apex and most of the body whorl so that only the perforated shoulder remains. Most cone shell artefacts are small centre-drilled discs which are ground from presumably the top of the shell. A small hole runs from the anterior to posterior upper dorsal margin of the *Calypttraea* shell. The lower root area of animal teeth is perforated. Human teeth are drilled in the same location but after one root stem has been cut away.

The *Trochus* shell artefact is a narrow and curved segment of a larger object. It most closely resembles a bangle. The *Melo* shell specimen is a fragment of the shell's front margin which has been modified into a generally straight edge. Presumably it is also an incomplete artefact.

The distribution of shell and bone artefacts is described in Table VIII-6. *Nassa*, *Melo* and possibly *Calypttraea* shell specimens occur in the uppermost stratigraphic levels and may, therefore, have been deposited during the protohistoric/historic phase of site use. The *Trochus* shell artefact, human teeth and drilled pig incisor are restricted to the ceramic horizon. All other types of bone and shell artefacts may be assigned to either of these phases. *Oliva*, *Conus* and *Cypraea* shell artefacts are the only specimens which occur in a non-ceramic context and in all instances these artefacts appear in excavation units adjacent to those containing potsherds.
Plate VIII-2  Excavated shell artefacts

a. Rupo: *Nassa* shell ornament  
b. Rupo: ? *Calyptraea* shell artefact  
c. Rupo: *Melo* shell artefact  
d. Rupo: Fragment of a *Trochus* shell armband  
e. Rupo: *Conus* shell annulus  
f. Rupo: *Conus* disc shell bead  
g. Rupo: *Oliva* shell ornament  
h. Rupo: *Cypraea* shell ornament  
i. Ouloubomoto: *Strombus* shell artefact  
j. Ouloubomoto: Portion of a *Conus* shell armband  
k. Herekuna: *Caridiidae* shell artefact
Plate VIII-3  Excavated bone artefacts

a. Rupo: Drilled human tooth (R.M2)
b. Rupo: Drilled human tooth (R.M3)
c. Rupo: Drilled pig incisor
d. Ouloubomoto: Modified bone
e. Ouloubomoto: Modified bone implement (?)
f. Ouloubomoto: Modified and drilled bone
g. Herekuna: Drilled dog tooth (R.C1)
European artefacts

Most European artefacts are confined to the top 5 cm of the site (Table VIII-7). The heavy root penetration into lower stratigraphic levels in Pit C may account for the lower deposition of European artefacts here. The majority of the artefacts may be classed as personal effects, which were very likely left at the site to commemorate individuals interred here. The most notable item is a moulded glass imitation of a dog canine (Plate VI-3C). Although the evidence is unclear, its arrival into the area probably dates near the time of European contact (see Appendix 12).

Miscellaneous artefacts

Cooking stone, ironstone and haemitite are included in this artefact category. Table VIII-8 describes their distribution at the site. The occurrence of these items at Rupo cannot be ascribed to natural causes.

Subsistence Debris

Shellfish

Shellfish remains comprise the most common type of cultural debris at Rupo. Freshwater bivalves, primarily Batissa violacea, accounts for 37 percent of the total weight of shells. With the exception of a few specimens of land snail, Camaenidae, the remainder of the shell remains consists of freshwater gastropods. Specimens belonging to the family Viviparidae constitute 30 percent of the shell remains. Melanoides and Neritina shell form 19 percent and 9 percent, respectively, of the shell sample. Specimens of an unidentified fresh-water gastropod, towi (K), occur in very small numbers. Neritina spp. is the only type of shell present which does not appear in the immediate vicinity of Rupo. Local informants report its nearest occurrence is along the banks of the Veiru Creek, approximately 16 km to the south.
*Batissa violacea* is present throughout the site and constitutes from 17-65 percent of the shell remains from any one excavation unit (Table VIII-9). *Viviparidae* shell occurs in large numbers in only the upper portion of the site. The decline in its presence is roughly marked by the beginning of Horizon II (Fig. VIII-2). *Neritina* shell is found in both Horizon I and II, but its occurrence generally increases from the top of Horizon II downwards. *Melanoides* shell has a notable distribution in the sequence. While common in all units its presence frequently varies inversely to that of Viviparidae. Both of these shellfish occupy the same habitat and are most accessible for human exploitation during periods of drought (see p.43). Notable variation in their occurrence *vis-a-vis* each other is, therefore, not predictable unless more subtle distinctions (e.g. dietary preference) are postulated.

**Animal Skeletal Remains**

In the following analysis I segregate the faunal collection into three assemblages: pre-ceramic, early ceramic and recent ceramic. The separation of the first is supported by stratigraphic, artefactual and radiometric evidence. The subdivision of the ceramic phase collection into two assemblages is made to assess the possibility of a change in site use following the abandonment of Kulupuari. The allocation of specific excavation units to early and recent periods is for the most part arbitrary; however, the stratigraphic position of ANU-2233, the most recent C-14 estimate for Rupo, serves as a general guide in determining the most suitable level at which to separate the ceramic phase collection. The following list presents the units from which each faunal assemblage is derived.

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<th>Recent Ceramic</th>
<th>Early Ceramic</th>
<th>Pre-ceramic</th>
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<tbody>
<tr>
<td>Pit A, Spits:</td>
<td>1, 2</td>
<td>3 - 5</td>
<td>6 - 12</td>
</tr>
<tr>
<td>Pit B, Spits:</td>
<td>1, 2</td>
<td>3, 4</td>
<td>5</td>
</tr>
<tr>
<td>Pit C, Spits:</td>
<td>1 - 4</td>
<td>5 - 8</td>
<td>9</td>
</tr>
<tr>
<td>Test Pit 3, Spits:</td>
<td>1</td>
<td>2 - 5</td>
<td>6</td>
</tr>
</tbody>
</table>
**Pre-ceramic**

Aquatic fauna constitutes 73 percent (by weight) of the assemblage (Table VIII-10). One genus and two families of fish are represented. Ariid catfish (minimum number: 25), which comprise over two-thirds of the total weight of fish bones, vary from 28-53 cm in length with a mean size of 39 cm (Table VIII-11). Many of the other fish remains are indicative of medium to large individuals. Chelid turtle, Cherax crayfish and crabs also appear.

Identified terrestrial fauna includes pig, macropodid and varanid lizard. Pig and probable pig bone account for eight percent (by weight) of animal remains. A minimum number of two pigs is represented and based on dentition the age of one is greater than 22 months (see Appendix 13 for Aplin's discussion of aging techniques). Remains of one macropodid and two large varanid lizards occur.

*Phalanger maculatus* and *Pteropus neohibernicus* (fruit bat) are the only arboreal animals present. The skeletal material belonging to each probably indicates the occurrence of a single individual.

**Early Ceramic**

The diversity of animal types and the percentage distribution of certain faunal classes change considerably from that observed in the previous assemblage (Table VIII-10). The contribution of aquatic fauna decreases slightly to 68 percent (by weight). However, the percentage of chelid turtle bone increases by nearly 100 percent against a greater than 50 percent loss in the proportion of fish remains. The total weight of crustacean skeletal material also rises. The size range of turtles varies with medium-sized individuals being most common. Two additional fish taxa appear. Ariid catfish (minimum number: 17) are again the dominant fish present and the length of individuals range from 18-59 cm in length (Table VIII-11).

The contribution of terrestrial fauna increases to more than 18 percent. Pig and probable pig bone comprises 16 percent of the total weight of all animal remains. Based on dentition, two individuals are greater than two years in age and another is four months old. *Dorcopsis veterum* is the only identified species of macropodid. Two forms of bandicoot (Peramelidae), murid rat and varanid lizard also occur. The remains of the latter are representative of two medium and three large-sized individuals.
While the percentage of arboreal fauna decreases, more individuals and a greater range of animals are present. Identified phalanger species include *P. maculatus* and *Dactylopsila trivirgata*. Two species of fruit bat, *Pteropus neohibernicus* and *P. macrotis*, occur and these skeletal remains are indicative of two individuals.

Two families of snake also occur. Boidae, tree python, skeletal material is probably that of a single individual.

**Recent Ceramic**

The uppermost stratigraphic units evidence the strongest orientation toward the procurement of mammals. Terrestrial animal remains comprise more than 37 percent of the total weight of the assemblage (Table VIII-10). Pig and probable pig bone constitute the majority of identified specimens and most individuals represented are greater than 16 months old. The dentition of one pig suggests its age to be 2-4 months. Macropodid skeletal material identified as belonging to *Dorcopsis veterum* and *Dorcopsis sp.* or *Thylogale sp.* are numerous. Bandicoot bone appears infrequently. Identified arboreal mammals include *Dendrolagus c. goodfellowi* *Phalanger maculatus* and *Pteropus sp.*

Aquatic fauna accounts for 51 percent by weight. Fish and chelid turtle appear in roughly the same proportion, thus suggesting a decline in the quantity of turtles caught over that evidenced in the previous assemblage. The majority of turtle remains is indicative of small to medium-sized individuals. Ariid catfish (minimum number: 14) dominate the fish skeletal material and individual fish vary in size from small to moderately large (Table VIII-11). Crustaceans are proportionately the same as in the early ceramic assemblage. The only record of crocodile at the site occurs in the most recent deposits.

The remainder of identified material consists of cassowary (eggshell), boid snake and varanid lizard. The latter is represented by the bones of two large individuals.

**Summary**

The identified fauna in the three assemblages presents a consistent change in the class and range of animals. The orientation toward aquatic fauna in the pre-ceramic period alters through successive
habitation periods until, by the time people ceased using Rupo, the exploitation of terrestrial fauna assumes considerable importance. The number of animal families identified in the most recent deposits is approximately 100 percent greater than that of the pre-ceramic assemblage. Furthermore, the density of animal skeletal remains increases by 450 percent over the period of site use.

The most notable change occurring within the ceramic phase is the increase in the contribution of pig and macropodid. Also, the density of animal bone increases by 50 percent.

Human Skeletal Remains

The greatest density of human bone occurs in the uppermost excavation units. This probably corresponds to the recent use of the site as an ossuary. The most significant find is a human skull (Plate 17.1) which was first uncovered in Pit B 63 cm below ground surface. As this material does not directly bear upon the arguments developed here, the reader is advised to consult A. Thorne's description of human skeletal material, which appears in Appendix 17.

Site Summary

The cultural deposits at Rupo evidence three distinct phases of site use. The Pre-ceramic Phase encompasses a considerable span of time, which may be as great as 2,000 years. Artefacts are poorly represented and the absence of chipped stone is significant. Subsistence debris primarily consists of aquatic fauna, with shellfish remains comprising over 99 percent (by weight) of the total assemblage. The occurrence of game animals suggests that hunting was only a minor component of subsistence activities. There is no evidence supporting the processing of palm starch by the site's inhabitants.

The intensity of site use greatly increases during the Ceramic Phase, which probably lasts several centuries. The style of pottery and C-14 estimates confirm a large proportion of this habitation phase was contemporaneous with the early settlement at Kulupuari. However, it is important to note that the use of Rupo continues after the first major abandonment of Kulupuari. The occurrence of chert
representing the major source areas and the variety of shell artefacts, as well as pottery, support contact between the site's inhabitants and a number of neighbouring groups to the north and south. Subsistence activities are primarily directed at the procurement of riverine fauna, but the variety and proportion of game animals appearing in the uppermost excavation units suggest some increase in hunting. Non-subsistence activities are not well represented in the artefact assemblage.

Rupo has most recently been used as an ossuary. The exact time of use is not clear, but historical accounts and artefactual evidence suggests that the period beginning around the time of initial European contact and ending in the early 1920's is the most likely.

OULOBOMOTO

Ouloubomoto is the name given by the Kairi of Waira Village to a small cave located at the base of a solitary cone karst hill lying approximately 2.5 km south-east of the village (7°16'S, 144°13'W). Outside the low cave opening there is a large, partially sheltered platform which faces eastward. The Ouloubomoto archaeological site (Fig. VI-1, VIII-8; Plate VIII-4) includes the area just inside the cave entrance and the entire platform. The floor area of the site includes approximately 36 m², of which only 17 m² occurs within the dripline. Its maximum dimensions are 7 x 8 m.

The site is situated 1.5 km east of the Kikori River amid a dense alluvial rain forest. The Hevere Creek, a small perennial stream, lies 5-10 minutes walk away to the east. Most of the area near the site is subject to wet season flooding. Today Ouloubomoto serves only as a rain shelter for men hunting in the area. Informants report that prior to European contact some Kairi sought refuge from Goaribari head-hunting raids at the site.

Discovery and excavation

Kororu Homotamu, the site owner, first guided me to Ouloubomoto in April 1976. Shell, animal bones and stone implements were found littering the site surface. Disturbance caused by pig rooting was
noted at two areas near the back of the entrance platform. During this visit I excavated one hand test and established that the cultural deposits extended to a depth of 30-50 cm.

A few days later the excavation of the site was initiated. One 1 x 1 m test pit was dug near the south wall and this pit was later extended the remaining 50 cm to the wall, Test Pit 3. The artefact horizon continued without break to 35 cm in Test Pit 3; the next 25 cm of deposits was sterile. In Test Pit 2 the artefact horizon extended to 50 cm and approximately 79 cm below the surface another cultural layer was found. This deposit was only 3-5 cm thick and primarily restricted to the western portion of the pit. Unlike the upper cultural horizon no pottery was discovered and only burned bone and shell was discovered. My field observations suggest that the lower cultural layer may have consisted of a hearth with a light scattering of artefacts near its perimeter. Test Pit 3 was excavated to a depth of 80 cm and no further artefacts were found. Before concluding my work in this pit I excavated a 25 x 25 cm test in the south-west corner to a depth of 145 cm. No change in the soil matrix was observed and no cultural debris appeared.

I began my major excavations at Ouloubomoto in May 1977. Over a two week period three 1 x 2 m pits were dug. Pit A is an extension of the north wall of Test Pit 2. Two cultural horizons were again noted. The first extended to a depth of 20-30 cm and consisted of shell, animal bone, potsherds and chipped stone and ground stone artefacts. The second occurred at approximately 55 cm and yielded only one unique chipped stone implement (see p. 202; Fig. VI-23b). Pit B was set at right angles to Pit A and ran toward the entrance to the cave. Cultural debris was continuous to roughly 50 cm. Pit C was oriented at right angles to Pit B and included a portion of the entrance platform just inside the cave opening. An area of pig disturbance occurred along the pit's western margin. Artefacts were continuous to a depth of 61-63 cm. A small hearth was discovered near the pit's south-west corner at approximately 15 cm.
Stratigraphy

During excavations three soil horizons were noted. The demarcation of boundaries between horizons proved difficult even in cross-section because their colours graded into each other and the high level of soil moisture masked textural differences.

The uppermost soil layer, Horizon I, was a compact greyish brown clay (2.5 YR 3/2). It varied in depth from 10-20 cm. Medium-sized tree roots and filament roots penetrated only the top 5-10 cm of this horizon and within this zone the matrix colour was slightly darker. Medium to fine-size limestone gravel appeared between 0-10 cm. The upper portion of a large limestone boulder was first encountered in association with Horizon I in the northern half of Pit A and the eastern half of Pit B.

Horizon II was a very sticky brown clay (7.5 YR 5/4) which varied to a reddish brown colour east of the limestone boulder in Pit A. It occurred to a depth of 30-58 cm. Recent root activity rarely penetrated into this soil layer; however, several old root channels, some of which contained decayed organic material, appeared in Pits B and C. Limestone roof-fall, which had degraded into a very fine-sized gravel, was noted only in Pit B. The soil moisture content of the lower portion of Horizon II was notably greater than that of the above portion.

The bottom soil horizon was a very compact yellowish brown clay (10 YR 4/4). It appeared below 45-58 cm. This layer exhibited no root penetration and was devoid of roof-fall. With the exception of Test Pit 2 and Pit A cultural debris occurred only at the top of this horizon and most usually consisted of shell fragments.

Variability in the depths of the soil Horizons I and II generally corresponded to the surface fall of Horizon III away from the large roof-fall debris occurring outside the dripline and toward the entrance to the cave. The greatest build-up of cultural deposits occurred in the western portion of the excavated area and this produced a partial levelling of the site's surface.
Four carbon samples were submitted to the ANU laboratory for dating. Three were shell sample and their ages are reported as corrected (cf. p. 185).

ANU-2235: 720 ± 180 BP*

This estimate was obtained from 50.4 g of *Batissa violacea* shell, which was collected from Spit 1, Pit B. This sample was submitted in order to determine the maximum date for the final deposition of cultural deposits at Ouloubomoto.

ANU-2236: 1050 ± 170 BP*

This result refers to a 65.0 g sample of *Batissa violacea* shell excavated from Spit 4, Pit B. This sample was submitted to establish a minimum date for the initial deposition of pottery at Ouloubomoto.

ANU-2237: 400 ± 170 BP*

A 41.2 g sample of *Batissa violacea* shell from Spit 5, Pit B produced this estimate. This sample was to have identified the maximum date for the site's ceramic occupation. The resultant date is in disagreement with those obtained from samples occurring at a higher stratigraphic level and would, therefore, seem to warrant rejection.

According to J. Head (ANU C-14 laboratory), these are technical reasons why the date obtained is too young. A re-inspection of the undated portion of each of the shell samples reveals that the shells from which the inconsistent date was obtained have undergone a significantly greater degree of weathering than the other two samples. Their texture is very powdery and the porosity of the shell has increased. This alteration in shell structure would accommodate a greater absorption of ground water, which was observed in the field to be more prevalent in the lower levels of the site. These factors may have resulted in the addition of C-13 which naturally occurs in rain-water; therefore, the sample is putatively contaminated with more recently derived carbon.
ANU-1830: no date

This sample consisted of less than 1 g of charcoal and was collected from the hearth which appeared from 59-61 cm in Test Pit 2. The sample produced insufficient gas for dating.

A comparison of the dates for the pottery deposition at Ouloubomoto, Rupo and Kulupuari is presented in Table VII-12. The estimate for ANU-2236, which denotes a minimum date for the discard of pottery at Ouloubomoto, is comparable in age to all results with the exception of the most recent date for Ouloubomoto (ANU-2235) and the earliest estimate for Kulupuari (ANU-1963). The result marking the maximum age for pottery deposition at Ouloubomoto (ANU-2235) is comparable to only the most recent estimate from Rupo (ANU-2232). This evidence suggests that:

1. the deposition of pottery in Spits 1 and 2, Pit B, at Ouloubomoto probably represent two closely successive events,

2. pottery occurring in the early deposits at Ouloubomoto and Rupo and in the upper portion of the early phase at Kulupuari are of the same age, and

3. the recent use and discard of pottery at Rupo and Ouloubomoto are distinct and roughly contemporaneous events.

Based upon these conclusions and the stratigraphic distribution of cultural material I propose that there are two phases of site use at Ouloubomoto. The first is Pre-ceramic and may be approximately the same age as the similar phase at Rupo. The Ceramic Phase is divided into two periods: early and recent. The surface finds at Ouloubomoto may represent yet another depositional phase, but present evidence does not directly support its partition from the uppermost deposits. I return to this question below.
Features

Two hearths were found during excavations. Feature 1 occurred in Test Pit 2 below a break in the deposition of debris which began on the site surface. The soil matrix within the feature was a light greyish brown, gritty clay. A large amount of burned fish bone appeared within the feature and a light scattering of bone and shell fragments lay near its perimeter.

Feature 2 was found just below the surface in the southwestern portion of Pit C. A small portion of its northern margin appeared to be interrupted by recent pig rooting at the site. The soil within the hearth was light grey clay which was slightly less compact than the surrounding soil. Only snail shells appeared in the fill.

Artefacts

Pottery

The stratigraphic occurrence of pottery varies through the site (cf. Table VIII-13; Fig. VIII-8). In the south-east portion, Test Pits 2 and 3 and Pit A, potsherds are commonly restricted to the top 20 cm of deposits. Pottery continues to a depth of 50-55 cm in the north and north-west extent of excavations, Pit B and northern half of Pit C. Pottery rarely occurs below 30 cm near the cave entrance, the southern half of Pit C.

A detailed pottery analysis is presented in Appendix 15. The results demonstrate considerable disparity between jar rims recovered from the upper 10 cm and comparable sherds from Kulupuari. For each quantitative ceramic attribute, excepting orifice diameter and rim thickness B, three out of four sherds differ by more than two standard deviations from the mean values calculated for Kulupuari specimens (cf. Appendix 8: Table 8.2; Appendix 15). Only one of the jar rims is decorated and the motif present is parallel bands of paint applied angularly across the interior rim (Fig. VII-2c). Most other sherds recovered from Ouloubomoto are comparable Kulupuari pottery.

As I discussed above (see p. 113) the Papuan pottery assemblages which are available for comparison are limited to those described by Allen (1972) and Vanderwal (1973). The similarity of the Kulupuari collection with Allen's Zone I pottery from Nebira 4 and that
described by Vanderwal for Horizon I at Oposisi eliminate the comparison of these assemblages with the distinctive jar rims found at Ouloubomoto. The pottery collection from Urorina which dates at 720 ± 105 BP (Vanderwal 1973: 52) includes no painted jar rims (p. 115) and his rim angle measurements (1973: Table VI-16d) average between 51 and 54 degrees. This evidence lacks comparison with the Ouloubomoto jar rims.

Since the description of other excavated pottery assemblages from Papua are not presently available, I am unable to assign the Ouloubomoto sherds to a particular ceramic phase. However, my intuitive impression which has been substantiated by O. Rye (1979: pers. comm.) is that these sherds, in particular the decorated jar rim (Fig. VII-2c), closely resemble pottery recovered from the lower levels of excavations at Motupore Island (Allen 1977a). The earliest date for the pottery deposition at Motupore is 810 ± 80 BP (Allen 1977a: 443). The result of a Polach-Golson test on this date and the recent estimate for Ouloubomoto shows the two samples to be dating contemporaneous events. Considering the paucity of my evidence I hesitate to speculate further.

Chipped stone artefacts

The distribution of chipped stone artefacts at Ouloubomoto appears in Table VIII-14. Debitage is present in most of the stratigraphic layers of the site and comprises the best represented category of chipped stone artefact. Following the suggested difference in the deposition of pottery in the site, I segregate the debitage recovered in the first 10 cm of deposit from those specimens found in deeper spits and in association with pottery. Table VIII-15 presents the distribution of three attributes for each group. While some variation exists between the two samples, it is not of sufficient magnitude to postulate that the groups are distinct from one another.

Three non-utilised cores are also included among the chipped stone assemblage. One is a "limestone" chert and the others "volcanic" chert. All specimens retain original cortex on less than 10 percent of their surfaces. One core is a multiple platform core type; the other two cores cannot be categorised.
The three edge-altered flakes found at Ouloubomoto have all been retouched. Two specimens are fashioned from "limestone" chert and the other from "volcanic" chert. The quantitative and qualitative attributes for each specimen are described in Table VIII-16.

The remaining chipped stone artefact, which was discovered in what is interpreted as being a pre-ceramic deposition, is a unique edge-altered flake (Fig. VI-23b). Both of its lateral margins exhibit bifacial hinge and step flake retouch and toward the proximal end the sides have been heavily reduced almost to a point. Unifacial step and hinge flake retouch appear on the dorsal surface of the distal end. Edge alteration is restricted to the ventral surface of the distal end, where heavy macroscopic step flakes occur along the entire length of the edge. The artefact is 7.20 cm long and 1.50 cm thick. Its width at the butt is 1.50 cm and at the opposite end 5.00 cm. The angle of the altered edge is 63 degrees. Similar artefacts are not reported for other areas of Papua.

Ground stone artefacts

The two ground stone implements recovered from excavations at Ouloubomoto (Table VIII-12) are axe-adzes fashioned from meta-volcanic stone and having a hemispherical cross-section. The complete specimen, which was found in Spit 4 of Pit C, has a symmetrically bevelled edge and irregularly shaped sides. Its quantitative attributes are as follows:

- maximum length: 5.75 cm
- length from girth to cutting edge: 1.65 cm
- width at cutting edge: 2.95 cm
- width at girth: 4.05 cm
- width at butt: 1.60 cm
- maximum thickness: 1.20 cm
- inclination of ventral surface at cutting edge: 65°
- inclination of dorsal surface at cutting edge: 58°

The other specimen, which lay at 4 cm in Pit A, has no cutting edge present. Its maximum thickness is 3.40 cm. The width at the girth
is 2.43 cm and at the butt 2.00 cm. Both specimens compare most favourably with early phase axe-adzes from Kulupuari (Table VI-11).

The incomplete axe-adze found on the site surface is planilateral in cross-section and made from Highlands metamorphosed stone (I. Hughes and Chappell 1979: pers. comm.). Its maximum thickness is 2.85 cm and the sides are 1.80 cm in width. It is 2.15 cm wide at the butt.

Shell and bone artefacts

Four genera of shell are represented in the collection of shell artefacts (Table VIII-17; Plates VIII-2, VIII-3). Specimens belonging to Oliva spp. and Cypraea spp. are altered in the same manner as observed at Rupo (see p. 189). One shell artefact of Conus sp. is a centre-drilled disc. The other Conus shell artefact (Plate VIII-2j) appears to be a segment of the posterior body whorl which has a hole drilled at either end. The Strombus shell artefact (Plate VIII-2i) exhibits extensive modification. All but the shoulder of the body whorl has been removed and the spine has been cut away, thus creating a hole in the centre of the remaining disc.

The three bone artefacts (Plate VIII-3) discovered are fragments of larger items. Only two specimens are possibly identifiable with respect to type of animal and body part (K. Aplin 1979: pers. comm.). The first artefact (Plate VIII-3e) is the unburned right tibial shaft of an adult pig. Most of the cortical surface has been removed by grinding and the distal end is bifacially edge-ground into a form roughly square in plan and bevelled in cross-section. The second bone artefact (Plate VIII-3d) is most probably an unburned pig metapodial. All surfaces have been shaved and no cortical surface remains. One end of the artefact exhibits a tapering of one margin. The other end has been broken. This artefact is roughly planilaterial in cross-section. The remaining bone artefact (Plate VIII-3f) has been cooked and longitudinally split away from the original bone. The specimen is grooved along the centre of its long axis and a hole has been either cut or drilled through this altered surface. Another hole may have also appeared on the original artefact; however, most of the area where it might have been is broken off.
**Miscellaneous stone and clay artefacts**

The distribution of this category of artefacts at Ouloubomoto is presented in Table VIII-18. Cooking stone fragments and nodules of haematite generally occur throughout the stratigraphic layers of the site. The quartz crystal (Fig. VI-23d) is notable as no similar specimens appear in the collections from any other site in the region. Its maximum length and width are 2.70 and 1.05 cm respectively. One end of the artefact has been bevelled on one side and the other end is roughly squared.

**Subsistence Debris**

**Shellfish**

Table VIII-19 describes the density of shellfish remains at Ouloubomoto for each excavation unit. The bivalve *Batissa violacea* and the gastropod belonging to the family Viviparidae comprise 96 percent of identified specimens. These types of shellfish and those belonging to *Melanoides* spp. are found in the nearby Hevere Creek. *Neritina* spp. only occurs in the large, tidally influenced creeks lying 9-18 km to the south-east across the karst plateau.

**Animal Skeletal Remains**

In the following analysis I segregate the Ouloubomoto faunal collection into three assemblages: pre-ceramic, early ceramic and recent ceramic. The excavation units assigned to each are determined by the distribution of pottery collections (cf. p. 200: Table VIII-7) and the stratigraphic positions of C-14 estimates (see p. 198ff). The following list describes the excavation units from which each assemblage is derived.

<table>
<thead>
<tr>
<th>Recent Ceramic</th>
<th>Early Ceramic</th>
<th>Pre-ceramic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pit A/Spits:</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Pit B/Spits:</td>
<td>1</td>
<td>2-5</td>
</tr>
<tr>
<td>Pit C/Spits:</td>
<td>1</td>
<td>2-6</td>
</tr>
<tr>
<td>Test Pit 2/Spits:</td>
<td>1</td>
<td>2-4</td>
</tr>
<tr>
<td>Test Pit 3/Spits:</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>
Pre-ceramic

Aquatic fauna comprise 75 percent (by weight) of the total assemblage and over 70 percent of these remains are arbid catfish (Table VIII-20). Based on otoliths there are four arid fish and their lengths range from 25-52 cm with an average length of 38 cm (Table VIII-21). Two other, medium-sized fish, Plotosidae and Eleotridae families, are present. Chelid turtle and Cherax crayfish remains also occur.

Terrestrial faunal remains constitute over 15 percent by weight. Thylogale brunii skeletal material, representative of two individuals, is most numerous. Pig bone is indicative of a single individual whose age is from 6-12 months. A small and medium-sized bandicoot and cassowary (eggshell fragments) conclude the list of identified terrestrial fauna.

A single specimen of Phalanger gymnatis is included in the assemblage. Elapid and boid snake vertebrae, indicative of two individuals, also occur.

Early Ceramic

This assemblage exhibits a greater diversity of animal taxa than that present in either of the others. Aquatic fauna makes up the greatest proportion by weight. Fish bone constitutes 31 percent (by weight) of the total assemblage. All fish classes noted in the previous assemblage appear. However, two additional species (Lutjanus argentimaculatus and Acanthopagrus berda) are also present and their skeletal remains are representative a minimum number of three and two individuals respectively. Based on otoliths there is a minimum number of 17 arid catfish and their individual lengths range from 21-56 cm, with a mean of 32 cm (Table VIII-21). Chelid turtle bone comprises 17 percent by weight. A small number of crustacean chela are present.

Six families of terrestrial fauna occur. Pig and probable pig bone include 25 percent of the total weight of skeletal material. Based on dentition there are four pigs represented and their ages are 3-4, 4-6, 6-8 and 10-12 months. A basicranial fragment of
another individual is present and the size of the specimen suggests that this pig's age considerably exceeds the others. Two forms of bandicoot (minimum number: 5), possibly two species of macropodid (minimum number: 3) and Phalanger gymnolus (minimum number: 3) appear. Identified bird material includes one juvenile cassowary, one megapode and numerous fragments of cassowary eggshell. Varanid lizard and elapid snake occur and the skeletal remains of the former belong to one large individual.

Three species and one family of arboreal fauna are identified in the assemblage. Phalanger maculatus is represented by at least two individuals. Two species of fruit bat, Pteropus neohibernicus and P. macrotis, appear and there is a minimum number of two for each. Vertebrae belonging to boid snake, possibly two individuals, occur.

**Recent Ceramic**

The dominance of mammal skeletal remains in this assemblage clearly set it apart from the others (Table VIII-20). Pig and probable pig bone comprise 38 percent of the total weight of faunal remains. Based on dentition there are two individuals present; the age of one is greater than 26 months, that of the other between 1.5 and 4 months. Macropodid bone constitutes 17 percent and Dorcopsis veterum and Thylogale brunii occur. Two species of phalanger, P. maculatus and P. gymnolus, are present. One specimen of Pteropus macrotis appears.

Aquatic fauna consists mostly of ariid catfish and chelid turtle. Based on otoliths there are two ariids present and their lengths are 35 and 45 cm (Table VII-21). Turtle remains, which is mostly carapace, weigh five times greater than all fish bones; therefore, some alteration in the exploitation of aquatic resources is suggested. One crayfish chela is also present.

Fragments of cassowary eggshell and skeletal material of two snake families occur in the assemblage.

**Summary**

Two major trends appear in the Ouloubomoto faunal collection. The first is a steady increase in the contribution of mammal bone for each successive period of site use. This is paralleled by a relative decline in the amount of aquatic fauna. However, it is important to
note that the percentage of chelid turtle increases in each period and this poses an interesting question concerning exploitation strategies.

The second trend concerns the diversity of animals. The pre-ceramic and recent ceramic assemblages have roughly the same number of identified genera and families. The totals for the early ceramic assemblage exceed these totals by at least two-thirds.

Site Summary

There is a minimum of two distinct phases of occupation at Ouloubomoto. The first is denoted by the absence of pottery and is assumed to be roughly contemporaneous with the same habitation phase at Rupo. With the exception of cooking stones and an exceptional chipped stone implement, there are no artefacts associated with this phase. Aquatic fauna, mainly shellfish and ariid catfish, comprises the majority of animal bone. Hunted game is represented by a minimum number of eight individuals.

The Ceramic Phase of occupation spans several centuries and the initial period of site use is most probably contemporaneous with the Early Phase settlement at Kulupuari. However, Ouloubomoto continues in use after Kulupuari is abandoned. Contact with neighbouring groups is indicated by the pottery, types of chert, ground stone implements and shell ornaments. With regard to pottery it is important to note that the uppermost deposits contain rim sherds which are distinct from those recovered in excavations elsewhere in the research area. Aquatic fauna comprise the bulk of subsistence debris for the Ceramic Phase; however, by the time this phase ends hunting becomes more important. Non-subsistence activities demonstrated by artefactual evidence include only the repair and possibly the production of chipped stone implements.

The appearance of a single Highlands stone axe-adze blade on the surface of the site raises the possibility of a post-ceramic utilisation of Ouloubomoto. However, the exact age for this cannot be determined. Taking into account the distribution of pottery in the uppermost excavation units, I suggest that if there is a post-ceramic habitation it is probably brief.
HEREKUNA

The Herekuna rock shelter (Fig. VI-1; Plate VIII-5) is located approximately 3 km east of Waira Village (7°15'S, 144°13'E). It is situated 20 m up the northwestern face of a large karst hill. Cone karst hills of a similar size occur in the immediate vicinity of the site and the escarpment of an extensive karst plateau lies 1.5 km to the west. The landward margin of the alluvial plain is located just west of Herekuna. A large, localised swampland in which the Nodoro sagopalm stand (see Appendix 2) is sited appears immediately to the east of Herekuna. The Hevere Creek lies within sight of the shelter and numerous doline ponds occur in the general vicinity. The vegetation covering the low-lying areas near the site is dense, mixed alluvium forest. The lowlands rain forest present on the karst hills has a more open canopy.

Discovery and excavation

John Tovi, the site owner, first guided me to Herekuna in April 1976. Recent use of the site was evidenced by the presence of an open fire hearth and a palm leaf covered sleeping area (Fig. VIII-9). John reported that he and his family often lived in *kombati* at the site, as also had his father when he lived at Poialaviti Village (see p.21). A light scattering of shell was observed on the surface. Numerous limestone boulders, some of which had recently fallen from the upper slope of the hill, appeared throughout the site; this limited the inhabitable floor space to approximately 43 m², of which 18 m² occurred within the dripline. The maximum dimensions of the site at my last visit were approximately 4 x 21 m.

During my first visit I excavated only one hand test to a depth of 20 cm, at which point an air gap was encountered and further testing was suspended. I returned to the site a few days afterward and excavated a 50 x 80 cm test pit in an area situated in between the shelter wall and a large limestone boulder, which protruded well above the surface of the site. Excavation proved to be very difficult as I found several air gaps and several large pieces of roof-fall throughout the test pit. Work ended at 145 cm when a large limestone
Plate VIII-5  Front view of Herekuna rock shelter

Plate VIII-6  Herekuna: North wall of Pit A
boulder was uncovered at the base of the pit. Up to this point a continuous deposit of cultural material, mainly comprised of snail shell, had been excavated.

My major excavation of the site began in February 1977. I excavated one 3 x 3 m pit, Pit A, because my experience during the first field season indicated that a considerable area was needed to work around or remove the large limestone boulders which frequently appeared in the deposits. I also decided to excavate in 20 cm spits because a smaller unit might be difficult to maintain considering the frequency with which I could anticipate air gaps.

The excavation of Herekuna was a series of frustrating encounters with unmovable roof-fall boulders and air gaps (Plate VIII-6). I am confident that the upper 10-20 cm was removed as a stable deposit. Below this level I am less certain about the correspondence of the levels at which artefacts were deposited and excavated. This uncertainty does not concern artefacts which were recovered at the top of the roof-fall which eventually stopped further excavation of the site.

The extensive large roof-fall debris occurring near the shelter edge procluded the excavation of deposits below approximately 10-30 cm in the western 2 m of Pit A. In the south-east portion of the pit, near the shelter wall, I removed 90 cm of deposits. In the north-east portion excavations proceeded to a depth of 123 cm. After excavation ceased a long section of bamboo was used to examine the deposits below a gap in the roof-fall. Cultural deposits consisting of only snail shells were found in the top 10 cm of a very compact, yellowish brown soil matrix which began 4 m below the shelter surface.

Stratigraphy

During excavations three stratigraphic units were noted at Herekuna. Colour and textural differences served as the only means to distinguish each horizon. Horizon I was a compact dark brown clay (7.5 YR 3/2) which exhibited extensive filament root penetration. Through the northern two-thirds of Pit A this soil layer rarely occurred below 10 cm. This horizon reached its maximum depth of 20 cm along the shelter wall approximately 1 m from the pit's south-east
corner. Horizon II, which comprised the greatest part of the sediments at the site, was a loose and powdery greyish brown clay (10 YR 5/2). In the northern portion of Pit A this soil layer appeared close to the site surface and continued to a maximum depth of 1.23 m at the pit's north-east corner. This horizon did not generally occur in the south-west quadrant of Pit A. Horizon III was a very compact brown clay with some yellowish tinting (7.5 YR 5/8). This soil layer appeared sporadically in Pit A and was most usually found outside the dripline near the surface of limestone roof-fall.

Dating

One carbon sample was submitted to the ANU laboratory for dating.

ANU-1831: 107.0 ± 7.5% Modern (AD 1958/59)

This estimate was obtained from a 1.9 g sample of dispersed charcoal recovered from Test Pit 2. The material was situated 70-80 cm below ground surface directly under a limestone boulder which protruded above the surface of the site. This specimen exhibited "atomic bomb" and "Seuss" effect and has, therefore, been assigned a recent calendrical date (J. Head 1979: pers. comm.).

It is now my impression after excavating a major portion of the site that this date does not correspond to levels elsewhere in the site at the same depth. This contention is supported by two lines of evidence. Firstly, the face of the hill directly above the shelter has undergone recent alteration due to the removal of large portions of limestone, as is evident from the numerous boulders appearing along the shelter's downslope margin. A recent date for this deposition is postulated from the presence of living trees which came down with the rock-fall and which consequently lie in extraordinary growth positions. Secondly, the soil matrix in which the sample occurred is most comparable to the compact brown clay which appears near the surface of the site and from which European artefacts were recovered in Pit A.
Features

The three features noted at Herekuna occurred at a depth less than 20 cm below ground surface in Pit A. Features 1 and 3 are post holes with a portion of the original posts still present. These features may represent the remnants of a rain shelter which the site owner claimed to have erected when he and his family lived at Herekuna. Feature 2 is a fire hearth whose margins were difficult to define accurately. The soil matrix within this feature is differentiated from the soil layer in which it appeared on the basis of its powdery texture, noticeably lighter colour and the inclusion of dispersed charcoal and fire hardened clay nodules. No artefacts were found in direct association with Feature 2.

Artefacts

Pottery

Table VIII-22 describes the distribution of potsherds at Herekuna. Only one rim sherd (Fig. VIII-2d), which was recovered at a depth of approximately 110 cm, appears in the pottery assemblage. This sherd is an everted jar rim with a convex rim course, parallel profile and round lip. Its quantitative attributes are: orifice diameter 18 cm, orientation angle 25 degrees, inclination angle 110 degrees, rim length 1.70 cm, rim thickness A 0.53 cm and rim thickness B 0.61 cm. The interior surface is coloured with red clay and the interior rim is decorated with a tooled design, which is formed by two parallel incised lines with parallel gash-incised lines appearing in the intervening space. This sherd readily falls within the descriptive bounds for similar rim sherds found at Kulupuari (see Appendix 8:A.45ff; Table 8.2). The two body sherds from Spit 2, Pit A have a maximum thickness of 0.40 and 0.46 cm, while the remaining body sherd is 0.36 cm thick. These values compare well with those noted for body sherds in the Kulupuari collection (see Appendix 8:A.55ff). The stratigraphic position of all potsherds is generally below 15 cm.
Chipped stone artefacts

Table VIII-22 describes the distribution of this artefact category at Herekuna. Debitage appears in the artefact collection of each excavation unit of Pit A and has the greatest density in Spit 2. "Limestone" and "volcanic" chert stone types occur in roughly equal proportions among the debitage and most flakes exhibit little or no original cortex on their surfaces.

Two of the three non-utilised cores found at Herekuna are "volcanic" chert and have only a small amount of cortex remaining. The stone type of the remaining core cannot be identified. One core has several striking platforms, another has only one. The latter is heavily modified and the orientation of flake removal cannot be determined.

The quantitative and qualitative attributes of the three edge-altered flakes recovered during excavations are presented in Table VIII-23. All specimens are nearly square in plan and exhibit only macroscopic alteration. The flake found in Spit 3, Pit A, has been retouched along its altered edge. With the exception of their individual weights, all flakes most closely resemble those associated with the Early Phase of occupation at Kulupuari (see Appendix 8:A.57ff).

The remaining specimen is a nodule of quartzite which possesses percussive or battered alteration at either end of its longitudinal axis. My provisional interpretation is that this artefact has been employed as a hammerstone.

Ground stone artefacts

Only one ground stone artefact, an axe-adze whose cutting edge has been broken off, was found. It occurred at 52 cm below ground surface near the shelter wall and approximately 1.2 m from the south-east corner. This specimen, which was fashioned from meta-volcanic stone, is roughly hemispherical in cross-section and its sides are straight. Its maximum thickness is 1.67 cm. The girth width is 3.57 cm and the width at the poll is 2.25 cm. This artefact does not directly correspond to specimens from either the Recent or Early Phase at Kulupuari with regard to quantitative attributes.
Shell and bone artefacts

All artefacts belonging to this category (Table VIII-24) are altered in such a manner as to suggest they were either strung as beads or pendants or possibly sewn onto fabric. The Cypraea shell specimens are modified in the same way as those noted at Rupo (see p. 189). The one Conus shell artefact is a centre-drilled disc bead. The two artefacts made from ? Cardiidae shell have a hole drilled through the umbo (Plate VIII-2k). Elsewhere (Irwin 1977: 302, Fig. 8.3), similar artefacts are classified as net weights. While this may be the function of these artefacts, their infrequent occurrence in all sites suggests a more exotic use. The only bone artefact is a dog canine (Plate VIII-3g) which has a hole drilled the lower portion of the root.

Miscellaneous and European artefacts

Table VIII-25 lists the excavated distribution of these artefacts. Nodules of haemitite occurred throughout the stratigraphic layers of Pit A. Cooking stones only appeared in the lower portion of this excavation pit. The distribution of European artefacts (e.g. see Plate VI-3g) is restricted to the top 0-10 cm of the deposits of Pit A.

Subsistence Debris

Shellfish

Table VIII-26 presents the distribution of shellfish debris by type at Herekuna. The reader is reminded that only 20 percent of the total weight of shellfish remains from this site which was shipped to Canberra (cf. Appendix 7:A.40) are considered in this analysis. The figures recorded in Table VIII-26b indicate the extrapolated density of the various types of shellfish. Shells belonging to the family Viviparidae comprise more than 30 percent of the specimens from all excavation units. Batissa violacea shells make up the vast majority of the remaining shellfish. Both of these shellfish types are reportedly found along the banks of the nearby Hevere Creek.
Animal Skeletal Remains

For purposes of analysis the Herekuna faunal collection is segregated into two assemblages: recent historic and ceramic. Based on the distribution of recent European artefacts (Table VIII-25) I assign Spit 1, Pit A, to the recent historic phase. The absence of pottery (Table VIII-22) and the stratigraphic position of ANU-1831 in Test Pit 2 (see p.210) support the inclusion of all faunal material recovered from this excavation in the recent assemblage. The animal remains in Spits 2 and 3, Pit A, form the ceramic assemblage.

Ceramic

Aquatic fauna constitutes 53 percent (by weight) of the assemblage (Table VIII-27). Chelid turtle material accounts for 75 percent of these remains and the majority is representative of small to medium-sized individuals. Two families of fish are present and arid catfish bone comprises two-thirds of the weight of fish remains. Based on otoliths there are eight arids whose length varies from 24-48 cm with a mean of 37 cm (Table VIII-28). Crab and Cherax crayfish skeleton parts also appear.

More than 35 percent of the assemblage weight consists of terrestrial faunal remains. Pig and probable pig bone are most numerous. There is a minimum number of two individuals; one is either fetal or new born and the other, very young (see Appendix 13). At least four macropodids are represented: one Dorcopsis veterum, two Thylogale brunii and one unidentified individual. The remains of one bandicoot and two Phalanger gymnatis occur. Identified bird bone includes Talegalla sp., Casuarius casuarius and Megapodidae. Numerous fragments of cassowary eggshell are present. A single agamid lizard appears.

Three families of arboreal animals are identified. Phalangers include P. maculatus and Dactylopsila trivirgata (minimum number: 2). Two species of fruit bat Pteropus neothernicus and P. macrotis, representative of at least two individuals, and boid snake also occur.

Recent Historic

In contrast to the ceramic assemblage, mammal bone comprises over 60 percent by weight (Table VIII-27). Pig and probable pig bone
account for approximately one-third and there is a minimum number of
one, which is either a fetal or new born piglet. Macropodids are
represented by two individuals which may be either *Dorcopsis* sp. or
*Thylogale* sp. The remainder of identified mammal bone includes
*Phalanger orientalis*, *Pteropus neohiberinus*, *Canis* sp. and a small-
sized peramelid.

Aquatic fauna constitutes 32 percent by weight. Sixty percent
of this material is fish bone and the majority of identified specimens
belongs to ariid catfish. Based on otoliths there are four ariids
present and they range in length from 32-54 cm (Table VIII-28). The
assemblage also contains two *Cherax* gastroliths and one crab chela.

The remainder of identified faunal remains include two boid
vertebrae and cassowary eggshell fragments.

**Summary**

The two assemblages differ on two basic points: the diversity
of animals represented and the contribution of hunted game animals.
The number of identified genera in the ceramic assemblage is twice
that for the other; the number of identified families is approximately
the same. This disparity may not, however, be so extreme as there
is a high percentage of unidentified mammal bone in the recent historic
assemblage.

Despite a 60 percent decrease in the minimum number of mammals,
the contribution of hunted game to the total weight of the recent
historic assemblage increases over that of the other. This is
paralleled by a considerable loss in the percentage of chelid bone
present. However, this trend does not pertain to fish whose
representation by weight almost doubles. Although not identical, a
similar co-variance appears in the faunal collections from the other
rock shelters, but the significance of this tendency is not directly
discernible in the evidence presented by any one site. This issue will
be taken up in the discussion of inter-site comparison (Chapter 9).

**Site Summary**

The exact period during which Herekuna was first used is not
directly known. Artefactual evidence, however, supports the notion
that it was roughly contemporaneous with the Ceramic Phase
at Kulupuari and at least the Early Ceramic Periods at Rupo and Ouloubomoto. Subsistence activities are strongly oriented toward the procurement of aquatic fauna. A wide range of hunted game is also represented. Evidence indicative of non-subsistence activities is limited to chipped stone debitage and non-utilised cores.

The occurrence of recently manufactured European artefacts, in particular a plastic torch switch, confirms informant testimony regarding the near present-day use of Herekuna. The collecting of shellfish and fishing are major subsistence activities. Hunting also appears to be of some importance. Non-subsistence activities are poorly represented.

CONCLUSION

The three rock shelters discussed in this chapter exhibit contemporaneous phases of use, with the exception of Herekuna at which pre-ceramic deposits were not discovered. While a portion of the Ceramic Phase deposits at Rupo and Ouloubomoto share a common age with the Early Phase of settlement at Kulupuari and probably Mampaiu, evidence supports their occupation after the two open sites were abandoned. Post-ceramic site use appears at all rock shelters and the age of these deposits most probably relates to the protohistoric/historic occupation of the research area.

Pre-ceramic and Ceramic Phases evidence similar modes of site use. However, the frequency and/or intensity of use differs considerably between phases. With respect to recent site use, only the deposits at Herekuna suggest a pattern comparable to that of earlier periods.

The subsistence debris at all sites is similar. Aquatic resources form the majority of most deposits. Hunted game increases through the sequence at each site, but considering the difference in weight of the skeletal material of different animal taxa it can only be assumed that there is only a slight change in the direction of subsistence activities. No site contains sago choppers or their retouch flakes; therefore, the processing of palm starch may not have been an important activity carried out by people living in rock shelters. The repair and possibly manufacture of chipped stone implements are the only non-subsistence activities clearly represented at these sites.
In summary, the Ceramic Phase cultural deposits at all rock shelters supports their use by either the people who lived at Kulupuari or their close neighbours. The former seems the most likely considering the fact that all of the rock shelters may be easily reached within an hour after leaving Kulupuari.
CHAPTER 9

TOWARD PREHISTORY: IMAGES IN THE GLASS

Throughout this thesis the archaeological and ethnographic information which contribute to an understanding of the prehistoric inhabitants of the research area have been set out. The modes of land-use which have or may have existed in the region are described by reference to ethnography. The archaeological evidence presented in Chapters 6-8 is now considered against this backdrop.

The following assessment of prehistoric land-use systems proceeds from an analysis of site constellations which generally evidence contemporaneous use. The periods reviewed include Pre-ceramic, Early Ceramic, Middle Ceramic and Proto-historic/historic. Justification for the validity of these divisions is contained in the stratigraphic, radiometric and artefactual data presented during the discussion of individual sites.

While artefactual evidence has served as the basis from which site use is described, the scheduling of site habitation now assumes importance in the deduction of prehistoric land-use systems. Since the faunal remains constitute the primary source for such information, it is necessary to consider the bases from which the analysis proceeds.

Archaeological faunal materials are the end product of a number of agents from species distribution in nature to the preservational characteristics of their depositional environment (cf. Ziegler 1973 for further discussion). Although the full complement of factors is relevant to archaeological interpretations, I choose to base my analysis upon the relative contribution of specific animals to the faunal assemblages, as expressed by weight. This decision is made because (1) although the alterations to the faunal material which has resulted from human and natural influences may be significant, the range of body parts present and the preservational characteristics of bone belonging to individual animal classes appears to be roughly equivalent within and to some extent between sites (see Appendix 13) and (2) the fragmentary nature of the material reduces the applicability of minimum number measures.
The seasonal fluctuation in the availability of certain animals has been discussed in Chapter 3. The statements of Kairi informants provide an incomplete picture of the full range of animal behaviour. Thus, it is necessary to review the zoological literature before the scheduling of site habitation can be assessed.

The first section of this chapter presents a resume of a more detailed study (see Appendix 16) concerning the behavioural patterns of animals living in the research area. I next test the ethnographic models set forth in Chapters 4 and 5 and propose the probable land-use strategies employed during different periods of the prehistoric past in the middle Kikori River region.

ANIMAL ECOLOGY

Primary research into the ecology of animals which inhabit the lower and middle Kikori River region is limited to the studies of Liem and Haines (1977) and Haines (1979). Despite this, the behaviour of animals which live in the area or whose distribution in New Guinea suggest that they probably occur there, has been the subject of numerous works. In the summary which follows, and more particularly in the study presented in Appendix 16, the description of animal behaviour is based upon knowledge of the general patterns noted for particular species inhabiting environments similar to the research area.

Here I focus only upon those taxa present archaeologically about which enough is known to provide useful information about human activities. The relevant animals are pig, macropodids, phalanger, fish and shellfish.

Pig

Pig ecology has rarely formed a major component in the interpretation of human subsistence systems in New Guinea despite its position as a major food item in the diet of the island's peoples (Morren 1979). Also, this animal's status as a domesticate today often obscures its role as both a wild and feral resource. For example, although White is aware of the inherent difficulties in differentiating
between feral and domestic pig populations (1972: 144), he nevertheless biases his analysis of site function and the range of subsistence strategies associated with pig exploitation (p. 147) by classifying all pig bone in his sites as belonging to domesticated animals (pp. 16, 57, 92, 129).

Because pig remains form a considerable portion of the faunal assemblages recovered from sites described in this thesis, a detailed statement of pig ecology is warranted. This task is facilitated by comprehensive studies which have become available in recent years (e.g. Diong 1973; Barrett 1978). While there is no detailed zoological investigation of pig populations in New Guinea, those conducted elsewhere demonstrate a basic uniformity in feral and wild pig ecology regardless of environment. The ethnographic accounts of pig behaviour in New Guinea highlands (e.g. Morren 1974: 326-38) conform well with such studies and I feel confident that the ecology of pigs living in the research area may be described by comparative analysis.

General behaviour and food habits

Pigs are eminently adaptable omnivores, as exemplified by the wide range of habitats in which they are found. They are generally sedentary and prefer well-covered areas with a permanent water supply (Barrett 1978: 303). However, they readily shift their home range in response to unfavourable environmental conditions such as drought, flooding or severe disturbance. Daily movement in rain forest environments is usually restricted to twilight hours and always along well-marked tracks. Pigs feed on a wide variety of plant and animal food and always quickly alter their foraging patterns to exploit preferred foods.

Movements

Pig groups vary in size, the largest containing up to 25-30 individuals, and commonly range over a total area of 25-30 km². Adult boars travel alone and frequently move long distances within and beyond the home range in search of select foods and breeding opportunities. Sounders include an adult sow plus one to three generations of offspring and average approximately eight individuals. These groups maintain a
more restricted home range, which in the American Southwest is usually 10 km$^2$ (Barrett 1978: 304), and commonly shift to new localities within the home range only in response to seasonal changes in the environment. The daily range of sounders is more areally restricted usually centring upon specific resource localities. Most young hogs take up a home range within or adjacent to that of their dam and only males extend their movement patterns when they begin to breed.

Life history

The first six months of life is the critical period for pigs. Accidental deaths resulting from the crushing of piglets in the nest are common. If sows cannot obtain adequate amounts of necessary nutrients, particularly protein, milk production in a few teats will cease and some of the litter will starve. During the two to three months after weaning, which occurs at 3-4 months, piglets are particularly susceptible to starvation as they begin to re-orient their diet. The rate of mortality increases further if available food resources are protein deficient. These factors cause yearly fluctuations in the number of under six months age piglets found in pig groups. Thus in situations where there is marked seasonality in the availability of food resources the age structure of pig populations is directly linked to the survival history of particular generations.

Macropodids

The known distributional characteristics of Macropodinae in New Guinea (Laurie and Hill 1954) suggests that two species, *Dorcopsis veterum* and *Thylogale brunii*, inhabit the research area. Archaeological evidence, however, indicates that a species of tree kangaroo, *Dendrolagus cf. goodfellowi*, also lived there (see Appendix 13). The ecology of macropodids living in lowlands rain forest is not well known, so the behavioural characteristics recorded for other environments must serve as the basis from which the patterns relevant to the research area are derived (see Appendix 16 for a detailed discussion).
The forest wallaby, *Dorcopsis*, appears to favour deep forest or well-wooded areas (Tate 1948: 319; Van Deusen 1972: 151). While *Thylogale* also occurs in this environment, when in competition with other macropodids it usually inhabits the margin between open and closed forest and exploits both environments (Ziegler 1972: 11, 1977: 134-35). In the research area the movements of these wallabies probably includes much of the alluvial plain and karst escarpment. However, the areal focus of each is probably different, with *Dorcopsis* preferring the dense canopied areas of the plain and *Thylogale* the more open forests of the karst.

According to Kairi informants, wallabies shift their home range to areas near the karst escarpment in response to the seasonal flooding of the alluvial plain. This probably results in an increase in the density of *Dorcopsis* near the maximum extent of flood waters. The resulting effect on *Thylogale* populations is not known, but it seems likely that members of this species may alter their foraging patterns due to an increase in competition for food and spend a high proportion of their time on the karst plateau.

Since *Dendrolagus goodfellowi* is typically associated with high altitudinal rain forest environments (Lidicker and Ziegler 1968), no comment can be made concerning the distribution and movements of this species within the Kairi area.

**Phalanger**

Three species of *Phalanger* occupy the middle Kikori region. *Phalanger gymnotis* commonly forages on the ground and prefers rough, rocky terrain where it can find shelter in rock clefts or caves (Tate 1945: 16; George 1973: 421). This species, like most other
phalangers, feeds nocturnally and is commonly seen only during twilight hours. *P. maculatus* spends most of its time in dense tree foliage where it shelters during the day (George 1973: 421) and feeds on leafy fibrous food such as leaf shoots and tree fruits at night (Menzies 1972: 97). *P. orientalis* occurs throughout the New Guinea lowlands and, therefore, is probably present in the Kairi area. Little about the ecology of this animal is known.

Based upon this information it seems likely that the distribution of *P. gymnotis* in the research area is limited to karst landforms. *P. maculatus* probably occurs in a number of environments with the dense canopied areas of the alluvial plain being favoured. It is doubtful that seasonal floods would alter the movements of either species.

### Fish

The fish communities inhabiting the middle Kikori River system evidence singular qualities which set it apart from the majority of riverine environments in Papua. The diversity of species is large and most comparable to the situation found in coastal and lower esturine environments. The total biomass of the region is as high or higher than any setting, with the exception of reef habitats. Lastly, the fish taxa of the region exhibit a considerable degree of adaptive radiation, which probably occurred as a response to the nutrient-rich water conditions and the accessibility of terrestrial flora and fauna.

Fish families indigenous to the area primarily include Ariidae and Eleotridae. The greatest distribution and species diversity occurs among ariid catfish, which comprise on average 50 percent of the total fish biomass. They typically inhabit sluggish waterways with a moderately deep channel. Here they feed on molluscs, prawns and organic mud, the latter of which is their
most common source of food. Larger ariids are generally restricted to deeper waters, although during periods of high water they probably invade the headwaters of creeks and the fringes of the alluvial plain. Small ariids and eleotrids, gudgeons, usually feed on detritus and live in shallow and turbid waterways, such as the small creeks and streams of the alluvial plain. In these habitats they are probably the most common fish found. The Kairi classify Eleotridae as "swamp fish".

Other fish taxa appearing in the region represent a contribution from larger populations primarily centred in the Kikori/Purari delta. The range of species and abundance of individuals belonging to these invasive fish families are greatly diminished from those found in more favourable habitats and the distribution of such fish in the Middle Kikori region is generally restricted to fast flowing and turbid waterways, such as the Kikori and Sirebi Rivers.

The four most common species are *Acanthopagrus berda*, *Lutjanus argentimaculatus*, *Lates calcarifer* and *Plotosus papuensis*. *Acanthopagrus berda*, spiky bream, and *Plotosus papuensis*, eel-tailed catfish, live in deep water near the mouths of large tributaries, such as the Utiti Creek, and feed on molluscs and prawns occurring on the banks. *Lutjanus argentimaculatus*, mangrove jack, and the relatively uncommon *Lates calcarifer*, barramundi, occur in similar localities but subsist mostly on prawns. During high water conditions, such as wet season floods, these species expand inland up the course of moderately large waterways to exploit food resources only accessible at this time.

Shellfish

Two bivalves, *Batissa violacea* and *Hyeidella* spp., occur along the banks of waterways throughout the research area. Despite their
ubiquity, Kairi informants state that the most prolific collections are made at localities on the alluvial plain, particularly during the dry season. Similar reports are made concerning two types of gastropod, Viviparidae and *Melanoides* spp. Since all of these molluscs inhabit the lower banks of waterways (P. Coleman 1978: pers. comm.), it seems reasonable that the lowering of the water-table during dry season droughts facilitates their exploitation.

Other gastropods in the Kairi landholdings include *Neritina* spp. and *towi* (K). The latter occupies the same niche as Viviparidae and *Melanoides*. However, informants suggest that it lives at a different stratum along the banks of waterways and during the dry season is only found below the existing water-level "away from the heat of the sun". Shellfish collections made at this time always contain a poor representation of *towi*. Informants report that throughout the rest of the year *towi* inhabit the banks at or above the high-water mark where they are easily exploited.

*Neritina* gastropods are said to behave similarly in response to seasonal changes in the water-level. This genus, however, prefers muddy and brackish water environments (P. Coleman 1978: pers. comm.). This distribution is supported by informants, since they report that this shellfish appears only along waterways in the southern portion of their landholdings, where some salt water infiltration probably occurs.

**TESTING THE MODELS**

Drawing upon the information just presented and the archaeological evidence detailed in Chapters 6-8 I now describe the probable forms of land-use which may have operated during the major prehistoric periods of the study region.

**Pre-ceramic**

*Archaeological evidence*

Rupo and Ouloubomoto are the only sites discovered with evidence of Pre-ceramic habitation. The lower depositional unit at Rupo has been laid down over a considerable period at a rate of
approximately one centimetre every 40 years, as compared to one centimetre every 10 years during the Early Ceramic Period (see Chapter 8). This evidence suggests that Rupo has been used sporadically and for relatively short periods of time. The Pre-ceramic deposits in most excavations at Ouloubomoto consist of a thin layer of material sealed within naturally derived sediments, which indicates a similar mode of settlement as that at Rupo.

**Organisation of site use**

Both shelters have a small, inhabitable floor area which could accommodate only a few individuals. Artefacts are poorly represented at both sites; therefore, subsistence pursuits form the major activity of their inhabitants.

**Food resources**

The high proportion of aquatic faunal remains at both sites (Table IX-1) suggests that the exploitation of riverine resources was the dominant subsistence activity. Most fish represented inhabit sluggish and muddy waterways such as those occurring within and fringing the alluvial plain. Turtle, crayfish and shellfish also present are found in the same setting.

Terrestrial fauna represented at each site indicates the exploitation of different resource localities. The appearance of *Thylhogale* and *Phalanger gymnotis* at Ouloubomoto points to the alluvial plain/karst margin and/or karst plateau as favoured areas. Hunting sorties from Rupo may have included similar localities. The occurrence of *Phalanger maculatus*, however, suggests the exploitation of the alluvial plain.

**Schedule of site use**

The season during which each site is occupied is not readily discerned. The Vivparidae and *Melanoides* debris at Ouloubomoto seems to indicate occupation during the dry season. Other faunal evidence does not contradict this notion. Ouloubomoto is situated near the karst escarpment and the Hevere Creek and both of these areas may have been used during the capture of game. A minimum number of six fish is
represented at Ouloubomoto and all are medium-sized. This suggests that the fishing techniques did not include poisoning or the use of weirs because the catch obtained by these methods includes all sizes. Assuming that the inhabitants were apprised of such techniques, the fact that they were not used supports the idea that Ouloubomoto was not occupied during the rainy season not at the height of the dry season.

The high incidence of *Batissa violacea* and *Neritina* spp. at Rupo indicates that the site may have been inhabited during either season and that the area exploited for food from this site included resource zones lying well to the south, where *Neritina* snails are common. Considering the fish taxa represented, particularly Ariidae, it seems likely that fish were captured during a period of moderately high water, either when the alluvial plain is partially flooded or during the period when water captured in this area is subsiding. These conditions occur during the second half of the dry season or at the change-over between the wet and dry season. Mammal remains indicate the availability of fauna living on the alluvial plain. It may therefore be suggested that the habitation of Rupo was not necessarily restricted to one season and probably occurred during a season marked by a change in rainfall patterns.

**Land-use system**

The picture most immediately portrayed by the archaeological evidence is that of small groups occasionally venturing into the site area over a period always including a portion of the dry season. Food procurement is the major activity during site occupation and a wide range of resource localities are exploited. Aquatic fauna form a primary component of the people's diet. Therefore, a compatible land-use pattern would be one that includes short-term dry season *kombati* inhabited by a family-sized group.

Since both sites are situated adjacent to the alluvial plain, any of the following models may apply: Contemporary, Contact or Vagabond (see Table V-8). The first includes permanent village sites along the major rivers. However, given the fact that no Pre-ceramic open sites were found, it seems likely that the Contemporary Model is inappropriate. As my archaeological survey did not focus on inland open sites either of the remaining two models may apply.
Archaeological evidence suggests the possibility of yet another pattern. Pre-ceramic chipped stone artefacts only occur at Ouloubomoto. Assuming that raw material would be used if available, it seems likely that people using the site came from regions having sparse stone resources. Within the Papuan Gulf area this situation is best represented by the Kikori/Purari delta. Therefore, Rupo and Ouloubomoto may exemplify one aspect of an extensive land-use system centred around natural sagopalm resources in the delta.

Early Ceramic

Archaeological evidence

The Kulupuari open site and all three rock shelters have archaeological remains belonging to this period, which lasts from approximately 1500-1150 BP. The C-14 estimates bracketing Early Ceramic deposits at Rupo and Kulupuari probably date distinct events (see pp.186-87). Thus, it is unlikely that the cultural material at Kulupuari, Rupo and probably the remaining rock shelters was laid down continuously. The estimated rate of deposition at Rupo for this period is 1 cm every 10 years. The same figure also appears to apply at Kulupuari.

Organisation of site use

At Kulupuari the distribution of large pot sherds covers approximately one-half of the total site area of 2000 m². Within this area post moulds of varying sizes occur. Using the characterisation of post moulds established above (Chapter 6) it seems likely that moderate to large structures with raised floors were constructed at the site. Artefactual evidence supports the occurrence of a wide range of activities. Among these are: (1) manufacture and repair of chipped stone implements; (2) the use of ground stone tools, probably in relation to work projects which may have included the construction of canoes and gardens, as well as houses; (3) the preparation of food by boiling and steaming; (4) the processing of palm starch. Subsistence debris indicates that hunting and fishing were also major activities.
and the density of preferred foods is high. The information from Kulupuari suggests that the 20 percent of a feral pig population which normally fall between 12 and 24 months old (cf. Barrett 1978: Fig. 25) are utilised for food, whereas at most rock shelters the full complement of age groups are exploited.

There are three possible explanations for this pattern. Firstly, while living at Kulupuari hunters only employed techniques for pig capture which are effective against a small proportion of the total pig population in the area. This seems most unlikely considering the age structure of sounders and the mobility of adult boars. Furthermore, reports of such practices are not recorded among contemporary New Guinea communities and are not apparent in the assemblages at the rock shelters, where evidence for non-selective hunting techniques would appear to be documented. Secondly, the pig remains at Kulupuari are not the product of daily hunting trips initiated from the site, but rather hunters spent some days away from their primary residence and only returned with a select age range of pigs. While this may be the case, it is difficult to believe that juvenile pigs which are putatively easier to capture were either not taken or are all eaten in the bush. Also, my observations and those of others (Morren 1974: 330; Dornstreich 1973: Table VI-8) provide no confirmation for such behaviour. Thirdly, the inhabitants of Kulupuari are selectively culling a pig population whose movement is restricted by some form of taming. Since there seem to be few alternative explanations, I believe that the pig remains at Kulupuari are derived from the exploitation of domesticated herds.

Schedule of site use

The faunal material at Kulupuari most closely corresponds to site use when the alluvial plain is available for exploitation. Confirmation of this contention is indicated by the major riverine resources found in the deposits. Most fish and turtle remains belong to small individuals. Since the size of fish and possibly chelid turtle is a direct function of the depth of the waterways they usually inhabit, this evidence denotes the exploitation of the alluvial plain. Traditional fishing techniques are not applicable during prolonged periods of high water; therefore, it is probable that fish were captured
while flood waters advanced or receded across the alluvial plain. Furthermore, the small size of fish suggests that weirs were probably employed. The high concurrence of turtle size supports this conclusion because their capture by any other technique, with the exception of poisoning, is most unlikely.

The hunted mammalian taxa represented in the deposits of the site do not suggest a contradictory pattern. The occurrence of *Phalanger maculatus* and *P. gymnottis* indicates that the alluvial plain and karst escarpment were exploited. Both environments harbour *Dorcopsis*. Therefore, wet and/or dry season habitation of Kulupuari may be represented.

If only domesticated pigs are exploited at Kulupuari it is reasonable to assume that feral pigs were not available and that resource zones on the alluvial plain were not accessible to hunters for at least a portion of the time that the site was occupied. Given the relative contribution of pig and riverine resources to the subsistence debris (Table IX-2), it may be that domesticated pigs served as a major source of animal food during the wet season.

Taking into account all of the information concerning the Kulupuari faunal assemblage, I suggest that the site was occupied primarily around the beginning and end of the rains and possibly during them.

The faunal collections from the rock shelters provide no conclusive evidence for either dry or wet season occupation. The high occurrence of Viviparidae and *Melanoides* shellfish denotes low water conditions on the alluvial plain and therefore most likely supports the use of these sites during the early months of the dry season. The diverse range of fish taxa and individual sizes appearing in the deposits at Rupo and Ouloubomoto indicate the availability of a number of different resource localities, the most important of which is the area near the confluence of small waterways and perennial creeks and streams. The occurrence of *Lutjanus argentimaculatus* and *Acanthopagrus berda* indicates site use during a period of high water, which may include much of the wet season and the change-over between seasons. The fish identified at Herekuna may represent a similar pattern of exploitation, but they may also denote the use of small creeks occurring on the alluvial plain and therefore, dry season occupation.
The contribution of other riverine fauna evidenced at the rock shelters defines the exploitation patterns more precisely. The high occurrence of varying sized turtles at Rupo and Herekuna complies with the notion that the primary resource locality used is the area near the junction of perennial and seasonal streams or small waterways. Furthermore, an indiscriminate technique of capture was most likely employed. This evidence suggests the taking of turtles primarily during the change-over between seasons, probably by the use of poison and possibly weirs, techniques which are most effective early in the dry season. I base these conclusions for the greater part on my observation that the people of Waira rarely capture chelid turtles without the use of fish poison and that on these occasions the proportion of turtles relative to fish in a single catch achieves its greatest value. The contribution of crayfish at Rupo and Herekuna confirms the suggested dry season habitation of these sites. Evidence from Ouloubomoto concerning the exploitation of turtle and crayfish is not so conclusive.

Other animal remains from the rock shelter sites generally support the exploitation of the alluvial plains and thus dry season habitation. The occurrence of *Phalanger maculatus* is the single most important piece of evidence. However, based upon my conjectures that the greatest density of juvenile pigs is to be found on the alluvial plain (see p.229ff) the presence of individuals less than six months old at all sites suggests that hunting took place in areas subject to seasonal flooding. The presence of *Dorcopsis veterum*, though not as diagnostic, at Rupo and Ouloubomoto also implies that this area was available for exploitation.

In summary, the faunal collections recovered from the rock shelters demonstrate that these sites were inhabited during the dry season. While there is slight evidence, particularly at Ouloubomoto, to suggest that they may also have been occupied during the wet season, such occupation was probably minimal.

**Land-use system**

The archaeological evidence indicates that the settlement pattern operating during the Early Ceramic Period consisted of large village sites usually inhabited at the change-over between seasons and dry season temporary encampments situated on the alluvial plain.
or near the karst escarpment. Using the characteristics of kombati use only, either the Contemporary or Contact Model may apply to this period. The presence of a permanent village site on the Kikori River is not compatible with the Contact Model. However, since my search for open sites did not include inland localities this conclusion may be in error. In other words, over the 300-400 years represented by the occupation period in question the population in the area may also have operated from sites further inland. The absence of other large open sites along the Kikori and Sirebi Rivers and the probable habitation of Kulupuari at least twice during this period supports this conclusion.

On the other hand, it may be that Kulupuari was one of a few permanently maintained village sites which were briefly occupied at specific times of the year. If this was the case then villages may have been 'half-way houses' for most of the population as they shifted between two major resource areas. For example, the alluvial plain served as the focus for dry season settlement and the headwaters of the Sirebi River for wet season settlement. A similar use of village sites is noted elsewhere in New Guinea (e.g. Mimika - Pouwer 1970: 24; Kaluli - Schieffelin 1977: 32-40). The Kairi possibly followed a similar practice during the contact period (cf. Chapter 2).

Of the two possible land-use strategies, the latter seems more likely. Even allowing for differences in the proportion of individual sites sampled, the density of subsistence debris at Kulupuari is less than that at Rupo and Ouloubomoto (Table IX-2). This suggests that the intensity of occupation at village sites may have been low. Also, the subsistence potential of the Sirebi River headwaters during the wet season is greater than areas adjacent to Kulupuari. The spawning of mullet and the availability of turtle eggs during this season, as well as the accessibility of terrestrial and other riverine fauna, substantiate this advantage.

Middle Ceramic

Archaeological evidence

Material relating to this period, which in previous discussions was termed Recent Ceramic (see Chapter 8), occurs only in the upper
10-15 cm of deposits at Rupo and Ouloubomoto. The dates for the Middle Ceramic Period are from 900-700 BP, but comparative analysis of the radiocarbon determinations (see p. 299) suggests no marked break between this and the Early Ceramic Period. The reasons for distinguishing a separate period here are the recovery of unique vessel forms and the abandonment of river settlements.

Organisation of site use

As discussed above (see p.226) both Rupo and Ouloubomoto would accommodate only small-sized groups. The shallow depth of the Middle Ceramic deposits at each indicates infrequent use of these sites. There is little evidence indicative of work activities other than those directly associated with the acquisition of animal foods (see Chapter 8). The processing of palm starch is not represented at either site.

Food resources

Evidence for the exploitation of the alluvial plain and its interior waterways is strongly represented at Rupo by the dominant occurrence of *Dorcopsis veterum* (probably the only species of wallaby in the assemblage - K. Aplin 1979: pers. comm.), *Phalanger maculatus* and arid catfish. The presence of a juvenile pig remains also provides further support for this notion. The animal bones from Ouloubomoto indicate a reliance on riverine resources, which inhabit waterways on the alluvial plain, and game from there as well as from karst regions.

Schedule of site use

The most definitive indicator of the season of use of both rock shelter sites is the riverine fauna, which suggests dry season occupation. The occurrence of *Viviparidae* and *Melanoideos* shellfish and turtle indicates that the sites were used during periods of low water. The diverse range of arid catfish sizes at Rupo signifies that a wide variety of resource localities were available for exploitation. The large percentage of turtle remains possibly suggests the use of
weirs and/or poison. Fish are poorly represented at Ouloubomoto and this is particularly puzzling because turtle remains comprise nearly one-fourth of the total assemblage. This likely denotes a very specific natural occurrence which increased the local abundance of turtle and thereby afforded easy exploitation.

Among game animals represented at both sites, pig and wallaby comprise the greatest proportion by weight. Because both taxa change their foraging areas seasonally, they provide no clear determination of the time of site occupation. However, the appearance of juvenile pigs in both assemblages possibly indicates dry season habitation. The absence of *Phalanger gymnotis* and the probable omission of *Thylogale brunii* among the unspeciated macropodid material at Rupo further supports this notion.

In summary, faunal remains recovered from Middle Ceramic deposits suggest that these sites were occupied during the dry season.

**Land-use system**

The archaeological evidence for the Middle Ceramic Period is limited to two sites, which are best characterised as dry season *kombati*. The land-use systems best exemplifying this settlement pattern are the Contemporary and Contact Models. No village sites relating to this period were discovered along the major rivers. The Contemporary Model must therefore be rejected. Neither site exhibits an emphasis toward wet season habitation, which is a suggested component of the Contact Model, but there is reason why this model should be considered. While the exploitation of riverine resources plays a dominant role in the work activities during earlier periods at both Rupo and Ouloubomoto, there is a shift toward dry season hunting at these sites during the Middle Ceramic Period. This suggests that game living on the alluvial plains may not have been readily accessible from village sites. If permanent habitations were a feature of the settlement pattern, then villages were probably situated closer to the karst escarpment. Of course villages need not have necessarily been a feature of this period, but it seems unlikely that the village/*kombati* settlement pattern of the Early Ceramic Period would have been so drastically altered in such a short time.
To conclude, a modified version of the Contact Model best describes the land-use strategy practised during the Middle Ceramic Period. The wet season exploitation of the region forming the upper drainage of the Sirebi River may have also been a component of the land-use strategy of this period.

**Intermittent Period**

Between 700-400 BP there is no archaeological evidence of the Kairi area having been inhabited. But I believe that the lack of information does not denote abandonment. Firstly, during the preceding periods there evolved a well-established land-use strategy which probably centred around cultivated sagopalm stands. I suggest that only a series of dramatic events would promote the dissolution of this system. The archaeological evidence for the Early Ceramic and Middle Ceramic Periods records no such occurrence. Secondly, the general characteristics of chipped stone implements and the use of the same source areas during the periods bracketing the hiatus support some continuity of technological skills and similar knowledge of the non-subsistence resource potential which lay further inland. Finally, the subsistence strategy operating during the Middle Ceramic Period suggests that the population may have settled in the region away from the major rivers, an area not included in my archaeological survey.

The Ecotone Model is in agreement with all these factors. I strongly suspect that this is the strategy which sagopalm cultivators living in the area would have chosen if they had no desire for social or economic intercourse with communities inhabiting the region to the south.

**Proto-historic/Historic Period**

**Archaeological evidence**

With the possible exception of Mampaiu, all open sites discovered have evidence relating to this period, whose age ranges from approximately 400 BP to near the present. Proto-historic occupations occur at Kulupuari, Waira, Bageima and Ibira. Historic sites include Kulupuari, Ibira and Herekuna rock shelter.
Organisation of site use

Proto-historic settlements at Waira and Ibira cover only a small area and probably represent a single habitation, which is relatively brief. The structures erected at these sites cannot be well defined, but the post holes noted at Waira likely represent only a single, small stilt house. The Proto-historic settlement at Kulupuari encompasses roughly the same area as that of the Early Ceramic Period. The structures built at the site cannot be specified because the patterning of post moulds relating to this period are in part disguised by those dug during post-contact times. Evidence from Kulupuari suggests a single occupation.

The material culture remains excavated at Kulupuari indicate that a wide range of activities were conducted at or from the site:

1. manufacture and repair of stone and wooden implements;
2. major work projects, such as house building, canoe construction and possibly gardening;
3. all primary subsistence activities, such as sago processing, hunting and fishing.

The evidence from Waira suggests a more limited range of activities, with the manufacture and repair of stone tools and hunting as the tasks most clearly denoted. Exploitation of riverine resources is the only work activity portrayed in the remains from Ibira.

Two indications of historic occupation were recovered at Kulupuari. The first occurs in the primary excavation area and may be the post-contact village of Kikiniu. The second is situated near the southern limits of the site (Test Pit 8 - see Fig. VI-2) and dates to near present-day. No clear characterisation of the structures erected during either occupation can be made. However, the areal extent of the shell midden associated with the recent settlement and the absence of similar features elsewhere at the site suggests a limited dispersal of cultural material, perhaps much as might be represented by deposits associated with a garden hut. Work activities noted for the early historic settlement at Kulupuari are reminiscent of those associated with the cultural debris from the proto-historic occupation. If a portion of the pottery recovered from the upper levels
of the main excavation area was deposited in historic times, then the preparation of food by boiling also occurs. Cultural materials recovered from the most recent deposits provide evidence of subsistence activities, which include sago processing, hunting, fishing and collecting.

The settlement at Bageima is brief and covers a limited area. A few small buildings, probably with raised floors, were constructed at the site. The excavated materials suggest that activities conducted during habitation of the site consist of the repair of implements, execution of major woodworking projects, processing palm starch, fishing, hunting and collecting.

The Herekuna rock shelter was probably used on several occasions during recent times. The small habitable area of the site would have accommodated few individuals. There they performed duties such as the repair of implements, hunting, fishing and collecting.

Food resources

Animal food remains recovered from proto-historic and early historic deposits exhibit a strong orientation toward the exploitation of mammals. Faunal material from Kulupuari consists primarily of pig bone (Table IX-5). The age range of individuals present (Table IX-6) varies greatly, but the vast majority is over one year old. Information from other sites of a similar age is insufficient to enable useful comparison so no distinction between feral and domesticated pig resources can be demonstrated. It seems likely, however, that both types are represented because of (1) evidence supporting pig domestication in the research area at an earlier, but not distant, date and (2) informant reports of pig keeping before European contact.

Small mammals, such as wallabies and phalangers, comprise a small proportion of the faunal remains at Kulupuari. The identified specimens suggest that both the alluvial plain and karst were exploited. A wide range of taxa appear among the riverine fauna. Most fish and turtles are of small size which indicates that waterways on the alluvial plain were commonly used, although streams and creeks draining this area may also have served as a focus for some fishing activities.
The Bageima faunal assemblage includes a high proportion of mammal bone, with pig the greatest quantity (by weight). The ages of only a few individual pigs could be specified (Table IX-6) so the distinction between feral and domesticated resources cannot be made. Other identified mammal remains give no clear indication of the areas which may have been exploited.

A minimum number of eight fish is represented in the animal remains from Bageima. Most individuals are medium to large in size and belong to taxa more commonly found in the deltaic region to the south. This evidence indicates that the major waterways in the area were an important focus for fishing activities. The occurrence of large-sized turtles in the assemblage also supports this conjecture. The use of inland waterways is represented by shellfish species. The recovery of pith-chopping artefacts indicates the processing of sagopalsms, possibly situated nearby.

Only shellfish and turtle remains appear in the Ibira assemblage, thus suggesting the use of waterways on or possibly fringing the alluvial plain. The faunal material from Waira consists of pig and small mammal bone. Since this sample is small, the exploited resource area cannot be accurately deduced.

The most recent faunal assemblage from Kulupuari (Table IX-5) includes the remains of a minimum number of 12 individuals, not including shellfish. Mammalian taxa comprise the largest proportion by weight and may represent the exploitation of the alluvial plain and the area near the karst escarpment. A similar hunting range is indicated by the occurrence of cassowary remains. Only two fish appear among the identified material. Both are large and belong to species commonly found in large waterways. This suggests that they were most probably caught in a river or near the confluence of a river and creek. The shellfish and crustacean remains indicate the exploitation of localities situated on the alluvial plain. The occurrence of a stone sago chopper, which has been fashioned from chert derived from the Bainia quarry, supports the notion that sagopalms were located in the general vicinity of the site.
Schedule of site use

Only the Kulupuari and Bageima faunal assemblages provide enough evidence from which the timing of site use for the Proto-historic/Early Historic Period can be inferred. Unlike the fish identified in the Early Ceramic deposits at Kulupuari, those in the more recent assemblage vary considerably in size. As well, fish remains constitute only a small proportion of the total assemblage. These two pieces of evidence suggest that periods during which the water-level fluctuates, such as at the height of the dry season or at the change-over between seasons, are not specifically important aspects of the subsistence schedule. Generalised and sporadic fishing methods were therefore most common. Taking site location into account, catches were probably made throughout the dry season. The small number and varying size range of chelid turtles represented in the assemblage provide further evidence to support this view.

Of the identified mammal remains at Kulupuari, only that of the Phalanger maculatus and two or possibly three juvenile pigs suggests the use of the alluvial plain for dry season hunting. The time of capture for other mammals is unclear because these species shift their home range according to the season.

The substantial occurrence of Batissa shellfish at Bageima indicates that the site was inhabited during the dry season. Other riverine fauna include medium to large-sized fish and turtle, which inhabit rivers in the area. This suggests that non-traditional fishing technology (e.g. fish hooks) may have been available. If so, the capture of these animals would not be related to seasonal water conditions. The mammalian taxa in the assemblage provide no clear evidence regarding the time of site habitation.

Recent Historic faunal assemblages (Table IX-5) represent dry season habitation. At Herekuna, the occurrence of Batissa, Melanoides and Viviparidae shellfish and fish taxa, which frequent waterways on the alluvial plain, indicate the exploitation of riverine fauna during periods of moderate to low water-levels. The recovery of only juvenile pigs from the recent deposits possibly supports the notion of dry season occupation.
The information from Kulupuari is not as clear. There the density of faunal remains is low and the identified fish taxa suggest the exploitation of large waterways. The restriction of shellfish in the main to one species, Batissa violacea, is the major indicator of dry season occupation. Since the recent historic deposits at Kulupuari probably represent a single event, it seems reasonable to assume that the shellfish remains are an accurate marker for the scheduling of site habitation.

Summary of archaeological evidence

Most Proto-historic/Historic sites discovered in the research area may be characterised as small-scale residences which were inhabited for a short period of time. Kulupuari is the one exception because the post holes discovered in the major excavation area exemplify the construction of at least one large structure, which is probably indicative of a village. While the archaeological evidence is not conclusive, I suggest that the array and stratigraphic position of large post holes (Fig. VI-5) signify only one large building during the recent phase of site use and that it relates to the settlement at the post-contact village of Kikiniu. The period during which sites with substantial faunal remains are occupied is the dry season.

Land-use systems

The paucity of archaeological information for most Proto-historic/Historic sites and the assumptions necessarily made in order to interpret the habitation periods at Kulupuari create considerable problems for the deduction of land-use systems. However, as a portion of this period is recorded in the reports of European administrators, some guidance is available for the assessment of the archaeological record.

Prior to direct European influence in the research area the use of settlements located along the banks of major rivers occurs most frequently in the dry season and is best characterised as small encampments. The duration of site occupancy, the number of inhabitants and the diversity of work activities vary between sites. These characteristics do not exactly conform with the suite of test hypotheses of any of the land-use model, but they are relatively close
approximations of the Contact and Residence Flux Models.

The major point of disagreement with the Contact Model is that the areal extent of sites such as Waira, Ibira and possibly Kulupuari is small and the number of inhabitants does not necessarily exceed a family-sized unit. Since the occurrence of a large encampment is predicated upon the need for defense during head-hunting raids, it may be the case that the likelihood of such events during the pre-contact period may not have been great. Historical accounts lend some support to this conclusion; however, it is difficult to assess the extent to which the presence of Europeans living in the area influenced the relationships between tribal groups.

Another point of disagreement with the Contact Model is the absence of kombati sites near the karst escarpment evidencing wet season habitation. As noted above (see p. 45), temporary shelters are frequently erected while people are on kombati; therefore, such sites might not be amongst those readily discovered during an archaeological survey. Also, the necessity to establish wet season kombati near the karst might not have been great if the population lived in well-established communities near this region, as I suggest for the Middle Ceramic and Intermittent Periods.

Differences between the archaeological evidence and the Residence Flux Model also relates to the size of sites. These are said to show no variation between sites. Since the areal extent of Waira and Bageima only can be accurately assessed, the apparent lack of uniformity in site size may not portray the true archaeological situation.

In order to resolve this problem of equally appropriate land-use models it is necessary to take a wider view of the archaeological and historic evidence for the research area. The recovery of pottery, glass beads and ground stone implements fashioned from stone whose source area lies in the western Owen Stanley Mountain Range is a strong indication of the exchange of goods between coastal and inland peoples. Although sporadic periods of animosity may have occurred, it would seem that long-term hostilities is not a common characteristic of the Proto-historic Period. Therefore, if the sites of this period are dry season kombati there may have been little need for large groups to be present for purposes of defense.
Early historic accounts of the Kairi record the presence of moderate to large villages primarily in areas away from major rivers. This pattern is also suggested for the two periods immediately preceding the one in question. While my assessment of the Intermittent Period may be in error, the weight of the evidence for the Proto-historic Period supports only minor alterations in the previous land-use strategies. Thus, it would seem that the advent of a different system, such as that portrayed in the Residence Flux Model, is not needed to account for the archaeological information.

In conclusion, I believe that my working hypothesis of wet season habitation of the karst as a component of the contact land-use strategy is in error. Also, the test hypothesis concerning the size of dry season kombati is possibly inaccurate. With these corrections included the Contact Model best describes the land-use system in operation during the Proto-historic period.

SUMMARY

From the preceding analysis I suggest a general continuity in land-use patterns over roughly the last 1500 years. Temporary encampments sited within and along the fringe of the alluvial plain serve as short term bases from which seasonally accessible animal foods are exploited. Periods of extreme fluctuations in the water-table are preferred for establishing kombati.

Evidence for village habitation exists for the Early Ceramic and Early Historic Periods and by inference is probably a feature of the Recent Ceramic and Proto-historic settlement pattern. The subsistence activities conducted from villages change little between these periods, but discrete differences in the location and season of occupation do occur.

The use of villages situated along the banks of major rivers appears to be an exceptional feature of the settlement pattern and a case can be made that it is possibly restricted to periods during which the availability of foreign goods is highest (see Chapter 10). While my site reconnaissance omitted potential inland village sites, historical information and speculations supported above suggest that the area away from major rivers was the primary focus of
village sites during the most recent occupation periods. The scheduling of village use generally parallels that of the temporary encampment sites after the Early Ceramic Period, at which time the major village site, Kulupuari, is probably inhabited during the beginning or end of the wet season.

The most notable aspect of recent prehistoric and protohistoric land-use systems is the absence of sites with possible wet season habitation components. Two possible explanations for this are:

1. the majority of the population shifted residence to the region forming the headwaters of the Sirebi River to exploit game and seasonally available riverine resources;

2. inland villages were also a component of the area's settlement pattern and commonly served as the site of wet season quarters.

The resolution of this issue awaits further field investigations because either or possibly both of these conditions may obtain.

Evidence for the occupation of the study area prior to 1500 BP occurs at only two rock shelters and is represented at Rupo by a succession of brief habitations which may have begun roughly 3000 years ago. The scheduling of site use approximates that proposed for more recent periods and the exploitation of riverine resources is the major activity of people living at these rock shelters. It is not certain which land-use system was used during this period. The sites may be a component of an extensive subsistence strategy practised either by mobile groups travelling through the area or by sedentary people occasionally ranging into it. Alternatively, the research area may have been inhabited by a permanent population whose settlement pattern does not usually include temporary encampments.

Although the second proposition has not been previously put forward, it is as valid as the first. I infer this from the fact that between the Recent Ceramic and Proto-historic Periods there is no evidence for the habitation of the area. As it seems inappropriate to argue complete abandonment of the region, I have suggested that villages were established at localities away from the major rivers during the Recent Ceramic through Proto-historic Periods. Therefore, it may be
argued that temporary encampments drop out of regular use when the population is concentrated at inland localities during much of the year.

The deciphering of the Pre-ceramic Period is of some importance because it impinges on the processes effecting the peopling of the interior Gulf region and the establishment of inland exchange systems which probably flourished during the last 1500 years.
CONCLUSION
CHAPTER 10

REFLECTIONS ON PAPUAN PREHISTORY

In concluding this thesis I consider the effects which intergroup relations have in modifying land-use. So far discussions have focused upon the interplay between human populations and the natural environment. I now reorient my perspective and illustrate the contribution made by societal interaction to the prehistory of the middle Kikori River area and through such investigations gain entry into wider issues of Papuan prehistory.

This discussion centres around the material culture evidence for the movement of exotic (i.e. not locally available) goods into the middle Kikori River region. After first reviewing the archaeological sequence for such items, I then assess the extent to which contact with foreign peoples influenced the land-use systems proposed for the prehistoric occupation of the research area. This chapter ends with a discussion of the relevance of this study within the context of Papuan prehistory.

ARCHAEOLOGICAL EVIDENCE OF EXOTIC GOODS

With few exceptions, all artefacts recovered from sites discussed in this thesis originated in distant localities as either raw material or finished items (see Table X-1). The earliest to appear are the chipped stone artefacts which occur in the undated, Pre-ceramic deposits at Ouloubomoto. All are made from "volcanic" cherts which can be found some 30 km to the north-east in the region forming the headwaters of the Sirebi River.

The greatest concentration of exotic goods occurs during the Early Ceramic Period sites. Chipped stone artefacts are fashioned from chert originating in localities near the headwaters of not only the Sirebi River but now also the Kikori and the Omati Rivers, the material from the latter two being "limestone" chert. The pot clay is derived from the Cape Possession/Hall Sound area (see Appendix 11; Fig. II-1) and possibly from the Port Moresby region (M. Worthington 1977: pers. comm.).
The raw material for ground stone axe-adzes occurs in the western Owen Stanley Mountain Range near Tapini (see Appendix 11), which is situated inland from Hall Sound. Lastly, a number of shell artefacts (e.g. *Conus* spp. and *Cypraea* spp.) are made from species belonging to coral reef or sandy beach environments, commonly found south-east of Hall Sound as well as in the Torres Strait region.

Source areas for most Middle Ceramic artefacts are uncertain. Pottery recovered from Rupo possibly relates to Kulupuari Early Phase ceramics. The rim sherds discovered in the uppermost deposits at Ouloubomoto are, however, distinct. The decorative style on one rim (Fig. VII-2c) shows affinity with the earliest pottery at Motupore Island near Port Moresby, but this slender thread is not duplicated. Only the shell artefacts from Ouloubomoto (see Table VIII-17) can be definitely assigned to this period. These are a segment of a segment of a *Conus* shell armband and a *Strombus* disc, both of which are unique in the material I have examined. The single ground stone implement (see Table VIII-17) is fashioned from meta-volcanic stone which probably comes from the western Owen Stanley Mountain Range. Source areas of chipped stone artefacts only are known. All of these remain unchanged from the Early Ceramic Period, except for some evidence from Ouloubomoto which suggests that the Sirebi River source is most frequently used.

Two notable changes occur in the Proto-historic Period. Firstly, European trade beads appear in several sites, indicating that the movement of goods from the Torres Strait area to the Papuan Gulf occurred at an early date. Also, Highlands stone axe-adzes arrive in the region. It is not clear when this happened, but it possibly just precedes European contact. Some evidence suggests that Motuan pottery arrives in the area at about the same time. Lastly, chipped stone artefacts representative of stone from all identified sources continue to appear throughout this period.

**EXCHANGE SYSTEMS AND LAND-USE**

**Conditions of access**

Raw material used in the manufacture of chipped stone implements may have been acquired by direct exploitation, barter with peoples
living in the source area or possibly both procedures. Direct exploitation of the Sirebi River source area seems most probable because (1) "volcanic" chert artefacts occur in the Pre-ceramic deposits at Ouloubomoto and (2) it is likely that the region forming the headwaters of the Sirebi River provides suitable areas for wet season occupation during the Early Ceramic Period and possibly more recent times.

An ancient knowledge of the Omati River source area for "limestone" chert may be confirmed by the presence of unique chipped stone implements with patinated surfaces in the earliest levels of Kulupuari (see p. 144). However, this evidence may be interpreted in two ways. Firstly, Early Ceramic peoples may have settled in the Kairi area after migrating southward from inland localities and continued to exploit their traditional chert resources during occasional trips to their homeland or through exchange with their kinsmen still living near ancestral sites. Alternatively, the barter for "limestone" cherts may have begun sometime prior to the Early Ceramic occupation of the study area. Further comment on this problem appears at the conclusion of this section.

Baina chert chipped stone artefacts appear in only small numbers. Considering a distance of approximately 80 km which the inhabitants of the middle Kikori River region would have had to travel if they had directly exploited this resource themselves, it seems more likely that wasá was acquired via an exchange system.

The majority of exotic goods which originated at very remote localities are probably transported to the Papuan Gulf by long distance canoe voyages. Evidence in support of this conclusion is:

1. the closeness of the dates recording the deposition of similar pottery at Kulupuari, Oposisi and Nebira 4;
2. the probable occurrence of Motuan pottery at Bageima;
3. the early appearance of European glass beads at Ibira and Kulupuari.

However, once pots, ground stone implements, shell ornaments and glass beads reached the coast of the Papuan Gulf they probably moved inland via local exchange systems. It is unlikely that regular contact between coastal traders and the prehistoric inhabitants of the Kairi
The waterways of the Kikori/Purari Delta are not easily navigated by sail craft. Also, it is inconceivable that the rich environment of the delta was uninhabited while people lived in the Kairi region. Therefore, local inland redistribution of goods by the delta dwellers seems probable because it is questionable whether the delta peoples would permit their inland neighbours to have direct access to the source of exotic items thereby diminishing their control of such items in the exchange system. Of course, if there were kinship ties between inland and coastal peoples, delayed reciprocity may have been a feature of the local exchange system which may have allowed face-to-face meetings between traders and relatives from distant villages. The resolution of this issue is not possible on the basis of current archaeological evidence; however, future studies directed at sites in the delta and in particularly at the chert sources represented in the archaeological sequence may prove informative.

The recent movement of Highlands ground stone tools into the Kairi area is probably the result of interlinking exchange systems. Hughes (1977: 180-81) documents the presence of Abiamp axes at a number of areas today falling within the Gulf Province and suggests several routes by which they could have entered the region. With regard to the Kairi the most important of these runs from the Samberigi Valley north of Mt. Murray to a point near the junction of the Iehi Creek and Kikori River (see Fig. II-1). Kairi informants and historical accounts (e.g. Austen 1930) confirm the existence of this route and provide support for its extension to communities in the delta.

Intergroup exchange and land-use

The land-use systems practised in the middle Kikori region over the last 1500 years show no major changes in the range of subsistence pursuits nor in the types of activities conducted while people lived at villages or temporary encampments. However, the scheduling of site use and the locus of large settlements vary. The most striking land-use pattern revealed is the contemporaneity of
repeated reoccupations of inland *kombati* sites and the siting of villages along the major rivers during the Early Ceramic and Contemporary Periods. This strategy appears only as a short-lived variant of a more common system involving intensive occupation of the inland region bordering on the karst escarpment. A number of reasons are theoretically probable for this re-orientation, but the one which I believe made the greatest contribution was the increased availability of exotic goods arriving at communities along the coast of the Gulf of Papua.

The testing of this hypothesis is contingent upon archaeological evidence from sites situated in Kikori/Purari delta and adjacent coastal areas. To date only two sites, Samoa and Popo, have received detailed attention. The Samoa site is situated on the eastern slopes of Aird Hills (see Fig. II-1) in the present-day village of the same name. Excavations conducted by S. Bowdler in 1971 document the presence of small red-slipped or painted pottery, a *Tridaona* shell club-head and a fragment of a carved bone figurine; she received a radiocarbon determination of approximately 1,800 BP from a carbon sample associated with the pottery deposition (Bowdler 1976: pers. comm.). In 1976 I excavated a 1 x 1 m test pit near the location where villagers indicated that Bowdler had worked. Cultural deposits which consisted mostly of shell debris extended to an average depth of 60 cm below ground surface. Some slipped or painted pottery fragments were found throughout the deposits, but at no level did they appear in large numbers. A shell and carbon dating sample collected at a depth of 56 cm gave ages of 1220 ± 180 BP* (ANU 2061B) and 2430 ± 370 BP (ANU 2061A).

A comparison of these dates, using the Polach-Golson method, indicates that they represent significantly distinct events (at p <0.001). Since the shell submitted for dating probably originated in a non-karst environment, which differs notably from that of the shell used in establishing the shell date correction factor (see p. 123), I may assume that the shell date from Samoa is probably in error (J. Head 1979: pers. comm.). Therefore, the more ancient date seems more appropriate and, as well, it is comparable with Bowdler's date, at two standard deviations. Taking evidence relating to the introduction of pottery along the Papuan coast into account (cf. Allen 1972;
Vanderwal 1978; Irwin 1978; Bulmer 1979), I posit an age from 2,000-1,800 BP for the initial occupation of Samoa.

When the Samoa evidence is considered against the archaeological evidence for the middle Kikori region a most intriguing picture is revealed. On presently available data there is roughly a 300 year delay between the occurrence of pottery in the Gulf region and its appearance in the Kairi area. Several problems have to be considered when attempting to assess this information:

1. the very small sample of excavated sites;
2. the uncertainty of the Samoa dates and the source(s) of the pottery found there;
3. the possibility that societies ascribed different values to individual classes of exotic commodities (e.g. non-utilitarian versus utilitarian goods) and the effects of this on the rate of subsequent dispersal.

While the influence of these factors on the development of Gulf exchange systems can only be assessed after further archaeological investigations, I submit the following hypothesis as the most likely explanation for the current evidence:

The trading system which linked the Papuan Gulf with distant sources of pottery, stone axes and shell artefacts required considerable time to develop. At the time during which this system is documented in the archaeological record of the Kairi area, it had attained a period of peak intensity.

If the 1800 BP estimate for Samoa is correct then this site potentially represents the earliest example of long distance coastal trade. Alternatively, it may document a western settlement of pot-makers, but this seems unlikely. If, as I suspect, the antiquity of settlements in the Kikori/Purari delta exceeds 2000 BP, then the habitation of the area by alien peoples would have been most difficult. Also, the geographical and environmental setting of the Samoa site is distinct from the coastal and offshore island localities where the

However, despite the difficulties with the Samoa information the fact remains that the initial occurrence of pottery at Kulupuari, approximately 1500 years ago, stands as a unique event for the middle Kikori River region, which lies 25 km north-west of the Samoa site (Fig. II-1). Furthermore, the first occurrence of Baina and Omati chert and a notable change in the local land-use strategy appears at the same time. Chance alone cannot adequately account for this evidence. I suggest that the increased availability of exotic goods along the coast at this time prompted the establishment of formal relationships between communities which in turn facilitated the movement of goods from the coast to perhaps the Highlands fringe. I seriously doubt that maritime traders and coastal communities along the Gulf of Papua would be able to stabilise exchange agreements immediately. The pots, ground stone axe-adzes and shell artefacts which were offered in exchange for palm starch would have very little value among peoples who subsisted upon wild sagopalm stands and probably prepared their meals in sections of bamboo.

I here exceed the bounds of archaeological evidence. But what starch resource could facilitate the extensive and rapid expansion of pot-makers along the Papuan coast?* And what commodity did the coastal peoples of the Gulf peoples have to offer in exchange? The best answer to both these questions is sago.

It is difficult to speculate as to what commodities the inland peoples offered initially in exchange for the exotic goods presented by coastal groups. Perhaps they were chert cores or implements (? sago choppers). Perhaps they were items such as brides, plant or animal food or trees for canoes, traces of which would not survive in the archaeological record. However, given the reservoir of commodities which may have accumulated over at least 300 years of exchange with coastal traders it may have been the case that the establishment of a socio-economic market place was crucial. Until further relevant evidence is available, the matter must rest.

* I thank Jean Kennedy for first bringing this question to my attention.
This situation is repeated during the Proto-historic Period and this possibly has some bearing on the issue. Popo, the second near-coastal site documented in the Papuan Gulf, is situated 5 km inland from contemporary Orokolan villages (see Fig. II-1). During my 1976 test excavations of this site a number of potsherds were recovered. The rims are identical in form and decorative style to those excavated from the upper levels of Motupore Island (J. Allen 1976: pers. comm.). The clay fabric of a single sherd is tentatively sourced as originating in the Motupore area (O. Rye 1979: pers. comm.). A carbon sample recovered from 30 cm below ground surface in a continuous midden deposit, which reached a metre in depth, gave a radiometric age of 430 ± 110 BP (ANU-1829), which is comparable to the time of deposition for similar sherds at Motupore (J. Allen 1979: pers. comm.).

European glass beads occur in the middle Kikori River region at the same time and shortly thereafter shell artefacts and ground stone implements from the western Owen Stanley Mountains source area appear. Motuan pottery and Highlands axes do not arrive into the Kairi area until near the time of European contact, approximately 300 years after the deposition of pottery at Popo.

This evidence again suggests that coastal to inland exchange systems probably develop in response to intense coastal trade. The archaeological record of the Kairi area certainly presents inviting parallels between the Early Ceramic and Proto-historic Periods with regard to material culture and land-use strategies.

GULF AND PAPUAN PREHISTORY

Before the introduction of pottery to the Papuan Gulf the inhabitants of the middle Kikori area were either people from the delta region who ventured northward to exploit faunal resources, or permanent residents whose subsistence activities did not require them to establish temporary encampments. The latter seems more likely because the occurrence of "volcanic" chert at this time and the presence of Omatai and Baina chert at 1500 BP indicate that the prehistoric peoples already possessed an intimate knowledge of inland regions. Also, I do not believe that sago using peoples would have
quickly taken up the cultivation of *Metroxylon* palms, which is required if palm starch was to serve as the subsistence base while living in the interior, or that the arrival of exotic goods would have stimulated an inland expansion of coastal peoples. The gradual settlement of the Papuan foothills by coastal sago users seems to provide a model more consistent with the evidence.

By 1500 communities throughout the Gulf region were joined by a series of interlocking exchange systems whose advent was likely sponsored by a heightening of the movement of goods between coastal peoples and traders from the east. This situation was maintained for roughly 300 years. After this time foreign goods still filtered into the middle Kikori region, but the intensity of exchange between the coastal and the interior was greatly diminished.

The 1200 BP date for the abandonment of Kulupuari is important because discontinuities in the archaeological record appear at sites eastward along the Papuan coast. The occupation at Oposisi ends at roughly the same time, after 1000 years of repeated use, and settlements in the Hall Sound area do not reappear until 700 BP, by which time the pottery styles, raw material for chipped stone artefacts and settlement site location have changed (Vanderwal 1973: 192-95). In the Port Moresby area the period from 1000-500 BP marks the initial occupation of the coastal hill zone (Bulmer 1979). Irwin (1978) notes a major change in Mailu pottery styles at an unknown but suspected date of 800 BP.

This evidence may denote the occurrence of disruptions among the sago producers or the pot-makers. The dislocation of prehistoric Gulf communities either through internal strife or by the influx of new peoples could have promoted a situation where normal relations with pottery traders were impossible. Evidence supporting such an occurrence and indicating its probable age are not readily apparent. Kairi oral history, however, recounts a similar chain of events (see p. 16ff). In light of my suggestion that the middle Kikori River region may have been continuously occupied over the last 2000 to 3000 years, the Kairi may very well be the descendants of the area's prehistoric inhabitants. If this is so, then traditional history may reflect prehistoric events.
Vanderwal (*ibid.*) and Allen (1977b) posit a radical period of transition among pottery producing communities. Although Vanderwal only hints at the probable cause by labelling the post-Oposisi occupation of the Hall Sound area as the "Intrusive Phase" (p. 192), Allen straightforwardly suggests that the disruption is concomitant with the early development of specialised trading communities, such as the Motu, along the Papuan coast (p. 393-95).

Bulmer (1979) and Irwin (1978) stand in opposition to this view in their support of a model of localised development. Based upon her analysis of Port Moresby pottery assemblages Bulmer proposes a continuous evolution of decorative styles throughout all periods but the proto-historic (p. 23-4). Irwin concludes that with the exception of pottery styles all archaeological evidence from the Mailu area exhibits uninterrupted development (p. 412).

Evidence presented in this thesis suggests a major alteration in the conduct of coastal trade at approximately 1200 BP. Since the most probable point of origin for the pottery and stone axe-adzes occurring at Kulupuari is the Yule Island region, the explanation which comes first to mind for this instance of discontinuity is area specific developments. However, I believe that this conclusion evades a fundamental problem in Papuan prehistory: what were the conditions which promoted differences in the development of pot-making groups who seem to have a common ancestry and who possibly maintained inter-community exchange systems over 1000 years or more?

The capacity of the Kairi area to reflect and throw light back on developments along the coast is again seen during the Proto-historic Period. Between 400 BP and the establishment of European control over the Gulf region there is a revitalization of coastal trading systems linking the Gulf with south-east Papua and the Torres Strait region as well. The arrival of Motuan pottery and Highlands axes into the Kairi area near the time of initial European contact indicates that the intensity of the previous boom period was imminent. Perhaps Bevan's handshake interrupts its full development, or perhaps the European establishment represents the recent analogue of the prehistoric pottery traders.
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Errata

Through a Glass Darkly : J. Rhoads

page/paragraph/line

Precis
1/3/2 "Wairi" to read Waira
2/1/2 "suite" to read suites
2/1/3 "Wairi" .... Waira

Acknowledgements
1/4/5 "Paine" to read Pain
2/3/5 "thisis" .... thesis

Text
2/3/7 "Flack" to read Flach
3/2/3 "of the initial" to read of man's initial
3/2/4 "Chappel" .... Chappell
4/2/10 "Powell 1977" .... Powell 1976
4/1/20 "silicious" .... siliceous
5/2/12 delete "further"
6/2/12 "climax" .... mature
7/3/8 "by means survey" .... by means of survey
8/2/7 "(Fig.II-1)" .... (Fig.II-5)
10/4/2 delete sentence beginning "An evaluation of my use of ..."
12/1/4 "effects" .... affects
13/2/5 "Paijans" .... Paijmans
13/2/13 "pandanau" .... pandanus
13/3/4 "Favenc" .... Faveng
14/2/3 "(McAlpine, et al. 1973:127)" .... (McAlpine et al. 1975:127)
14/2/5 "per cent" .... percent
17/4/7 delete comma following Kaepa
18/last line "respete" .... respite
22/2/11 "shotgun" .... shot-gun
23/2/16 "Tugiri" .... Tutugi
24/3/1 "Tugiri" .... Tutugi
26/3/2 "an" .... a
27/2/7  "bulbous" .... bulbous
27/3/7  "(Fig.II-1)" .... (Fig.II-5)
29/2/4  "bark" .... bark
29/3/7  "papyrifera" .... papyrifera
31/1/12 "evidences" .... evidences
32/2/2  "(Table III-3)" .... (Table III-4)
32/2/11 "Yaemi" .... yaemi
34/2/5  "appetite" .... appetite
36/3/5  "affected" .... affected
39/4/9  "precludes" .... precludes
42/4/8  "sporadically" .... sporadically
43/2/4  "faci" .... foci
49/3/4  ""morning"" .... "moning"
49/3/10 "Pigin" .... Pidgin
52/1/2  "(Table III-2)" .... (Table IV-2)
54/1/1  "(Fig.IV-3)" .... (Fig. IV-8)
54/4/4  following "sago" insert processing
57/1/9  "household" .... household
59/footnote/4  "ad" .... and
59/footnote/6  "household" .... household
62/2/2  "household" .... household
63/3/11  "reneguing" .... reneging
63/3/12  following "demonstrate" insert precise
64/3/3  "latter" .... latter's
70/1/2  following "margin" insert comma
72/1/8  "irregardless" .... regardless
74/1/5  "man" .... men
77/1/16  for "chapter" insert part of this thesis
79/1/3  "Ruddle, et al. 1977" .... Ruddle et al. 1978
79/1/10  "Table IV-1" .... Table V-1
79/1/11  "Figure VI-1" .... Figure V-1
79/2/10  "for" .... against
81/1/2  "suckers are planted (Ibid.). In these cases" .... suckers are planted (Ibid.) and in such cases
82/1/last  "Ruddle et al. 1977" .... Ruddle et al. 1978
83/1/2  "Among the Kairi and other peoples" .... Among the Kairi, as well as other peoples
83/1/4  following "pers.comm." insert comma
85/3/5  "cassarium" .... canarium
3.

85/4/2 "hinder" .... hinders
86/1/5 delete sentence beginning "Ambiguous references ...."
89/2/9 "refug" .... refuge
91/3/5 "macropods" .... macropodids
92/1/5 following "that" insert most
92/3/1 "varied" .... varies
97/4/2 "assumption" .... assumptions
97/5/3 delete "and Hope"
103/2/1 "bana" .... banana
105/3/4 "probably" .... probable
107/2/4 "Orokaiva" .... Orokaiva
107/4/6 "soild" .... soils
111/4/2 "seas" .... season
113/1/5 "repertoire" .... repertoire
115/1/3 "repertoire" .... repertoire
124/3/8 delete "the" following "therefore,"
125/3/4 "affect" .... affects
128/3/12 "(Fig. 96)" .... (Fig. 9b)
132/3/4 "(see Appendix 8)" .... (see Appendix 8)
137/3/8 "originally" .... originally
142/1/1 "Ceramic phase" .... Early phase
142/1/4 "(Appendix 8: Table 8.20)" .... (Appendix 8: Table 8.20)
144/6/1 "(Fig. VI-23c; see Appendix 8: for further discussion)" .... (Fig. VI-23c; see Appendix 8: A.62 for further discussion)
146/1/4 "for all specimens" .... for all but one specimen
148/1/8 "Julupuari" .... Julupuari
149/2/9 "from AD 1700" .... from AD 1700 at the latest
154/1/1 "radiometric" .... radiometric
154/1/3 "1,200-1,500 BP" .... 1,250-1,500 BP
156/2/2 "probable" .... probably
156/2/5 "assemblage" .... assemblages
161/4/5 "(Fig. VI-23d)" .... (Fig. VI-25d)
161/4/last "Duft" .... Duff
162/3/12 "Mampai" .... Mampaiu
162/4/3 "Fig. VI-23b" .... Fig. VI-25b
163/2/10 following "(see pp." insert 146ff).
168/4/4 "sparce" .... sparse
169/5/6 "and another" .... and another two
170/2/3 "100.4%" .... 100.4 ± 1.0%
172/3/7  "Macropod" .... Macropodid
173/4/7  "east" .... west
181/2/4  "Test Pit 3," .... Test Pit 3.
183/1/18 "in situ" .... in situ
192/2/1  "macropod" .... macropodid
192/2/6  "macropod" .... macropodid
192/5/5  "macropod" .... macropodid
193/3/2  "portion" .... proportion
193/3/7  "Macropod" .... Macropodid
193/3/10 "Dendrologus cf. goodfellowi" .... Dendrologus cf. goodfellowi
194/1/1  "living at" .... using
194/2/2  "macropod" .... macropodid
194/4/2  "Pre-Ceramic" .... Pre-ceramic
194/4/2  "phase" .... Phase
199/2/5  'th' .... the
206/1/3  "Macropod" .... Macropodid
206/1/5  "megapod" .... megapode
206/3/6  "Macropod" .... Macropodid
206/6/3  "general" .... relative
214/3/5  "macropods" .... macropodids
215/1/2  "Macropods" .... macropodids
222
delete paragraph 3 and insert since *Dendrologus goodfellowi* is typically associated with high altitudinal rain forest environments (Lidicker and Ziegler 1968), no comment can be made concerning the movements and distribution of this species within the Kairi area.

223/4/2
delete "diversi"
224/1/8  ""Swamp" .... swamp
226/5/6  "in" .... during
228/1/4  "sparce" .... sparse
228/1/6  "Puari" .... Purari
230/2/5  "boar" .... boars
232/2/8  "bacterium" .... *bacterium*
234/2/3  "recent ceramic" .... Middle Ceramic
234/4/3  "Vivparidae" .... Vivparidae
235/3/1  "Recent" .... Middle
235/4/1  "Recent" .... Middle
235/4/12 "Recent" .... Middle
"Recent" .... Middle
"Ecotone Model" .... The Ecotone Model
"History" .... Historic
"Recent historic" .... Recent Historic
"small scale" .... small-scale
"primary" .... primarily
following "inland localities" insert during much of the year
"(Table VIII-" .... (Table VIII-17)
"Samoan" .... Samoa
"Proro" .... Proto
"near coastal" .... near-coastal
following "resources" insert comma
"residence" .... residents

Bibliography
263/entry 3/1 "Pirari" .... Purari
263/entry 4/1 "fisher" .... fishes
263/entry 4/1 "Pirari" .... Purari
264/entry 4/2 "(Corstensz)" .... (Carstenz)
266/entry 8/1 "Moth" .... Motu
267/after entry 7 insert Löffler, E.
1977 Geomorphology of Papua New Guinea
ANU Press, Canberra.

276/entry 16/1 "Rodento" .... Rodents

Appendices
A.6/3/14 "mathematical" .... mathematical
A.7/3/2 "history, in relation to" .... history and
A.10/3/3 "Narapa" .... Napara
A.10/3/11 "suggests" .... suggest
A.14/1/3 "bourne" .... borne
A.16/4/7 "at the Oboro Bush" .... at the Oboro bush locality
A.23/2/8         "Kirokai" .... Kirokae
A.24/column 2/8  insert 7°16' S 144°9'E
A.24/column 5/27 following "to" insert 20 cm
A.26/1/5         "(½ in.)" .... (½ in.)
A.37/item 9/2    "completed" .... computed
A.41/1/5         "(pp.)" .... (pp. A.28 - A.32)
A.42/2/5         following "7:" insert A.29
A.56/3/1         following "pp." insert A.32 - A.37
A.57/1/5         "core" .... cores
A.57/4/8         "are similar samples" .... are similar between samples
A.59/4/16        "by-produce" .... by-product
A.63/2/2         "Paine" .... Pain
A.64/2/1         "Tables 10.3 - 10.6" .... Tables 9.3 - 9.6
A.69/1/3         close parentheses at end of sentence
A.71/item II/8 XF "hornblends" .... hornblende
A.76/3/1         "examing" .... examining
A.77/1/2         "inalyng" .... inlaying
A.82/1/4         following "unburnt bone" insert comma
A.89/2/2         following "Haines" insert an inverted comma
A.103/1/5        "reamin" .... remain
A.111/4/4        "specis" .... species
A.111/5/5        "toothraw" .... toothrow
A.114/2/11       "farnal" .... faunal
A.114/2/11       "kikori" .... Kikori
A.116/1/6        following "pp." insert 157,
A.122/3/7        following "Appendix 8:" insert A.55ff
A.122/4/7        following "Appendix 8:" insert A.55ff
A.129/4/7        "valocity" .... velocity
A.135/2/8        "reproducing" .... reproducing
A.138/heading    "Broidae" .... Boidae
A.139/2/8        "Morren 1980" .... Morren 1979
A.139/4/1        "ominoovers" .... omnivores
A.141/3/4        "perenial" .... perennial
A.143/3/8        "sparce" .... sparse
A.143/4/2        "Karst" .... karst
A.147/4/5        "unprecedented" .... unprecedented
A.148/1/7        "remakrs" .... remarks
A.156/2/7        "es" .... is
"valut" .... vault

Plates
III-18/caption "rock" .... rack

Figures
II-2 "MacAlpine et. al. 1975" .... *McAlpine et al. 1975
II-3 "MacAlpine et. al. 1975" .... *McAlpine et al. 1975
II-5 "Pinni Crk" .... Pinini Crk
IV-2 before "Peter" insert a.
IV-2 before Oboro insert b.
IV-2 before Poialaviti insert c.
V-1 "Wania" .... Waina
V-2 "Wania" .... Waina
V-3 "Wania-Sowander" .... Waina-Sowanda
V-3 add unfilled taro symbol for Abelam
V-4 "Wania" .... Waina
VIII-2 labelled faces on pit walls should read:
Pit A: East, Pit B: East, Pit C: West (reversed)
VIII-4/caption following "units" insert by percentage
2.3 above tree foliage base from 120-200 m insert
closed canopy

Tables
II-1 "After MacAlpine" .... After McAlpine
II-2 "After MacAlpine" .... After McAlpine
III-1 "Aiyauku" .... Aiyauki
III-1 "Amiona" .... Aimona
III-1 "lanagai" .... Lanagae
III-2/footnote 1/3 "stores" .... stored
III-4/page 1/column 1/25 insert ?
III-4/page 1/column 2/10 "Lamaikae" .... lomakaie
III-4/page 2/column 1/2 insert Ananas comosus
III-4/page 2/column 1/3 insert Carica papaya
III-4/page 2/column 1/4 insert ?
"Korou" .... Kororu
"coconuts" .... coconut
"Ho(K)" .... ho(K)
"hibika" ..... (aibika)
"Araeae" .... Araeae
"corn" .... tuber
"Balus" .. balus
"argentimaculatus" .... argentimaculatus
"papuensis" .... papuensis
"Mariko" .... mariko(K)
"Acanthographeus" .... Acanthographeus
"Name" .... name
"Wania" .... Waina
"Wania" .... Waina
"Wania" .... Waina
"Wania" .... Waina
"ANU-2173" .... ANU-2174
"X" .... *
all "F" .... t
"-2.04" .... 2.04
"provence" .... provenance
following "Appendix 7:" insert A.38).
"maculatus" .... maculatus
"Macropod" .... Macropodid
"macropod" .... macropodid
"*" .... x
"candidimaculatus" .... candidimaculatus
see attachment #1
"Oxyeleotris sp." .... Oxyeleotris sp.
"Scincidac" .... Scincidace
"Elopa" .... Elopidae
"candidimaculatus" .... candidimaculatus
"Bageima" .... Bageima
2.1/page 1/column 3/6  "Dyscaxyllum sp." .... Dyscaxyllum sp.
2.1/page 1/column 3/9  "conoides" .... conoides
2.1/page 2/column 3/8  "Sloanea sp." .... Sloanea sp.
2.1/page 2/column 3/9  "Areca sp." .... Areca sp.
2.1/page 3/column 3/12  "papyrifer" .... papyrifer
2.2/column 1/11      "lost" .... last

Additional errata for text

30/5/4  "Mjoule" .... Kjoule
30/5/6  "Mjoule" .... Kjoule
32/3/1  "(Amaranthus)" .... (? Amaranthus
<table>
<thead>
<tr>
<th></th>
<th>KULUPURARI</th>
<th>Rupo</th>
<th>OUROBOROMO</th>
<th>Ouroboromoto</th>
</tr>
</thead>
<tbody>
<tr>
<td>270 + 225</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>320 + 188</td>
<td>x</td>
<td>x</td>
<td>x</td>
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</tr>
<tr>
<td>370 + 188</td>
<td>x</td>
<td>x</td>
<td>x</td>
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</tr>
<tr>
<td>430 + 189</td>
<td>x</td>
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<td>x</td>
<td>x</td>
</tr>
<tr>
<td>490 + 192</td>
<td>x</td>
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</tbody>
</table>

* For methods of interpretation see p. 121

** Table VI-12**

Comparison of dates for pottery deposition at Ouroboromoto, Rupo and Kulupurari

Attachment #1