PATTERNS IN GLASS: OBSIDIAN AND ECONOMIC SPECIALISATION IN THE ADMIRALTY ISLANDS

VOLUME 1

TEXT

by

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This work is a thesis submitted for
the Degree of Doctor of Philosophy
at the Australian National University

December 1994

Except where otherwise stated in the text, this thesis is based entirely on my own research.

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ABSTRACT

This thesis considers the association between western Melanesian ethnographic economic specialisation and prehistoric systems of production and distribution. Contrasting theories for the development of historical specialisation are reviewed and the criticism made that these are chronologically limited to the late Holocene. The statement is made that to fully appreciate temporal change we must expand our view to encompass the preceramic period.

Obsidian is one of the few archaeologically visible materials which was distributed in both preceramic and ceramic times. This material is chosen as a "measuring device" to map variation in production and distribution patterns in the Admiralty Islands, Papua New Guinea. A review of ethnographic and anthropological literature revealed that the Admiralty Islands were characterised by a high level of village or lineage-based economic specialisation. Obsidian was one of the materials produced and distributed within this system.

A study was carried out on obsidian use at Pamwak Rockshelter on Manus Island, and at a number of mid to late Holocene localities on Manus and Mouk. Characterisation analysis revealed that offshore obsidian, probably from the Pam Islands, began to be utilised in the terminal Pleistocene. Trends of increasing accessibility through time and a move to incorporate increasing quantities of Lou obsidian were revealed. A significant discovery is the possibility of a major increase in the use of Lou obsidian coincident with the appearance of Lapita.

Retouched obsidian blades and microblades were found to be present in only post-Lapita contexts. Chronological change in blade production strategies was revealed on Lou. This involved the development of highly standardised triangular forms by approximately 1600-1300 BP, followed by a simplification of technology as reflected in the appearance of minimally modified tanged forms. This occurred within the last 1000 years and is interpreted as showing increased demand for weapon points. This demonstrates a move toward the form of spearpoint production recorded by nineteenth century ethnographers.

The conclusion drawn is that none of the models yet advanced for the devlopment of economic specialisation in Melanesia is adequate for interpreting change in production and distribution in the Admiralty Islands. The roots of economic specialisation may lie further back in time than catered for by existing models.

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PART FOUR: COMMENTARY AND DISCUSSION

ACKNOWLEDGMENTS

So many friends and colleagues assisted me during the course of this research that it is difficult to know where to begin the acknowledgments. But at the top of the list must be my wife, Jan Ferguson, who had to tolerate my absence in Papua New Guinea soon after our arrival in Canberra, and who provided support and encouragement throughout the subsequent long period of analysis and writing up. My supervisors, Matthew Spriggs and Wal Ambrose, organised the Pamwak investigation and it is because of them that I was able to engage in some of the most fascinating and rewarding fieldwork I have ever experienced. The government of Papua New Guinea and the Manus Provincial Government made this fieldwork possible. Thanks must also go to the people of Drabitou village, and especially the excavation crew who displayed ever more interest as the hole got deeper. The Australian National University's postgraduate scholarship scheme and the support of the then Department of Prehistory, Research School of Pacific Studies, allowed me to participate in the Pamwak project.

Post-fieldwork, Jean Kennedy kindly granted me access to obsidian from Kohin, Father's Water and Peli Louson and shared her unpublished fieldnotes with me. Holly McEldowney consented to me analysing the Mouk obsidian. I am grateful to both these people for providing me with the opportunity to broaden my study. EDAX analysis of the obsidian was made possible by two people, Wal Ambrose, who suggested I try the technique he was then applying to pottery, and David Vowles of the Electron Microscopy Unit (Research School of Biological Sciences). David Buckle assisted at the controls on numerous long analysis sessions. Assistance with statistical manipulation of the resulting data came from Yvonne Pittelkow, who introduced me to the intricacies of RELOC. Still on the technical side, Tom Loy allowed me access to facilities and provided much helpful advice during residue analysis of the pitchstone tools. Dan Witter discussed with me how the past inhabitants of Lou may have manufactured their retouched blades. Jim Specht (Australian Museum) granted me permission to study the Farrell collection of spears.

During writing up this thesis Matthew Spriggs and Wal Ambrose were always ready to read and reread chapter drafts. Their comments have been invaluable. Other people who read various chapter drafts include Susan Bulmer, Michael Donnan, Michael Hanslip, Jean Kennedy, Mike Smith and Ephraim Wahome. I thank them all for their input, and particularly Wahome who unselfishly shared information on the ceramic sequence and engaged in many long discussions on production and trade in the Admiralties. Ian Faulkner and Sally Maingay prepared the illustrations for this thesis, my thanks to them both.

Some months after the birth of our daughter in 1992 my wife and I returned to New Zealand. My wife's parents, Lindo and Laetitia Ferguson, invited us to stay in the beautiful surroundings of Butler Point so that I could focus on finishing this thesis. I will always be grateful for their kindness and generosity. During this time my parents, as always, offered encouragement and support. Over the past two years I have made five trips back to Canberra to attend conferences and maintain the momentum of writing. On three of these visits I stayed with Janet and Wal Ambrose; the hospitality I was afforded during this time will not be forgotten. During the final stages of preparing this thesis Barry Fankhauser and Georgina McGill kindly offered me a room in their home. I extend my gratitude to them as well.

I received help from so many people that I offer my apologies to any who I have forgotten to mention. This work is dedicated to Gurumayi Chidvilasananda.

Der Greis *Ndrahot* - a Manus bigman in ceremonial attire and armed with obsidian-tipped spear (from Meier 1907)

CHAPTER 1
SPECIALISATION IN MELANESIA: PERSPECTIVES FROM ETHNOGRAPHY AND ARCHAEOLOGY

INTRODUCTION

> Broadly speaking, there are two ways in which the benefits of specialization of labor may be realized: exchange of goods among the specialist producers, and redistributive allocation by a central agency. The redistributive role of chiefs was a prominent aspect of the regional economic organization of many Polynesian and Micronesian societies, but in Melanesia the exchange mode was dominant (Harding 1970:94).

This quote summarises an important distinction drawn by many anthropologists between economic specialisation among the generally egalitarian societies of western Melanesia and socially stratified cultures elsewhere in the Pacific. Within a cultural evolutionary framework the picture for Micronesia and Polynesia appears as the norm, while western Melanesia presents something of a paradox. At European contact most Melanesian societies were not hierarchical or centrally organised but many exhibited a high degree of village-level economic specialisation, an apparent contradiction generally acknowledged by those working outside the region (Brumfiel and Earle 1987; Rathje 1978; Yoffee 1985). The picture for early historic Melanesia has naturally engendered interest among prehistorians, who have addressed issues of timing and direction in the emergence of economic specialisation for coastal mainland New Guinea and nearby islands (Allen 1984a; 1985; Irwin 1978a; 1978b; Lilley 1988; 1991a).

Most of our evidence for prehistoric production and interaction in Melanesia comes from two materials, pottery and obsidian. Pottery contains a great deal of encoded cultural information, but its occurrence is limited to at most the last 3500 years of prehistory, notwithstanding suggestions of earlier occurrences in northern coastal

New Guinea (Gorecki 1992:33ff; Swadling and Hope 1992:36). If the task is one of examining the roots of economic specialisation, it may be unwise to limit our temporal unit of study to the ceramic phase of Melanesian prehistory. Obsidian on the other hand was distributed between islands from Pleistocene times (Fredericksen et al. 1993; Summerhayes and Allen 1993), while analysis of technological variation at "source" localities has begun to reveal interesting patterns of change (Torrence 1992). Diachronic examination of obsidian use therefore has the potential to illuminate the rate and direction of change in systems of production and distribution from much nearer the time of first human settlement of particularly Island Melanesia. In this thesis I use the obsidian evidence to examine these issues in the context of the development of economic specialisation.

What exactly is meant by the term "economic specialisation"? Researchers generally concur that economically specialised groups (villages, clans, guilds, etc) are those which depend for their livelihood on the provision of particular goods or services to other groups (Knapp 1990:184; Muller 1987:15; Shafer and Hester 1991:79). Major aspects of specialisation are an effective distribution system and the intra-community manufacture of particular commodities for trade. The degree of economic specialisation can vary enormously, from non-specialised in societies composed of economically undifferentiated groups, to highly specialised in capitalist market economies. A useful way to consider specialisation is in terms of fully and semi-specialised, or full-time and part-time (Muller 1984:491). A fully specialised economy would be commonly associated with stratified, centrally organised societies, in which groups with particular skills were sponsored by elites or supported by the market (Brumfiel and Earle 1987). Semi-specialisation would characterise pre-state level societies in which, as we will see below, even groups relying to a large extent on their specialist products and skills still devoted a portion of their time to subsistence activities.

SPECIALISATION IN WESTERN MELANESIA

In the colonial period a number of production and distribution networks existed in New Guinea and smaller islands of western Melanesia. Over 90% of exchange involved the generalised transfer of consumables between territorially adjoining communities (Brookfield with Hart 1971:319). However, many communities were acknowledged as the providers of specific manufactured items within particular trade networks. In this section I will examine this production within the framework of economic specialisation for coastal New Guinea and Island Melanesia. It should be noted that similar production for local trade existed in regions of the New Guinea Highlands (see for example Gell 1992; Godelier 1971; Hughes 1977), but examination of this is beyond the scope of the present discussion.

SPECIALIST PRODUCTION

Specialist production was a feature of local trade systems throughout Melanesia. Much of this was directed by ecological differences between coastally oriented communities and inland groups. Marine and coastal produce (fish, turtles, shellfish, shells, coconuts) was readily available to most coastal fringing communities while access to many terrestrial plant and animal foods and raw materials (fibres, wood, stone) was often more restricted; the reverse situation generally held for inland groups. Accordingly, coastal communities were in a position to distribute coastal materials and items manufactured from these materials to neighbouring inland groups, who reciprocated with forest products and associated manufactured items (eg; Chowning 1978:298; Malinowski 1961 [1922]:187; Oram 1982:3; Specht 1974:228-229; Tueting 1935:20). Within these two resource zones were geographically restricted resources, such as obsidian, high quality axe stone, and good pottery clay, the utilisation of which was controlled by particular groups. Associated manufactured goods, such as obsidian cores, stone axes and clay pots, were often transferred over long distances, usually by secondary exchange. However, although environmental differentiation played a major part in production variation, production and trade were not simply undertaken to even out imbalances in the natural distribution of resources, a point emphasised by Specht (1974) in his study of Buka Island trade. Many groups consciously chose to import commodities from their neighbours which they could themselves produce with little effort. Specialist production was therefore often socially prescribed rather than determined by inequalities in access to resources.

Most communities were only semi-specialised, depending on the trade of their particular products for a relatively minor portion of their livelihood. An exception were some coastal and small island communities which relied for the provision of most of their subsistence needs on maritime trade in specialist manufactured commodities. These constituted the ethnographically well attested specialist traders.

SPECIALIST TRADE

Commentaries by modern researchers on early historic specialisation in coastal and island Melanesia often emphasise the role of "specialist traders". This term covers those communities which derived all or a substantial portion of their subsistence requirements through exchange:

> ...Melanesian specialist traders use trade as a basic mode of subsistence procurement. They are not merchants, they are subsistence traders (Allen 1985:50).

Specialist trading communities characteristically occupied localities of marginal agricultural productivity (typically small islands, exposed reefs, and ecologically impoverished coastal situations) which were strategically located with respect to potential trade partners (Irwin 1983:57). Accordingly, most relied on frequent trade with neighbouring communities for the bulk of their subsistence requirements (see Harding 1967:30, for the Tami Islands; Hogbin 1935:398, the Murik of the Sepik; Irwin 1985:15-17, Mailu Island; Lauer 1970:168, Amphlett Islands; Seligmann 1910:195ff, Yule Island; Tueting 1935:9, Tubetube Island). An exception to this pattern were the Western Motu who, although conducting trade with their Koita and Koiari neighbours, depended on annual long distance trading expeditions known as *hiri* for the bulk of their wet season staple, sago (Barton 1910; Dutton 1982). *Hiri* expeditions took approximately four months, except when severe food shortages prompted emergency supply voyages of three weeks duration (Oram 1982:14). Some debate surrounds the question of why the Motu undertook these voyages; Oram (1982) contends that the *hiri* was an adaptation to ensure their survival in an ecologically unfavourable environment, while Allen (1984a:446) considers it an extension of a trade system established by the Motu before their migration into southeast Papua.

Most specialist trading groups undertook maritime trade with communities outside the orbit of day-to-day exchange (see Irwin 1985:17 for the Mailu, Harding 1967 the Siassi, and Tueting 1935:14 the Amphlett Islanders). Aside from the Western Motu case, the primary purpose of long distance trade was to acquire not basic foodstuffs but an array of utilitarian and status commodities whose value could be increased by trading on to other communities. Most long distance trade involved the transfer of prestige goods (shell necklaces, shell armbands, dogs' teeth necklaces, boars' tusks); in the Massim *kula* (Leach and Leach 1983; Malinowski 1961 [1922]) and the Vitiaz Strait system (Harding 1967) this trade was motivated by the reciprocal exchange of complementary prestige items. Obsidian is not mentioned among these prestige items, and evidently was not a high status exchange commodity at European contact. Functionalist interpretations emphasise the role that prestige goods exchange played in maintaining the incentive for exchanging utilitarian goods over long distances

(Lauer 1970; Uberoi 1962), although such conclusions may understate the part trade assumed in reinforcing social ties (Persson 1983).

Long distance exchange was common to the majority of specialists but it was not exclusive to these groups. Some non-specialist communities which inhabited fertile regions and provided their own subsistence requirements, such as the western Papuan Gulf Elema (Williams 1932), the Wogeo of the Schouten Islands (Hogbin 1935) and the Dobu of the D'Entrecasteaux Group (Fortune 1963), also undertook long trading voyages. The actual geographic distances involved in long distance coastal trade varied from only 50 km to more than 600 km. Trading voyages took place far less frequently than local trade, occurring between once every three months and once every six years (Hogbin 1935:375; Irwin 1985:17; Malinowski 1961 [1922]:94, 207; Oram 1982:14). The timing of these voyages also depended on the annual cycle of favourable sailing conditions, mediated by the northwest monsoon and southeast trade winds in the region. Long distance trade routes were integrated with local systems of exchange to form series of "linked interaction systems" (Irwin 1985:19) or regional trade "spheres" (Harding 1967:18).

Producer Traders

Most historic specialist trading communities manufactured clay pots for trade. Other commodities such as armshells (Malinowski 1915:622) were also manufactured, although no mention is made of the production of obsidian implements or cores for further exchange. Pottery, in contrast, stands out in terms of both its singular importance as an exchange item and the sheer volume of pots produced (e.g. Allen 1977a:437; 1984a:435; Irwin 1985:15; Lauer 1970:166; Tueting 1935:32). Not all pottery was made or exchanged by specialist traders, but this industry formed the manufacturing base of the majority of these communities (Allen 1984a:410). In some regions producer traders had a virtual monopoly on pot production. Examples include the Papuan coast (Malinowski 1915; Oram 1982) and the northern Massim (Malinowski 1961 [1922]:282-283), although by 1968 other pottery centres had appeared in the latter region (Lauer 1970:170), showing that at least some production/trade systems were far from static. Production in other regions was shared with generalised trading groups, as was the case with the Tami Islands pottery producers of the Huon Gulf (Harding 1967:36) and the M'buke Islanders of the Admiralty Islands (Mead 1961 [1937]:211).

The making of clay pots was almost universally the domain of women among Austronesian speaking communities. Men sometimes assisted in collecting pottery clay, particularly in cases where the clay source was in neighbouring territory, as with the Amphletts' pottery industry (Malinowski 1961 [1922]:283). Although little information is available, it seems that production was undertaken more or less continuously to maintain a steady supply of pots for regular local exchange. In the weeks prior to a long distance trading voyage production was intensified to ensure enough pots were ready for the expedition (Irwin 1985:64; Oram 1982:12). Interestingly while men traded pots, women may have maintained ownership until the point at which the vessels were actually exchanged. This was certainly the situation for the Western Motu (Oram 1982:13).

The quality of the clay pots made by women of producer trader communities appears to have been very high. Malinowski (1961 [1922]:286) commented that Amphletts' pottery was the finest he had encountered in Melanesia, and analysis of Western Motu pots by Rye (1976) has shown the existence of a skilled and relatively sophisticated manufacturing technique. Irwin's detailed research on the modern (1970s) Mailu Island potters shows remarkable control over manufacture:

> All of the data...confirms that the modern potters of Mailu have a very sophisticated control of their craft and that the industry as a whole is very standardised. There is such uniformity in manufacture and firing that it is

> not possible to distinguish potters in the areas [of the village] examined. In every respect including the formal, decorative, spatial and sociological distribution of ceramic attributes, the industry is quite homogeneous (Irwin 1985:64-65).

No comparative data are available on the degree of craft skills in pottery production among communities not depending on trade for their subsistence. However in some regions locally made pots were considered inferior to those made by specialists and the local product was reserved for only mundane usage (Tueting 1935:11, 28). This provides some indication that pots made by specialist traders were at least in some cases technically or stylistically more refined than locally made vessels.

Middleman Traders

One aspect of specialised trade which deserves particular mention is intermediary or middleman exchange. This involved redistributing commodities acquired during both local exchange and long distance trading voyages. Almost all producer traders engaged in middleman exchange (e.g. Allen 1977b:404; Irwin 1985:17). However some middleman traders were principally traders, not manufacturers. These groups relied for much of their livelihood on the "profit" obtained from controlling the flow of consumables and manufactured items between producer groups. The two best documented of these groups are the Siassi Islanders of the Vitiaz Strait (Harding 1967; 1970) and the Titan speakers of the southern Admiralty Islands (Schwartz 1963). The inhabitants of Tubetube in the southern Massim were also middlemen traders whose livelihood depended predominantly, although not exclusively, on re-exporting commodities imported from neighbouring islands (Macintyre and Allen 1990). Obsidian is mentioned as one of the items exchanged by all three groups. The Siassi and Tubetube apparently traded obsidian as unworked pieces (Harding 1967:42; Macintyre and Allen 1990:127) while the Titan exchanged it in the form of unworked blocks and spear and dagger points, specifically manufactured by communities on Lou Island (Mead 1963 [1930]:221; 1956:250). There is no indication in any of these cases however that obsidian was regarded as a prestige commodity. The inhabitants of Tubetube for instance classified obsidian as a *pali* commodity, i.e. a utilitarian item of fixed value (Macintyre and Allen 1990:127).

ETHNOGRAPHIC ANALOGY AND PREHISTORIC PRODUCTION AND TRADE

The particularly rich ethnographic data on production and trade in New Guinea and Island Melanesia briefly reviewed above provides a valuable corpus of material for comparison with evidence uncovered by archaeology. Prehistorians have used such information in particular to model changes which took place in commodity distribution patterns after the beginning of the Lapita cultural phase.

Archaeology has revealed that around 3500 BP a distinctive elaborate dentate stamped pottery appeared in assemblages in Melanesia. Associated with the appearance of pottery was the introduction of the dog, the Polynesian rat and possibly the pig, as well as a number of technological innovations, including improved fishing technology, possibly new food storage and cooking techniques, and new adze and shell ornament varieties (Green 1992). This material repertoire has come to be known as the "Lapita Cultural Complex". Considerable debate has taken place in the last decade over whether the appearance of this complex represents migration out of Island Southeast Asia (Bellwood 1989; Spriggs 1989) or mainly indigenous development (Allen 1984b; 1991:1-2; Terrell 1989), an issue which is far from resolved.

The most remarkable aspect of the emergence of the Lapita complex is not so much the appearance of new traits, and perhaps settlement patterns, but (1) the wide geographic compass over which traits appear within an archaeologically brief time span, probably only a few centuries (Spriggs 1990), and (2) the subsequent movement of commodities (obsidian, pottery, lithics) between localities separated by sometimes extensive bodies of water. These two factors imply the appearance by 3500 BP of an organised maritime technology, including highly developed navigational ability in advanced sea-going vessels, enabling the maintenance of communication over thousands of kilometres (see Irwin 1992:31ff). By approximately 2500-2000 BP, although this date varies from region to region, distinctive Lapita pottery had been replaced by stylistically more heterogeneous regional forms, and long range contact between distant communities had declined in favour of the utilisation of more local resources.

A number of models have been proposed for the transformation of the Lapita cultural complex into its successors (see Spriggs 1992 for a recent review). Owing to the preliminary nature of archaeological research in Melanesia most of these draw heavily on ethnography, anthropology and linguistics to fill out gaps in the material evidence. This is also true for the more specific issue of change in production and trade, to which I will now turn.

MODELLING POST-LAPITA CHANGE

Archaeological evidence suggests that in western Melanesia prehistoric long distance trade systems became more localised after Lapita times (e.g. Allen 1985; Ambrose 1978; Egloff 1978; Irwin 1985; Kirch 1990; Vanderwal 1978). A number of investigators have used the detailed information on historic specialist trade to generate hypotheses concerning the direction of this prehistoric change. Their views can be divided into three broad models or scenarios which have been most fully articulated by three researchers - Kirch, Ambrose and Allen. The models are reviewed below.

Kirch Model

This model proposes that Lapita long distance distribution involved the exchange of prestige commodities between socially stratified communities, and that over time this was transformed into numerous localised egalitarian systems (Kirch 1988; 1990). Much of this model draws upon ideas advanced by Friedman (1982), although the suggestion of stratification in Lapita society has also been entertained by a number of prehistorians, such as Bellwood (1978:255), Hayden (1983) and Lilley (1985). Kirch argued that 3500 years ago people possessing a highly stratified social structure migrated into the Melanesian region. As migration proceeded eastward colonists enhanced their chances of successful colonisation by maintaining links to established parent communities to the west. This communication was facilitated through the exchange of prestige goods, including obsidian:

> The importance of exchange for Lapita communities did not lie in assuring access to certain material resources such as obsidian or temper, but as a formal mechanism assuring a 'lifeline' back to larger and securely established homeland communities.....The ability to draw upon the total range of social and demographic, as well as material, resources of a homeland community could have meant the difference between survival and extinction. A formal exchange system centering on the status-enhancing acquisition of prestige goods (shell valuables, high-quality obsidian, adzes, etc.) provided the social mechanism for maintaining what was in effect an essential component of the Lapita dispersal and colonization strategy (Kirch 1988:113-114).

Archaeological evidence for the production in some Lapita age sites of items resembling ethnographically recorded shell valuables is nominated as evidence for early prestige goods exchange (Kirch 1988:107-108). Long distance exchange was maintained for some centuries after colonisation of western Melanesia, and Kirch (1988:114) puts this down to the momentum generated by "social forces" within the nodal communities connected by these trade networks. A particularly significant aspect of the model is the suggestion that the manufacture of certain commodities (shell valuables, pottery) for long distance exchange was the preserve of specific communities (Kirch 1990:125), which provides a direct link with ethnographically recorded specialist manufacture.

The demise of regular long distance prestige goods exchange followed the establishment of demographic, ecological and economic self-sufficiency among coloniser communities (Kirch 1988:114). Hazardous long distance voyaging became unnecessary and was replaced by regionalised production and trade. Changes in the structure of trade after 2500-2000 BP are seen as proceeding hand in hand with a decrease in *societal* complexity, possibly arising from ultimately unsuccessful attempts to intensify subsistence production (Kirch 1990:130; see also Spriggs 1992:224). It is not clear from Kirch's published accounts (1988:114; 1990:128) whether a movement toward increasing or decreasing economic complexity is posited for the post-Lapita period.

Ambrose Model

The roots of this model lie with the question of whether the structural foundations of ethnographic Melanesian production/trade networks can be validly ascribed to systems of commodity transfer operating 2000-3000 years earlier. Ambrose (1976; 1978) was the first to query the assumption of historical continuity in ethnographic production and trade. He pointed out that the descendants of those Lapita migrants who colonised Polynesia lacked any vestige of specialised trade, which strongly suggests that whatever form Lapita production and distribution took it did not resemble ethnographic specialised Melanesian systems (Ambrose 1976:372). Instead Ambrose (1976:374; 1978:332) saw historical specialised trade as arising out of more generalised systems of transfer through adaptation to local ecological and social circumstances. Whether this change is considered directional or not is not stated, although Ambrose (1981) hinted that specialisation might oscillate rather than undergo lineal development. There is however no suggestion of evolutionary increase toward ever more complex and specialised systems as set out in Allen's model discussed below. The model also leaves open the possibility of a very recent date for the origin of Melanesian specialised production and trade, although this is not explicitly stated.

Allen Model

The fullest exposition of a model of change in past Melanesian production/trade systems has been provided by Allen (1977b:395; 1982:202; 1984a; 1985). On information obtained by himself and other researchers (Bulmer 1979; Irwin 1978a; 1978b; Rhoads 1980; Vanderwal 1973) Allen has formulated a detailed scenario for change in south Papuan coastal trade over the last 2000 years. He postulated that around 2000 BP people using pottery similar to Lapita and familiar with long distance commodity transfer migrated to the Papuan region (Allen 1984a:445). At 1200 BP the regional system experienced the first of many "disruptions" which saw trade networks becoming progressively localised and production focussed on a smaller number of communities, a pattern of change which ultimately resulted in the emergence of the production and trade systems of ethnography (Allen 1984a:446). Allen (1984a:433, 446) considered that the occupation of localities strategically placed to control production and trade in the Port Moresby area was carried out from the very beginning by pre-adapted specialised traders, which implies that group specialisation developed some time *before* 800 BP (the date for the first occupation of Motupore). This somewhat contradicts Allen's earlier statement (1977b:395) that complex (i.e. specialised) systems only developed within the last 500-800 years.

Allen hypothesised that an increase in the overall complexity of trade accompanied this spatial contraction. This took the form of an increase in diversification of food procurement, increasing population density, the growth of intra-community craft specialisation, an increase in the efficiency of maritime communication, utilisation of distant markets, and flexibility of local social organisation (Allen 1984a:442-443). To account for the absence of strong social stratification or centralised control of production and distribution in ethnographic times, the model posits that a threshold prevented the attainment of this order of complexity. Specifically, increase in the complexity of each trade system led to greater instability, which eventually resulted in system breakdown (Allen 1984a:443). This pattern of development and collapse occurred repeatedly in wavelike fashion over the last 2000 years of Papuan prehistory. Allen's model is evolutionary in that it proposes that each period of collapse returned a trade system to a level of complexity slightly higher than that of its predecessor, resulting in an overall increase in the complexity of trade systems through time.

This model does not altogether tally with evidence amassed by Irwin for the development of specialised pottery manufacture in southeastern Papua. Like Allen, Irwin made a case for evolutionary development but saw this as occurring late in the prehistoric sequence of the area (Irwin 1985:240-241). Additionally, contrasting Allen's model of fluctuating complexity, Irwin interpreted the rise of Mailu in terms of gradualistic change toward increasingly centralised and standardised production.

EVALUATING DIACHRONIC VARIATION

Was early historic specialisation the remnant of a more economically and politically complex Lapita system, one manifestation of an oscillating and presumably unstable system, or the end-point of an overall evolutionary trajectory toward ever greater specialisation? To examine these models requires investigating for a specific region first the origins of commodity distribution, and second the development of specialist craft production.

If obsidian is to be employed as our "measuring device" for illuminating change in production and distribution, then we face the likelihood that for many parts of Melanesia the information obtained from this material will be of only limited value. Information on historic economic specialisation reviewed in this chapter shows that within most regions obsidian artefacts were produced for expedient use rather than trade, and obsidian blocks constituted only one of numerous utilitarian commodities conveyed by specialist trading groups. For many situations obsidian is probably an insufficiently sensitive indicator of change to facilitate examination of the development of historic specialisation. However, the exception to this could be expected to be those regions where obsidian occurs naturally and was an indispensable tool making material. One such region is the Admiralty Islands (Figure 1.1). Here, as I will outline in Chapters 2 and 3, obsidian is present as natural deposits in a number of localities, from where in historic times it was transported throughout the archipelago by specialist traders. Obsidian deposits were first utilised around 12,000 BP (Chapter 4), presenting a sequence of obsidian use extending back to well before the appearance of pottery and enabling the models of economic specialisation discussed above to be placed in wider temporal perspective.

This thesis therefore addresses the issue of the development of economic specialisation by reference to change in obsidian use in the Admiralty Islands from the late Pleistocene to early historic times. To facilitate this discussion the thesis is organised into four parts. Part One (Chapters 2 and 3) provides an introduction to the study region and a review of ethnographic data on economic specialisation, particularly with reference to obsidian distribution and obsidian spearpoint production. Part Two (Chapters 4 and 5) examines the origins of obsidian distribution and outlines evidence for change in access to obsidian as revealed in assemblages from the islands of Manus and Mouk. Part Three (Chapters 6 and 7) introduces four obsidian production localities on Lou Island and presents evidence for the development of craft specialisation in retouched obsidian point manufacture. Part Four (Chapters 8 and 9) provides a summary of chronological change in obsidian use and discussion of how this compares with the models advanced by other commentators for the development of specialisation.

PART ONE: HISTORICAL CONTEXT

CHAPTER 2
THE ADMIRALTY ISLANDS: ENVIRONMENT, SOCIETY AND ECONOMIC STRUCTURE

INTRODUCTION

The Admiralty Islands are situated approximately 300 km off the northern coast of New Guinea and 270 km west of New Hanover (see Figure 1.1). The islands form the Manus Province administrative unit of Papua New Guinea. The provincial capital, Lorengau, is situated on Manus which, at approximately 95 km by 30 km, is the largest island in the archipelago. Other major islands include Los Negros (separated from Manus by a narrow channel), Rambutyo, Lou, Baluan, Tong and Pak (Figure 2.1).

ENVIRONMENT

CLIMATE

The archipelago possesses an equatorial climate with high temperatures, humidity and rainfall throughout the year. Some regional variation probably exists between the large landmass of Manus and the smaller islands, but information on inter-island climatic differences is unavailable as all recording has been carried out on coastal Manus and Los Negros. Data for Manus indicate a grand mean annual temperature of 27^{o} Celsius, minimum and maximum means of 24^{o} and 30^{o} Celsius, and no marked variation for any month (Freyne and Bell 1982:15). Humidity is also constant throughout the year. Mean monthly humidity for Momote on Los Negros varies between 70% and 80% (Kisokau 1980:13). Mean annual rainfall for four recording stations on Manus is between 3,300 and 4000 mm but greater variation can be expected between inland and coastal localities (Freyne and Bell 1982:8, 9). There is no marked dry season in the islands.

FLORA AND FAUNA

Almost half (48%) of Manus is under rainforest cover (Freyne and Bell 1982:28). Some of this, particularly on the western end of the island, is dominated by one or two species suggesting former natural or anthropogenic disturbance. Gardens and regrowth account for 37% of the vegetation (Freyne and Bell 1982:28). The remaining 15% is comprised of tree swamp, mangrove cover, sago palm and coconut plantations. Larger off-shore islands such as Rambutyo and Lou also possess rainforest cover while some smaller islands are completely planted with coconut plantations (Kisokau 1980:30).

Fauna of the Admiralty Islands is dominated by birdlife and reptiles. Kisokau (1980:62-64) lists 42 species of land bird, 15 shoreline and reef species, 12 open ocean species, and 10 freshwater species. Reptiles include two species of crocodile, five of turtle, 11 lizard species and two species of snake (Kisokau 1980:65-66). Few mammal species are present in the archipelago (Kisokau 1980:65), and at least one (*Felis domesticus*) is a European introduction. The majority consist of various species of bat (Kisokau 1980:65; Kula et al. nd:15). Other mammals include pig (*Sus scrofa*), cuscus (*Spilocuscus maculatus* and possibly also *Phalanger orientalis*), bandicoot (*Echymipera kalubu*) and rats (*Rattus* spp.). Kula and colleagues (nd:14) record that 39 bird species, 10 mammal species and five species of reptile were considered of economic importance by people inhabiting western Manus. Many terrestrial species were introduced relatively late in the history of the islands, the truly indigenous land fauna is relatively small. The marine component has therefore always been very important in the diet of the islanders.

GEOLOGY

The Admiralties are situated on the North Bismarck plate, a region of tectonic activity resulting from the convergence of the northward moving Indo-Australian plate and the South Bismarck and Solomon Sea plates (Johnson 1976). The archipelago is located near the centre of the North Bismarck plate, away from zones of seismic activity on the boundaries of the plate (McCue 1988:42-44). Recent Quaternary volcanism in the archipelago probably represents localised intra-plate activity and hot spot volcanism (Jaques 1981:217; Johnson and Smith 1974; Johnson et al. 1978).

The archipelago is characterised by a diverse and complex geology. The oldest rocks outcrop in central Manus and are of middle Eocene to earliest Miocene age (Jaques 1980). These were formed by volcanic activity from plate-boundary friction at a time when the Admiralties were situated on a region of plate conjunction (Jaques 1981:216-217). In western Manus, Pliocene deposits are overlain by Pleistocene basalt which erupted from the now extinct volcanic centre of Southwest Bay around 1.7 million years ago, according to Jaques (1981:215). The rock formations of Manus are fringed in coastal regions by Quaternary coral reefs and alluvial deposits. Evidence for uplift of some former reefs is visible on Manus, early Pliocene coral deposits in a number of areas are now up to 80 m above sea level (Francis 1988:38) and in near coastal situations possess wave notches between 2 m and 4 m above present sea level (Francis 1975:71), while late Pleistocene/Holocene coral reefs on the south coast have been raised 4 m above sea level (Francis 1977:146). Uplift is probably due to faulting along the Manus Basin between the Admiralties and New Britain (Marlow et al. 1988:234).

The formation of the St Andrew Strait islands (Baluan, Lou, Pam Lin, Pam Mandian, St Andrew Group, Fedarb Group, and San Miguel Group) resulted from intra-plate volcanism, possibly during late Pleistocene or Holocene times (Johnson and Smith 1974:334). Activity is still occurring near Lou (Reynolds and Best 1976). Radiocarbon dating of tephra on Lou has revealed a sequence of eruptions stretching back 2000 years (Ambrose 1988; Pain 1981). Earlier tephras are present beneath these deposits but have not been dated. (The tephra deposits on Lou are useful chronostratigraphic markers for archaeological research, as discussed in later chapters). A hot mantle diapir probably underlies St Andrew Strait and has produced not only localised basaltic volcanism but also partial melting of the overlying basaltic crust (Johnson et al. 1978). This has resulted in geological variation between islands such as Baluan and those in the Fedarb Group, and has also produced extensive rhyolitic flows on Lou and the Pam Islands (Jaques 1980:5). The latter provide high quality obsidian which, as discussed later, was an important item of trade in prehistoric and early historic times. The only other rhyolite is found in localised deposits at the southwestern end of Manus Island (Kennedy et al. 1991). There is no geological information on the age of this material and obsidian from here was evidently not extensively traded in prehistory, as I will outline in later chapters.

Most other smaller islands of the archipelago, such as Los Negros, Tong, Pak and the minor low-lying islands, are raised Quaternary coral platforms. An exception is Rambutyo which, like Manus, is comprised of uplifted Tertiary rocks (Jaques 1980:2). The inhabitants of most islands therefore had direct access to only a limited range of rock types for implement manufacture.

POPULATION

BIOLOGY

A number of exploratory studies have been undertaken to determine the biological affinity of the inhabitants of the Admiralty Islands. The first was by Simmons and Graydon (1947) who compared blood group distribution between 42 Manus Islanders and 70 inhabitants of the smaller off-shore islands. No significant difference between populations was revealed. A later study of the blood group distribution and gene frequencies of 101 Manus Islanders and 39 people from M'buke also revealed no difference between the sampled groups (Booth and Vines 1968). A similar result was revealed by the comparison of gene frequencies between schoolchildren from M'Bunai and Pere villages (Malcolm et al. 1972). These investigators concluded (Malcolm et al. 1972:318) that the apparent absence of variation between inland and coastal populations was a result of gene flow over a considerable period of time.

LINGUISTICS

The people of the Admiralty Islands are exclusively Austronesian language speakers. The first observations and recording of the archipelago's languages were undertaken in the late nineteenth and early twentieth centuries (Healey 1976a). Comprehensive comparative studies have however only been carried out since the 1970s (Smythe 1970; Healey 1976b; Blust 1978; Jackson 1986; Ross 1988). The work of Ross (1988:315ff) is the most complete analysis of the languages of the islands so far published. Ross, along with other researchers, recognises Admiralties languages as forming a unique first-order Oceanic subgroup, divided into Proto Western Admiralty and Proto Eastern Admiralty. The latter incorporates Manus and adjacent islands

(Ross 1988:318). Ross identifies 26 separate languages in the Eastern Admiralty group. The distribution of these is illustrated in Figure 2.2 (after Ross 1988:Map 15).

Some claims have been made for external contact with the Admiralty Islands on the basis of linguistic evidence, with Smythe (1970) perhaps the strongest advocate. He proposed that the Titan language is closely allied with Indonesian vocabulary and advanced the idea that this represents recent migration from that region (Smythe 1970:1228-1229). However, this hypothesis has been questioned on linguistic grounds by Healey (1976b:360). Smythe also mooted the existence of a strong connection between some Manus Island languages and those of parts of Micronesia (Smythe 1970:1224-1228), although the basis for this comparison has been queried by Blust (1984:128-129). The possibility of contact between the Admiralty Islands and Micronesia has also been raised by Jackson (1986:226) and Ross (1988:326). Ross (1988:326) noted that linguistic similarities do not necessarily demonstrate direct contact between Micronesia and the Admiralties, and may instead reflect settlement of these regions from a common Mussau Island homeland.

It is not clear how the evidence for linguistic variation ties in with observed biological homogeneity. Malcolm and colleagues (1972:318) discounted the possibility that the populations they sampled might belong to the same biological population on the grounds that the two villages were linguistically differentiated, which is a rather circular argument. Explanations for this situation include the possibility that all of the people residing in these islands stem from the same biological population and developed a measure of linguistic differentiation over time, or that there has always been a great deal of gene flow but not linguistic assimilation between the islands' inhabitants. Elements of both hypotheses may reflect the actual situation. The archipelago has been settled since the late Pleistocene but all languages are a single subgroup of Austronesian, which linguists suggest has a time depth of no more than

3000-4000 years. A scenario could therefore be envisaged in which indigenous non-Austronesian speakers intermarried with Austronesian speaking newcomers and adopted their language(s). Over time linguistic differentiation took place, resulting in the contact situation of a large number of separate Austronesian languages spoken by the same biological population.

SOCIAL ORGANISATION

Population Groupings

Western commentators traditionally see Admiralty Islands society in terms of three broad groupings, Titan (referring to speakers of Titan, these people are often referred to in the literature as Manus or Manus Tru), Matankor and Usiai. The Titan are distinguished by both their language and settlement pattern on reefs and smaller off-shore islands south of Manus (Mitton 1979:15-16). The Usiai and Matankor are said to be distinguished not on linguistic grounds, since many languages are spoken by each, but by their distribution. The Usiai inhabit the interior regions of Manus while the Matankor are restricted to coastal Manus, islands to the north and the larger southern islands (Mitton 1979:15-16).

Exactly where this tripartite division of Admiralties society originated from is unknown. The first use of the word "usiya" (i.e. Usiai) can be found in the diaries of Mikloucho-Maclay (1876:71; 1879:161) and seems to be a generic term for "enemy". During the period of German administration the word Usiai encompassed only inland dwellers, while from this time the terms Manus (in the context of the Titan speaking group) and Matankor appear in the literature (Bennigsen 1908:623; Leber 1914:2; Parkinson 1907:297, 313-314; Vogel 1911:74ff). A map published by Meier (1907), which was probably drawn from information supplied by the son of a Titan bigman (Parkinson 1907:313), shows the perceived distribution of these three groups closely matches that described by Mitton (1979), who based his data on information supplied by a Manus Island student at the University of Papua New Guinea. The Titan are illustrated occupying smaller southern islands and coastal fringes; the Matankor inhabiting northern islands, larger southern islands and coastal areas on Manus; and the Usiai the interior of Manus (with the notable exception of an outlying community on Baluan).

Meier's identification of Usiai on Baluan is interesting as in the 1930s Bühler (1935) concluded from a comparison of physical attributes and material culture that a separate Paluan group inhabited Baluan and much of Lou. Bühler hypothesised that the Usiai represent the original inhabitants of the islands and were relegated to the interior of Manus Island following later migrations by the presumably culturally superior Titan, Matankor and Paluan groups (Bühler 1935:28ff). This theory of a correspondence between group affiliation and descendancy from different migrant populations appears to have been first advanced by Parkinson (1907:312), and has been more recently invoked by Schwartz (1975a:116-117). An underlying assumption in this is the cultural superiority of coastal inhabitants over those people who were supposedly displaced to the Manus interior. This view is perhaps most evident in the writings of Margaret Mead.

Mead conducted the first comprehensive anthropological research in the islands (Mead 1930, 1931, 1934, 1956, 1961 [1937], 1963 [1930], 1977). She adopted the tripartite division of Admiralties society, largely it seems from information obtained from the coastal people of Pere village with whom she lived. This undoubtedly coloured her perception of inland communities:

> The inhabitants of the Great Admiralty are called collectively the Usiai - a word meaning "inland" in the sea people's tongue. They are divided into many small groups whose languages are relatively unintelligible to one another, and their customs differ considerably one from another. They are united by a common agricultural way of life and a common hatred of the

> more aggressive sea people, who in turn despise them. Timid, underfed, often bandy-legged, fearful of the sea, the general contempt in which they are held seems to give them a certain awkwardness of aspect, - the uncertainty and clumsiness of gesture which so often characterize the lighter-skinned, smaller-bodied "man-o-bush" in Melanesia (Mead 1930:115).

A virtually identical description of the inhabitants of interior Manus was supplied to Parkinson (Parkinson 1907:314) by a Titan speaking informant almost 30 years before Mead's study. This reflects the contempt with which coastal informants held their inland neighbours.

The accuracy of the information on which Europeans based their division of Admiralties society can be seriously questioned. Indeed a number of early German observers saw no strict distinction for either the spatial boundaries or population composition of the Usiai, Matankor and Titan. Börnstein (1914:316) went so far as to suggest these social groupings were not relevant for Manus Island. Nevermann observed that ethnographers on the 1908 scientific expedition recorded a great deal of population movement, with membership of villages and some off-shore islands changing within a short time (Nevermann 1934:52ff). Many of the social characteristics employed to differentiate coastal and inland populations as separate "tribes" or "ethnic groups" pale into insignificance when viewed against the high degree of similarity in social and political organisation throughout the Admiralties (see Gilliam 1992:42). The population of the archipelago in early historic times can be more accurately conceived of as consisting of numerous autonomous villages.

Village Composition

In the early part of this century village composition appears to have been in a state of flux due to an almost continual process of fission and amalgamation. This was brought about by conflict between villages (Parkinson 1907:325, 328, 329), by discord between lineages within villages (Mead 1961 [1937]:212), or sometimes by fear of supernatural forces (Fortune 1935:76).

The main unifying factor in Admiralty Islands society was not the village unit but kin-based totemic groups (Carrier and Carrier 1991:35ff; Parkinson 1907:329). Mead (1934:206ff) described how each Titan speaking village was composed of a number of patrilineal unilateral groupings (clans or gens) in which membership was determined by descent from a common recent ancestor. Schwartz observed (1975a:120) that each clan possessed its own area within the village and owned sections of territorial resources, as well as particular material items and ceremonies. Property owning clan-based village organisation has recently been reported for the islands of Ponam, M'buke and Baluan (Carrier and Carrier 1991:38ff; Gustafsson 1992:201ff; Otto 1991:13ff).

Political Structure

Until recent times social status within Admiralty Islands villages was achieved solely through individual prowess. Mikloucho-Maclay (1876:79) remarked on the absence of hereditary leaders in Loniu village on eastern Manus while Parkinson (1907:331-33) noted the authority of "chiefs" rested on their ability to provide material goods to their retainers. Upon his death all the property of a leader, with the exception of land, canoes and obsidian-tipped spears, was distributed among the village so that potential successors were obliged to acquire their own wealth by initiating external exchange (Parkinson 1907:333). Mead (1934:204) observed a degree of hereditary social stratification in Pere village, while recent work has revealed the importance of inherited rank on M'buke and Baluan (Gustafsson 1992:235; Otto 1991:48-50). Nevertheless, maintaining a high status position was contingent on success in affinal exchange (Otto 1991:70-71) and, in earlier times, prowess in war (Mead 1934:204; Otto 1991:74-75; Schwartz 1963:65). A leader's influence was limited to an individual village and entirely contigent on local support, an authority Schwartz (1978:222) described as 'subject...to cleavage of the local constituency'.

HISTORIC ECONOMIC STRUCTURE

EUROPEAN CONTACT

The first recorded European visit to the Admiralty Islands occurred in 1528 with the visit of the Spanish navigator Saavedra (Sharp 1960:19-20). Although he spent three days in the island group the only information we have of interaction with the local inhabitants is a brief note of an attack on his ship (Nevermann 1934:1). Subsequent contact was made by Ortiz de Retes in 1545, followed by fleeting visits by Le Maire and Schouten in 1616 and Roggeveen in 1722. The explorer Carteret paid a visit in 1767, during which his ship was attacked by islanders wielding obsidian-tipped spears (Wallis 1965:194-195). Maurelle stopped over in the islands in 1781 but we have no information of any contact with the local population. A peaceful reception was given in 1791 to a visiting English ship commanded by Hunter (Hunter 1793:240), and similarly in the following year to the French explorer D'Entrecasteaux (Labillardière 1800:298-309). A number of ships made brief visits to the islands during the first half of the nineteenth century (Nevermann 1934:4-6), but published accounts provide little information on the nature of any contact.

The *Challenger* expedition of 1875 undertook the first scientific study of the islands (Spry 1877:267-273). In 1876 and 1879 the Russian ethnographer Mikloucho-Maclay made extensive observations on the people inhabiting the eastern end of Manus and islands off the north coast (Mikloucho-Maclay 1876; 1879). Coastal surveys of the islands south of Manus were conducted by the British naval ships *Danae* and *Beagle* in 1879 and 1880 respectively (Nevermann 1934:7). German and

Russian warships also made visits in the early 1880s. By this time traders were making frequent expeditions to the archipelago, mainly in search of pearlshell, tortoiseshell and *beche de mer* for Asian markets. In 1876 a doomed attempt was made to establish shore-based trading stations on the northern and southern coasts of Manus and on Andra (Mikloucho-Maclay 1879:155ff). An equally unsuccessful attempt was made on Rambutyo in 1881 (Nevermann 1934:7, 9).

In 1884 Germany annexed the Admiralty Islands, along with New Britain, New Ireland and portions of the northeast coast of mainland New Guinea. German interests lay more with the mainland than the Bismarck Archipelago so virtually no attempt was made to impose an administrative structure in the latter region until well into the 1890s (Hempenstall 1978:126). Of the islands in the Bismarck chain the Admiralties were considered the most peripheral and therefore remained largely uninfluenced by German rule until the turn of the century. The establishment of European trading stations in the Admiralty Islands during the 1890s remained a hazardous undertaking, with six traders killed during this decade (Hempenstall 1978:153). Sometimes bloody reprisals by the German navy in the late 1890s were largely ineffectual and failed to deter attacks (Hempenstall 1978:153-154; King 1978:62-63), although in 1898 two German traders did establish a permanent station on southeastern Manus (King 1978:48). One consequence of these trading expeditions was an increased opportunity for islanders to acquire firearms. This increased the scope of conflict between villages, with one oral account recording how armed villagers from M'buke Island south of Manus succeeded in defeating a chain of villages as far north as Pityilu Island (Crocombe 1965:50).

The first decade of the twentieth century witnessed continued attacks on traders, prompting the administration to mount a major military expedition every eighteen months (Hempenstall 1978:154). The turning point probably came in 1909 with the appointment of the first islander government officials (*luluais*) to assist in enforcing German law (Hempenstall 1978:154-155). In 1911 the Imperial administration established a permanent government station at Lorengau on northeastern Manus. By this time European businesses had established a firm foothold in the island group, which offered new sources of labour and land for copra plantations (King 1978:119-120). The strengthening German hold on the islands saw the arrival of ethnographers such as Thilenius in 1899, Parkinson in 1904 and the 1908 Hamburg scientific expedition (Nevermann 1934). By the outbreak of the First World War the process of pacification was well under way. A direct reflection of this was a steady increase in the number of men recruited for wage labour on German plantations (Hempenstall 1978:158).

PRODUCTION AND TRADE 1800-1975 AD

First Observations

Eighteenth and nineteenth century visitors to the Admiralty Islands frequently remarked on the propensity of the islanders to engage in barter (Hunter 1793:240; Labillardière 1800:300-302, 308-310; Moseley 1877:412; Spry 1877:268; Romilly 1887:113; Ray 1892:5; Strauch 1892:228-229; Cayley-Webster 1898:305, 311-312, 314-316). Objects commonly exchanged for European goods (of which iron was the most prized) included shell ornaments, carved wooden vessels, textile products, stone axes, items associated with betel chewing, and obsidian-tipped spears. From the latter half of the nineteenth century human skeletal parts (Spry 1877:272) and sometimes live humans (Romilly 1887:113) were proffered for trade. Unfortunately, early accounts of trade are generally brief. Although we have glimpses of the kinds of goods which moved through the local exchange system, little information is available on how this system was structured. Some useful observations are present however in the journals of Mikloucho-Maclay (1876; 1879). Mikloucho-Maclay noted how the occupants of small off-shore islands and Manus coastal villages traded goods with the inland inhabitants of Manus, the example he gives is the exchange of hoop iron acquired from European ships (Mikloucho-Maclay 1879:169). No direct communication apparently existed between villages on the southern and northern coasts of Manus but the northern islands of Andra, Ponam and Sori were in regular and friendly contact (Mikloucho-Maclay 1879:173, 180). The people of Sori also appeared to have had (trade?) connections with the Ninigo Islands far to the west (Mikloucho-Maclay 1879:170).

The Admiralties in 1904

Much of the available information on the "early" economic system was recorded by Parkinson during a visit to the archipelago in 1904 (Parkinson 1906; 1907). Parkinson observed how the manufacture of specific items for trade was often the preserve of certain villages (see also Börnstein 1914 for a brief description of this). One of these items was pottery which although made in a number of villages was produced to a high quality in only a few, from where it was traded to other communities (Parkinson 1907:299). Parkinson mentioned three pottery manufacturing communities, those on the small islands of M'buke and Hus (1907:320, 327), and a village on the southern coast of Manus named "Tjapale" (1907:320). The Hus Islanders made pots from clay obtained from Manus Island (Parkinson 1907:327). Brief observations on pottery manufacture on M'buke and Hus were also made during the 1908 Hamburg scientific expedition (Nevermann 1934:236-237; Vogel 1911:92).

Shell "money" production was another restricted craft activity. This was confined to the women of the northern coastal islands of Andra and Sori (Parkinson 1907:323, 327). Strings of shells formed a kind of currency which could be used in exchange for a wide range of goods (Parkinson 1907:327). An apparently even more valuable exchange item were dogs' teeth. Unfortunately comparatively little is recorded on exactly which communities produced these for trade, but we do know that the value of dogs' teeth rapidly declined after the large-scale introduction of "counterfeits" by European traders in 1912 (Gustafsson 1992:55-56). Other group-specific manufactured products included canoes, the production of which was the speciality of inhabitants of the Manus coast and larger off-shore islands (Parkinson 1907:308), and baskets, belts and armrings, which were made exclusively by occupants of the Manus interior (Parkinson 1907:318). Some communities also supplied certain foodstuffs and raw materials, such as fish traded from Titan speaking villages (Parkinson 1907:319-320), yams from Baluan (1907:323), and obsidian from Lou (1907:318).

Little information is available on how commodities were transferred between islands of the northern Admiralties but in the south this was mainly carried out by maritime traders from Titan speaking villages. Parkinson recorded (1907:326-327) that Titan traders transferred shell money manufactured on Sori throughout the islands, and supplied the inhabitants of Pityilu Island with canoes from Rambutyo, pots from a number of Titan communities, and obsidian from Lou. Another form of commodity transfer was direct exchange. The Hus potters for instance traded most of their wares directly to neighbouring Manus (Parkinson 1907:327), while the inhabitants of Baluan traded food and other products to adjacent Mouk (1907:323).

Long distance voyages were made during early historic times. Parkinson (1907:295) observed that M'buke islanders visited New Hanover, as well as the Schouten Islands off the northern coast of the New Guinea mainland. His account makes no mention of the purpose of these ocean voyages, but the M'buke people are stated as intending to stay in the Schoutens for six months (1907:295) so it seems likely that these were more than occasional or accidental journeys. It is entirely possible, given the evidence from elsewhere in Melanesia, that these voyages were undertaken to maintain contact with distant trade partners.

The Southern Admiralties in 1928

The 1928 fieldwork of Mead and Fortune provided the first major synthesis of production and distribution in the Admiralty Islands. Although by the 1920s the Australian administration had the islands under firm control and outside influences were beginning to be felt, many attributes of pre-colonial society were still present or remembered from the recent past. Mead and Fortune were therefore able to record in greater detail than previous observers aspects of indigenous economic organisation.

Mead articulated how the Titan speaking Pere villagers with whom she lived were middlemen traders. She wrote (1930; 1961 [1937]:210ff) that a Titan near monopoly on the ownership of sailing canoes allowed them to dominate the cross-water transport of goods between inhabitants of the smaller islands of the southern Admiralties and communities on the south coast of Manus. They achieved this by exchanging goods with other Titan speakers, who subsequently traded the goods to their neighbouring non-Titan trade partners. Titan communities depended almost entirely on their ability to regulate the supply, and hence the value, of goods for their subsistence. This economic specialisation ensured that they had access to the widest range of food products and material goods of any of the communities in the southern Admiralty Islands (Mead 1956:50).

Mead (1956:49-50) wrote that as Titan villages generally owned little land they only produced fish for exchange. (Although this is somewhat contradicted by her statement, Mead 1961 [1937]:218, that large quantities of coconut oil and grass skirts were also produced for exchange by certain villages). An exception were the M'buke potters. At the time of Mead's research these people constituted the only Titan speaking community regularly manufacturing specialist craft goods for exchange. A relatively high level of production is indicated for this community. The potters were said to have produced one pot per person per day (Börnstein 1914:317), while groups of canoes travelled to Manus twice a week laden with ceramic pots for trade (Mead 1930:118). The explanation given for the existence of this Titan pottery-producing community was simply that M'buke was too far from from agricultural producers to facilitate trade in fish, so the islanders had to manufacture pots to provide a commodity to trade (Mead 1961 [1937]:211). However, the presence of Titan speakers on M'buke can be clearly traced to a migration from Manus some time in the early twentieth century (Crocombe 1965:44-49). Gustaffson (1992:127) has related that M'buke oral history describes an event in which the leaders of these islands allowed Titan speakers to settle in return for protection from raids by other Titan communities. The presence of Titan speaking potters on M'buke can therefore be plausibly explained as the result of historically recent intermarriage between M'buke women potters and immigrant Titan men.

Aside from the M'buke case, most craft production for trade in 1928 appears to have been in the hands of non-Titan speaking communities. Mead observed that these coastal and inland people produced a wide range of largely dissimilar products, reflecting the different ecological environments which they inhabited. Table 2.1 lists the consumables, raw materials and manufactured goods produced by these groups (information from Mead 1930; 1963 [1930]:221-223). Clearly production of some traded items was undertaken by more than one group. This illustrates a situation in which production and trade were regarded as social as well as economic activities, a point emphasised by Fortune (1963:206) in his description of the exchange of cooking water between inland and lagoon communities.

Ponam during the Post-War Years

The end of World War Two heralded massive change in production and trade. This has been discussed at length by James and Achsah Carrier for one Admiralties society, Ponam Island (Carrier 1992; Carrier and Carrier 1989; Carrier and Carrier 1991). Prior to the War Ponam Islanders relied on exchange with villages in many parts of the archipelago for their supply of assorted foodstuffs and manufactured products. However, in the post-War years huge amounts of surplus Allied military material entered local exchange networks. This inevitably replaced many indigenous products, which were often perceived as inferior. Additionally this period witnessed increased access to imported goods purchased by kin employed in wage work outside the Admiralties (see Schwartz 1975b for the Admiralties as a whole). These two factors then, access to surplus war goods and, more important in recent decades, the importation of cash and the purchase of foreign products resulted in the disappearance of inter-island exchange. (Mead 1956:292-294 recounted a similar situation for Pere village in 1953). At the time of the Carriers' fieldwork (the 1970s) Ponam Island partner transactions had become limited to trade with communities on the neighbouring north coast of Manus for basic foodstuffs and building materials (Carrier and Carrier 1989:153ff).

The post-war accessibility to foreign made goods by many communities throughout the archipelago has witnessed the complete disappearance of almost all production for trade. This is exemplified by changes in pottery manufacture. Although pots continue to be made for personal use at a number of localities in the archipelago (May and Tuckson 1982), the number of villages making pots specifically for trade has declined since the turn of the century; Parkinson (1907:320-327) observed three major specialised potting centres in 1904, Mead (1963 [1930]:222) two in 1928, while the last one ceased production in the early 1950s (Carrier and Carrier 1989:81). This general decline in production has also occurred on Ponam. A notable exception to this pattern is shell money manufacture, which survived probably due to a change in the function of this commodity from a "currency" to a prestige item of bridewealth payment (Carrier and Carrier 1989:102). Interestingly, earlier this century the manufacture of shell money was the prerogative of the women of Andra and Sori (Parkinson 1907:323, 327).

ECONOMIC SPECIALISATION

The picture which emerges for Admiralty Islands society in the late nineteenth and early twentieth centuries is one of linguistically differentiated but biologically and culturally similar communities bound together in a system of economic interdependence. The foundation of this regional integration was specialist production and trade. A comprehensive synthesis of this system has been provided by Schwartz (1963) from information obtained during his visit to inland Manus in 1953-1954, and from Mead's 1928 work on coastal communities (Schwartz 1963:94).

In his synthesis, Schwartz described how inland, coastal and small island communities undertook quite different forms of economic activity, which he (Schwartz 1963:75) termed "primary specialisation". The inhabitants of inland Manus, occupying the island with the greatest potential for agricultural and animal productivity, were at a considerable advantage over particularly the occupants of very small islands in this form of production. The second type of production Schwartz recognised is that which differentiated communities *within* these broad ecological zones. This "secondary specialisation" (Schwartz 1963:76) could involve monopoly on the use of very localised resources, in manufacture, or in access to the resources of other groups. The latter was particularly important as groups which controlled access could tap the wealth of producer communities. Although all islanders regarded specialisation in the use of particular resources and manufacture of specific products as the sole preserve of certain villages (Schwartz 1963:78), control over access to goods was not considered the perogative of any one village or group of villages.

In the southern Admiralties communities possessing "specialisation of access" consisted of those Titan-speaking villages which were strategically situated in offshore lagoons and on small islets, localities enabling control of inter-island trade. A similar system of specialist control of maritime trade was perhaps also present in the northern part of the archipelago, but information from here is sketchy. The ownership of trading vessels and control of trade routes among Titan villages may have been restricted to intra-community groups (Börnstein 1914:316), possibly specific lineages. On information gathered by Mead and Schwartz it is clear that although the inhabitants of maritime trading villages engaged in fishing, they relied for their basic livelihood on their speciality as conveyers of commodities. Items distributed by Titan traders included consumables (particularly sago), localised raw materials (such as canoe wood and obsidian), and numerous specialist manufactured goods whose production was the prerogative of specific land-based villages. Although Mead described Titan speaking villages as non-producing middleman traders it is clear from the M'buke case that they could conquer or amalgamate with other communities to acquire control of specialist production when the opportunity arose. It is quite conceivable then that the level of production undertaken by specialist traders in the nineteenth and early twentieth centuries fluctuated according to social, political and economic circumstances.

However, the extent of production for trade among Titan speaking communities at any one time is probably largely irrelevant; the main point is that their economic specialisation could only be sustained by the maintenance of group-exclusiveness over the production of certain commodities, and accordingly by the continuation of regular demand for these commodities by spatially separated communities. This relationship is illustrated by the mid-twentieth century disappearance of specialist trading communities following a shift to more generalised production with integration within a wider market economy.

The evidence presented in this chapter for the interrelatedness of community-specific production and inter-island trade can be used to formulate the proposition that in an archaeological context the material items of production can be examined to determine how significant the trade in these commodities is to the community's economy. Specifically, the production of high quality commodities (where "high quality" is determined by comparison with products manufactured in other communities) in quantities far beyond the needs of the local community will signal a community which is integrated within a trade system involving more than casual or infrequent exchange. In the next chapter I will examine this through the evidence for production of one material which was widely used and traded in the archipelago - obsidian.

CHAPTER 3
PRODUCTION, DISTRIBUTION AND ECONOMIC SPECIALISATION: THE OBSIDIAN EVIDENCE

INTRODUCTION

Obsidian occurs naturally in the Admiralty Islands in three known localities - the southwest region of Manus Island, the Pam Islands (Pam Lin and Pam Mandian), and Lou Island (Figure 3.1). Manus obsidian is present as stream sorted nodules at Southwest Bay and Mount Hahei (Kennedy et al. 1991). This obsidian has not been identified in archaeological assemblages outside southwestern Manus. Pam Lin obsidian occurs as exposures in the centre of the island and in near shore deposits, while obsidian on Pam Mandian is present as boulders and within rhyolitic flows (Ambrose et al. 1981a:7; 1981b:397). All obsidian is flake quality but that from Pam Mandian has a higher proportion of relatively inferior material (Ambrose 1981a:7).

Lou Island is the only source locality which has been investigated both archaeologically and geologically. The island is dominated topographically by 13 dormant volcanic cones, with one attaining a maximum elevation of 270 m above sea level. Lou is in fact entirely composed of volcanic deposits. The sequence of ashfalls was first described by Pain (1981), and recently revised by Ambrose (1988). Four tephras have been identified and dated by radiocarbon estimates obtained for charcoal and shell immediately underlying the ashes (see Ambrose 1988) - Rei ash (deposited 1650 BP), Pisik ash (1920 BP), Sasi ash (2100 BP), and Baun ash (undated but stratigraphically the earliest). These deposits have provided useful chronometric markers for archaeological investigation, as discussed in Chapter 6. Although currently dormant, the island has the potential for renewed volcanism, as vividly demonstrated by the 1953 eruptions which formed Tuluman Island 1 km off the southern coast (Reynolds and Best 1976). Obsidian occurs on Lou within eroded gully deposits, as water-rolled beach material, and in subterranean breccia which was prehistorically accessed by digging vertical mineshafts (Ambrose 1976:359; Ambrose et al 1981a:5-7; Fullagar and Torrence 1991:118-120). Obsidian from Lou, along with that from the Pam Islands, was widely distributed in Island Melanesia after approximately 3500 BP. In early historic times Lou appears to have been the main obsidian supplier for the Admiralties archipelago (Ambrose 1993:207).

OBSIDIAN AND ARCHAEOLOGICAL RESEARCH

Archaeological research was initiated in the Admiralty Islands for two reasons (Kennedy 1979a) - (1) to provide a general chronological sequence of occupation for the islands, and (2) to elicit information on the structure of prehistoric trading systems. Ambrose undertook the first archaeological reconnaissance in 1974, and this was followed three years later by a more extensive survey by Ambrose, Kennedy and Allen (all from the then Department of Prehistory, Research School of Pacific Studies, Australian National University). Two areas were subsequently selected for further investigation - the southeast coast of Manus Island and Lou Island (Kennedy 1979b:72). Investigations on Manus were directed to providing information on the sequence of settlement. The main focus of research on Lou was ascertaining the chronology of obsidian utilisation as part of a program to examine past obsidian distribution systems. I will begin by discussing the results of the Manus research and the debate that these engendered.

THE ISSUE OF CULTURAL CONTINUITY

Investigations on the southeastern coastal region of Manus were initiated by Kennedy and Allen. Kennedy excavated at two localities on Manus itself, in 1978 and 1979 at a cave near the south coast named Kohin (site register designation GDN), and in 1981 an interior rockshelter called Peli Louson (GFJ). Also in 1981 Kennedy excavated a site on Los Negros known as Father's Water or Papitalai (GAC). I will only summarise these investigations briefly here as they are discussed in detail in Chapter 5. The major of the three investigations was at Kohin Cave where an occupation sequence extending back to around 3500 BP was revealed (Kennedy 1981a:Table 1). The cave deposits contained obsidian and 2567 pottery sherds (Kennedy 1981a:Table 2). Four sherds from near the bottom of the site were dentate-stamped and clearly within the Lapita tradition (Kennedy 1981a:758). On the basis of this and the absence of Admiralties obsidian outside the archipelago before 3500 BP, Kennedy (1981a) postulated that the Admiralties may have been settled by Lapita colonists.

This hypothesis was revised following 1981 test pitting at Peli Louson rockshelter and a more substantial excavation at the Father's Water terrace site. Peli Louson revealed a date of 4610 bp (Kennedy 1983:116), while initial occupation at Father's Water was considered by Kennedy (1983:118) to have taken place in the period 4400-3800 BP. Obsidian was present in varying quantities throughout the stratigraphic deposits of both sites while pottery, none diagnostically Lapita, occurred only in the upper layers of both (Kennedy 1983:118). Kennedy suggested that continuity in ceramic characteristics and obsidian use, as well as associated indirect evidence for knowledge of maritime technology, was evidence of cultural continuity between ceramic and aceramic occupation phases (Kennedy 1981a; 1983).

Ambrose (1991a) has subsequently shown that sherds in the Kohin site, on which Kennedy based much of her hypothesis for continuity and change, have been almost certainly stratigraphically displaced. Nevertheless, the presence of obsidian throughout the layers of all of the localities investigated by Kennedy does demonstrate that a widespread distribution system was operating since before the introduction of pottery. However, the question remains whether this continuity of distribution reflects *in situ* cultural development or the adoption and utilisation of an industrially useful material by an immigrant people.

THE ISSUE OF PAST TRADE

By the time of Margaret Mead's ethnographic research in 1928 obsidian was no longer used or traded in the Admiralty Islands, having been supplanted by implements of iron and steel (Mead 1963 [1930]:231). Earlier observers noted the common occurrence of obsidian and its use for tools ranging from simple unmodified flakes to hafted implements (Cayley-Webster 1898:312; Labillardière 1800:303, 307; Mikloucho-Maclay 1878:428; 1879:169; Parkinson 1907:302; Romilly 1887:116). The earliest reference to obsidian dates to 1545 when Ortiz de Retes was attacked by islanders armed with what were probably obsidian-tipped spears ('Feuersteinpfeile' in Nevermann's translation, 1934:1). Hostile encounters with islanders brandishing obsidian spears continued until well into the 1890s (Schnee 1900:329). Parkinson (1907:311, 327) observed that obsidian from Lou was traded as spearpoints and unworked blocks. The amount of obsidian distributed to meet demand for spears and utilitarian implements must have been huge. Mikloucho-Maclay (1879:169) for instance recorded such an abundance during his stay on the small island of Andra off the northern coast of Manus that he doubted that there could ever be an insufficiency.

Although the historic trade of obsidian seems to have been restricted to within the archipelago, in prehistory this commodity was distributed far more widely. Archaeological research has revealed that from 3500 BP obsidian from Lou and the Pam Islands was transported to localities as distant as the Reef/Santa Cruz Islands and Vanuatu (Sheppard 1992:147; Ambrose 1978:331). Characterisation studies on obsidian from archaeological contexts show that the Admiralty Islands were a significant source for sites on the northern New Guinea coast, as well as those located in an island arc stretching from the Mussau Group, through northern New Ireland, and out to the Solomons (Table 3.1). Only a small proportion of obsidian from sites in the New Britain region and Remote Oceania was derived from Lou or the Pam Islands. On current evidence this obsidian never entered the distribution networks of southeast Papua or the Massim. A likely explanation for this is that source deposits are present on New Britain and Fergusson Island. Commentators have observed that generally the post-Lapita period saw an increase in the proportion of Admiralties obsidian transported to the northern Bismarcks and parts of the Solomons (e.g. Spriggs 1991a:230). Characterisation analysis undertaken during the "Lapita Homeland Project" (Allen and Gosden 1991) revealed that approximately 85% of Admiralties obsidian exported beyond the archipelago was obtained from deposits on Lou, with the remaining 15% originating from the Pam Islands (Bird in prep.). The only region outside the Admiralties archipelago where Pam Islands obsidian is present in significant quantities is the Mussau Islands, where almost exactly 50% of obsidian originated from the Pams (Bird in prep). If the Mussau results are excluded from consideration, Pam Islands obsidian comprised only 9% of the material transported beyond the Admiralties.

As recounted in Chapter 1, some prehistorians consider that the transfer of Admiralties obsidian to other regions of western Melanesia from around 3500 BP is evidence for the arrival of specialist traders, similar to those observed historically

(Kirch 1990). I have also outlined how this assumption has been questioned by Ambrose (1976; 1978) on the basis of comparison with ethnographically observed Titan middlemen traders. In the period 1978-1985 Ambrose undertook a program to examine how and when obsidian was utilised in the Admiralties, research which had the potential to provide a better understanding of why obsidian from this archipelago came to be distributed to distant locales. Ambrose excavated at five sites on Lou - Umleang (GBJ), Pisik School (GBC), Emsin (GEB), Sasi (GEF, formerly designated GDY) and Pisik Knoll (no designation). The Pisik Knoll excavation revealed little in the way of cultural material, but the other four uncovered pottery and quantities of worked obsidian. Details of these investigations can be found in Chapter 6; here I will provide only a brief overview. The Emsin and Sasi sites were obsidian workshops containing hundreds of semi-completed retouched points (Ambrose 1988:484; 1991a:107; Antcliff 1988). Radiocarbon dates place occupation of Emsin at approximately 1650 BP, that at Sasi 2100 BP. The Pisik School site is adjacent to and approximately contemporary with Emsin, but unlike its neighbour was not the locus of large-scale point manufacture (Ambrose 1991a:107). Umleang is distinguished by evidence of extensive obsidian working, much of which was probably associated with the use of a nearby obsidian mineshaft (Ambrose et al. 1981a:7; see also Fullagar and Torrence 1991). Recent results of obsidian hydration dating by Ambrose (in press) indicate that use of the mineshaft may have begun only within the last 200 years.

Ambrose and colleagues undertook characterisation analysis on obsidian from Emsin and Umleang to provide a chronological framework for the use of particular Lou subsources (Ambrose et al. 1981a; 1981b; Ambrose and Duerden 1982). Although preliminary, the results suggest that multiple obsidian sources were used at both sites, and that a chronological pattern exists to this utilisation (Ambrose et al. 1981a; 1981b). Interestingly, the study revealed that mineshaft upcast at Umleang possessed obsidian compositionally identical to some used at Emsin, suggesting that shafts were sunk to re-access deposits used 1600 years previously. Analysis was also carried out on assemblages from sites beyond Lou; within the Admiralties these consisted of Kohin and a test pit on Hus Island associated with a "modern" date (Ambrose et al. 1981a:14a); material from outside the archipelago included that from Masahet Island, Eloaua and Lossu. The results demonstrated a correspondence with the pattern for Emsin and Umleang; occupations dated to pre-1600 BP had obsidian compositionally similar to that found in Emsin, occupations occurring within the last 1000 years or so possessed a predominance of Lou obsidian similar to that from layers in Umleang dated to less than 300 BP (Ambrose et al. 1981a; 1981b). Although it is tempting to see this patterning as demonstrating change in trade patterns, a more likely explanation is that this reflects the burial of Lou obsidian deposits by major volcanic ashfall events over the last 2000 years (Ambrose 1988; Ambrose et al. 1981a).

Excavations on Lou therefore uncovered diachronic variation in the use of obsidian subsources, a pattern also shown by the temporal distribution of particular Lou obsidians in sites beyond this island. Continuity in the use of Lou obsidian in off-island sites demonstrates that periods of volcanically-induced disruption in the supply of this material did not result in its complete replacement in the external distribution system by obsidian from the Pam Islands, or sources beyond the archipelago. This may say something about the enduring nature of trade between the inhabitants of Lou and communities within and beyond the Admiralties archipelago. Additionally, the large-scale manufacture of stylistically similar retouched artefacts in Sasi and Emsin shows continuity in the production of a particular implement form over a period of perhaps 450 years, a time during which two major eruptive episodes blanketed Lou in tephra (Ambrose 1988:484). At least some artefacts of this style were traded beyond the Admiralties; similar artefacts have been found on New Ireland in association with a cultural deposit dated to 1700-1650 BP (White and Downie 1980:Fig 7), and on Buka from a possible 2500-2200 BP context (Wickler 1990:147).

The Lou investigations uncovered other lines of evidence for prehistoric contact with regions beyond the Admiralties. The most dramatic is a piece of worked bronze found in the Sasi site (Ambrose 1988). This provides unequivocal evidence that some form of communication existed 2100 years ago between the Admiralties and metal using cultures of Island Southeast Asia. Interestingly, Badner (1972) entertained the possibility that similarities in the art of the Admiralties and Indonesia could reflect direct contact between these regions (see also Kennedy 1982 for a similar discussion, and Ambrose 1991b for the possibility of past contact with Micronesia on the basis of similarities in stone mortar morphology). The clay composition of pottery obtained from the Lou excavations is currently being chemically analysed by Ambrose (1991a; 1992; 1993) for evidence of patterning in the distribution of pots, although research is at a too preliminary stage for any conclusions to be drawn. Trade connections between Manus and the Mussau group have been posited by Hunt (1989) on the basis of his sourcing work on Mussau ceramics. This ties in with the distribution of obsidian which in all of the Mussau sites so far investigated originated from mainly Admiralties sources (Kirch et al. 1991:157). However, Ambrose (1993:210) has observed that Hunt's analysis relies on data which are at best ambiguous.

OBSIDIAN USE IN HISTORIC TIMES

Obsidian was used for a range of utilitarian tasks in early historic times. Mikloucho-Maclay (1879:169) for instance mentions that flakes were hafted in wooden handles and used for cutting rope and vegetable tubers, while unhafted obsidian 'splinters' were employed for shaving, tattooing and surgical operations. However, most information contained in ethnographic accounts refers to the use of obsidian as weapon points. One of the first detailed descriptions of the use of obsidian-tipped spears was made by Carteret on his visit in 1767 (Hawkesworth 1773:383-385; Wallis 1965:194-195), during which islanders 'hove their darts and spears' at his vessel (Wallis 1965:195). By the first decade of the twentieth century the use of obsidian-tipped spears had largely ceased following the imposition of peace by German colonial administrators, evidently much to the satisfaction of communities depending on trade for their livelihood (Mead 1961:234).

Historic accounts mention three types of obsidian-tipped weapon - a crudely shaped obsidian blade mounted in a light wooden shaft up to two metres long (Labillardière 1800:311), a small obsidian flake in a much shorter shaft (Moseley 1877:409), and a short handled obsidian-tipped knife or dagger (Cayley-Webster 1898:315). I will refer to these as respectively spears, darts and daggers (Plate 1). Spears appear to have been the most common type observed by Europeans. These were stored in bundles on the platforms of the islanders' canoes (Linklater 1972:185; Mikloucho-Maclay 1876:67; Moseley 1877:409) and thrown *en masse* in engagements. Mikloucho-Maclay provides the following graphic description of their use in an attack upon a trading vessel in 1879:

> The number [of spears thrown at the ship] was so great that when the battle was over nobody had the idea of making a count of them; there were so many and all were so broken (the end is made from slivers of obsidian, a very brittle material) that in order to clear the deck they were just swept into the sea. Many of the spears pierced the thick doors of the cabin and in spite of the heavy copper wire screen and thick glass two windows were pierced (Mikloucho-Maclay 1879:157).

The use of throwing spears in warfare appears to have been widespread, Cayley-Webster (1898:316) noted that many of the men he encountered had spear wounds to their backs. Large obsidian flakes formed the points on most historically recorded spears, although wooden points coloured to appear like obsidian were also observed (Labillardière 1800:312; Linklater 1972:187; Moseley 1877:409; Strauch 1892:227).

Shaping of spearpoints was either non-existent (Moseley 1877:408) or minimal (Cayley-Webster 1898:309). Many late nineteenth century illustrations show spears with broken or very irregular points (Plate 1). This provides a contrast with the binding decoration, which on many pieces was intricate and well-formed (Plate 2).

Darts are seldom mentioned in historical accounts, probably because they were of little interest to European collectors (but see Birgham 1877:202; Hunter 1793:240; Moseley 1877:409). These were functionally similar to throwing spears and carried in bundles of approximately a dozen (Moseley 1877:409). Descriptive information is limited but from Spry's illustration (Plate 1) and the account given by Moseley (1877) they appear to have been undecorated with a point comprised of a small unmodified obsidian flake. Daggers are mentioned frequently, although they were not extensively traded with Europeans until the twentieth century (Torrence 1993:477). These were concealed on individuals, usually in the hair (Romilly 1887:116), presumably for close quarter combat. They probably also functioned as utilitarian knives (Parkinson 1907:298). Illustrations show elaborate decoration on the hafts of daggers, while the blades consisted of large unmodified or lightly modified obsidian flakes (Nevermann 1934:349).

Only fragmentary ethnographic information exists on the production of obsidian-tipped weapons. Actual manufacture, observed on one of the Pam islands by Parkinson (1907:311), involved the use of hard-hammer percussion to remove a blade flake from an obsidian block, followed by light retouching to form the final shape of the point. According to Nevermann (1934:236) in 1909 a commentator named Klink observed obsidian blocks being heated and then rapidly cooled to facilitate blade removal. Lou Island is invariably referred to as the main source of obsidian (Mikloucho-Maclay 1876:79; Parkinson 1907:329). Local oral tradition states that the manufacture of spearpoints ceased around 1910 when the German administration forbade their further production (Mitton 1979:68). A geological expedition which visited Lou in 1909 seems to have encountered no active obsidian working (Wichmann 1911). Although blade flake manufacture for weapon points probably did cease during the first decade of the twentieth century, a major impetus for this probably also came from a change in the function of obsidian-tipped spears and daggers from much needed weapons to items exclusively for personal adornment (Leber 1914:6) and European trade (Torrence 1993:470).

OBSIDIAN AND ECONOMIC SPECIALISATION

How was the historic production of obsidian and obsidian implements integrated within the ethnographically recorded system of specialist manufacture and Titan-dominated inter-island trade? Obsidian was certainly among the commodities carried by specialist traders. Parkinson (1907:327) even recorded the value of obsidian points in relation to other traded items, which interestingly shows spearpoints were considered less valuable than unworked obsidian. Given the evidence for widespread trade in obsidian and the very localised natural occurrence of this material, we might expect historic obsidian production to be the proprietary right of specific communities, as was the case with pottery, shell money, carved wooden bowls and numerous other manufactured goods (Chapter 2). In the following discussion I will review the evidence for this from both ethnographic sources and museum collections.

EVIDENCE FROM ETHNOGRAPHY

In the late nineteenth century the manufacture of obsidian spearpoints appears to have been limited to a small number of individuals in only a few villages. In 1904 Parkinson (1907:311) found that no one in two Lou villages and only one person on the Pam islands could manufacture points. Vogel (1911:118), writing of information obtained during Thilenius' visit to Lou in 1899, recorded a claim by islanders that obsidian knapping was carried out by no more than a handful of people residing in inland villages. Similarly, Nevermann (1934:235) observed that the 1899 expedition to Lou found that obsidian implement manufacture in a particular village was restricted to only a few people. Of course some caution must be exercised when interpreting these statements as the German colonial administration of the time had only recently brought warfare under control (Chapter 2). It is entirely possible that less than complete information on the extent of spearpoint manufacture was provided to visiting German ethnographers. Nevertheless on the face of the information it does appear that manufacture was not widespread in communities on these islands (see Fullagar and Torrence 1991:116 for a similar interpretation). The scale of obsidian manufacture had evidently declined by the time detailed observations were made. This probably occurred not long before the turn of the century. Hydration dating of flakes associated with mining shows that at least some mines were dug within the last 200 years (see above).

Prior to the late nineteenth century the acquisition of obsidian and production of obsidian implements were apparently controlled, well-organised activities. Thilenius' expedition to Lou in 1899 apparently discovered that obsidian deposits were owned by specific villages and the right to mine obsidian was the prerogative of the "chief" and his sons (Nevermann 1934:234-235). Knowledge of the spearpoint manufacturing process was a carefully guarded secret held by particular men or lineages (Nevermann 1934:236). A similar picture is evident from this oral account related by a present-day Lou village elder:

> Traditional belief tells that only select elders of the local Umbuangkoe clan could locate the boulders of obsidian and tell others where to dig the [obsidian mine] access shafts. Apparently ginger was chewed and spat onto a certain magical stone which, when carried, could tell the holder the location of boulders. Often closely spaced shafts were interconnected by horizontal underground galleries.

> Once located the boulders of black obsidian were dug out and hauled to the surface using a basket and rope of strong bush vine. Using a particular strong stone, pieces of obsidian were flaked into shapes suitable for use as spearheads, knives or scrapers, work only carried out by certain clan members in the community (Anon 1993:21-22).

In 1985 the same informant related similar information to Ambrose and Fullagar (Fullagar and Torrence 1991:117), adding that obsidian for spearpoints was always obtained from mines.

This information seems to show that by the late nineteenth and early twentieth centuries obsidian production on Lou was a remnant of a formerly more intensive system in which individuals specialised in particular aspects of production. The presence of disused mineshafts very possibly abandoned only shortly before the arrival of the first European ethnographers reflects an attempt to maximise production from a given area of land. This would make sense if movement around the island was constrained in some way, such as by a strict enforcement of territorial boundaries. When the evidence is brought together the picture formed is one of community control of obsidian production with the actual manufacture of implements undertaken by specific, skilled members of the community.

EVIDENCE FROM MATERIAL CULTURE

Ethnographic evidence reviewed previously in this chapter shows that obsidian-tipped spears were widely used in the nineteenth century in what seems to have been a period of endemic warfare. European collectors acquired large numbers of spears, especially from the mid-nineteenth century on. Many are today housed in various museums around the world. The work carried out by Torrence (1993) demonstrates that the analysis of these has the potential to provide significant information on change in production patterns. With this in mind I compared a late nineteenth century collection of obsidian-tipped spears held by the Australian Museum with data on two prehistoric collections of retouched blades recovered during surveys of southwest Manus (Kennedy et al. 1991).

The following comparison rests on an assumption that pre-contact retouched blades were intended to be used in a broadly similar fashion to historic spearpoints. Artefacts morphologically similar to those in the southwest Manus collections have been recovered from prehistoric contexts on Lou. These have been termed spearpoints (Ambrose 1991a:109; Antcliff 1988:48). This interpretation seems plausible. Although it cannot be proven that prehistoric retouched blades were used as the tips of throwing spears, their finely tapered distal ends do indicate a weapon point function of some kind. There is every likelihood therefore that retouched blades recovered from archaeological contexts are functionally similar to historically observed weapon points.

The historic spear assemblage examined in this study was collected by a Captain Farrell who from 1877 operated a trading station on New Britain. Farrell made frequent journeys to the Admiralty Islands, during which he obtained a large number of obsidian-tipped spears. In 1887 179 of these were accessioned by the Australian Museum. From this collection I arbitrarily selected 100 spears for analysis (Plate 2). The prehistoric retouched blades used for comparison were recovered by Kennedy and colleagues from localities GNE and GIU during the southwest Manus survey. The pre-contact status of these pieces is attested by an absence of European materials (glass, trade beads, etc) at their find-spot localities (Wadra 1990:30ff). Quantitative data on these artefacts were obtained from Wadra's thesis (Wadra 1990:Table 5).

Retouched blades in the GNE and GIU collections were broken and discarded at various stages in the production sequence. It seems reasonable to assume that the more heavily retouched pieces are associated with the terminal stages of manufacture, and that they are the closest examples of completed implements in the collections. I therefore compared these for morphological regularity with the Farrell spearpoints. Figure 3.2 illustrates plots of the size and shape distribution of the 100 Farrell points and blades in the GNE and GIU collections possessing retouch over more than 75% of their surface area. For the Farrell pieces width and thickness were maximum measurements, which strictly speaking are not exactly equivalent to the measurement through the artefact mid-section taken by Wadra for the Manus artefacts. I could not take the mid-section measurement on the Farrell points as in most instances the binding which attached the spearhead flake to its shaft obscured the proximal end of the flake. This made it impossible to determine where on the flake the central axis lay. This discrepancy in the measurements taken on the two assemblages is however not significant for the purposes of this study, which was directed to explicating the degree of variability in overall flake morphology to give a general impression of differences in the size/shape distributions of the assemblages. I used the coefficient of variation (V) to quantify the range of variability in width and point thickness, and the coefficient of determination (r^2) as a measure of association *between* width and thickness.

Examining the coefficient of variation first, little difference in thickness is apparent between the collections (Table 3.2). However, Farrell points exhibit greater variability in width than the other two collections. Values for the coefficient of determination show the relationship between width and thickness on the Farrell points is 0.11, while for the GNE and GIU collections the values are higher at 0.23 and 0.51 (Table 3.2). What this means is that there is only 11% association between width and thickness for Farrell points, while for the 39 GNE artefacts and the 33 GIU examples there is 23% and 51% respectively. The GIU pieces stand out as possessing a much higher correlation between width and thickness. All were made to a triangular sectional shape, similar to the situation reported by Antcliff (1988) for the Emsin assemblage on Lou. A significant difference is therefore evident for point width between the Farrell collection and the two Manus assemblages, while only minor differences in point thickness are evident. A much stronger correlation *between* width and thickness is demonstrated for the Manus points, which were purposefully shaped to a triangular sectional shape. For locality GNE 75% of artefacts exhibit a triangular cross section while 83% of pieces from GIU are triangular. This shape was accomplished by the application of extensive retouching to the lateral margins of a blade flake. By contrast no spearpoints in the Farrell collection were extensively retouched, and 13 bear no retouching at all.

The conclusion drawn is that the Farrell spearpoints are much less standardised in cross-sectional shape than the two prehistoric collections from Manus. It could of course be argued that Farrell and other European collectors were presented with "cheap" imitations of indigenous manufacture which were produced exclusively for trade with outsiders, while finely made points were reserved for indigenous exchange. This explanation however fails to account for the fact that none of the numerous historical observations on the spears carried and used by the islanders make mention of spearpoints as extensively modified as the retouched blades in the southwest Manus or Emsin collections. A decline in the skill and effort involved in obsidian production appears to have taken place. Some of this was almost certainly the result of European contact. Torrence's (1993) examination of a large number of obsidian-tipped spears in museum collections has revealed that the effort devoted to production decreased between the late 1800s and the 1920s. This is attributed to a shift from production for local exchange to manufacture for trade with European collectors, who favoured spears with elaborate haft decoration over those with artfully shaped points (Torrence 1993:475-476). The impact of European trade on indigenous manufacture certainly cannot be underestimated. In Chapter 2 I discussed how the increasing availability of foreign goods saw an inexorable erosion of local manufacture. In Part Three I outline in more detail the influence of European trade on obsidian point morphology.

This chapter has provided an outline of the historic production and trade of obsidian within the context of a system of economic specialisation. Historical information shows that the inter-island distribution of obsidian was the prerogative of specialist middleman trading communities, at least in the southern part of the archipelago. Obsidian-tipped spears are the obsidian implement most frequently mentioned in written accounts as traded between and used by communities throughout the Admiralties. The production of these was probably restricted to particular individuals or lineages, but detailed first-hand information is lacking as production had largely ceased by the latter part of the nineteenth century. A decline seems to have occurred in the skill involved in spearpoint manufacture; obsidian-tipped spears used and traded in the early to latter 1800s were armed with minimally shaped points, while in at least some prehistoric assemblages points were extensively retouched to produce a morphologically standardised form. This chronological variation is significant for it indicates that major change occurred in the context of production.

I have set the historical scene, let us now trace the sequence through from Pleistocene to Recent, so bridging pre- and post-Lapita periods to allow an evaluation of change in obsidian production and distribution. This discussion forms the next two parts of this thesis.

PART TWO: PREHISTORIC DISTRIBUTION AND USE

CHAPTER 4
OBSIDIAN USE IN PLEISTOCENE PERSPECTIVE: EVIDENCE FROM PAMWAK ROCKSHELTER

INTRODUCTION

In Part One I reviewed evidence for the production and use of obsidian and obsidian implements in early historic times. In this and the following chapter I examine the Pleistocene origins of obsidian use and outline chronological variation in source exploitation and tool production. This is carried out with reference to five excavated assemblages from Manus and Mouk. The earliest evidence for obsidian use in the Admiralties comes from Pamwak Rockshelter on Manus. This chapter provides a discussion of obsidian use at this locality.

PAMWAK ROCKSHELTER

Pamwak Rockshelter (site register designation GOD) is located 4 km inland from the south coast of Manus (Figure 4.1). The site consists of a limestone overhang shelter (Plate 3). The shelter is 30 m above sea level and 100 m west of the Losa River (misnamed Chobur River on topographic maps). North of the shelter is rugged terrain covered in dense rainforest while to the south is a swampy plain which reaches to the coast (Figure 4.2). Pamwak is today used as a temporary campsite during hunting and gardening activity. Evidence of recent use in 1989 and 1990 was present in the form of a remnant wooden bed at the rear of the shelter and glass bottles deposited along the base of the shelter wall.

EXCAVATIONS

Two seasons of excavation have been carried out at Pamwak. In 1989 Spriggs and Ambrose investigated two 1 m x 1 m squares (Squares 1 and 2 in Figure 4.3). This revealed a rich cultural deposit of shell and bone midden, flaked chert and obsidian, retouched tools, and axes of stone and *Tridacna* shell. A second excavation was undertaken in 1990, in which I participated. During this nine week investigation a further two 1 m x 1 m squares were excavated (Squares 3 and 4 in Figure 4.3), making a total of four square metres of excavation (Plate 4). Additionally, the baulk between the shelter wall and the excavation squares was removed in two segments. During the latter part of the first season and for the entire second season each square was divided into four 50 cm x 50 cm quadrants, so that the investigation proceeded by the systematic excavation of 16 separate quadrants. Two quadrants in Square 1 were excavated to a depth of almost 4 m, at which the base of the cultural deposit was revealed.

Excavation proceeded by 10 cm spits in the first season of excavation and 5 cm spits in the second. All material was wet-sieved through mosquito wire netting (1.4 mm mesh) and bulk samples were taken from selected quadrants and spits for laboratory sorting.

STRATIGRAPHY

In the preliminary report of the Pamwak investigation (Fredericksen et al. 1993) seven layers were described for the site. The identification of these was made on the basis of visual differences in colour, texture and composition. The layers are (Figures 4.4 and 4.5):

Layer 1: a disturbed dark friable soil with scattered shell (mainly freshwater species), pottery, bottle glass, small amounts of flaked obsidian and stone, and some trade beads.

Layer 2: a dense shell midden containing marine, mangrove and freshwater species; stone included numerous obsidian flakes as well as lesser amounts of oven stone fragments and flaked chert and other stone.

Layer 3: a mixed layer consisting of fragmentary shell midden and dark grey sediment.

Layer 4: a brown fine textured sediment with scattered shell fragments in the upper few spits and flaked obsidian and smaller amounts of stone throughout.

Layer 5: a dark grey to brown sediment containing flaked stone (predominantly locally available chert) and small amounts of obsidian.

Layer 6: a light brown sediment characterised by numerous small indistinct lenses and virtually no obsidian among the flake debitage.

Layer 7: a dense, compacted orange-brown clay containing flaked stone but very little organic matter.

These divisions were identified to facilitate broad comparison between squares. However, with the obvious exception of the Layer 2 midden, the distinctiveness of these layers is probably due to pedogenic processes rather than cultural activity. Although useful for providing an overview of the stratigraphic composition of the shelter, analysis by layer has the serious limitation that any fine-grained variation in human activity will be subsumed within a broad stratigraphic unit which may encompass a time period spanning more than a millennium (see discussion on dating below). For a more detailed explication of temporal change an analysis by excavation spit is required. In the following discussion I therefore employ individual excavation spits as the stratigraphic unit of study. The relationship between excavation spits and sediment layers can be ascertained by reference to the vertical scale in Figures 4.4 and 4.5 (Note that Spits 1 and 2 are 20 cm thick, the remainder are 10 cm).

DATING

A general chronology has been previously presented for Pamwak (Fredericksen et al. 1993:146-147); Layer 1 probably dates to within the last 2000 years, Layer 2 to mid Holocene times, Layers 3 and 4 to the terminal Pleistocene (c 11,000 BP for 4), while Layers 5, 6 and 7 have yet to be adequately dated but possibly represent occupation extending back to before 20,000 BP (Fredericksen et al. 1993:149). In all 32 radiocarbon estimates are now available, these are set out in Appendix A of this thesis. Calibrated age estimates at two sigmas are shown in Table 4.1. No reliable estimates are available below Spit 21, although flaked stone is present down to Spit 37. Dates of 6190 ± 550 b.p. (ANU 7508) and 5230 ± 450 b.p. (ANU 7509) have been obtained for Spits 34A and 28A, but these are far too recent to make stratigraphic sense. There is no obvious explanation for these anomalous dates, although sample contamination is one possibility. They have been omitted from Table 4.1. Ascertaining radiometric determinations for lower excavation spits is made difficult by the paucity of organic material from deeper deposits. Small flecks of charcoal obtained from toward the base of the excavation have been submitted for dating by accelerator mass spectrometry, but results are not yet available. Thermoluminescence has been shown to possess great potential for determining the age of Pleistocene deposits in this region of the world (see Roberts et al. 1990), and a case could be made for a further expedition to Pamwak to collect samples for dating using this technique.

In Table 4.1 some spits are shown with age ranges in parentheses. These are summed probabilities of estimates for two or more samples collected from the same spit;

ranges representing the highest percentage of the area under the calibration curve are shown (see Stuiver and Reimer 1993:8, 10). All dates are on charcoal and uncarbonised *Celtis* (native elm) seed. By weight *Celtis* seed is the most abundant non-marine dating material in Pamwak. While it is not known how groundwater uptake by a *Celtis* tree growing in a limestone environment will influence carbon accumulation in the tree's seeds, dates on *Celtis* do generally correlate with those on charcoal. Two dates on marine shell were obtained for Spit 8 of Square 1, on *Anadara* (ANU 6977) and an unidentified species (ANU 6978). These encompass an age range of 8138-5551 BP, which is significantly earlier than the most representative probability range of 9439-8503 BP on charcoal and *Celtis* seed.

Ambrose (1994) has recently undertaken hydration dating on obsidian from a 1.3 m column in the SE quadrant of Square 2. Using measurements taken from inside the internal fissures of flakes Ambrose found a fair correlation between age and depth. His results (1994:Table 2) are presented as a graph in Figure 4.6.

Comparison of all dates reveals the likelihood of disturbance within the site. An age range of 13,110-8204 BP obtained for Spit 21 in Square 1 is much too recent and should probably be discounted. Chronometric inversion is apparent for dates in Spits 4 and 5 in Square 1, and Spits 7 and 9 in the SW quadrant of Square 4. This is clear evidence of deposit mixing, also evident in fluctuations in the age/depth curve of obsidian dates for the SE quadrant of Square 2 (Figure 4.6). In the NW quadrant of Square 4 age ranges of 12,273-11,048 and 9644-8415 BP were obtained on samples collected from near the base of the Layer 2 midden. These are considerably earlier than other estimates for this deposit. Clearly, at least some of the midden has been mixed with earlier deposits.

Despite these chronometric inconsistencies the general pattern is one of increasing age with depth. Spits above the Layer 2 midden have not been dated by radiocarbon. However, the presence of distinctive pottery styles, including Sasi and Puian types (Ambrose 1991:106-109), strongly indicates occupation took place within the last 2000 years. Pottery was recovered from the uppermost spit of the midden in most excavation quadrants. Stylistically this is similar to sherds from overlying spits and some conjoins were observed between pieces vertically separated by up to 10 cm. Rather than representing a mid Holocene pottery tradition, it seems likely that this indicates the incorporation of later material within an earlier midden.

Radiocarbon estimates show the midden was deposited between around 7200 BP and 5000 BP. The combined probabilities for all age estimates obtained for the midden, discounting probabilities for the two anomalous old estimates for the NW quadrant of Square 4, indicate the deposit accumulated during the period 7180-5260 BP. The midden was clearly laid down over a number of occupation episodes, during which the shelter was probably a campsite for people focussing on the exploitation of marine and estuarine resources. Discrete shell lenses and bands of different compactness were evident within the midden, testimony to a series of formation events. More information on the composition of the midden will be forthcoming after analysis of its faunal component is completed by Corrie Williams of Monash University.

ARTEFACTS

One of the most notable features of the Pamwak investigation was the richness of the artefact assemblage. All diagnostic artefacts were recovered from obsidian-bearing deposits, i.e. above Spits 12-15. The provenance of artefacts is recorded for the four excavated squares in Table 4.2.

Pitchstone Flakes

Most numerous of the retouched pieces were 65 flakes of pitchstone, an opaque black fine-grained, almost glassy material, verging on obsidian. The chemical composition of six flakes was analysed using energy dispersive spectrometry (Appendix B, and below). This revealed a similar elemental signature to obsidian except for an iron content which is higher than found in any other volcanic glasses from the Admiralties. A correspondence plot by elements (Figure 4.7) shows that the six artefacts lie outside the compositional range of obsidian from known Lou and Pam Islands sources. Pitchstone is associated with rhyolite, as for example seen in the recent historic past when pitchstone, obsidian and pumice were formed with the 1954 eruption of Tuluman Island, off Lou Island (Reynolds and Best 1976). The Pamwak pitchstone was probably obtained from the same region as obsidian recovered from the shelter (below). Table 4.2 sets out the provenance of pitchstone flakes. It should be mentioned that only 56 pieces are shown in Table 4.2 as nine were found in the baulk; the vertical distribution of these for the baulk segment adjoining Square 2 is Spits 6-9, and Spits 5-8 in the segment adjoining Square 4. Sixty pitchstone artefacts are flakes of almost equilateral shape while five are blade-like (Figure 4.8). All five blade pieces were recovered from Spit 6 - one in Square 2 NW quadrant, three in Square 3 NE quadrant, and one in Square 4 SW quadrant. This restricted vertical distribution could mean they were deposited in the same period. Some pitchstone flakes were found in discrete groups, suggesting that they may have been cached; large numbers are particularly evident for Spit 8 in the NW quadrant of Square 2 and Spit 7 in the SW quadrant of Square 4 (Table 4.2). With the exception of a single item from the disturbed deposit in the NW quadrant of Square 4, all pieces were recovered from below the dense Layer 2 shell midden. This is slightly different to the distribution recorded in Fredericksen et al. (1993:Table 2), in which three pieces were considered to be associated with the midden. On the basis of stratigraphic distribution and radiocarbon estimates (Table 4.1) a terminal Pleistocene age for these artefacts seems likely, somewhere between 12,000 BP and 10,000 BP.

From the pronounced bulbs on most pitchstone flakes, it is evident that they were produced by a percussion technique. Very little pitchstone debitage was recovered from the site (Fredericksen et al. 1993:148) so it appears that completed tools were transported to the shelter. The presence of snapped flakes and reworked pieces indicates implements were reformed (resharpened?) in the shelter. Unifacial retouching was present on 47 square flakes and three blade-like pieces. This involved the removal of the platform and extensive modification of the proximal end of the flake. Retouching on blade-like flakes was restricted to the platform and was probably undertaken to facilitate prehension or hafting. On equilateral flakes retouching was more extensive and carried out to create a discoidal shaped implement (Plate 5). These implements are perfectly shaped for hand-held use, in which case the unmodified edge would constitute the cutting or scraping surface. There is however the possibility that retouching was undertaken to produce a steep angled working edge, in which the unmodified edge was probably fitted into a haft.

A high magnification microscopic study (up to x400) was carried out on one half of the retouched discoidal pieces in an attempt to determine the location of the working edge and possible tool function. Although the search for use-associated polish was somewhat hampered by the fact that most were not washed, in order to preserve residues, polish was visible on some retouched edges. However the evidence was too ambiguous to enable a conclusion to be drawn as to whether this was through use or haft abrasion. No traces of polish or use-wear were apparent on any unretouched edges. Interestingly most of the examined tools had *aroid* raphides throughout their adhering soil matrix. Identification of these was based on size and the presence of diagnostic barbs (see Loy et al. 1992:Figure 7). Raphides were not detected during examination of two blade-like flakes and three stone axes. Raphides and starch grains identified as *Colocasia* have been discovered on unmodified Pleistocene flake tools from a rockshelter on Buka Island (Loy et al. 1992). However, it is unlikely that raphides on the Pamwak discoidal tools are associated with implement use. All discoids have a matt patina on both dorsal and ventral surfaces. This must have formed after flake detachment, almost certainly over the thousands of years the tools lay in the shelter. The soil matrix within which raphides are present overlies the patinated tool surface, demonstrating that the raphides became attached to the tool *after* formation of the surface patina. Clearly, ascertaining the nature of the association between residues and pitchstone artefacts is not straightforward and requires a more extensive programme of research than possible here. In other research in the Bismarck archipelago, Brown (1988) and Fullagar (1992) have undertaken comprehensive residue studies using a range of visual and chemical techniques to identify flake tool function. Their results suggest that the flakes were used in a number of tasks involving the cutting and scraping of animal and pliable vegetal material.

Two pitchstone flakes were decorated with red ochre, including a blade-like flake possessing two vertical bands of ochre on ventral and dorsal surfaces (Plate 6). This raises the possibility that they were employed for more than mundane use. A pebble with red ochre banding was recovered from Kafiavana in the New Guinea Highlands (White 1972:99), but this form of decoration appears to be generally rare on stone tools in the New Guinea region.

Edge Ground Tools

Also recovered from Pamwak shelter were 16 *Tridacna* shell adzes and five stone axes (Plate 7). I draw the distinction between adzes and axes on the basis of bevel symmetry. All *Tridacna* implements possess asymmetrical bevels and consequently are here termed "adzes", while the edge ground tools are symmetrically bevelled and are classified as "axes". This is however not to say that this morphological distinction is necessarily correlated with function. Stone tools with symmetrical bevels have been recorded as being used in adze-like fashion in the Highlands of Papua New Guinea (Bulmer 1977:53).

The size/shape distribution of the Pamwak axes and adzes is illustrated in Figure 4.9. Table 4.2 sets out the provenance of all axes and 11 of the shell adzes. Five adzes are not included as they were recovered from the baulk, two from the segment adjoining Square 2 in Spits 3 and 4, and three in the deposit adjoining Square 4 in Spits 4, 7 and 8. The majority of shell implements are associated with the midden deposit but five in Square 2 and the northern baulk segment occur below the midden. Some have probably become mixed with the spits immediately underlying the midden but one, in Spit 9 of the SE quadrant of Square 2 (Table 4.2), appears to be too deep to be associated with the midden. There are two possible explanations; either this shell adze is of late Pleistocene age or there has been some vertical mixing of deposits in this quadrant. As we will see below, this latter possibility is more likely.

Four of the five stone axes recovered are simply water rounded cobbles which have been ground along one edge, although one does possess side notching or waisting, presumably for lashing to a haft (Plate 7). The exception to these pieces is the smallest ground stone implement, which is fully ground to form a symmetrically shaped small axe or chisel (Figure 4.10a). This was recovered from Spit 9 in the SE quadrant of Square 2, which has a calibrated age of 10,909-10,150 BP. Like the two axes in Square 1 and possibly one in Square 4 (Table 4.2), the fully ground implement appears to be associated with a Pleistocene deposit. This presents interpretative problems. In no locality outside Pamwak has a stone tool ground on all surfaces been found in a context older than the Holocene, and none have been found pre-Lapita in

Island Melanesia. When this early association is combined with the unusual presence of a shell adze in the same spit the conclusion which must be drawn is that some vertical mixing has taken place in the SE quadrant of Square 2, at least below the Layer 2 midden. A parsimonious explanation for this early date for a fully ground implement is that it was introduced from overlying deposits by mixing of the deposit, or, perhaps less likely, by purposeful deposition in a cache pit (for which there was no stratigraphic evidence).

Other Artefacts

Other diagnostic artefacts recovered from Pamwak included five pieces of worked *Trochus* shell, which are provisionally identified as fishhook blank fragments (Spriggs 1991b:309), one *Trochus* armband segment, and the tip of a bifacially retouched obsidian point (Table 4.2). Two fishhook blanks were associated with the midden layer while three occurred in spits up to 20 cm below this deposit, but probably still in Holocene occupation. *Trochus* shell fishhooks are not recorded ethnographically in the Admiralty Islands and have not been recovered from excavations elsewhere in the archipelago, although they have been identified in Lapita contexts on the Mussau Islands (Kirch et al. 1991:152). The armband fragment and obsidian point were recovered from a ceramic deposit in a spit or spits above the midden. A date of somewhere within the last 2000 years is likely for these.

Other pieces include a range of water-rolled cobbles from mainly Holocene levels. A number have impact crushing on one or more edges and were evidently used as percussive implements. Hammerstones for obsidian flaking are a likely function for some smaller cobbles, while the larger pieces were possibly employed in preparing vegetal foods. A selection of percussive implements is illustrated in Plate 8.

FLAKED STONE AND OBSIDIAN

The Pamwak investigation unearthed one of the richest flake assemblages for any rockshelter site in Melanesia. The approximately 7.5 cubic metres of excavated deposit yielded 27.7 kg of stone and 28.8 kg of obsidian. The bulk of the stone is chert, some of which is water rolled. Chert is present as nodules in the nearby Losa River and its tributaries (Figure 4.2). Most of the stone bears evidence of conchoidal fracturing but heat shattered material is also common. This indicates either post-discard firing or the use of heat treatment to aid flaking. Chert pieces are generally larger than obsidian, with the 14,043 items present weighing on average 2.0 gm in comparison with an average of 1.2 gm for the 23,788 obsidian pieces recovered.

The stratigraphic distribution of stone and obsidian by weight and count for each excavation unit in the four squares is presented in Tables 4.3 and 4.4. In Figure 4.11 the weight of stone and obsidian for each square is presented as grams per cubic metre of excavated deposit. What the graphs illustrate is a rapid decrease in the weight of stone following the introduction of obsidian. Clearly, imported obsidian rapidly replaced locally available chert and other stone for the manufacture of flake tools. The graphs also demonstrate variation in the amount of obsidian between squares. Squares 1 and 3, those squares placed near the front of the shelter, yielded relatively little obsidian while Square 2 and especially Square 4, both near the rear shelter wall, possessed large amounts of obsidian per unit volume. Obsidian debitage therefore appears to have been discarded toward the back of the shelter, presumably away from the living area.

Tables 4.5 and 4.6 present a breakdown of obsidian distribution by quadrant. Some detailed information is missing for Squares 1 and 2 because in the first excavation season a detailed record was not kept of location by quadrant. A number of very small pieces were recovered from lower spits than shown in the tables; specifically one piece from each of Spits 18, 19 and 24 in Square 1 (total weight 1.4 gm), and two pieces from Spit 16 in Square 2 (weight 0.1 gm). These are almost certainly intrusive and will not be considered here. The tables show that overall the highest obsidian concentration occurs in the midden layer.

This information is presented graphically in Figure 4.12. All quadrants except the NW quadrant of Square 4 show a rapid decline in the amount of obsidian above the midden. In this quadrant obsidian weight remains relatively high demonstrating either an episode or episodes of intensive knapping within the last 2000 years, or mixing of this deposit with the underlying midden. In comparison with ceramic-bearing spits in other quadrants, the uppermost spit of the NW quadrant in Square 4 was notable for the high amount of shell present. Stratigraphic disturbance is therefore a distinct possibility.

OBSIDIAN ASSEMBLAGE VARIABILITY

VARIABILITY IN SOURCE USE

The potential value of obsidian as an indicator of prehistoric interaction in the Melanesian region has long been recognised (Ambrose 1976; Smith et al. 1977.) Compositional analyses on obsidian have been invaluable in establishing how far (Ambrose and Green 1972; Best 1987) and how long ago (Summerhayes and Allen 1993) commodities were moved between the islands of Melanesia. Much research has focussed on determining the extent of chronological variation in the use of source areas and specific source deposits, or subsources (Ambrose and Duerden 1982; Ambrose et al. 1981a, 1981b; Bird et al. 1981; Summerhayes and Hotchkis 1992; Summerhayes et al. 1993). Particularly relevant to the Pamwak situation is research which has been undertaken on New Britain over the past few years (Summerhayes et al. 1993.; Torrence et al. 1992). This has looked at the development of distribution over a period extending back well before the Lapita phase of prehistory. Information on the differential use of subsources during the Pleistocene has been obtained. One particularly significant piece of information to come out of this research is that specific Talasea subsources may have been targeted for exploitation for reasons not connected with access or quality, i.e. for extra-economic reasons (Summerhayes et al. 1993:63). This is the kind of information which is needed for any reconstruction of developmental change in systems of trade and exchange.

The impetus for undertaking a characterisation study of obsidian from Pamwak was therefore the knowledge that this could reveal cultural patterning in the use of obsidian sources over time. A sample consisting of 172 obsidian pieces was selected for analysis. The majority (159) came from the SE quadrant of Square 2, representing 10% of all pieces in each excavation spit of this quadrant. Although only 0.7% of the entire obsidian assemblage by count was analysed the focus on a single column sample provided a good basis for stratigraphic comparison. I employed energy dispersive spectrometry (EDS) to measure the proportion of major elements in each piece. A number of statistical procedures were used to compare the compositional signature of these pieces with signatures obtained for obsidian from known deposits. In this way the Pamwak obsidian was "sourced" to geological provenance. A detailed discussion of the EDS technique and the statistical procedures employed in the analysis can be found in Appendix B.

Results of the characterisation analysis are summarised in Table 4.7. Three of the 172 analysed pieces are excluded from the table as these revealed signatures well outside the range for any other pieces. The reason for these anomalous results has not been examined. They are however distinct from the signature for any known source, including those in southwest Manus. Pieces originating from the Wekwok or Baun deposits on Lou were able to be distinguished from other Lou samples (Appendix B), but for ease of comparison I have in Table 4.7 included these with the Lou material. Three broad groups derived from the archaeological data are therefore shown in the table - pieces which correspond with obsidian from Lou, pieces corresponding with obsidian from Pam (i.e. Pam Lin and Pam Mandian) and pieces which form an entirely distinct group, which I have termed Source X. The latter is compositionally discrete from any of the analysed reference obsidian, but does fall very close to obsidian from the Pam Islands. This can be visually determined by examining the correspondence plot in Figure 4.13. A Pam origin would therefore seem likely for Source X obsidian.

Table 4.7 shows that Source X material predominates in the Pleistocene and early Holocene levels of the quadrant (Spits 7-16). Obsidian from Lou and Pam sources is present in only small quantities. This could indicate either only occasional use of these sources or the intrusion of obsidian from overlying deposits. The latter is perhaps more likely as some vertical mixing was evident in this quadrant (above). A sudden change occurs in Spit 6, the unit immediately underlying the Layer 2 midden (Spits 3-5). Seven of nine analysed samples from Spit 6 originated from a Pam Islands source. A predominance of Pam obsidian is maintained in Spits 4 and 5. However, in Spit 3, the uppermost unit of the midden, there is an increase in the proportion of Lou obsidian to almost 50% of the analysed material. This pattern continues into Spit 2.

The Pleistocene occupation of Pamwak (Spits 9-16 in the SE quadrant of Square 2, on radiocarbon dating) therefore saw an overwhelming reliance on Source X obsidian. Small amounts of Source X obsidian are present in the upper levels of Pamwak, but these are probably intrusive from underlying deposits. The basis for this interpretation is that no obsidian from this source has been identified by EDS or the more discriminatory PIXE/PIGME technique in any upper Holocene sites elsewhere in the Admiralty Islands (see Chapters 5 and 7). This presents further evidence, albeit indirect evidence, for stratigraphic disturbance in the Pamwak site. I would argue that utilisation of Source X had ceased by the mid Holocene.

The decline of Source X need not be due to purely social factors. If this source was situated on one of the Pam Islands its decline could easily be a result of the inundation of the deposit by rising Holocene sea levels. Alternatively, the volcanic activity and tectonic instability of the St Andrews Strait islands could account for the changes in obsidian source accessibility over time. Volcanism certainly had a major impact on the exploitation of various New Britain sources during prehistory (Summerhayes and Hotchkis 1992:132; Torrence et al. 1990; Torrence et al. 1992:91).

The Spit 6 shift to Pam Islands obsidian took place somewhere between 9440 and 8500 BP, on the basis of summed probabilities for age ranges on three radiocarbon samples from this spit. Deriving an absolute date for the subsequent emergence of Lou as a source of equal importance to the Pam Islands is more problematical. Spit 3 in the SE quadrant of Square 2, the unit in which there is a sudden increase of Lou obsidian (Table 4.7), straddles the transition between mid Holocene occupation and late Holocene ceramic occupation. The two alternatives are that Lou became an important source at either approximately 5000 BP, or at some time between this date and post-Lapita site reoccupation. The possibility therefore exists of a correlation between the advent of the Lapita phase of the prehistoric sequence and an increase in the circulation of Lou obsidian. Pamwak was not occupied in Lapita times so unfortunately a more refined chronology of obsidian use cannot be determined on data from this shelter.

VARIABILITY IN FLAKE PRODUCTION

Analysis of flake production was undertaken for two reasons. The first was to determine if change in lithic resource "maximisation" (Sheppard 1993) or "rationing" (Hiscock 1986) could be discerned from obsidian imported into Pamwak. Commentators have sometimes remarked that the size of obsidian blocks traded in Melanesia decreased the further they were transported from the source (Green 1987:246; Harding 1967:42, see also Watson 1986:8), while the value of the obsidian increased proportionally. Consumers at the tail end of a distribution chain could therefore be expected to have access to cores smaller than those acquired by communities further up the chain, and to treat these pieces in a more economical way. One of the few researchers to address this issue in Melanesian archaeology is Sheppard (1992; 1993). Sheppard's work on obsidian reduction in the Reefs/Santa Cruz Islands was specifically directed toward testing the "lithic maximisation" hypothesis. Surprisingly, he found that obsidian reduction in these remote islands in Lapita times was not directed to conserving raw material, something which he (Sheppard 1993:135) attributes to the social value of obsidian flake tools and cores being less than that of unworked blocks.

Despite the somewhat equivocal findings of Sheppard's research, the possibilities of employing a maximisation model as a way of measuring the degree of accessibility to obsidian are clear. In regard to Pamwak, analysing artefacts for variation in the economy of reduction was carried out to ascertain if the availability of obsidian had changed through time. I particularly wished to see if any evidence of more economical use of obsidian was correlated with changes in the utilisation of particular source deposits, as defined from the characterisation study. Such a correlation could provide evidence of significant change in the obsidian distribution network.

A second reason for studying variability in flake morphology at Pamwak was to determine the chronological origins of the blade technology observed at European contact, and uncovered by archaeological research on Lou and southwest Manus (Chapter 3). Five large pitchstone blade-like flakes were present in Pleistocene deposits at Pamwak (see Plate 6 and Fredericksen et al. 1993:Figure 7), while the largest obsidian flake recovered, from an early to mid Holocene deposit, was similarly blade-like in form (Figure 4.14). The presence of these demonstrates that the pre-ceramic occupants of Manus had the technological capability to prepare cores and remove long, narrow flakes. I wished to determine whether this technique continued through into the later Holocene by examining the shape profile of smaller, less spectacular flakes.

Obsidian Maximisation

All intact flakes from the following excavation quadrants were examined, Square 1/SE quadrant, Square 2/SE quadrant, Square 3/NE quadrant, Square 4/SW quadrant. Intact flakes are here defined as conchoidal pieces possessing both an intact platform and distal termination. In total, 649 flakes were selected for study. Three measurements were made on each. To gauge overall size each flake was weighed, while the shape of pieces was determined by measurement of medial length and medial width. A scatterplot of flake size and shape is illustrated in Figure 4.15.

In addition to size/shape, the presence of dorsal detachments was also examined. These are indicative of flake removal from a previously worked core and can be an indicator of the intensity of stone use. No retouching or macroscopic edge-wear was observed on any flakes from the four quadrants, although this does not necessarily mean none were used as implements (Fredericksen and Sewell 1991).

Most flakes had impact fractures on their striking platforms, large percussion bulbs, and distinctive percussion "ripples" radiating from the proximal end of the flake. All these features suggest flakes were detached by hard hammer percussion (Odell 1989). Many broken flakes in the four sampled quadrants possess platform remnants which had been completely crushed by hammer impact. A bipolar technique has been observed in obsidian assemblages from elsewhere in the Bismarck Archipelago (Freslov 1989; Goulding 1987) but this was almost entirely absent in the Pamwak assemblage. Bipolar reduction is one way of economising on raw material use as it enables flakes to be struck from very small cores. The virtual absence of bipolar reduction could demonstrate obsidian was easily available at all stages of occupation at Pamwak, although the use of this technique can also be a response to factors other than raw material shortage (Goulding 1987:86-87).

Stratigraphic variation in the size and shape of obsidian flakes in the four quadrants is illustrated in plots of mean flake width and length (Figure 4.16). Although there is deviation between quadrants, the overall trend is toward shorter and narrower flakes with increasing depth. The trajectory for each quadrant demonstrates a plateau in particular spits - Square 1, Spits 5-7; Square 2, Spits 3-5; Square 3, Spits 3-4; Square 4, Spits 1-3. These spits are generally those which possess the highest concentrations of obsidian, and are also those which either occur within or bracket the vertical distribution of the dense midden layer (refer Table 4.5). On this evidence it therefore appears that during mid Holocene occupation and associated shell midden deposition not only was a large amount of obsidian being imported into Pamwak, but it was being used for the production of flakes generally larger than those made in earlier occupation.

To facilitate comparison between the four quadrants I have divided the columns of each into four broad phases (Table 4.8). Phase I correlates with the ceramic period of site occupation over the last 2000 years or so. Phase II incorporates the time when the shell midden was deposited in the shelter. The top of the midden is defined by a sharp decline in the quantity of sherds and an increase in shell density. For quadrants in Squares 1 and 3 this approximately equates with the spit boundaries shown in Table 4.5. However, the boundary in the SE quadrant of Square 2 occurs midway through Spit 3 while for the SW quadrant of Square 4 this occurs midway through Spit 2 (2B). The base of the midden is defined by a sudden decrease in the density of shell. Phase III incorporates the early Holocene prior to the period of midden deposition. This is distinguished on the basis of the stratigraphic distribution of radiocarbon dates (Table 4.1). Phase IV includes all underlying Pleistocene age spits down to where obsidian first appears in any quantity.

Table 4.9 sets out comparative data on the flake assemblage by the four occupation phases. This confirms the impression of a stratigraphic decrease in flake size, and also indicates a trend in Phases I and II toward greater length relative to width. The large coefficients of variation in all phases reflect a wide distributional size range for flakes. To quantify the differences in flake weight, length and width between the four phases I employed a Mann-Whitney test (Siegel 1956:116ff). This is the non-parametric analog of a t-test and compares the means of two sets of observations to test the hypothesis that they derive from the same population. The probability values at a 95% confidence interval are presented in Table 4.10. A value of 1.00 indicates that the two populations are identical while a 0.00 value reflects entirely dissimilar populations. For difference between assemblages to be statistically significant requires a value of less than 0.95, which is a robust measure. It is clear from data in Table 4.10 that flake assemblages from all phases at Pamwak are *statistically* dissimilar. Nevertheless less variation is exhibited in weight, length and width between the flake assemblages associated with Phase I and II occupation than between Phase III and IV flakes. Flakes from Phase III and Phase IV form two entirely discrete assemblages, bearing no similarity with either one another or the flake assemblages associated with Phases I and II. This reflects a trend of decreasing flake size with increasing time depth for pieces recovered from early Holocene and Pleistocene deposits.

Table 4.11 contains information on the cores and core fragments recovered from the four quadrants. Cores are identified here as non-flake pieces possessing detachment scars on one or more of their surfaces. The scars are placed irregularly and bear little resemblance to the patterned scars produced by implement retouching. All cores in Pamwak are multidirectional (Torrence 1992:119). As with flakes, a decrease in size is apparent with increasing stratigraphic depth. Variability is also evident in the amount of reduction on each core and core fragment; the proportions of cores covered entirely with flake detachment scars are 30% (6) in Phase IV, 37.5% (6) in Phase III, 44.4% (4) in Phase I, and only 7.7% (2) in Phase II occupation. This suggests that a relatively low intensity of reduction per unit of imported obsidian was carried out in Phase II. This could be expected if a plentiful and easily accessible supply of obsidian was available at this time.

The picture which emerges is one of the production of small approximately square shaped flakes in Phase IV Pleistocene occupation. Dorsal detachment scars are present on 19% (34) of flakes in the spits of Phase IV. This is a surprisingly low proportion and could indicate that small unworked cores were transported to the site. Early Holocene Phase III saw a general increase in flake size, as well as an increase in the proportion of flakes with dorsal scars (29.2%). In mid Holocene Phase II occupation the pattern is toward larger and longer flakes. Dorsal scars are present on 25.7% (74) of Phase II flakes. Flakes in Phase I ceramic period occupation are very similar in length and width to those in Phase II. However, only 5.7% (4) of flakes possess dorsal scars, which again could indicate the importation of a relatively greater number of unworked cores.

Blade Technology

Traditionally flakes possessing a length dimension at least twice that of the width are referred to as blade flakes (Crabtree 1972:42). To avoid confusion with prismatic blades and microblades, introduced in following chapters, I will use the alternative term "elongate flake" when referring to long narrow flakes.

Elongate flakes are extremely rare in the four sampled quadrants (see Figure 4.15). In Pleistocene Phase IV, elongate flakes comprise only 2.8% (5) of the total. For Phase III the proportion is around the same, at 2.6% (3). Of the 288 flakes associated with Phase II occupation, 9% (26) are elongate. Elongate flakes constitute 8.6% (6) of the Phase I assemblage. A clear discrepancy exists between the proportions of elongate flakes in Pleistocene/early Holocene occupation, and occupation during the mid to late Holocene. Between these two periods the proportion increases three-fold. Interestingly, there is no real change between Phase II (mid Holocene) and Phase I (post-Lapita).

An examination of the entire obsidian assemblage revealed 10 microblades or microblade segments, all in mid to late Holocene deposits. Blades and microblades are here distinguished from elongate flakes by regular, parallel sides and the presence of a distinctive crest, indicative of removal from a blade core. These are illustrated in Figures 4.17, 4.18 and 4.19. One (Figure 4.17b) has been bifacially retouched into a form resembling some blades recovered from sites on Lou (Chapter 6), although it is much smaller. The low number of microblades demonstrates that reduction was principally directed to the production of flakes. The retouched segment was probably imported into the site already completed, perhaps for reworking after breakage.

Excluding the retouched microblade, only five obsidian pieces in the shelter have edge scarring which can be unambiguously classed as deliberate modification. These were not shaped to any particular form and were all recovered from spits associated with the midden. Four are illustrated in Figures 4.20 and 4.21. Six other pieces exhibit less regular edge microflaking which could be use-wear. Only one, from Spit 9B in the SE quadrant of Square 2, was in a Pleistocene context.

PATTERNS OF ARTEFACT USE

Major chronological changes took place in artefact use at Pamwak. The initial period of site occupation, beginning possibly before 20,000 BP on the basis of age/depth extrapolation, saw the use of water-rolled nodules for the manufacture of unretouched flakes. As I have mentioned previously in this chapter, stream cobbles are present in the nearby Losa River. On hand specimen comparison the nodules in Pamwak are lithologically similar to some of the river cobbles. I make the logical assumption that the Losa or its tributaries provided the source for the water-rolled archaeological stone recovered from the shelter. In comparison with the later obsidian flakes, the chert and other stone pieces from these levels are large. No pieces possessed retouch. The picture at this time is therefore of Pamwak being used as a stopover camp during expeditions inland.

Obsidian appears in the shelter around the time of the Pleistocene/Holocene transition. Its appearance is associated with a rapid decline in the use of locally available stone. Two age range estimates are available for this change, one of 13,129-12,625 BP (ANU 8253) from Spit 14 in the SE quadrant of Square 1 and the other of 13,802-13,247 BP (ANU 8242) for Spit 13 in the NW quadrant of Square 2. These estimates are statistically significantly different at a 95% confidence level; T = 11.35, chi square

= 3.84. The summed probabilities of these two estimates provides a range of 13,786-12,627 BP for the period when obsidian begins to be transported to the shelter. The virtual total replacement of local stone by obsidian after this time suggests the utilisation of distant resources was carried out sufficiently regularly to maintain a constant flow of material into the site. Obsidian used during Pleistocene occupation is compositionally unlike the southwest Manus source and is very similar to material from the Pam Islands. If these islands were the source, and on available evidence they are the best candidate, regular water crossings must have been made at this time. At this time crossings of approximately 20 km would have had to have been made to collect obsidian from the enlarged landmass that now constitutes the Pam Islands and Lou.

The appearance of retouched pitchstone tools and stone axes in the terminal Pleistocene signifies a major change in stone tool technology. Retouched implements of the kind found in Pamwak occur nowhere else in Melanesia, although tools very similar to the discoids have been recovered from early Holocene contexts in localities further to the west in Southeast Asia (Anderson 1987:223; Glover 1977:55). Edge ground axes are documented for the terminal Pleistocene on mainland New Guinea (White 1972:95), as well as Australia (Morwood and Trezise 1989; C. White 1967) and, further afield, Japan (Blundell and Bleed 1974). The appearance of edge ground axes in Pamwak may signify the beginning of land clearance and, by implication, the first stages in agriculture (Groube 1989; Spriggs 1993).

The early Holocene witnessed the disappearance of pitchstone implements but a continuation in the use of stone axes. *Tridacna* shell adzes probably appeared between the early and mid Holocene. In previous publications both Spriggs (1991b:309) and myself (Fredericksen et al. 1993:149) have argued for a late Pleistocene association for shell adzes at Pamwak. While an early occurrence remains a possibility, I now consider that evidence for stratigraphic disturbance, discussed above, makes it likely that some Holocene shell adzes have been displaced downward into underlying Pleistocene deposits.

A marine focus to occupation in the early Holocene is evident in the presence of sparse midden and *trochus* fishhook blanks. This economic focus is probably a reflection of rising sea levels transforming the shelter into a near-coastal locality. In the period 9400-8500 BP obsidian from known Pam Islands source deposits came to replace Source X obsidian.

Between approximately 7200 BP and 5000 BP occupation of the shelter was heavily associated with marine exploitation. This is clear from the presence of a dense marine and estuarine midden in all excavation squares. At this time Pamwak may have been at its closest to the shoreline, although any estimate of distance is dependant on more information on the rate and timing of Holocene uplift on southern Manus (Chapter 2) Shell adzes and fishhook blanks are associated with the midden. The amount of obsidian reaching the shelter increased dramatically. The Pam Islands were the major obsidian source during this occupation but obsidian from Lou begins to appear in significant quantities. At some time between approximately 5000 BP and 2000 BP obsidian from Lou became as important as that from the Pam Islands.

After the mid Holocene there appears to have been an hiatus in site occupation until the last 2000 years or so. Pottery associated with occupation at 2100 BP and 1650 BP elsewhere in the Admiralties is associated with the terminal occupation phase at Pamwak (Phase I). Generally, this occupation is ephemeral in comparison with the earlier Holocene. Edge ground tools are absent and an overall decline in the amount of obsidian reaching the shelter is apparent. Lou obsidian has by this time become as important as that from the Pam Islands. Compositional analysis of the single retouched microblade segment using EDS revealed that the obsidian originated from a Pam Islands source.

OBSIDIAN USE

What can the Pamwak evidence tell us about the development of production and trade as viewed in obsidian? With regard to distribution the evidence demonstrates that offshore sources were exploited in the Admiralties far earlier than previously supposed. The only evidence of earlier maritime transport in Island Melanesia is the transfer of New Britain obsidian to New Ireland at around 20,000-18,000 BP (Summerhayes and Allen 1993). However, the difference with Pamwak is that beginning somewhere between 13,800 BP and 12,600 BP obsidian was virtually the only lithic material imported and used in the shelter.

The examination of flakes for evidence of maximisation of obsidian use revealed that mid- and upper Holocene flake assemblages possessed pieces of a relatively similar size, but flakes recovered from below these levels exhibited a marked trend toward decreasing size with depth. Part of the explanation for this probably lies with change in the distance from the coast to the shelter. During Pleistocene and early Holocene occupation Pamwak would have been perhaps six to ten kilometres from the coast, according to available bathymetric data (Marlow et al. 1988b) and assuming no significant uplift took place. As obsidian was moved from the coast, either directly by forager/horticulturalists during subsistence activity or indirectly by trade between coastal and interior populations, some progressive reduction of obsidian and concomitant decrease in the size of pieces could be expected. Accordingly, obsidian pieces reaching Pamwak during this time would be smaller than those landed on the coast. By mid Holocene times Pamwak was probably in a near-coastal location and therefore directly accessible to people transporting obsidian from offshore deposits.

Larger pieces would have been available for reduction, resulting in the production of a higher proportion of large flakes.

Site location relative to the coast cannot however be a complete explanation for change in flake size. There is no decrease in mean flake size between mid- and upper Holocene occupation, when the combined affects of uplift and progradation would have shifted the coast away from the shelter to its present position. Additionally, in the late Pleistocene Pamwak was no more than half a day's walk inland. When compared with, for example, the overland movement of obsidian from coastal New Guinea to the Highlands (Watson 1986), the transport of material to Pamwak during this period involved traversing a relatively insignificant distance. Indeed, the low "cost" of transport can be seen in the almost exclusive use of obsidian in the shelter from Pleistocene times on, despite the local occurrence of stream-bed cherts. I consider that a steady rise in the amount of obsidian being transported to Manus from offshore deposits is another, perhaps the major, factor in the progressive increase in flake size from terminal Pleistocene to mid Holocene occupation. An increase in obsidian availability would result in less need for economical use of this material. This postulated mid Holocene rise in the amount of obsidian transferred to Manus has obvious implications for the development of distribution systems within the archipelago.

Turning to obsidian blade production, the Pamwak investigation revealed a Pleistocene retouched tool technology based on equilateral flakes and blade-like pieces of pitchstone. These must represent components of a specialised toolkit cached in the shelter during a phase when this site was the base camp for maintenance or food procurement activity. The technology involved in the manufacture of these implements demonstrates a familiarity with core preparation and retouching. Although five pieces are blade-like, it may be pushing the evidence too far to present this as demonstrating an ancestral relationship with the late Holocene blade technology on Lou (Chapter 6). Microblades and elongate flakes do not appear in significant proportions in the Pamwak obsidian assemblage.

Flakes do however exhibit a tendency to become longer in relation to width between Pleistocene/early Holocene and mid Holocene periods. A similar tendency toward "bladedness" is exhibited by flakes associated with post-2000 BP occupation. This minor variability does not however represent a significant shift toward a blade technology. Instead it probably relates to the importation of larger cores during the mid- and late Holocene (above). Blade-like flakes cannot be removed from small worked out cores, which were transported to the shelter during Pleistocene and early Holocene occupation.

CONCLUDING REMARKS

Investigations at Pamwak Rockshelter revealed an extremely long time depth for the use of obsidian, perhaps as much as 13,800 years. Perhaps the most remarkable aspect of this is however not so much the age of first use, but the fact that obsidian was probably obtained from an offshore island source, and that this source was utilised *continuously*. During the terminal Pleistocene the inhabitants of Manus obviously possessed the maritime capability to commute between the main island and smaller islands to the south.

The Pam Islands stand out as the only source utilised until obsidian from Lou Island makes an appearance in mid Holocene occupation. At this time the coastline was probably at its closest to the shelter. However, Lou obsidian was utilised in significant proportions only in either the last phase of mid Holocene shelter occupation (c5000 BP) or post-Lapita site reuse (c2000 BP).

An increase in mean flake size from Pleistocene to mid Holocene occupation is interpreted as the result of progressively less need for economical use of obsidian. This is viewed as the result of a gradual increase in the amount of obsidian moved to Manus, coupled with a decrease in the distance between the coast and the shelter following the Holocene marine transgression. An absence of significant change in flake size after the mid Holocene demonstrates that there was no succeeding variation in the availability of obsidian. One possible explanation for this is that the mid Holocene witnessed the emergence of a less mobile existence, which enabled the establishment of more formal exchange networks.

Elongate flakes, including a number of large examples from Pleistocene deposits, were present throughout the Pamwak sequence. A small number of microblades was recovered from Holocene deposits. However, the proportions of elongate flakes and microblades are too small to support an argument for the use of a true blade technology at any stage of shelter use. Rockshelters may be generally the wrong places to search for blade assemblages, where flake tools could be expected to be employed in wooden implement maintenance and food processing (see Hayden 1978:193). Unfortunately for the period prior to the mid Holocene evidence from the Admiralty Islands is limited to that recovered from rockshelters and caves, as it is with much of the rest of Melanesia. However, the potential for discovering early open sites certainly exists, as shown by recent discoveries by Pavlides and Gosden (1994) on New Britain.

One period for which the Pamwak data are deficient is the time between 5000 BP and approximately 2000 BP. This period is crucial because it is here that the Lapita phenomenon makes its appearance elsewhere in Island Melanesia. It is crucial for an understanding of the sequence of obsidian use in the Admiralties to discover what influences, if any, the appearance of Lapita had on obsidian source use and flake technology. For this reason and to provide a wider regional perspective on obsidian use in the later Holocene, I will in the following chapter spread the observational net to encompass four localities on Manus and Mouk Islands.

CHAPTER 5

OBSIDIAN USE IN UPPER HOLOCENE PERSPECTIVE: EVIDENCE FROM FOUR LOCALITIES

INTRODUCTION

In Chapter 4 I presented evidence for temporal variation in obsidian use at Pamwak Rockshelter. This begs the obvious question, does the pattern revealed for Pamwak reflect idiosyncratic behaviour by the various occupants of this shelter, or is it part of a wider picture of regional trends? To answer this requires an examination of obsidian use in other Admiralty Islands localities. Few stratigraphic excavations have been undertaken in the archipelago and, discounting those carried out at Pamwak and on Lou, really only three qualify as anything more than small test pits. These are Kohin Cave on Manus, Father's Water on Los Negros, and Site GLT on Mouk (henceforth referred to as simply the Mouk site) (Figure 5.1). The Kohin and Father's Water excavations were carried out by Jean Kennedy, that at Mouk by Holly McEldowney and Chris Ballard. The first two have been referred to previously in Chapter 3. Excavation of the Mouk site has been described by McEldowney and Ballard (1991). These sites will be included in the following discussion as all contained comparatively large obsidian assemblages from stratified deposits spanning a number of occupation episodes. Another locality, Peli Louson rockshelter (Figure 5.1) will also be included as, although only minimally test pitted, this site is located in the interior of Manus and most of its obsidian was recovered from deposits containing no pottery. The assemblage therefore represents not only the sole obsidian collection from an interior Manus locality, but also the only obsidian outside Pamwak from unambiguously preceramic contexts.

This chapter is divided into three sections. In the first I describe each site in terms of the material recovered and its stratigraphic and temporal context. The second section comprises an outline of the extent of inter- and intra-site variability in obsidian source use and flake assemblage composition. The third section provides an overview of the results presented in this chapter.

THE SITES

KOHIN CAVE (Site GDN)

Kohin Cave is located near Mbunai village within one kilometre of the south coast of Manus (Figure 5.1). The site consists of a cave formed on a raised limestone ridge. The cave faces landward over a tidal swamp, which in earlier times was probably an embayment. Pottery, obsidian and marine shells were recorded on the cave floor (Kennedy 1979a:72). The investigation of Kohin Cave is, after Pamwak, the second most extensive excavation undertaken on Manus.

Two seasons of excavation were carried out at Kohin by Kennedy (general descriptions can be found in Kennedy 1979a, 1979b, 1981a, 1981b). The first, in 1978, involved excavating a 6 m x 1 m trench across the cave entrance. This revealed charcoal lenses and a midden deposit, as well as pottery and obsidian (Kennedy 1979a, 1979b). In 1979 the excavation was extended so that in total 11 square metres of the floor of the cave mouth was investigated. The excavation proceeded by following depositional strata, and all material was sieved through 6 mm mesh.

Stratigraphy and Dating

Ten stratigraphic layers were revealed. All contained pottery and obsidian. The following layer descriptions are from published information (Kennedy 1981a) and notes supplied to myself by Kennedy. The layers are as follows:

Layer 1: Topsoil.

Layers 2 and 3: Clay deposits differentiated by texture and colour. In total 826 sherds were recovered from these two layers and Layer 1 (Kennedy 1981a:Table 2).

Layer 4: An occupation layer defined by hearths and scattered ash and charcoal. Pottery consisted of 591 sherds.

Layers 5 and 6: Friable clay deposits distinguished by texture and colour. Associated with these layers were 259 sherds.

Layers 7, 8 and 9: Deposits of compacted clay differentiated by texture and colour. These layers contained 883 sherds, four of which possess Lapita-like decorative motifs (Kennedy 1981a:757).

Layer 10: A shell midden overlying basal rock. Only eight sherds (none decorated) were recovered from the midden. Kennedy (1981a:757) suggested that this deposit may have been laid down during a single "cultural event".

Eight radiocarbon age determinations have been obtained for Kohin Cave. Kennedy (1981a:757) has published four while four (ANU 2211, 2213, 2214 and 2249) were not reported owing to possible sample contamination (Kennedy 1981a:759). The provenance of the four reported radiocarbon samples and their conventional and calibrated ages are set out in Table 5.1. The two age estimates for Layer 4 are statistically indistinguishable at a 95% confidence interval (T = 1.13, chi square = 3.84). The sum of the probabilities for these two ages is 2210-1691 BP, representing 92% of the calibration curve. Layer 10 was dated by shell, a sample of *Tridacna* clam. Kennedy (1981a) has argued for initial use of the cave by Lapita pottery users, but recalibration of the Layer 10 date indicates that pre-Lapita occupation is a distinct possibility.

Questions have arisen over the integrity of the occupation sequence at Kohin Cave. Kennedy (1981a:757) has stated that the sequence is stratigraphically ordered and that 'there is no evidence to suggest a chronological hiatus between layer 10 and those above it'. However, Ambrose has posed the possibility of an hiatus in site use of up to 1800 years between Lapita occupation represented by Layers 7-10, and more recent occupation which he dates as beginning around 1650 BP from the presence of chronologically discrete Puian ware (Ambrose 1991a:109; Kennedy 1981a:Fig. 1). The 1650 BP date does not accord with the radiocarbon estimate for Layer 6 (Table 5.1), but there is always the possibility that later style pottery became combined with earlier deposits (Ambrose 1991a:109). It will be difficult to resolve these chronometric issues without recourse to more radiocarbon dating. However, from present dating and stylistic evidence it seems likely that Lapita occupation is restricted to Layers 7 and below. On the basis of summed age probabilities for the three estimates from Layers 4 and 6, it is likely these deposits represent perhaps discontinuous occupation between 2739 BP and 1700 BP. Layers 1-3 may therefore be associated with site use within the last 1700 years.

Obsidian

Obsidian was present in all layers with very little other lithic material present. In total 1.2 kg of obsidian was recovered. The number and weight of pieces in each layer is set out in Table 5.2, while the calculated weight per layer is presented in Figure 5.2. The highest densities of obsidian occur in Layers 3, 4, 7, 8 and especially Layer 9. Yet these densities generally do not approach those for Pamwak. This indicates far less intensive use of Kohin, at least in terms of obsidian knapping.

Four retouched pieces are present in the Kohin assemblage. Two, from Layers 1 and 3, do not appear to have been shaped to a formalised design or to facilitate use and may represent unsuccessful attempts to manufacture tools (Figure 5.3). One of these is formed on a triangular sectioned microblade (Figure 5.3a). The other two pieces are bilaterally retouched prismatic microblades (Figure 5.4). One is transversely broken, the other apparently unfinished. These were also recovered from Layers 1 and 3.

Discussion

On archaeological evidence Kohin Cave was a coastal or near-coastal camping shelter first occupied at least partly for the exploitation of marine resources. Virtually the only lithic material introduced into the site in all periods was obsidian, indicating that movement to or contact with Lou and/or the Pam Islands was present from initial occupation and continued throughout use of the cave. The presence of two retouched obsidian microblades in upper layers supports evidence from Pamwak for the introduction of this artefact type in post-Lapita times.

FATHER'S WATER (Site GAC)

The Father's Water site (also known as Papitalai) is situated on Los Negros Island (Figure 5.1). Surface evidence consisted of obsidian densely scattered across the surface of a natural terrace near present Papitalai village (Kennedy 1983:116). The front of the terrace was eroding into a tidal creek, while the rear had been modified by road construction. This site is significant in that it represents the only open coastal site investigated in the Admiralties, save for those on Lou and Mouk.

Father's Water was investigated in 1981 by Kennedy. A full excavation report has yet to be prepared so for the following description I have relied on a brief published description (Kennedy 1983), notes prepared by Kennedy and the site record form obtained from the Papua New Guinea archaeological site register. The investigation was of a preliminary nature, consisting of a 1 m x 1 m test square excavated to approximately 1 m deep. The square was placed near the front of the terrace, but no site plans are available.

Stratigraphy and Dating

A description of the stratigraphic composition of the site is given in Kennedy (1983). Five layers were identified:

Layer 1: A disturbed brown/black clay-silt garden soil containing obsidian, 11 pottery sherds and bones of fish, turtle and crocodile.

Layer 2: Dense black clay with obsidian, one chert flake, three sherds and the same marine fauna as Layer 1.

Layer 3: Yellow/red mottled sandy clay containing only a small amount of obsidian, one chert flake, and some fishbone.

Layer 4: Coarse coral sand with very little obsidian and one murid femur.

Layer 5: Yellow clay-silt with a small amount of obsidian and shell only in the top 40 cm of the layer. The lower levels of this layer probably represented a natural deposit. Layer 5 deposit was exposed in section at the face of the terrace where it extended to a depth of 4 m and rested upon a basalt formation (Kennedy 1983:116).

Most of the evidence for past occupation was therefore restricted to the upper two layers of the site. The proportion of obsidian in Layers 3, 4 and 5 was very low (see below) and these deposits contained no pottery. All 15 sherds recovered during excavation were found on the surface and in Layers 1 and 2. Two have applique decoration, which Kennedy suggests belongs with the incised-impressed relief ware of Kohin Cave (Kennedy 1983:116). Dating of the site is problematical as charcoal and shell submitted for age determination was obtained from a depth of between 50 cm and 1.3 m below surface, i.e. to near the top of Layer 5. It is difficult to assess exactly how dates on material collected from throughout a 60-80 cm deep column can be interpreted, except that perhaps they should be treated as average dates for the column. Conventional and calibrated ages for the combined charcoal and combined shell samples are presented in Table 5.3. At the two sigma level these span a period of approximately 800 years, between 5070 and 4290 BP.

Obsidian

The Father's Water flake assemblage consists almost entirely of obsidian; only six non-obsidian items are present - two chert flakes (weighing 5.4 gm and 8 gm) from Layers 2 and 3, and four abraded pebbles from Layers 1 and 2. The obsidian weighs 1.6 kg in total. The weight and count of pieces in each layer is presented in Table 5.4. Some information in the table is somewhat at variance with that given by Kennedy, who wrote (1983:118) of only six pieces in Layer 5 and a complete absence in Layer 4. I cannot account for this discrepancy. Figure 5.5 illustrates the calculated weight of obsidian for each cubic metre of deposit. This shows an extremely high concentration in Layers 1 and 2 (compare with the figures for Kohin given above). Clearly, intensive obsidian reduction took place during these occupation episodes. No retouched pieces are present suggesting reduction was carried out to produce unmodified flakes for non-specialised usage. One worked piece is a cobble with water-rolled cortex.

Discussion

The past inhabitants of the Father's Water locality engaged in the exploitation of a range of marine resources and used simple unretouched tools almost exclusively of obsidian. Pottery was uncommon and restricted to the surface and top two layers. Temporally diagnostic decoration on two Layer 2 sherds suggests this phase of site occupation took place as long ago as 2000 BP, or around 1650 BP (depending on whether one accepts the argument of Kennedy or Ambrose on the chronological context of incised-impressed pottery - see above). Obsidian in Layer 2 and above constitutes 93.6% by weight of the total for the site. The evidence from pottery and obsidian therefore demonstrates that the most intensive phase of site use occurred some time after 2000 BP. There is in fact a strong possibility that all occupation took place during this period, and that the small amount of stratigraphically earlier material is intrusive. At least the major phase, and perhaps all, site occupation therefore took place in the post-Lapita period.

PELI LOUSON (Site GFJ)

Peli Louson is a small limestone shelter situated east of the Warei River in the interior of Manus (Figure 5.1). The site was test excavated in 1981 by Kennedy. No report on the investigation has been prepared so for the following information I have relied on a brief published account (Kennedy 1983), Kennedy's unpublished field report and site record form data.

Excavation of Peli Louson shelter was of a very preliminary nature, consisting of two small test pits each 25 cm x 25 cm in area. No plan of the exact location of the pits within the shelter are available. However, sketch plans attached to the site record form show that one test pit (Test Pit 1) was placed against the back wall of the shelter. This was excavated to a depth of 75 cm without reaching bedrock. The other pit (Test Pit 2) was excavated to 25 cm at which depth bedrock was possibly reached.

Stratigraphy and dating

Three general layers were present in Test Pit 1:

Layer 1: An ashy, friable topsoil reaching a depth of approximately 10 cm.

Layer 2: A grey/black ashy soil 15 cm deep.

Layer 3: Yellow clay becoming increasingly gritty and "sticky" with depth. This deposit continued to the base of the excavation.

Forty pottery sherds were recovered, all from Layers 1 and 2. None were diagnostically Lapita. Shell fragments were more prevalent in Layers 2 and 3 than Layer 1 while flaked obsidian was concentrated in Layer 3 (see below). One radiocarbon age determination is available. This is on shell collected between 30 cm and 75 cm below the excavation surface (i.e. from throughout Layer 3). The conventional age is 4610 ± 90 b.p. (Kennedy 1983:116), which calibrates to 5026-4554 BP at two sigmas. As dating material was collected from throughout Layer 3, these age spans can only be regarded as average dates for the deposit.

Obsidian

Flaked obsidian was the only lithic material found in Peli Louson. Twenty eight pieces were recovered, of which two derived from Layer 1, four from Layer 2 and 22 from Layer 3. One piece from Layer 3 exhibits light retouching. The predominance of obsidian in Layer 3 is interesting given that no pottery was recovered, thereby confirming a pre-3500 BP date for this deposit. The combined weight of obsidian in Layer 3 is 76.8 gm, which calculates to 2457 gm per cubic metre. Although not wishing to draw too many conclusions from such a small sample, this does suggest far more intensive obsidian use than at Kohin. but somewhat less than at Pamwak or the top layer of Father's Water.

Discussion

Test pitting at Peli Louson was carried out on a scale far too small to enable much to be said about past activity in the shelter. Nevertheless a stratified deposit was uncovered, apparently spanning ceramic and aceramic occupation phases. The calibrated age estimate of approximately 5000-4500 BP for Layer 3 is certainly suggestive of pre-Lapita occupation. Most of the obsidian (78.6% by count) was associated with this layer. Peli Louson provides additional evidence to Pamwak for the transfer of obsidian to inland localities on Manus.

THE MOUK SITE (Site GLT)

The Mouk site is situated on the islet of Mouk (300 m x 600 m), approximately 500 m north of Baluan Island (Figure 5.1). Investigation at this locality was undertaken by McEldowney and Ballard after a Lapita sherd was discovered in the spoil heap of a newly dug grave in the island's cemetery. A 2 m x 1 m excavation square was subsequently laid out and dug to a maximum depth of 1.6 m (McEldowney and Ballard 1991:94). Sieving through 1 cm mesh recovered pottery and obsidian, but no faunal material (McEldowney and Ballard 1991:95). The absence of the latter was probably due to a highly acidic soil.

Stratigraphy and dating

Excavation of the Mouk Site was carried out in 10 cm and 20 cm spits but three broad stratigraphic layers were identified (McEldowney and Ballard 1991:Figure 4). These are as follows (after McEldowney and Ballard 1991:95):

Layer 1 (Spits 1 and 2): dark brown clay-like compacted soil approximately 20-30 cm deep.

Layer 2 (approximately Spits 3-11): yellow to orange deposit of similar texture to Layer 1 and between 80 cm and 1 m deep.

Layer 3 (approximately Spits 12-14): light orange friable deposit, more homogeneous than Layers 1 and 2. This layer was excavated down to what was considered to be a pre-cultural horizon.

The absence of organic material precluded radiometric dating of spits or layers. However, seven of the 1199 recovered sherds possess characteristics which were identified as having a similarity with certain Lapita forms (McEldowney and Ballard 1991:98). Five were recovered from Spits 5-11 (Layer 2), one from Spits 12/13 (Layer 3), and one from the grave spoil heap on the surface of the site (McEldowney and Ballard 1991:Table 2). However, results of a more comprehensive analysis of the ceramic component of the Mouk assemblage by Ephraim Wahome (pers. comm.) indicate that only sherds from Spit 9 and below belong with the Lapita corpus. The stratigraphic distribution of diagnostic sherds suggests that users of Lapita pottery were the first occupants of Mouk, and that occupation continued into post-Lapita times (i.e. the last 2500 years or so).

Obsidian

In 1993 a crate containing the excavation finds from the site was discovered in a Lae warehouse, some years after having disappeared *en route* between the Admiralties and Australia (McEldowney and Ballard 1991:95). McEldowney kindly granted permission to conduct a detailed examination of the flaked stone component of this material.

Obsidian was the only lithic material present in the assemblage, perhaps not surprising considering the close proximity of Mouk to Lou and Pam source deposits. In total 1.2 kg of obsidian was present (slightly higher than the figure given by McEldowney and Ballard 1991:Table 1). The weight by excavation spit is presented in Table 5.5, while the adjusted weight per cubic metre of deposit is illustrated in Figure 5.6. Spit 4, near the top of Layer 2, stands out as possessing a high density of obsidian. Obsidian is also densely distributed in Spits 7 and 8, near the base of Layer 2. Many of the largest obsidian pieces from the site were found in Spits 4, 7 and 8. Very little obsidian was recovered from Spits 12, 13 and 14 (Layer 3). Only 19 sherds were associated with these spits (McEldowney and Ballard 1991:Table 2), so there is a possibility that material had filtered down from overlying deposits. Spits 12, 13 and 14 may therefore represent a pre-occupation surface containing Lapita age material from Spits 9, 10 and 11.

Most of the obsidian consists of unmodified flakes, flaked pieces and core remnants. Six of 91 intact flakes are elongate flakes and one is an unbroken prismatic microblade. This is associated with Spit 4 and has been retouched on two sides (Figure 5.7). This piece has similarities with the two retouched microblades recovered from Kohin Cave (above). It may however be a few hundred years earlier, although still post-Lapita on the basis of an absence of Lapita sherds in Spit 4 and above (with the exception of one piece out of context in the grave spoil heap).

Discussion

Archaeological investigation of the Mouk Site revealed that Mouk Island may have been first occupied by users of Lapita pottery. However, from the relative richness of the deposits, it seems that the most intensive phase of site use took place in post-Lapita times. Obsidian was used throughout site occupation but surprisingly not particularly intensively, considering the presence of nearby source islands. The density of obsidian in terms of weight per cubic metre is far less than recorded for the Holocene levels of Pamwak, or for Father's Water and Peli Louson. Densities more closely approximate those for Kohin. This suggests that either occupation in the excavated locality on Mouk took the form of numerous short episodes, or that obsidian use was not a major component of past site activity. The recovery of a retouched blade from post-Lapita levels suggests this artefact type appeared within approximately the last 2500 years.

OBSIDIAN ASSEMBLAGE VARIABILITY

VARIABILITY IN SOURCE USE

In Chapter 4 I examined variation in obsidian source use at Pamwak Rockshelter. Trends in exploitation were revealed. Until approximately 9400-8500 BP Pam Islands sources were almost exclusively utilised. After this time Lou Island obsidian was introduced in significant quantities, with a particularly notable increase in the use of this source during the period of shelter reoccupation at around 2000 BP. Stratigraphic disturbance meant the time of this upper Holocene change could not be determined with any precision, it took place either at around 5000 BP or some time after this date, but before 2000 BP. Clearly, an analysis of obsidian source use in the period 5000-2000 BP is required to bridge the gap in the sequence.

To examine variability in source use over this period pieces were selected from stratigraphic columns taken from Kohin, Father's Water and Mouk. At Peli Louson only the pre-ceramic deposit (Layer 3) was sampled. I employed the same method of analysis as used on obsidian from Pamwak and the Lou sites. Details can be found in Appendix B.

The following number of pieces were selected from each site: Kohin - 54 (representing 18% of the total assemblage), Father's Water - 41 (4.7%), Peli Louson - 19 (67.8%), and Mouk - 34 (5.9%). This represents 148 pieces in total, which is not an especially large sample of the four site assemblages. A larger number of pieces, particularly for the sites of Father's Water and Mouk, would provide a more representative sample but difficulties were initially encountered in running the analysis, mainly arising from EDS beam current fluctuation in the early stages of the project. Although a total of 627 analyses on obsidian and pitchstone were carried out for this thesis research, the actual number of pieces studied was smaller as many pieces had to be reanalysed. In the event data from over 30% of the analyses were clearly spurious and had to be discarded. Unfortunately, there was insufficient time to reanalyse all those pieces which gave unusual readings, or to introduce additional obsidian.

The EDS study revealed that obsidian from only Lou and the Pam Islands was present in the four assemblages. Source X obsidian was not identified in any of the assemblages. This supports the conclusion reached in the previous chapter that the presence of this obsidian in late Holocene contexts at Pamwak is a result of mixing between early and more recent deposits. Source allocation for each site can be found in Appendix B. At Kohin and Mouk both Lou and Pam obsidian was exploited in all occupation levels. Obsidian from Layer 3 of Peli Louson is predominantly from the Pam Islands. However, almost all of the Father's Water obsidian originated from Lou. If the obsidian of Layers 3, 4 and 5 in this site is *in situ* this reflects a surprisingly long focus on one source locality, no other Holocene site outside Lou exhibits this pattern. The indication is that the small amount of obsidian in Layers 3, 4 and 5 may be intrusive from overlying deposits.

Comparison of chronological variability in obsidian source use within and between the four sites presented difficulties. I have already discussed how in some localities units were dated by submitting a combined sample composed of vertically disparate material, while units in other sites were not radiometrically dated at all. This absence of fine temporal resolution means comparison between occupation episodes in different sites is not possible. I therefore compared source use in the four localities in the context of three broad periods - pre-Lapita (before 3500 BP), Lapita (3500-2500 BP), and post-Lapita (later than approximately 2500 BP). I will adopt the convention that Lapita begins at around 3500 BP while acknowledging that the temporal/cultural boundary between Lapita and post-Lapita has yet to be properly defined for the Admiralty Islands. However, certainly by 2100 BP diagnostic Sasi ware entirely dissimilar to Lapita had appeared on Lou, although we have yet to discover the relationship between this presumably indigenous ware and Lapita forms (Ambrose 1991a:109).

According to the three period schema the temporal association of obsidian-bearing deposits in the four sites is as follows:

(1) Kohin Cave: *Pre-Lapita* - obsidian in Layer 10 might be of this age but the evidence is equivocal, as discussed above. *Lapita* - obsidian from Layers 7, 8 and 9 probably belongs to this period, from the presence of sherds similar to Lapita forms. *Post-Lapita* - suggested for Layers 1-6 on both radiocarbon evidence and the presence of Puian sherds in Layers 5 and 6.

(2) Father's Water: *Pre-Lapita* - Layers 3, 4 and 5 might date to this period on the basis of radiocarbon dates and an absence of sherds. However, as mentioned above, there is a strong possibility that this obsidian derives from more recent deposits. *Post-Lapita* - obsidian from the surface almost certainly belongs to the period after 2500 BP, as probably does that in Layers 1 and 2 on the presence of diagnostic sherds.

(3) Peli Louson: *Pre-Lapita* - obsidian in Layer 3 can be associated with occupation before 3500 BP on radiocarbon and, less conclusively, an absence of pottery. The few obsidian pieces in the more recent Layer 1 and Layer 2 deposits were not analysed.

(4) Mouk Site: *Lapita* - the concentration of Lapita-like sherds in Spit 9 and below is suggestive of a Lapita association for these levels. *Post-Lapita* - this period is assumed to be encompassed by Spits 1-8.

Source allocation by chronological phase for each site is presented in Table 5.6. The results for Kohin generally confirm those obtained by Ambrose and colleagues (Ambrose et al. 1981a) using the PIXE/PIGME technique. Although obsidian was analysed from Kohin Layer 10 and Father's Water Layers 3, 4 and 5 these results have been excluded from the table owing to uncertainties over their stratigraphic affiliation, discussed above. It must be noted however that the results for these do not deviate from the pattern revealed for obsidian in immediately overlying strata (Appendix B).

Analysis revealed the following variability in source use. Obsidian in the pre-Lapita deposit of Peli Louson is dominated by Pam Islands material. This correlates with Pamwak where 69% of obsidian in mid Holocene units was from Pam sources (Chapter 4). Results from Lapita phase obsidian in Kohin and Mouk suggest that by 3500 BP Lou Island had become an equally important source. Obsidian from this island comprises around one half the analysed Kohin material and just over one third of that in the Mouk site. The picture for the post-Lapita period appears to be one of a focus on Lou obsidian in at least some localities (Kohin and Father's Water). In other localities (Mouk, as well as Pamwak) the Pam Islands appear to have remained an important source.

VARIABILITY IN FLAKE PRODUCTION

Following along the lines of the analysis carried out for Pamwak, I undertook a study to determine the extent of obsidian maximisation, and the spatial and chronological parameters of obsidian blade technology. Analysis was carried out on flakes from

Kohin Cave, Father's Water and Mouk. The Peli Louson assemblage was too small for meaningful comparison and excluded from study. All pieces were unretouched flakes, with the exception of the microblade from Spit 4 of Mouk. Macroscopic use-wear was not observed on any flakes.

Arriving at a fine chronological framework for analysis is precluded by the relatively few absolute dates available for each site, the likelihood of stratigraphic disturbance in at least some sites, and the comparatively small amount of obsidian recovered. For these reasons I examined the three site assemblages in terms of Lapita and post-Lapita periods, as with the obsidian characterisation study (above). Both periods encompass a wide time span, within which we could expect to find significant intra- and inter-site differences in obsidian reduction. However, it must be said that this two period scheme forms the basic sequence for much of the archaeology of Island Melanesia, so there is some methodological justification for its application in chronologically ordering the Admiralties obsidian evidence.

Obsidian Maximisation

All flakes in Lapita and post-Lapita levels at Kohin, Father's Water and Mouk were manufactured by the application of hammer percussion. This was identified by the presence of large percussion bulbs and platform crushing on all pieces. As with Pamwak, the regular use of a bipolar technique was not in evidence, suggesting that obsidian was a material which was never sufficiently scarce to warrant the reduction of very small cores. Intact, unshattered cores were however notable for their general absence.

Variation in flake weight for Lapita and post-Lapita assemblages is illustrated by boxplots in Figures 5.8 and 5.9. Flakes from post-2000 BP contexts at Pamwak have been included for comparison with the other post-Lapita assemblages. A marked difference is apparent for the two Lapita period assemblages. The Mouk flake assemblage is shown to be skewed toward larger pieces, in comparison with flakes from Kohin (Figure 5.8). By contrast, the post-Lapita Mouk assemblage exhibits a distribution toward much smaller flakes, similar to the Lapita and post-Lapita assemblages in Kohin (Figure 5.9). Interestingly, both the Mouk and Kohin post-Lapita assemblages contain a far higher proportion of large flakes than Father's Water or Pamwak (Figure 5.9).

Scatterplots of flake shape in terms of length and width are shown in Figures 5.10, 5.11 and 5.12. The flake population from Lapita deposits in Mouk is skewed toward an equilateral distribution, while Kohin flakes tend toward greater length than width (Figure 5.10). Little noticeable difference is apparent between the four post-Lapita assemblages, with all exhibiting a tendency toward greater length than width (Figures 5.11 and 5.12). Mean, standard deviation and maximum and minimum values are presented in Tables 5.7 and 5.8. This data highlights the tendency for Kohin Lapita flakes to be more blade-like than those at Mouk, and supports the impression of minor variability in the ratio of length to width between the four post-Lapita assemblages. Many flakes from a post-Lapita context in Mouk are however markedly heavier than those of the other three assemblages, reflecting the presence of comparatively thicker pieces in the upper levels of this site.

I employed the Mann-Whitney test to quantitatively assess the significance of differences between like flake variables for the four sites. Analysis of flake weight, length and width revealed a statistically high level of dissimilarity between the Kohin and Mouk Lapita assemblages. Values for flake weight and width are low, at respectively 0.03 and 0.01. The Lapita context flake assemblages from Kohin and Mouk are therefore almost entirely dissimilar, with the Kohin assemblage distributed toward pieces which are lighter and narrower than those in Mouk. Comparison of flake length revealed a relatively higher level of inter-assemblage similarity, although still a low value (0.29).

The limited Lapita evidence suggests that flake morphology can be expected to vary considerably between sites. This may not always be explainable in functional terms. The relatively wide, heavy flakes recovered from Mouk are not sufficiently different from their Kohin counterparts for gross functional variation to be an explanation of inter-assemblage variability, particularly when contrasted with the picture of very large flakes at obsidian production sites on Lou (Chapter 6). Rather, the variation between Mouk and Kohin is probably correlated with the closer proximity of Lou and Pam obsidian sources to Mouk Island than Manus. The inhabitants of Mouk may have had more direct access to obsidian deposits, resulting in less need to conserve obsidian by striking smaller flakes from cores.

Results of Mann-Whitney tests on post-Lapita flake assemblages are set out in Tables 5.9a, b and c. All four assemblages are statistically different in terms of flake weight, length and width. There is however patterning in the data with some sites displaying greater inter-assemblage similarity than others. For flake weight (Table 5.9a) Pamwak and Father's Water possess a relatively high level of assemblage similarity. Both sites have comparatively light (small) flakes. Flakes from Pamwak and Mouk are closest to one another in terms of length (Table 5.9b), reflecting the presence of relatively long pieces. The Pamwak and Father's Water assemblages are similar with respect to flake width (i.e. narrow flakes), as are the assemblages from Kohin and Mouk (wide flakes) (Table 5.9c). The latter observation is particularly interesting as comparison of the weight of Lapita context flakes from Kohin and Mouk demonstrated no similarity between the two assemblages.

The evidence suggests that post-Lapita flake assemblages will be locationally variable, like the Lapita period material. Given the small number of excavated sites it is at this stage difficult to discern spatial patterning in the data. One thing is obvious however and that is that the Mouk assemblage exhibits generally larger flakes than the other post-Lapita assemblages. Again this may relate to accessibility to nearby obsidian-bearing islands from Mouk. Nevertheless, Mouk flakes exhibit some degree of similarity in terms of length and width to flakes from respectively Pamwak and Kohin. It is not clear what this means. However both Pamwak and Kohin are rockshelters while Father's Water is an open site. A different range of tool using activities probably took places in shelters than in villages, necessitating more intensive use of stone in the latter situation.

Intra-site comparison of Lapita and post-Lapita flake assemblages in Kohin revealed no similarity in mean length (Mann-Whitney probability value is 0.08) or width (0.03). A similar picture is evident for Lapita and post-Lapita flake assemblages from Mouk, (length = 0.15; width = 0.00). However this Lapita/post-Lapita differentiation in flake shape does not follow the same pattern for the two sites. In Kohin flakes become generally wider through time while flakes recovered from Mouk become narrower (Tables 5.7 and 5.8). The Mouk pattern probably relates to the post-Lapita production of small retouched blades in this site (see below).

Dorsal detachment scars are present on flakes in all assemblages. For the Lapita period, the Mouk assemblage has scars on 38.9% (7) of flakes and Kohin on 23.6% (17). Only minor difference in these proportions is apparent for flakes from post-Lapita contexts. For Mouk 31.5% (23) flakes possess dorsal scars, Kohin 26.2% (11) and Father's Water 31.3% (31). Interestingly however, these proportions are far greater than the 5.7% recorded for post-Lapita levels at Pamwak (Chapter 4). One possible explanation for this is that smaller unworked incipient cores were imported into Pamwak, in comparison with other localities. Obviously, fewer flakes can be removed from small cores, and proportionally more of these will be primary flakes. This may explain the presence of relatively few flakes with dorsal scars in the Pamwak assemblage. If this interpretation is correct, then the higher proportions of flakes with dorsal scars in the other assemblages probably reflects the importation of larger cores, which were systematically reduced in a number of stages. That flakes at Pamwak are not noticeably smaller than those in other localities, Table 5.8, indicates that some degree of economical use of obsidian was carried out in reducing large cores at the other sites.

Table 5.10 sets out data on cores and core pieces. No cores were recognised in the Mouk assemblage. Cores in post-Lapita contexts at Kohin and Father's Water possess a higher combined mean weight than Lapita cores at Kohin. This is suggestive of less economical use of obsidian in post-Lapita times, but the sample is too small for any definite conclusions to be drawn. The large coefficient of variation for cores in post-Lapita deposits at Kohin is due to the presence of an exceptionally large intact core. This was recovered from surface deposits and weighed 121.6 gm. No cores possess cortex and, as with Pamwak, all were flaked multidirectionally. Unlike Pamwak however, no pieces bear flake detachment scars on all facets. At Kohin and Father's Water cores were evidently broken up or discarded before they were completely exhausted. This could be interpreted as demonstrating less economical use of obsidian.

Blade Technology

No blades or microblades are present in Lapita contexts at Kohin or the Mouk site. However, at Kohin these levels are distinguished by the presence of 12 elongate flakes, comprising 14.8% of the entire Lapita period assemblage. By contrast no elongate flakes are present in the Mouk Lapita assemblage. The evidence from Kohin is interesting in that it shows what may be two flaking techniques in the Lapita levels of this shelter, one oriented to the production of small equilateral flakes and the other to elongate flakes. No diagnostic blade cores were recovered however.

Elongate flakes are present in all post-Lapita assemblages; Kohin possesses four (9.5%), Mouk six (8.2%), including the retouched microblade, and Father's Water eight (8.1%). These proportions are within the same range as post-2000 BP levels at Pamwak, from which six elongate flakes, representing 8.6% of the assemblage, were recovered. The occurrence at Mouk of elongate flakes in post-Lapita levels provides a contrast with the pattern for Kohin, where elongate flakes are proportionally more common in Lapita levels. Flaking techniques were therefore evidently situationally variable, and cannot be used as chronological markers. The notable exception is prismatic microblade manufacture, a technique which on present evidence seem to appear in post-Lapita times.

OBSIDIAN USE IN THE UPPER HOLOCENE

In summary, a picture of obsidian use during Lapita/post-Lapita times can be obtained by examination of assemblages at Kohin Cave, Father's Water, Mouk, Peli Louson and upper levels at Pamwak. The ubiquitous presence of obsidian in these localities shows that from mid Holocene times obsidian was being regularly moved to both inland and coastal localities on Manus. Indeed, obsidian appears to have been so readily available that even in campsites such as Kohin, where lithic tool production was apparently a relatively minor activity, obsidian was used in preference to local stone. The absence of a bipolar technique in Lapita or post-Lapita assemblages demonstrates that very small cores were not used in flake production. Obsidian was apparently never sufficiently scarce to warrant use of this reduction technique.

The chronological increase in flake size observed between Pleistocene/early Holocene and mid/upper Holocene assemblages at Pamwak is also apparent between Lapita and post-Lapita periods at Kohin and Mouk, although not as marked. This is suggestive that obsidian was more easily accessed by the inhabitants of these localities after approximately 2500 BP. Whether or not this is a regional pattern awaits further investigation of sites with occupation spanning Lapita and post-Lapita periods. Synchronic variation in flake size, and hence obsidian availability, is most strongly exhibited between sites on southern Manus and Mouk. At Mouk flakes tend to be larger in both Lapita and post-Lapita assemblages in comparison with contemporaneous Manus assemblages. The obvious explanation for this is that site proximity to source deposits was a major determinant of the extent to which obsidian was conserved. The inhabitants of Mouk may have always possessed easier access than the Manus Islanders to obsidian from the neighbouring Pam Islands and Lou. Again, more fieldwork is required to determine whether this is a regional pattern differentiating Manus from the southern islands.

Elongate flakes constitute less than 10% of pieces in all flake assemblages, with the exception of the Lapita levels of Kohin where around 15% of flakes are elongate. The Kohin assemblage is an interesting case because it represents the only Lapita assemblage so far recorded which possesses a significant proportion of blade-like flakes. The picture for Lapita flaked lithic technology in Melanesia generally is one of the production of undiagnostic flakes (Allen and Bell 1988). I do not see the proportionally large number of elongate flakes at Kohin as representing a technological innovation accompanying the appearance of pottery. This is for two reasons. First, elongate and blade-like flakes are present, albeit in small proportions, in Pleistocene and early Holocene contexts at Pamwak (Chapter 4), and second Lapita levels at Mouk contain no elongate flakes.

The stratigraphic location of retouched microblades at Kohin and Mouk suggests that this flake type is limited to the post-Lapita period. Providing a more secure date for the appearance of microblades is not possible on present data, but on the basis of radiocarbon dates for the upper three layers of Kohin an estimate of within the last 2000 years may not be far off the mark. The earliest date for retouched blade (point) manufacture on Lou falls around this time (Chapter 3). Obvious technological similarities exist between the production of microblades and elongate flakes. Possibilities for a direct developmental relationship are discussed in Chapter 8.

Compositional analysis of obsidian revealed that a regional shift in source use took place in the upper Holocene. The Pam Islands were the major obsidian source during the mid Holocene but by 3500 BP Lou had emerged as equally important. The 5026-4554 BP date for the Peli Louson obsidian assemblage with its dominance of Pam Islands material suggests that the increasing use of Lou obsidian occurred after this time, which fits the general picture for Pamwak (Chapter 4). Unfortunately none of the sites discussed in this chapter has an unbroken sequence unambiguously spanning pre-Lapita and Lapita periods. Obsidian from Layer 10 at Kohin, which radiocarbon estimates indicate could represent a pre-ceramic midden, has obsidian from both Lou and the Pam Islands (Appendix B). However, sherds were also found in the midden, so if this is to be interpreted as a pre-Lapita deposit then a degree of mixing with overlying deposits will also have to be accepted. Although the information presented in this chapter for an increase in the use of Lou obsidian corroborates the picture from Pamwak, we are still not in a position to state whether this occurred with the onset of the Lapita phenomenon or is associated with other totally unrelated factors, such as the formation of new obsidian deposits on Lou. This question must be a priority for any future research on obsidian use in the Admiralties.

Inter-locality variability is evident within this broad pattern of changing source use. At Kohin there is an increase in the importance of Lou obsidian between Lapita and post-Lapita periods, while the post-Lapita Father's Water assemblage is almost entirely composed of Lou obsidian. A trend to the late dominance of Lou obsidian is also evident from the results of work by Ambrose and colleagues (Ambrose et al. 1981:15) on material from the northern island of Hus. However, at Pamwak and Mouk the Pam Islands remain an equally important source over the last 2500-2000 years. Although it may be unwise to draw fine distinctions on the relative importance of obsidian sources given the proportionally small number of pieces analysed from these localities, the results do tend to suggest that by the post-Lapita period different groups were favouring the utilisation of particular sources.

CONCLUDING REMARKS

This chapter has examined upper Holocene obsidian use at rockshelters on Manus, and open sites on Los Negros and Mouk. Although this does not by any means provide a full picture of obsidian use in this region of the Admiralties, it does reveal change took place in source exploitation and flake production. This evidence corroborates that obtained for Pamwak. The picture is one of a dramatic increase in the use of Lou obsidian in the period circa 5000-3500 BP, subsequent post-Lapita dependence on this source in at least some localities, and the appearance of prismatic blade technology in post-Lapita times. This and the preceding chapter have therefore presented a broad portrayal of chronological variation in obsidian use since the late Pleistocene. In Part Three of this thesis I narrow the focus to an examination of change in obsidian blade production on Lou over the last 2000 years. This discussion will be undertaken within the context of the development of craft specialisation.

PART THREE: PREHISTORIC PRODUCTION

CHAPTER 6

RETOUCHED BLADE MANUFACTURE ON LOU ISLAND: INTRODUCING FOUR LOCALITIES

INTRODUCTION

In Part One of this thesis I documented how most of the written information on historic obsidian production relates to Lou Island, which in the late nineteenth and early twentieth centuries was the main source of obsidian blocks and spearpoints for the rest of the archipelago. The review of archaeological evidence for mainland Manus and Mouk presented in Part Two demonstrated that before the mid Holocene the Pam Islands were the predominant obsidian source, by Lapita times obsidian from Lou had become as important, while in the period after approximately 2500 BP Lou had in at least some localities become the predominant or exclusive source. To begin to understand how this prehistoric pattern articulates with the historically observed situation demands an in-depth diachronic analysis of production on Lou itself.

In Chapter 3 I reviewed how Ambrose and colleagues uncovered evidence of obsidian working at Sasi, Emsin, Umleang and Pisik School (Figure 6.1). The first three localities were quite clearly workshops where various stages of retouched blade production had been carried out (Ambrose 1991a; Antcliff 1988; Fullagar and Torrence 1991) (Plate 9). Pisik School was associated with a lesser amount of obsidian which does not appear to represent workshop activity (Ambrose 1991a:107). In this and the following chapter I describe the evidence from these four localities and outline chronological variation in production techniques over the past 2100 years or so.

Four artefact categories are referred to in the following overview; points, blades, flakes and pieces with detachment scars (core pieces and snapped flakes). The term "point" is hereafter used in reference to retouched blades. Examples are shown in Figures 6.2 - 6.5. The extent of retouch on points is distinguished in terms of the percentage of the artefact surface area exhibiting detachment scars, i.e. less than 25% coverage, 25-50%, 50-75%, 75-99%, and 100%. Points are triangular or trapezoidal in section and retouch is accordingly identified as occurring on one face (unifacial), two faces (bifacial), three faces (trifacial), or, on trapezoidal pieces only, four faces (quadrafacial) (Figure 6.6). This is simplified from the descriptive procedure developed by Antcliff (1988). Along with other commentators I have argued (Chapter 3) that prehistoric retouched points were probably intended for use as weapon tips.

Blades are the technological equivalent of the microblades recovered from Pamwak, Kohin and Mouk (Part Two). The Lou examples are however much larger. These fall into two types; (a) a trapezoidal cross-sectioned blade (some prismatic) with a characteristic longitudinal dorsal scar formed by the removal of a blade at an earlier stage in the reduction sequence, and (b) a distinctive triangular cross-sectioned piece formed by removing the crest or ridge created on a blade core by bifacial flaking, often upon removal of two adjacent prismatic blades. Examples are illustrated in Figures 6.7 - 6.10. The majority of blades recovered were transversely broken. Blades in all assemblages had been manufactured using a percussion technique, as evident from pronounced bulbs on proximal segments.

Criteria for distinguishing flakes are the same as outlined in Chapter 4. Pieces with detachment scars include core pieces and snapped flakes bearing dorsal scars. Obsidian pieces which were not blades or flakes and did not possess detachment scars were not examined. These consisted of undiagnostic flake fragments and miscellaneous shatter which always occur as a byproduct of lithic reduction.

THE EXCAVATIONS AND THE OBSIDIAN

SASI (Site GEF)

Sasi is located on the southwest coast of Lou approximately 200 m east of present-day Baun village, some distance from the other three sites (Figure 6.1). Sasi was discovered by Ambrose and I. Smith in 1982 when a buried soil was revealed beneath 5 m of tephra in a rapidly collapsing section of 7 m high beach cliff. Abundant pottery, obsidian and other cultural debris was visible eroding out of the cliff through wave action (Ambrose 1988). Accordingly the cliff face was cut back and seven squares laid out for excavation (Figure 6.11). The squares were of slightly different proportions as the ever present danger of face collapse by wave erosion necessitated hasty investigation.

Stratigraphy and Dating

The stratigraphic composition of the site has been previously described in general terms by Ambrose (1988:484). The strata are illustrated in detail in Figure 6.12. This shows only the eastern part of the cliff section as the western portion collapsed before it could be drawn. Cultural material discussed here was associated with a buried soil possessing features clearly evident in section. Underlying this was a thick deposit of undated culturally sterile volcanic ash (Baun ash). Overlying the soil was Sasi ash, which appears to have been deposited during the course of a number of closely spaced eruptions. Evidence for this is the presence of bands of fluviatile deposit and breccia within the ash (Figure 6.12). These must have been formed during lulls in the ashfall and with the onset of new eruptive episodes. No stratigraphic discontinuity existed between the buried soil and the overlying Sasi ash, so the site was probably occupied up until the time of the first ashfall event.

The buried soil was internally homogeneous and varied between 10 cm and 25 cm thick. A number of postholes, some quite large, were visible cut down into Baun ash (Figure 6.12). Rhyolite slabs were present in association with the soil in all seven excavated squares. These had been deliberately placed over an extensive amount of obsidian, presumably to form a pavement. In addition to artefactual material a large quantity of shellfish and bone was recovered from the buried soil; bone consisted of mainly fishbone but turtle, phalanger, a pig mandible fragment, and two human teeth and jawbone were also found.

Six radiocarbon dates have been obtained for the Sasi buried soil, three on charcoal (ANU 3014, 4855, 5398) and three on shell (ANU 2908, 4981, 5399). Some difficulties have been encountered in dating. The shell samples gave estimates which do not correlate with dates on charcoal, while one charcoal date is anomalous and probably relates to a later ashfall. Ambrose (1988:489) provides a discussion of these problems. I will here focus on the two more reliable charcoal determinations - ANU 3014 and 5398. The conventional ages for these are 2070 ± 80 b.p. and 2090 ± 100 b.p., which calibrate to respectively 2307-1834 BP and 2331-1825 BP at the two sigma level. No statistical difference between the two is present at a 95% confidence level (T = 0.02, chi square = 3.84). The summed probabilities for these two ranges is 2209-1863 BP, representing 90% of the radiocarbon curve. The estimated time of site occupation can be narrowed because Pisik ash, dated to approximately 1920 BP (Ambrose 1988:484), is present overlying the site. The resulting range of 2209-1920 BP brackets the pooled estimate of 2100 BP given by Ambrose (1988:489).

Non-obsidian Artefacts

Numerically the predominant non-obsidian artefact from the Sasi buried soil is pottery. Many sherds are large, suggesting little trampling had occurred on the site. Two different wares are apparent, a fine plain ware and a coarse thick ware with incised decoration on platform rims and neck pieces (Ambrose 1991a:107). Vessels of the former may have been water containers, while those of the latter were probably used for cooking (Ambrose 1992:173-174). In addition to vessel fragments a polygonal pottery disc with a perforation through the centre was also recovered, from Square D.

Turning to other artefacts, two polished stone axes were recovered from Squares C and E. The former is broken and an attempt had been made at resharpening. But the most unusual non-obsidian artefact from the Sasi site is a small piece of bronze found 10-20 cm below the buried soil surface of Square C. This was almost certainly *in situ* (Ambrose 1988:484), providing evidence that around 2100 years ago people of the Admiralty Islands were in contact with metal using cultures to the west (Ambrose 1988:489-490).

The Obsidian Assemblage

In total 64,194 gm of obsidian was collected during the excavation. The weight of obsidian is shown by square and excavation spit in Table 6.1. Consideration should be taken of the fact that in some squares excavation was carried out in 5 cm spits, and 10 cm spits in others. The information in Table 6.1 shows spatial differentiation in the density of obsidian in the site. Most (61.4%) occurs in three squares - D, E and F. Square E in particular has a high density with 29.6% of all obsidian by weight recovered from this square. Most of this material derived from the bottom 10 cm of the buried soil layer.

This patterning is also reflected in the spatial distribution of retouched point fragments. Table 6.2 sets out the number of points by square. Of the 747 points in the site 472 (63.2%) were recovered from Squares D, E and F, with 235 (31.5% of the total) associated with Square E.

Owing to the large amount of obsidian in the site I undertook detailed analysis of only a sample of the assemblage. The objective was not to analyse all or most of the material recovered but rather to ensure that all possible obsidian reduction activities were sampled for comparison with assemblages from the other Lou sites. I therefore chose to examine material from either end of the site where differences were apparent in the density of obsidian; from Square B (including mixed obsidian which came from either A or B) where the concentration was not particularly dense, and from Square F (including mixed material from F or G) which possessed a high density of material. By weight this sample comprises 19,063 gm, or 29.7% of the obsidian from the site. I also examined points recovered from Square D. In all 376 points were analysed (50.3% of the total).

As the excavation of Square B proceeded in spits of different thicknesses to those of Squares D and F a vertical comparison of material between squares was not able to be undertaken. I therefore treated the obsidian as one assemblage; this can be justified by the absence of internal differentiation in the buried soil and the temporal closeness of the radiocarbon dates, both demonstrating that no measurable time depth was involved in deposition of the obsidian. Tables 6.3 and 6.4 set out the number and weight of analysed pieces by square. Generally pieces are more numerous in the western part of the excavation (represented by Square F), while some large items also appear to be present in this sector.

Points

As with the other three Lou sites discussed below, no intact retouched points were present at Sasi. A wide range of point sizes is exhibited in the assemblage, determined not only by the stage of reduction (Figures 6.13 and 6.14), but also by variation in finished morphology (Figure 6.15). The size distribution of points by square is illustrated in Figure 6.16. A number of exceptionally long point segments are shown for Square F. In Figures 6.17a, b and c I have plotted the cross-sectional size of pieces illustrating the extent of retouching. Square F is again shown to possess a number of large points; three of these have more than 50% scar coverage demonstrating that some particularly wide and thick points were produced in this site.

The extent and orientation of retouch on points from each square is illustrated in Tables 6.5 and 6.6. Most points exhibit unifacial or bifacial retouch. The single piece with quadrafacial retouch may represent an attempt to rework a discarded point or correct a mistake made during production. Points with more than 75% retouch cover are uncommon in all squares; for Square B the proportion is 1.8%, Square D 9.5%, and Square F 4.6%. The two entirely retouched points in Square D are small distal tip segments. Turning to the sectional shape of points (Table 6.6), there is a tendency for triangular pieces to predominate among those with unifacial and bifacial retouch. The converse is generally true for pieces with trifacial retouch, with the exception of Square B where the number of triangular and trapezoidal segments is approximately the same.

Blades

The size distribution of 252 blade pieces in Squares B and F is plotted in Figure 6.18. The presence of some large segments in Square F is shown. In Figure 6.19 the cross-sectional size distribution is illustrated. Again a number of exceptionally large (wide and thick) pieces are evident associated with Square F. This ties in with the pattern for the size distribution of points in the site (above) and suggests that an exceptionally large obsidian core or cores was reduced in this part of the site. Such intra-site diversity in blade and point size is suggestive of rather unsystematic production.

The mean and standard deviation for the maximum width and maximum thickness measures for blade and point fragments is compared in Table 6.7. Little variation is apparent between squares for each category of artefact. However, differences are present between artefact categories; the mean values for the maximum width of blade pieces are greater than those for points, while maximum thickness values are smaller. If most blades were intended as blanks for point manufacture, which seems likely, then the former would be expected as blades would obviously become narrower with retouching. However, the presence of points thicker than unretouched blades suggests that many blade segments were probably considered too thin to be suitable for point manufacture.

Flakes

Squares B and F possessed 129 intact flakes. Many (63.6%) have removal scars on their dorsal face, which suggests most were removed during retouching and after primary core preparation. Examination of mean length and width (Table 6.8) shows that there is a tendency for flakes in Square F to be longer and wider than those in Square B. However a plot of flake size (Figure 6.20) demonstrates a good deal of overlap exists between the two squares. The presence of only five flakes smaller than 20 mm x 20 mm is somewhat puzzling given that small flakes of this size would be expected from implement retouching. This is not a product of sampling as in Square B all small pieces were specifically recovered. Rather it suggests that the deposit is a waste dump, containing only larger pieces of debitage. Small retouch flakes may not have been collected for discard along with broken points, unusable blades and larger obsidian waste.

Nineteen flakes are elongate. Most are in the upper size range and would not be produced by implement retouching. Core preparation or initial preform shaping are activities likely to be associated with the production of these.

Pieces with removal scars

In total 242 obsidian pieces which were not points or flakes had removal scars, 176 of these were flake remnants and 66 were core pieces. The mean and standard deviation by square is set out in Table 6.9. Again a pattern of larger pieces in Square F is revealed. This is particularly significant with respect to core pieces; the mean weight for items associated with Square F is more than twice that for those in Square B. However, a particularly large standard deviation for Square F is evidence that a wide size range is present.. The heaviest flake remnant and core piece in Square F at 128.7 gm and 273.6 gm are more than twice as large as any in Square B. The largest core recovered from Sasi was associated with Square F (Figure 6.21). This patterning is further evidence of spatial variation in obsidian reduction and/or deposition.

Other obsidian artefacts

A number of other obsidian artefacts were also recovered from Sasi. One is a water eroded retouched item, possibly a point preform (Plate 10). No attempt had been made to rework this piece, which was possibly collected by the occupants of Sasi from the adjacent beach, perhaps as a curio. The most interesting piece is what appears to be an obsidian adze preform (Figure 6.22). An obsidian adze would not be an effective heavy woodworking implement, the edge would shatter on impact, but it may have been intended as a non-utilitarian exchange item. Obsidian adze blades have been recorded on the New Guinea mainland (Watson 1986:9), while, further afield, ceremonial obsidian adzes are known from New Zealand (Furey 1985). In terms of shape and orientation of retouch this is certainly quite unlike any of the broken points in the Sasi site.

Discussion of the Sasi Evidence

On the basis of the presence of large postholes, ceramic pots, stone axes, and abundant faunal remains (of both terrestrial and marine species) Sasi can be interpreted as a refuse dump for a settlement whose inhabitants fished, raised pigs, and probably gardened inland areas of the island. Clay for pots and stone suitable for ground axes do not occur naturally on Lou and must have been imported as either raw materials or finished products from other islands in the Admiralties group. More distant contacts are reflected in the presence of the bronze artefact, although this may have been obtained indirectly from elsewhere in Melanesia and does not necessarily demonstrate direct contact with metal-manufacturing cultures.

The quantity of obsidian in the site highlights obsidian tool production as a major facet of settlement occupation. The main tool type made was the retouched point. Other obsidian implements were probably also made, as evidenced by the "adze" preform, but the recovery of 747 point segments demonstrates point production was overwhelmingly predominant. Sasi can therefore be justifiably termed a point workshop, or more correctly a workshop dump. Some internal differentiation in site activity is indicated. Large flakes and core pieces produced by core preparation were associated with the western sector of the site, along with smaller flakes probably produced by implement retouching. Large flakes and core pieces were generally absent from the eastern area of the site.

Only one phase of occupation is exhibited at Sasi. The 10-25 cm deep cultural layer rested directly upon Baun ash (which had no evidence of earlier modification). Occupation of this locality was therefore probably the first following the Baun ashfall.

Site occupation may have been only relatively brief before deposition of the Sasi ash buried this locality. This is suggested by the relative shallowness of the cultural deposit and the absence of cultural deposit over earlier occupation debris. Site reorganisation is evident however in the placement of tabular stones over much of the site, probably to form a pavement over potentially hazardous knapping debitage.

EMSIN (Site GEB)

The Emsin site is located approximately 100 m inland from the north coast of Lou on a promontory above Rei village (Figure 6.1). Emsin was excavated in 1978 by Ambrose and Kennedy. The investigation unearthed more than 300 broken mainly triangular sectioned obsidian points all of which possessed extensive retouching (Antcliff 1988). Excavation was undertaken in two squares, which I will label Squares A and B (Figure 6.23). Square A measured 3 m x 3 m and was situated on a small knoll. Located slightly downslope and separated by a 30 cm baulk was Square B, which measured 2 m x 1.5 m.

Stratigraphy and Dating

The stratigraphic composition of the two squares is illustrated in Figures 6.24 and 6.25. The entire site was covered by a 3 m deep culturally sterile layer of tephra, known as Rei ash (Ambrose 1988:484). The ash sealed a soil rich with cultural material. In Square A the soil was excavated to a depth of 30-40 cm; in Square B this deposit was removed down to the surface of a yellow weathered ash which probably represented a remnant pre-occupation surface (Figure 6.25). I have divided the pre-Rei ash deposits into the following stratigraphic units:

Unit 1: a 20-40 cm deep deposit present immediately beneath the Rei ash. The deposit was coarse textured and undifferentiated. Excavation of Unit 1 was undertaken in three arbitrary spits.

Unit 2: a fine silt or weathered ash. In Square B this deposit was 5-10 cm deep.

Unit 3: a friable deposit revealed in Square B. This was 8-20 cm deep and associated with a particularly dense concentration of obsidian.

Unit 4: fine textured yellow weathered ash possessing only a small number of artefacts. This probably represented the unmodified pre-occupation surface.

Two radiocarbon dates are available, both on charcoal. One (ANU 2193) gave a conventional age of 1640 ± 90 b.p. for the top spit of Unit 1, the other (ANU 2194) a date of 1860 ± 140 b.p. for the bottom spit of this unit. When calibrated for two sigmas these provide ranges of respectively 1722-1329 BP and 2123-1418 BP. These are statistically the same at a 95% confidence level (T = 1.73, chi square = 3.84). The combined probabilities for these two ranges is 2215-1319 BP, representing 87% of the variance in the radiocarbon curve. This also provides an approximate age span for deposition of the Rei tephra. The 1920 BP Pisik tephra is not present in any excavation levels, which indicates that occupation probably took place some time within the 600 years between 1920 BP and 1319 BP. In the absence of evidence for significant stratigraphic discontinuity, I will assume that different episodes of site occupation are not separated by any great time depth.

Non-Obsidian Artefacts

Pottery sherds are the most numerous non-obsidian artefacts. Most sherds were recovered from Units 1 and 3. Both coarse and sandy tempered wares are present (Ambrose 1991a:107). The latter is undecorated and provides a striking contrast with the large number of shell impressed sherds recovered from the contemporaneous Pisik School site (see below).

The only diagnostic non-obsidian lithic artefact is a small fishing sinker. Unfortunately there is no record of the stratigraphic provenance of this piece.

The Obsidian Assemblage

The investigation of Emsin yielded 23,229 gm of obsidian. The weight by unit is shown in Table 6.10, after data presented by Antcliff (1988:Table 2). Most obsidian (60%) was associated with Unit 1. However, Unit 3 in Square B also possessed a particularly high concentration. Here obsidian was largely restricted to a dense concentration in the northern half of the square adjacent to a probable hearth (Figure 6.26). This in all likelihood represents an *in situ* flaking floor. The recovery of only a small amount of obsidian from Unit 4 in Square B suggests that this lower level was probably a pre-occupation surface.

Tables 6.11 and 6.12 present the number and weight of retouched points, blades and other obsidian items for each unit. This information is collated partly from data in Antcliff (1988:Table 2), but I have identified a larger number of points than recorded by Antcliff. The high proportion of "other" obsidian pieces in Unit 1 in comparison with Units 2 and 3 is a product of sampling. While all obsidian was collected from Square A, small pieces from Square B, the square which Units 2 and 3 were restricted to, were not retained, except for a small grab sample. Retouched point segments are clearly shown as concentrated in Units 1 and 3. Blades however occur predominantly in Unit 1.

All points from Emsin were selected for analysis. Of the other obsidian items only those from Square B were examined. A little over half (56%) of the obsidian was associated with this square. The number and weight of analysed pieces by artefact category is presented in Tables 6.13 and 6.14. As mentioned above, small pieces which were not points or blades were not systematically collected from Square B so the sample does not include microflakes and other smaller flaked pieces.

Points

The size distribution of the 320 retouched points is illustrated in Figure 6.27. There is no obvious difference between each unit. The cross-sectional size distribution of points is shown in Figures 6.28a, b, c and d. Again, no marked difference is evident between units, except for the presence of two exceptionally large pieces in Unit 1. These are points in an advanced stage of manufacture, evident by the presence of more than 50% retouch cover on both. This demonstrates that at least some very large points were manufactured at Emsin. Points of this size must have been intended for use as non-projectile weapons, or perhaps to be employed as ceremonial or status items.

All points were shaped by percussion retouch flaking of blades. This is contrary to the claim by Antcliff (1988:23) that pressure flaking was employed. Edge crushing and deep removal scars on points, as well as the presence of retouch flakes with pronounced bulbs and shattered platforms, unequivocally demonstrate the use of a percussion technique. One point has reduction at one end which resembles a tang (Figure 6.29), similar to that found on some points at Umleang (below). Antcliff (1988) interpreted the tang as a triangular point in the process of production. However, I am not convinced of this as no other point preforms at Emsin exhibit this kind of bilateral reduction. Rather the preferred technique was to completely retouch one side of a blade and then switch to the opposing face, as illustrated by the examples in Figure 6.30. The presence of the tanged piece as an unbroken artefact in a discard context suggests it was not regarded as functionally viable.

One half (50.6%) of Emsin points are trifacially retouched and many of these (34.6%) are entirely retouched on all surfaces (Table 6.15). Sometimes retouching was initiated on a triangular corner blade (Figure 6.31a), but was evidently always continued onto three faces (as in Figure 6.31b). Antcliff's (1988) study demonstrates that point production was directed toward producing pieces with a triangular cross-section. This is illustrated in Table 6.16. Overall triangular sectioned points outnumber trapezoidal pieces by 3.6:1, while for trifacially retouched pieces this ratio increases to 7.4:1.

Blades

Mainly broken blades were recovered from Emsin. The size distribution of this assemblage is illustrated in Figures 6.32 and 6.33. Although a number of large outliers are present, most pieces from the four units group together. Comparison of the mean and standard deviation of maximum width and maximum thickness for blades and points in each unit is set out in Table 6.17. I have combined the small amount of material from Unit 4 with Unit 3 for this comparison. Blades are shown to be generally slightly wider than points and have a similar standard deviation. However, blade mean maximum thickness is much less than that for points. This would suggest that, as at Sasi, thicker blades than those recovered from the excavation were preferred as point. Antcliff (1988:33) estimated that over two thirds of the blade pieces at Emsin were too small to be manufactured into points. Many blades are probably rejects which were discarded because they did not meet necessary size criteria for conversion into points.

Flakes

The mean length, width and standard deviations of intact flakes recovered from Square B are shown in Table 6.18. Again Unit 3 and 4 material has been combined. Unit 1 is shown to possess an assemblage with a tendency toward relatively smaller flakes. A plot of length by width (Figure 6.34) illustrates that most flakes in all units fall within a 60 mm x 60 mm size range. The overall rarity of very large flakes could indicate primary core preparation was mainly carried out elsewhere.

Elongate flakes were predominantly from Unit 1 and are generally smaller than those found at Sasi (above). Their stratigraphic association with retouch flakes could indicate they are by-products of point shaping, although an independent use could also be posited. As with Sasi, elongate flakes comprise only a small proportion of the assemblage.

Pieces with removal scars

Discounting points and intact flakes with scars, 634 pieces with removal scars were recovered from Square B. Of these, 593 were remnant flakes and 41 were core shatter. The mean and standard deviation of the weight by unit is presented in Table 6.19. (remembering that very small pieces were not recovered from Square B). The relatively low mean values for remnant flakes supports the argument that primary block preparation was not carried out at this locality. The low mean weight values for core pieces indicate cores were either discarded off-site or completely reduced.

Other obsidian artefacts

The only pieces in Square B to exhibit clear usewear were two flake fragments from Unit 1 (Figure 6.35). Antcliff (1988:Plate 14c, 14d) identified these tools as "piercers", presumably on the basis of their beaked points. However, the orientation of retouch or use-wear scars along the inside of the concave surface of these pieces suggests a shaft scraping usage. Both tools also have microflake removal scars along one edge, which would facilitate gripping during a scraping activity.

Discussion of the Emsin Evidence

Activity at Emsin was focussed in Units 1 and 3 but retouched points were present in all levels. A relatively undisturbed living surface was associated with Unit 3. An unusually high density of broken points was discovered in this unit around a probable hearth feature (Figure 6.26). Large flakes, broken flakes and core pieces were also recovered from Unit 3. This indicates cores were reduced *in situ* during point manufacture. The overlying shallow Unit 2 deposit may be a buried soil and possessed material exhibiting similar stages of obsidian reduction. Unit 1 occupation signalled a shift in locality usage. Few large flakes and core pieces were found in this disturbed deposit, contrasting a high density of points. This suggests that during the phase of site occupation immediately preceding the Rei ashfall the focus was on point shaping.

PISIK SCHOOL (Site GBC)

The Pisik School site is located on a ridge 500 m southeast of Emsin (Figure 6.1). The site was excavated in 1978 by Ambrose after erosion revealed three intact ceramic cauldrons in a drainage channel near the school dormitory (Ambrose 1991a:107). The investigation involved excavating a 3 m x 1.5 m square through Rei ash to cultural deposits constituting the pre-eruption land surface. Although not a great deal of obsidian was recovered I will discuss the Pisik assemblage as it provides a good comparison with material from Emsin.

Stratigraphy and Dating

Ten stratigraphic layers were excavated after removal of the overlying Rei tephra (Figure 6.36):

Layer 1: Buried soil 5-7 cm deep.

Layer 2: Coarse pumice laden ash.

Layers 3-6: Four spits each approximately 10 cm deep and excavated through a mixed deposit of soil and ash. Postholes were present in these layers (not visible in the section diagram).

Layer 7: Sediment with weathered pumice fragments and small stones up to 10 cm in diameter.

Layer 8: Mixed pumice and fine textured ash.

Layer 9: Grey fine ash

Layer 10: Brown ashy pumice

Layer 10 was a culturally sterile deposit. On the basis of certain sherd characteristics Wahome (pers. comm.) sees these layers as forming three main units; Unit 1 (Layers 1 and 2), Unit 2 (Layers 3-6), and Unit 3 (Layers 7-9). I will adopt these divisions in the following discussion. Only a small amount of obsidian was associated with Unit 3.

Two radiocarbon estimates from charcoal are available for the upper half of Unit 1. One (ANU 4980) is anomalous, revealing a "modern" date. The other (ANU 4979) provided a conventional date of 1720 ± 100 b.p.. This calibrates to 1867-1395 BP at two sigmas. At the 95% confidence level this is statistically the same as the two age estimates for Emsin (ANU 2193 - T = 0.35, chi square = 7.81; ANU 2194 - T = 0.65, chi square = 3.84). The terminal phase of occupation at Pisik therefore took place in the same time period as Unit 1 occupation of Emsin.

Non-obsidian Artefacts

Other than obsidian the numerically most predominant material in the Pisik School site was pottery. Decorated coarse and plain sandy tempered wares were found. The former predominates and is similar to pottery found elsewhere in the Admiralty Islands. Ambrose (1991a:109) has named this distinctive style "Puian ware". Other cultural material includes a small stone adze recovered from Unit 2, and oven stones from Units 2 and 3.

The Obsidian Assemblage

The Pisik assemblage was not large, 4150.4 gm of obsidian was recovered from the entire site. The stratigraphic provenance of obsidian is shown in Table 6.20. The provenance of 522.7 gm of obsidian is unknown owing to missing artefact bag labels or incomplete stratigraphic or spatial information on the labels. Some of this material probably derives from Unit 1 of the Southern quadrant, for which no bags were present. However, as there is uncertainty over the location of this obsidian it will be discounted from further discussion.

The combined number and weight of pieces in each artefact category is presented in Tables 6.21 and 6.22. Most pieces are restricted to Units 1 and 2. The small number of recovered point and blade fragments demonstrates this locality was not the locus of intensive point manufacture.

Points

The size distribution of the eight point fragments by unit is illustrated in Figure 6.37. Two particularly long points are present in Unit 2; these fall within the length range for some of the longer points from Emsin. Figures 6.38a and 6.38b present the cross-sectional size distribution of the eight points. Very thick pieces are absent but the widest is as wide as some of the largest recovered from Emsin. Two points in Units 1 and 2 are similar to examples from Emsin in possessing intensive retouching, more than 75% scar coverage, and triangular cross sections.

Blades

The size and sectional size distribution of blade segments is illustrated in Figures 6.39 and 6.40. The graphs show these pieces fall within the range of blades from Emsin, although this site does possess a number of blades larger than those in the Pisik site (see above). A comparison of the cross-sectional size of blade and point fragments from Pisik is set out in Table 6.23, with Units 2 and 3 combined. The data illustrate that in terms of maximum width there is little difference in the mean values between blades and points, although points have a wider distribution (i.e. larger standard deviation). For maximum thickness blades and points have a similar restricted size distribution (small standard deviations), but the mean value for blades is slightly smaller than for points. As with Sasi and Emsin, it seems as if thicker blades were preferred for transformation into points.

Flakes

The means and standard deviations for intact flake length and width are set out in Table 6.24. Generally, smaller flakes are present in Unit 1 in comparison with Units 2 and 3.. A plot of flake size distribution (Figure 6.41) reveals that many Unit 2 flakes are longer and/or wider than those in Units 1 and 3. The absence of very small flakes (10 mm x 10 mm and smaller) is again probably the result of sampling bias. Only 12 flakes in the site are elongate.

Pieces with removal scars

The mean weight and standard deviation of pieces with removal scars is set out in Table 6.25. Again pieces associated with Unit 1 are generally smaller than those in Units 2/3. This applies to both the 79 flake remnants and 81 core pieces recovered. The largest flake remnant weighs 34.3 gm, the largest core piece 201.4 gm.

Discussion of the Pisik School Evidence

The discovery of postholes, pottery (including some intact vessels), a stone adze, and oven stones demonstrates that habitation activity was associated with occupation at the Pisik site. Core pieces and larger flakes are generally absent from Unit 1 so there was a shift in locality usage from core reduction to activity involving only secondary flaking.

The small number of point fragments recovered indicates that Pisik was not a workshop on the scale of Sasi or Emsin. By count retouched points constitute 0.9%

of the entire Pisik assemblage, compared with 3.8% for Emsin. The question which must be addressed is were points manufactured at the site or were they imported from a separate workshop? Ambrose (1991a:107) has suggested that most of the obsidian at Pisik is related to the production of unmodified flake tools. Certainly no diagnostic blade cores were present in the site. On the other hand no pieces exhibit macroscopic use-wear, although this is no sure indicator of assemblage function. However, if points were imported into Pisik from elsewhere we might expect the segments recovered during excavation to represent finished articles which had broken in use, and had either been discarded or were in the process of being reworked. The presence of three obviously incomplete unifacially retouched point segments in the assemblage strongly suggests that this was not the case and that blades were transformed into points at Pisik.

Evidence from blade pieces provides additional support for this interpretation. As shown in Chapters 4 and 5, blades are rare in localities where production was geared to making expedient, unretouched flake tools. Twenty four blade fragments were recovered from Pisik, a high overall proportion in comparison with assemblages from Manus and Mouk. Additionally, unlike the small pieces recovered from these two islands, blades at Pisik generally fall within the width and thickness range of those from the Emsin workshop. The exception is the maximum thickness measurement for Unit 1 pieces, which exhibits a tendency to be smaller than the same measurement on blades from Emsin (compare Tables 6.17 and 6.23).

A strong case can therefore be made that retouched points were manufactured *in situ* during prehistoric occupation of the Pisik locality. However, at least for the excavated part of the site, this was clearly undertaken on only a small scale and did not constitute a major aspect of site activity.

UMLEANG (Site GBJ)

Umleang is a former village located near the northern coast of Lou (Figure 6.1). The broad ridge on which the village was located is distinguished by the presence of 23 vertical mineshafts dug some time in the past to access subterranean obsidian deposits (Figure 6.42 and Plate 11). The deepest shaft extends 17 m below ground surface (Ambrose et al. 1981a:7). Abandoned mineshafts are also visible near Solang village, five kilometres from Umleang (Ambrose et al. 1981a:7) A major reason for investigating the Umleang site was to attempt to date the use of obsidian mineshafts. Excavation was accordingly carried out through a scree slope of obsidian and mine upcast which probably originated from nearby shafts (Figure 6.42). Two phases of excavation were carried out. In the first in 1977 Ambrose, Kennedy and Allen excavated a 25 cm x 25 cm test pit to provide material for radiocarbon dating. In the following year Ambrose and Kennedy extended the pit into a 6 m x 1 m trench divided into six squares. One square (Square C) was left unexcavated.

Stratigraphy and Dating

The excavators identified 10 layers in Squares A and B and 12 in Squares D, E and F. These divisions were based on sometimes minor visual differences in sediment colour and texture. All layers contained artefacts so the cultural origin of these deposits is beyond doubt. However, the mixed appearance of the ash and sediment constituting the layers suggests they were redeposited. Much of the associated obsidian probably originated from activity at nearby mineshafts (see below).

In the following discussion I combine the original stratigraphic layers into eight broader units to enable correlation between the two sections of the trench (Figure 6.43). This has been accomplished by treating as one unit stratigraphically adjacent layers described in the fieldnotes as exhibiting similar texture and colour. It should therefore be borne in mind that the units referred to in the following discussion may represent a number of combined depositional events.

The following restricted stratigraphic units are recognised (Figure 6.43):

Unit 1a: Dark mottled soil

Unit 1b: Mixed ash/pumice deposit

Unit 2: Friable mottled sediment described in the fieldnotes as a fine textured soil with small pumice nodules; possibly a buried soil

Unit 3: Compacted light coloured sediment

Unit 4: A mixed deposit of dark brown/black ashy sediment and pumice fragments; heat fractured stones were present in this layer in Square B

Unit 5: Coarse textured sediment with pumice pieces 5 mm to 30 mm in size

Unit 6: A very dense and compacted yellow pumice-rich sediment containing few artefacts

Of particular interest are Units 1a and 1b (henceforth collectively referred to as Unit 1)) which were restricted to Squares D, E and F, i.e. the eastern half of the excavation. The material comprising this deposit was probably upcast from nearby obsidian mineshafts.

The only feature revealed during excavation was a channel in Unit 1 containing water-sorted ash (Figure 6.43). Areal excavation showed this ran in a curve from the centre of the southern side to the northeast corner of Square D. The feature might simply have been a tree root impression (Ambrose pers. comm.).

Four radiocarbon dates have been obtained for Umleang; three for samples from Unit 1 (1a), the middle of Unit 2, and the base of Unit 4, and one on a sample from the base of Unit 6. All samples were charcoal. Units 2 and 4 revealed "modern" dates

(ANU 2195 and 2196), Unit 1 a date of 220 ± 80 b.p. (ANU 2019), and Unit 6 a date of 860 ± 200 b.p. (ANU 8254). When calibrated the Unit 1 and Unit 6 determinations calculate to 469-0 BP and 1175-509 BP at two sigmas. The date for Unit 1 probably relates to the historic era as 87% of the calibration curve falls within the range 330-0 BP. Recently Ambrose (in press) has initiated dating of the site using obsidian hydration. Figure 6.44 is a plot of the hydration dates obtained from measurement of rind thickness in the internal fissures of 14 flakes (adapted from Ambrose in press:Figure 7). This shows a general correspondence between depth and age for Units 2-6, representing occupation which extends from around 730 ± 30 BP to historic times. The former date falls within the radiocarbon age range estimate for Unit 6. There is one flake in Unit 4 however which gives an estimate of 1130 ± 70 BP, which is considerably older than the range of 630 ± 40 BP to 440 ± 30 BP calculated on other flakes in this unit. This may indicate some use of obsidian from considerably earlier deposits during this occupation. The discrepancy between stratigraphic provenance and dates from hydration is however most pronounced in Unit 1. Dates for this unit fluctuate widely, indicating mixing of recently flaked obsidian with material from older deposits. Ambrose (in press:13-14) suggests that this may indicate recent mineshaft use, in which mine excavation introduced earlier flaked obsidian into recent deposits.

Non-Obsidian Artefacts

Potsherds were the only non-obsidian artefacts recovered from Umleang. Sherds were present throughout all excavation layers but occurred only infrequently in Unit 6.

The Obsidian Assemblage

Excavations at Umleang uncovered approximately 70,588 gm of obsidian (the true figure is a little higher but obsidian from Unit 3 in Square A is missing and hence excluded from this study). Table 6.26 sets out the weight of obsidian by unit and square. This illustrates that most obsidian (64%) is associated with Units 1 and 4. Spatial variation is also apparent, with much of the obsidian in Units 1 and 2 concentrated in Squares D, E and F. The high volume of obsidian in Unit 1 reflects its likely origin as mineshaft upcast.

Tables 6.27 and 6.28 set out the number and weight of items in each artefact category by unit. Eighty four point fragments were recovered, with the greatest concentration occurring in Unit 4. Owing to the large amount of obsidian in the site I examined only those blades, flakes, and pieces with removal scars recovered from Squares D, E and F. Most of the 259 analysed blade pieces were found in Units 1, 2 and 4. A similar distribution is evident for the 154 examined flakes. Observation of flake weight indicates the presence in Unit 1 of some very large pieces. Likewise Unit 1 possesses very large (heavy) pieces with removal scars. Again this probably relates to mineworking activity.

Points

Such a wide range of segments was recovered that the impression gained is that they represent a more heterogenous assemblage than that of the Emsin site (Figures 6.45-6.47). The size distribution of point segments from all squares is illustrated in Figure 6.48. No obvious differentiation between units is evident, although two of the four points in Unit 1 group with a number of other exceptionally wide pieces from Units 3 and 4. The small number of retouched points in the Unit 1 mineshaft upcast indicates that point manufacture was not a major activity during this episode of site use. According to local oral tradition (Chapter 3) spearpoints and other obsidian implements were not made at mineshaft localities but in villages, which may account for this archaeological pattern. Sixteen points possess a definite stem or tang (Figures 6.49 and 6.50). Stylistically these resemble spearpoints used and traded in the

Admiralties during the nineteenth century. They are however considerably smaller than those in museum collections. Tanged or stemmed blades have been discovered in pre-Lapita contexts on New Britain (Torrence et al. 1990:460-461), and the results of a functional analysis of one suggest it may have been used in a number of food processing activities (Fullagar 1993). A functional study was not undertaken on the Umleang point segments, or on any from the other Lou sites, as they were clearly in a production context. These pieces were discarded after breakage during manufacture, and hence never used for their intended function. The identification of the Umleang tanged point segments as weapon points rests on (1) analogy with ethnographic weapon points, which historically were a major implement type produced from obsidian mined at Umleang, and (2) their contextual relationship with more extensively retouched blades from Sasi, Emsin and Pisik School, which on morphological ground are almost certainly weapon points of some kind (Chapter 3).

Figures 6.51a-6.51f are plots of points by maximum width and maximum thickness, showing the extent of retouching. Tanged points are present in all units, which demonstrates an antiquity for this type of approximately 700 to 1100 years, as assessed from radiocarbon and hydration estimates for Unit 6. The plots show that many tanged pieces are much thinner than untanged specimens, including those with extensive retouching. It therefore appears that comparatively thin blades were chosen for the manufacture of tanged points. (We do not of course know whether some "untanged" points originally possessed a tang before breakage, although no refits were evident). Only lightly retouched points are associated with Unit 1 (Figure 6.51a). Of the two thickest and widest tanged points recovered from the site, one was associated with Unit 1 and the other with Unit 4 (Figure 6.52).

The extent of retouch and sectional shape for untanged points is summarised in Tables 6.29 and 6.30. In all units extensively retouched point segments are uncommon or absent. Most pieces display only minimal (<25%) or light (25-50%) retouch cover. Those points which possess retouch scars over 75% or more of their surface are triangular in sectional shape (Table 6.30). This is similar to the situation for Emsin and Pisik (above). In Tables 6.31 and 6.32 the same information is presented for tanged point segments. On one half of these points retouch is restricted to the tang. Five of the remaining eight are only lightly retouched on the blade portion of the artefact. Tanged pieces are unlikely to be extensively retouched points in the making. Tang reduction is in all cases multilateral, while more extensively retouched points were usually made by first completely flaking *one* face of the blade back to the dorsal ridge and then proceeding with reduction on the other faces (Figure 6.53). Examination of the cross-sectional shape of tanged points (Table 6.32) demonstrates no strong preference existed for pieces of any particular form. Both triangular and trapezoidal shaped blades were chosen for pieces where retouching is restricted to the tang.

Blades

Figures 6.54 and 6.55 are plots of length by width, and maximum width by maximum thickness for blades and blade fragments from Squares D, E and F. The presence of exceptionally long and wide pieces is demonstrated for Units 1, 2 and 3 in Figure 6.54. The same is true for maximum width and thickness (Figure 6.55), although three thick Unit 4 blades are also illustrated. Some blades at less than 10 mm wide are narrower than any of the point segments and may be associated with another function. Possibilities include use as cutting implements or perhaps the sharp components of booby traps recorded from recent oral history (Fullagar and Torrence 1991:117). Alternative and perhaps more likely explanations are that they represent "mistakes" made during the reduction process, or are by-products from reworking malformed points (e.g. Figure 6.32b).

Table 6.33 sets out the mean maximum width and maximum thickness for blades and points. To provide a more adequate sample the Unit 2 and 3 assemblages have been combined, as have those in Units 5 and 6. Generally blades are shown to be wider than points, which is what would be expected. However, the mean maximum thickness for points is greater than blade fragments, with the exception of pieces from Units 2/3. This suggests that again thicker blades were generally chosen for point manufacture. As with the other Lou sites, many of the blades recovered during excavation are probably those which were deemed too thin for further working and discarded.

Fullagar and Torrence (1991) have carried out a technological study on a surface collection of obsidian artefacts obtained at two Umleang localities, from near the entrance to mineshaft 19, approximately 80 m northeast of the Umleang excavation, and in the vicinity of a village, 150 m to the south. In that study they identified the phases of blade core reduction by plotting intact blades onto a "core reduction chart" (Fullagar and Torrence 1991:132). They interpreted the wide cross-sectional size range of blades at the mineshaft as demonstrating the occurrence of all stages of reduction, from core preparation to the manufacture of blade blanks. Using axes to the same scale as Fullagar and Torrence and the same parameters for specific reduction phases I overlay the plots for intact blades recovered from all units of Squares D, E and F. The resulting distribution (Figure 6.56) is dissimilar to that derived by Fullagar and Torrence in that most blades fall into a group in the smaller size range (phases 4 and 5). Only one blade can be associated with core preparation (phase 2) while the larger blades of phase 3 are not as numerous as recorded by Fullagar and Torrence for mineshaft 19. Possible reasons for the absence of large blades from the Umleang excavation are that they were chosen for points (see above) or that they were more likely to be broken after deposition and are not represented as intact pieces (very thick blade *fragments* are present in the assemblage - see Figure 6.55 above).

Flakes

The size and shape distribution of intact flakes is illustrated in Figure 6.57. Most flake dimensions do not exceed approximately 50 mm by 70 mm. However, a number of Unit 1 flakes are significantly longer or wider than most others in the assemblage. These undoubtedly represent flakes produced during the preparation of obsidian blocks for reduction. In earlier occupation primary reduction was not a major activity at the site. Smaller flakes occur in all units and represent secondary core preparation, preform shaping and final implement retouching. Very small flakes (10 mm x 10 mm and smaller) are not present in the Umleang assemblage. A likely explanation for this anomaly is sampling bias. The absence of a ready supply of water on the island meant wet sieving was not undertaken during the excavation (Ambrose pers. comm.), so very small flakes were not collected.

Twenty eight elongate flakes are present, including two large examples from Unit 1. These may have been functionally similar to the microblade fragments mentioned above, i.e. by-products from preparing a crest on a core to facilitate blade removal.

Inter-unit differences in flake size are summarised in Table 6.34. The comparatively large mean length and width for Unit 1 flakes reflect the presence of primary reduction flakes, but wide standard deviations also show considerable overlap with flakes from underlying levels. Flakes in Units 2/3 and 5/6 exhibit similar mean values but Unit 4 flakes are significantly smaller, particularly in terms of length. Most point and blade segments were recovered from Unit 4 and the presence of a flake assemblage exhibiting a tendency toward smaller pieces suggests that point retouching was a major reduction activity in this occupation phase.

Pieces with removal scars

Large pieces of core shatter and large remnant flakes with dorsal scars are restricted to Unit 1 (Table 6.35). No remnant flakes were found in Units 5 or 6. The largest and most intact core recovered from Umleang is associated with Unit 1 (see Plate 14). This weighs 1756 gm and has crushed platform areas and irregularly terminated flake scars, the hallmarks of blade detachment by direct percussion. To provide a measure of the degree of reduction on core pieces I estimated the extent of detachment scar coverage in terms of broad percentage groupings (Table 6.36). For most units the majority (approximately 60% to 70%) of core pieces possess between 25% and 50% scar coverage, demonstrating many cores were not fully utilised. Core pieces below the Unit 1 mine upcast generally exhibit no more reduction than material associated with this unit. Smaller cores may therefore have been used prior to mine exploitation. An exception to this pattern is Unit 4 where one third of core pieces possess more than 50% scar coverage, illustrating that more intensive reduction took place in this phase.

Other obsidian artefacts

The only pieces from Umleang which exhibit possible use-wear are two concave flake fragments similar to those recovered from Emsin (Figure 6.58). Again a scraper function is a possibility for these. If obsidian points were intended to be attached to wooden shafts, which is more than likely, it is tempting to interpret the concave pieces as spokeshave implements.

A water-worn obsidian block with indentations on two sides was recovered from Unit 4 (Plate 12). These appear to have been formed through striking or crushing an object against the block. In the context of the Umleang evidence a likely function is that of a bipolar anvil, used to steady the core during blade removal.

Discussion of the Umleang Evidence

Obsidian working at Umleang began within the period 1170-500 BP. This range can be narrowed down to 760-700 BP if we accept the results of hydration dating. Four broad periods of occupation activity can be discerned from the obsidian. The initial period incorporates Units 5 and 6 and represents first point production at this locality. Unit 4 activity constitutes the second period and is associated with much more intensive point manufacture. The third occupation phase is represented by Units 2 and 3. Point manufacture was less intensive than in the preceding period. The fourth phase of occupation almost certainly extended into historic times and witnessed use of a nearby mineshaft, accompanied by a low intensity of *in situ* point production. In this final phase obsidian production largely took the form of block and core preparation and blade manufacture. Most obsidian point manufacture seems to have been undertaken away from the mine, perhaps in village workshops as recorded ethnographically.

OVERVIEW AND ASSEMBLAGE COMPARISON

Evidence uncovered by excavation of the four obsidian working localities is summarised below:

(1) Sasi: excavation at this locality revealed abundant evidence of refuse from a single phase of occupation which took place somewhere between 2200 BP and 1920 BP, possibly around 2100 BP. Cultural material was sealed between two volcanic ash layers and constituted a deposit no more than 25 cm deep. Obsidian debitage was prevalent over the entire locality and included 747 retouched point segments. This site was clearly the locus for the dumping of refuse from comparatively large-scale point manufacture. A second episode of activity saw tabular rhyolite slabs placed over the obsidian.

(2) Emsin: a number of occupation phases are suggested for this locality. All occupations took place after deposition of the Pisik ash, i.e. after approximately 1920 BP (Ambrose 1988:484), and before the Rei ash buried the site some time between 1722 BP and 1329 BP. The presence of postholes indicates a structure, perhaps a dwelling or cooking place, existed during one phase of occupation. Obsidian working was a major activity in all episodes of site use. In total 320 point fragments were recovered from all levels of the site.

(3) Pisik School: this site was also occupied in a number of episodes. Occupation associated with the upper stratigraphic unit occurred at the same time as the final occupation phase for Emsin. The presence of abundant highly decorated pottery and intact vessels in the upper units suggests the locality was a habitation site. Only eight obsidian point segments were present, while the general paucity of obsidian indicates a low level of production took place in the site.

(4) Umleang: a number of occupation phases are evident for this locality. First occupation took place somewhere between 1175 BP and 509 BP and probably in the period 760-700 BP, on hydration measurements. A phase of relatively extensive obsidian point manufacture is associated with the Unit 4 deposit, approximately 630 $\pm$ 40 b.p. to 440 $\pm$ 30 b.p. The most recent phase of activity took place within the last 200 years or so and witnessed the deposition of mineshaft upcast over the eastern half of the site. By weight most of the obsidian recovered from the site was associated with this recent phase. A major change in site function took place at this time, with the focus of activity on block reduction and blade manufacture. This may indicate that at this time obsidian deposits were closer at hand, providing inferential evidence for the late use of obsidian mineshafts.

A GENERALISED REDUCTION SEQUENCE

Examination of the four assemblages provides an inductive view of the production sequence involved in the manufacture of retouched points. This is illustrated schematically in Figure 6.59. Four basic reduction stages are shown. In the first an obsidian block undergoes initial shaping. This results in large primary flakes and large pieces of shatter, the latter discarded due to accidental block breakage or material inconsistency (Plate 13). The second stage of reduction involves shaping the incipient core in readiness for blade detachment. By-products from this include secondary flakes. The third reduction stage sees blade removal and subsequent core reshaping in preparing the piece for further removals. Aside from blades, material resulting from this activity would include smaller tertiary flakes, small or malformed blades, and spent or heavily reduced cores (Plate 14). In the fourth and final stage of the reduction sequence blades are shaped by controlled percussion flaking. By-products of this activity comprise comparatively small retouch flakes with dorsal scars, and incomplete, broken point segments.

Boxplots of the weight of core pieces and flakes provide a visual method of comparing differences in the by-products of reduction. These are illustrated in Figures 6.60a and b and Figures 6.61a and b. Clearly evident is the restriction of very large items to Unit 1 at Umleang. This reflects the preparation of large obsidian blocks in the occupation phase associated with mineshaft use. This first stage of the reduction sequence is evident in no other assemblage. Second stage core preparation is suggested for Sasi, Emsin 2 and 3/4, as well as Umleang 1, by the presence of comparatively large flakes and core pieces in the upper quartiles of the plots for these assemblages. Third stage blade removal and core re-preparation is suggested for the aforementioned assemblages plus Pisik 2/3 and all levels of Umleang. Two core rejuvenation blades from Sasi are illustrated in Figure 6.62. The fourth reduction stage in which blades were transformed into retouched points took place in all localities, as I have shown in this chapter. However, it appears that during the final and synchronic occupation phases of Emsin and Pisik activity was limited to only point shaping. Boxplots of the weight of core pieces (Figure 6.60a) and flakes (Figure 6.61a) reveal that these assemblages are composed of relatively much smaller pieces, which would be expected if retouching but not core preparation was carried out.

These conclusions on inter-assemblage variability in reduction activity are summarised in Table 6.37.

COMPARISON OF THE POINT ASSEMBLAGES

Quantitative comparison of the four point assemblages in terms of the variables medial width and thickness, and maximum width and thickness is presented as a correspondence plot in Figure 6.63. Discussion of the correspondence technique is given in Appendix B of this thesis. With the exception of a small number of outliers, no separation is evident between the sites. However, when the site assemblages are examined by excavation unit for two variables, maximum width and maximum thickness, subtle differences in point size become apparent (Figures 6.64a, b and 6.65a, b). Examining maximum width first, a number of particularly wide points are evident for Sasi (Figure 6.64a). Umleang points, with the exception of those from Units 2/3, possess a distribution skewed toward wider pieces than the other Lou assemblages (Figure 6.64b). A different picture is evident for maximum thickness. Points from all levels of Emsin exhibit a tendency toward greater thickness than Sasi, Pisik or most levels of Umleang (Figure 6.65a, b). The exception to this pattern is the small number of Umleang Unit 1 points, which fall within the range for Emsin.

Much of this variability could be expected to be due to differences in the amount of point retouching between the four localities. Inter-site comparison of retouching (Figures 6.66a-d) illustrates that at Emsin and also Pisik, although this assemblage is really too small for meaningful comparison, a higher proportion of points display extensive (>75%) retouching than at Sasi or Umleang. As retouching obviously results in an overall decrease in artefact size, the presence of a high number of wide outliers for Sasi and a tendency for most levels of Umleang to possess wide points can be parsimoniously explained by the application of less retouching than at Emsin. However, the use of extensive retouching at this locality cannot account for a distribution skewed toward comparatively thick pieces (above). Clearly then, at Emsin much thicker blades were removed and utilised as point blanks. This could arguably demonstrate that the knappers at this locality possessed greater skill than those in the other sites. The use of thicker blades at Emsin is not indicated by a comparison of maximum blade thickness (Figures 6.65a, b). However, as I have previously related, discarded blades were probably those considered unsuitable for conversion into points; the boxplot merely illustrates that in all localities a similar range of blade sizes was deemed unsuitable for use as point blanks.

Variation in point retouching between the sites is summarised by a correspondence plot (Figure 6.67). In this the orientation of retouching is treated as four variables (U=unifacial, B=bifacial, T=trifacial, and Q=quadrafacial), and the extent of retouching as five (1=<25%, 2=25-50%, 3=50-75%, 4=75-99%, 5=100%). A trend is evident from less intensively retouched points on the right hand side of the plot, to extensively modified trifacially and quadrafacially retouched pieces on the left. Unifacial and bifacial modification and relatively light retouching are associated with the Sasi and Umleang assemblages. Remembering that the vertical axis accounts for only 20% of the variance, the Pisik assemblage can be seen as possessing no strong bias for either light or more extensive point modification. Less ambiguous is the close relationship between extensively modified points with trifacial retouching and the Emsin assemblage. This corroborates conclusions drawn by Antcliff (1988) that point making at Emsin was oriented to the production of triangular sectioned implements, a manufacturing routine which involved the application of extensive retouching. This will be considered further in the next chapter.

CONCLUDING REMARKS

The assemblages from Sasi, Emsin, Pisik School and Umleang present an opportunity to obtain a perspective on retouched point manufacture over a period of 2100 years. Inter-site variation has been shown to exist in the degree of time and effort devoted to manufacture. This produced morphological distinctions between the extensively retouched points recovered from Sasi and Emsin points, and the lightly retouched and tanged points at Umleang. The next chapter expands upon the evidence for this variability, and documents how we might ascribe meaning to this in the context of the scale and organisation of production.

CHAPTER 7
OBSIDIAN AND SPECIALISED PRODUCTION ON LOU ISLAND

INTRODUCTION

In this chapter I address the topic of variation in obsidian point manufacture. This chapter is in three parts. In the first I introduce ways in which production for local consumption might be differentiated from production for exchange. In the second part I apply these criteria to evidence at the point manufacturing localities introduced in the previous chapter. The third part of this chapter is a discussion in which I examine the evidence from Lou for obsidian point production for exchange.

PRODUCTION AND EXCHANGE

Researchers generally concur that regular production for exchange is distinguished from production for local consumption by a higher level of organisation in some or all stages of the manufacturing process (e.g. Blackman et al. 1993; Brumfiel 1987; Evans 1978; Junker 1993; Irwin 1985; Kramer 1985; Rice 1981; Shafer and Hester 1991). Specifically, production for exchange is often considered to be characterised by (1) the presence of discrete workshops and sometimes storage areas, with evidence of production in excess of that needed by a household or community, (2) the systematic and intensive use of specific, usually high quality, raw material sources, and (3) products manufactured in a way indicating routine and large-scale production. In a pioneering study, Torrence (1986) has examined specialised economic behaviour in the context of developing a "middle range theory" for lithic production and exchange, and applied the defined behavioural correlates to a study of obsidian use in the prehistoric Aegean. The main theme of Torrence's work is that the level of exchange complexity, conceptualised as a continuum from direct access to negative reciprocity, is positively correlated with the efficiency of obsidian production, in which efficiency is defined as the ratio of benefits/costs or outputs/inputs (Torrence 1986:40).

The level of production efficiency in an industry can therefore be assessed by examining the degree of systematisation in and control over raw material extraction, and the extent to which production is carried out in a routine or systematic fashion. In combination with estimates for the scale of production, these can be sensitive indicators for distinguishing different modes of production (Torrence 1986:203). In the following section I apply these to an examination of obsidian point manufacture at Sasi, Emsin, Pisik School and Umleang.

POINT MANUFACTURE ON LOU

SCALE OF PRODUCTION

The scale of production can be conceived of as beginning with production for individual or household requirements, to full-time production in which the entire subsistence requirements of an individual are met by his or her craft activity (Muller 1984). Regular production for an individual household or community will obviously be smaller in scale than regular production for a wider consumer market. There is no evidence that even the most specialised manufacturing communities of Island Melanesia engaged in full-time production for exchange for anything other than brief periods of the year (Chapter 1). Specialist ceramic production was however distinguished by a very large output volume, resulting from the cumulative effect of continuous low intensity manufacture for regular exchange with neighbouring communities (Börnstein 1914:317; Irwin 1985:15), and short periods within each year of highly intensive production to provision long distance trading expeditions (Oram 1982:22). However, the archaeological signature from this type of behaviour might be difficult to decipher from production for only local use. Bulmer (1982:122) for instance has criticised Allen's interpretation of Motupore as a community of specialist manufacturers and traders, claiming that archaeological evidence for large scale production could justifiably be interpreted as manufacture for community consumption (see Allen and Rye 1982 for a rejoinder). Turning to lithic material, ethnographic observations on quarrying for axe stone in the New Guinea highlands (Burton 1984; Chappell 1966; Vial 1940) have shown that large amounts of debitage can be produced from relatively short periods of intensive stone working undertaken to satisfy personal requirements. It should also be borne in mind that low intensity production over a long period can also result in the accumulation of very large quantities of debitage (Healan 1993:452-453).

As mentioned previously, one way of aiding an assessment of production efficiency is to ascertain the rate of output per individual. Determining the scale of production is common in studies where the object is to discover whether lithic manufacture was undertaken for trade or personal use (Arnold 1987:237; Healan 1993:452-453; Mallory 1986:156; Santley 1984:60; Shafer and Hester 1986:162, 1991:87; Torrence 1986:205-206). The calculated weight of obsidian per cubic metre of excavated deposit for each site is shown in Figure 7.1. Particularly high densities of obsidian by weight are indicated for Umleang and Sasi. The figure for the single-phase Sasi site suggests that intensive obsidian reduction and subsequent dumping was carried out. In the case of Umleang however, the high density is solely due to the presence of primary reduction flakes and other large pieces in the most recent occupation deposit, associated with mineshaft extraction (Chapter 4). An examination of intra-site differences is required to arrive at an appreciation of the level of obsidian using activity within the three stratified sites.

Table 7.1 sets out the calculated weight of obsidian and number of point and blade segments for Sasi and each excavation unit in the three stratified sites. Clearly, only Sasi and Unit 3 at Emsin exhibit sufficiently dense concentrations of point segments per cubic metre of deposit to indicate intensive manufacture. Densities for stratigraphic units at Pisik School and Umleang are too low for these to be associated with workshop activity. The pattern for Umleang is interesting however in that the top four units have high densities of obsidian, in conjunction with comparatively low densities of blade and point segments. For Unit 1 this is clearly the result of an activity which predominantly involved the preparation of large obsidian blocks obtained from nearby mineshafts (Chapter 4). An explanation is less clear for Units 2, 3 and 4, in which there is little evidence of primary block or core preparation. Possibilities include the removal (recycling?) of many broken blades and points, or alternatively the removal of large previously discarded blocks, cores and flakes. Whatever the case, it is Sasi and Emsin which hold the promise of providing information on a scale of production beyond the requirements of the local community.

In narrowing the focus of discussion to the rate of point manufacture per person some control must be obtained over the length of site occupation. An ideal assemblage for analysis would be one abandoned after one knapping episode, and sealed from post-depositional disturbance. The assemblage closest to this ideal is that recovered from the 3 m^2 Unit 3 deposit at Emsin. This consisted of a shallow (maximum 20 cm) artefact-bearing horizon apparently formed by a number of closely spaced *in situ* episodes of mainly point retouching (Chapter 4). As an aside, the much lower density of blade segments recovered from the Emsin workshop in comparison with Sasi could reflect a situation in which only a small proportion of blades were actually manufactured on site, most may have been introduced from a separate core reduction area. Material uncovered by the 6 m^2 Sasi excavation also occurred in a relatively shallow (maximum 25 cm) horizon. I have previously (Chapter 4) interpreted this assemblage as a deposit formed by the purposeful deposition of obsidian debris from adjacent reduction areas. The time depth involved in the formation of this lithic dump was also probably not great, judging by the shallowness of the deposit and its structure as an undifferentiated soil/obsidian matrix. One important factor to remember is that only a proportion of the areal extent of these two localities was uncovered by excavation. However, although the true extent of these obsidian-bearing areas may be significantly greater, this need not imply any great increase in the time span of occupation. Sheets (1975:99) for instance records that in one month a competent knapper can manufacture one ton of debitage, which shows the time taken to form a lithic deposit may be better judged by the presence or absence of stratigraphic disconformity than by the overall size of the deposit.

Point segments from Sasi and Emsin represent pieces broken and discarded during the manufacturing process. Arriving at an estimate for the proportion of points which were successfully manufactured and removed off-site is problematical. Few observations on production error rates have been made in ethnographic studies of flaked tool making in Melanesia (e.g. Blackwood 1950; Sillitoe 1982, 1988; Strathern 1969; White and Thomas 1972) or elsewhere (Binford 1989; Clark 1991; Gallagher 1977; Gould 1980; Jones and White 1988). Additionally, not many archaeologists have attempted to estimate from debitage the number of blade implements successfully manufactured during past site occupation. One exception is Arnold (1987:236-238) who calculated a success rate of between 43% and 61% for large-scale blade production in the prehistoric Californian sequence. These figures are based on a comparison between the number of successful blade removals as evident in core scar morphology, and the number of successful but broken blades in discard context. Cores were absent or extremely rare in all four Lou sites (Chapter 4) so the direct application of Arnold's methodology is not possible. I will therefore rely on the higher estimate from Arnold's data and assume a 60% success rate for the transformation of blades into points at the Lou sites. Accordingly for 374 points to be discarded at Sasi (i.e. 747 transverse segments divided by two) approximately 560 useable points would have had to have been manufactured. This gives a grand total of 934 pieces, counting failures and successes. For the 75 discarded points at Unit 3 of Emsin (149 segments divided by two) the figure is 113 completed points, i.e. in total 188 pieces. Assuming for the sake of argument that manufacture was carried out by one individual over a year, the calculated production rate for Sasi is 2.6 points per day, and for Emsin 0.5 per day. If hypothetical production was at the rate of 32 points per day (averaging 4 per hour for 8 hours), it would take only a little over one month (29.2 days) to account for the points assessed to have been made at Sasi, and just under a week (5.9 days) for those calculated to have been produced in Unit 3 occupation at Emsin. Even if the number of points broken during manufacture has been overestimated, the production rate would still remain very low.

The next question is, what would be the expected community "consumption" rate for retouched points? Women have been recorded making and using stone tools in Melanesia (Bird 1993:26), but historically only men used obsidian-tipped weapons in the Admiralty Islands. I will therefore assume that in prehistory retouched points were manufactured exclusively for use by adult men. Determining the age and sex structure of prehistoric settlements is obviously not a simple task, particularly given the absence of spatial information from archaeological sites on Lou or elsewhere in the Admiralty Islands. For this kind of information we must rely on ethnography, specifically an observation by Moseley (1877:397) that two coastal villages off northern Manus were inhabited by between 250 and 500 people. If we disregard the possibility of change in village size during early historic settlement pattern shifts (Chapter 2) and also assume 20% of the community were adult males, then we can make an estimate of approximately 50 to 100 adult weapon-using males for every prehistoric settlement. Applying this population figure to Lou, this calculates to the production of between six and eleven points per man for the period during which Sasi was inhabited, and approximately one to two points for every man from manufacture at the Emsin Unit 3 workshop. This latter figure increases to a maximum of five per person if points from all units are included. These are not large production rates, particularly if points were components of throwing spears and expended in large numbers during engagements. Once again note must be taken that only a proportion of both localities was excavated, so the number of points per person is probably higher.

The verdict which can be reached from this examination of production volume is that (1) point manufacture at Pisik School and Umleang was not intensive and probably limited to personal requirements, and (2) while manufacture at Sasi and at least one phase of site use at Emsin was comparatively intensive there is, given the limitations of sampling, no unequivocal support for the contention that production at either site was geared to creating a surplus far beyond the requirements of local use or occasional exchange.

RAW MATERIAL PROCUREMENT

Control over access to raw material sources is crucial for the maintenance of an economy based on production for exchange. Torrence (1986:42-43) has suggested that in many situations control will be accompanied by methods for reducing the cost of procurement, which involve increasing the efficiency of acquisition. Ethnographic data reviewed in Chapter 3 reveal that early historic obsidian production in at least some Lou villages was characterised by direct control of mineshafts. This control over access was associated with an apparently task-demarcated procurement system. Specific individuals selected high quality obsidian from the mineshafts, while others transformed the blocks into cores for subsequent reduction.

The use of mineshafts certainly demonstrates the existence within the last 200 years of a well-planned system of obsidian procurement. This appears to have been an attempt to maximise obsidian output from specific localities. The use of mineshafts is not however particularly efficient as obsidian blocks of equivalent size and quality are present in dry stream beds not far from Umleang (Ambrose pers. comm.). The procurement of these would obviously have required less effort than driving shafts down to subterranean deposits. The relatively high cost of mineshaft excavation indicates a need to focus procurement on specific localities. I have suggested in Chapter 3 that this may relate to a period of intensified warfare in which any movement beyond settlements was a somewhat hazardous undertaking. An alternative explanation proposed by Fullagar and Torrence (1991:120) is that construction was initiated to signal ownership and control of obsidian acquisition in order to ensure participation in inter-island exchange. However, the mere presence of mineshafts cannot by itself be used as unequivocal evidence for production for trade. In the New Guinea highlands deep shafts were dug to acquire sufficient axe making stone to satisfy only the personal requirements of those involved in the quarrying operation (Burton 1984:236-237; Vial 1940:161). The number of people involved and the technology utilised in excavating obsidian mineshafts on Lou need not have been great.

Were more cost-effective ways of procuring obsidian employed at Sasi, Emsin, Pisik School and the pre-mine levels of Umleang? A major aspect of efficient procurement is a focus on the exploitation of specific high yielding, high grade source deposits (Torrence 1986:44). Hand-specimen examination of obsidian from the four sites revealed differences in flow banding, colour, and opaqueness, but my impression is that all of the obsidian is admirably suited to flaking. Some pieces do however possess cortex, and a number of these are water-rolled. These probably originate from stream beds, which on Lou are dry for much of the year but do experience flooding after episodes of particularly heavy rainfall. Pieces with cortex would be less suitable for flaking than blocks. Interestingly, 14 core pieces with cortex were recovered from Unit 1 at Umleang. Most of the obsidian from this level originated from mine working and would not be expected to possess weathered cortex. Utilisation as hammerstones may explain the presence of cortical obsidian at Umleang, as well as in other localities. One water-rolled piece from Umleang is almost certainly a hammerstone (Plate 7). An absence of cortical obsidian at Emsin may indicate a high degree of raw material selectivity at this site, or alternatively simply the importation of pieces with cortex already removed.

As discussed in Chapter 3, Ambrose and colleagues have used the PIXE/PIGME technique to measure the range of obsidian sources utilised at Emsin and Umleang (Ambrose et al. 1981a). This work revealed that multiple deposits were exploited at both localities. Using energy dispersive spectroscopy (EDS), discussed in Part Two, I undertook a separate compositional analysis on obsidian from Sasi and Pisik School to determine whether this was also the case for these two localities. Additionally, obsidian from Emsin was re-examined to facilitate comparison between the results obtained using EDS and those obtained from Ambrose's PIXE/PIGME study. The proportions of selected major chemical elements were accordingly measured for 30 obsidian pieces from Emsin, 48 from Sasi and 21 from Pisik School. The resulting data were statistically manipulated and compared with groups derived from data obtained on obsidian from known western Melanesian sources. This procedure enabled archaeological samples to be correlated with known source areas, but not specific deposits. Appendix B sets out in detail the procedures involved in the analysis.

Results of the analysis are summarised in Table 7.2. Obsidian from Emsin falls into two groups, which overlap in their chemical composition. Clearly this discrimination is not as fine as that possible using PIXE/PIGME. Obsidian from the other two sites is also placed predominantly in these two groups, with the interesting exception of a single piece from Sasi. The statistical clustering techniques employed placed this piece in a separate group along with known standards from two specific Lou subsources (Wekwok and Southeast Baun) and Pam Lin and Pam Mandian sources. This uncertainty over allocation to source area is unique among the analyses run on data provided by EDS. Although measurement of major elements generally did not facilitate discrimination between subsources (Appendix B and below), in all other analyses carried out for this thesis the output from EDS was sufficient to enable major source areas to be distinguished. This piece may have originated from either a Lou subsource not encountered in the other assemblages, or alternatively from one of the Pam Islands sources. Whichever is the case, the deposit was evidently not widely exploited during the time the three sites were occupied.

All of the examined obsidian therefore probably falls within the compositional range of Lou Island deposits. Moreover, the extent of compositional variation within these three assemblages suggests that multiple deposits were utilised, if we use the comparison of results from EDS and PIXE/PIGME as a guideline. Identifying exactly which source deposits on Lou were used will not be easily answered, even by employing more discriminatory procedures such as PIXE/PIGME. Prehistorically utilised deposits are now beneath metres of volcanic tephra, thereby placing obvious constraints on the collection of obsidian for use as reference standards.

Rather ambiguous results were therefore obtained from the analysis of efficiency in raw material procurement. The prehistoric occupants of all localities utilised more than one chemically distinguishable obsidian deposit. This could imply a strategy of "foraging" for obsidian blocks, perhaps in dry stream beds and erosion channels. However, the exploitation of multiple source deposits at Umleang is explicable for at least the most recent phase of occupation by the extraction of obsidian from mineshafts dug through different subterranean ash deposits. Mineshaft use would be the more systematised of the two procurement strategies, but not necessarily the more efficient in terms of the ratio of energy expended to amount of obsidian recovered. As I have suggested above, social factors may have overridden economic efficiency in the use of mining techniques.

STANDARDISED MANUFACTURE

Researchers, particularly those studying ceramic manufacture, often use the presence of a low level of variability in production to discriminate specialist craft manufacture for exchange from manufacture for community or household requirements (e.g. Frankel 1988; Hagstrum 1985; Junker 1993; Kramer 1985; Rice 1981; Sinopoli 1989). This research makes the assumption that manufacture for exchange will be differentiated from manufacture for home consumption by the following (see Blackman et al. 1993:61); (1) large production runs favouring a repetitive mode of manufacture, (2) an emphasis on reliability of manufacture manifesting as a low level of diversity in production techniques, and (3) often the presence of an homogeneous style acting as a "trademark" identifying the producer, or producing community, to the end user. This assumed correlation between product standardisation and specialist production for exchange has been generally proven valid, with qualifications, by two critical studies on variability in ceramic manufacture (Arnold and Nieves 1992; Blackman et al. 1993). In Island Melanesia, both Irwin (1985) and Kennedy (1983) have examined standardisation in pottery manufacture. Irwin's ethnoarchaeological study of Mailu potters revealed a high level of homogeneity within an industry geared toward making pots for trade with neighbouring communities (Irwin 1985:64-66). The women potters of that island had developed their craft to such a high level that there was virtually no variation in either the temperature attained during firing the pots or the thickness of finished vessels (Irwin 1985:45ff, 65). Apparently one result of this highly standardised production was a complete absence of vessel breakage during manufacture (Irwin 1985:49).

The presence of a highly standardised manufacturing sequence and an assemblage exhibiting little internal variability have been used by lithic analysts as major criteria for identifying stone tool production by task specialised artisans (Arnold 1987; Clark 1986; Shafer and Hester 1991). Torrence (1986) has examined the applicability of these kinds of criteria to lithic studies. Standardisation in Torrence's view (1986:43-44) is associated with the "routinization" of production, in which a standard production method is adopted to minimise the time involved in manufacture. This is a major consideration when production is geared to supplying a large consumer market, particularly in an economically competitive environment. A routine manufacturing method may also result in more efficient use of raw materials and a low level of morphological variability in the products of manufacture. I will now turn to examining the level of diversity in production method and retouched point morphology for the Lou sites.

Production Method

Following a definition proposed by Crabtree (1972:2) I see method in lithic production as representing the 'logical manner of systematic and orderly flaking'. One way to assess the level of efficiency in production is by examining regularity in the production method. This can be measured by a study of core preparation and the way in which flakes or blades are removed from the core. For example, the presence in many Mesoamerican sites of regular polyhedral cores possessing unidirectional blade scars is testimony to the presence of a well developed, standardised pressure technique (Crabtree 1968). Few intact cores were recovered from the Lou sites, most were reduced to small pieces weighing less than 100 gms. Presumably either many cores were removed from these sites, or alternatively when reduced to a size no longer suitable for blade removal were further reduced during the manufacture of miscellaneous scraping and cutting flakes. Core pieces weighing more than 100 gm were present in the following proportions in the sampled areas of the four sites: Sasi - eight (weight range 101 gm to 273.6 gm), Emsin - two (126.3 gm and 145.3 gm), Pisik School - one (201.4 gm), Umleang - 33 (105.9 gm to 1756 gm). Of the Umleang pieces, only six (weight range 106.6 gm to 317.5 gm) were recovered from deposits beneath the Unit 1 mineworking debris.

None of the larger core pieces possess any indication of a highly systematic technique of blade removal. Two larger core pieces from the Sasi workshop are illustrated in Figure 7.2. (See also Figure 6.21 for the largest Sasi core and Plate 14 for the largest cores from Umleang and Emsin). On most pieces blade scars are not parallel, demonstrating that knappers rotated the cores during blade detachment. Miscalculations occurred during blade removal. This is evident by the presence of blades with the distal ends of the core remaining attached (Figure 7.3). This occurs when too much force is used in removing a blade, or when a thick blade is mistakenly removed from a small core (Crabtree 1968:466).

In terms of the intensity of core reduction, five of the eight pieces from Sasi and one of two Emsin pieces possess blade detachment scars over more than 75% of their surface area. Only three of the 27 core pieces weighing more than 100 gm from Unit 1 at Umleang exhibit a similar proportion of scar coverage. This is undoubtedly associated with the testing and discarding of unsuitable mineshaft blocks during the last phase of site activity. The remaining six large core pieces at Umleang were all recovered from Unit 2 and exhibit scars over less than 75% of their surface. This raises the possibility that obsidian testing may have also been carried out in this occupation phase. The single core piece from Pisik School weighing more than 100 gm exhibits detachment scars over approximately two thirds of its surface area.

In all cases blades were removed by hammer percussion. This is indicated by the presence of proximal impact fractures and ripple marks (see Crabtree 1968:454). Platform preparation is present on few pieces (<5%). Generally, blade segments exhibit an extremely variable geometry, as shown by the examples in Figures 7.4-7.8. Occasionally pieces do display a regularity of form approaching that of, for example, blades in the prepared core industries of Mesoamerica. An example from Sasi is illustrated in Figure 7.4b. In the context of the diversity of most blades, these regular pieces must however be considered fortuitous occurrences.

The conclusions drawn from these observations are that at all localities blade removal was governed mainly by the variable geometry of minimally prepared cores, and that little attempt was made to maximise the number of blades removed from each core. Blade scars on many core pieces are too narrow to have been left by blades subsequently shaped into points. Two examples of pieces with small blade scars, both from Emsin, are illustrated in Figure 7.9. Fullagar and Torrence (1991:130) reported a similar finding from examination of cores recovered from surface contexts at Umleang. They posit the possibility that these cores may have been utilised in the production of implements other than spearpoints. There is another possibility however, suggested by examination of the piece shown in Figure 7.9a. Some cores may have been manufactured into points, by first removing longitudinal blades, more properly microblades, to thin the piece down, followed by retouching to form the final shape of the implement.

Another way of measuring the level of systematisation in production is by examining the degree of variability in the flakes and blades removed from cores. This was carried out using two statistics - the coefficients of variation (V) and determination (r^2), both described previously in connection with analysis of the Farrell and southwest Manus point assemblages (Chapter 3). For intact flakes I examined variation in terms of length and width, for blades maximum width and maximum thickness. Blade length was not included in the analysis as most blades were transversely broken, making such measurement meaningless for the study of technological variation. For a similar reason I chose maximum measurements over medial measurements. Uni- and bivariate statistical measures such as V and r^2 are highly susceptible to the influence of outliers. From discussion presented in Chapter 4, it is clear that flakes and blades which lie well outside the mean or median are present in all assemblages. This variability is functional in that it reflects different stages of core reduction. The inclusion of these will unduly skew any analysis toward a result of greater intra-assemblage variability than might otherwise be expected. For this reason I included only those pieces which fell between the 25% and 75% quartiles of the boxplots of flake length, flake width, blade maximum width and blade maximum thickness (see Chapter 4). This effectively filtered out all outliers and pieces constituting the tails of the distribution curves for the assemblages. The results are presented in Tables 7.3 and 7.4.

Table 7.3 shows that both flakes and blades exhibit wide variability for V. (A value of 0 indicates no difference between observations). Flake length is highly variable except for the bottom unit of Umleang, while flakes from Sasi, the top two units at Emsin and the bottom unit of Umleang exhibit relatively little variability in width. There is no obvious spatial or temporal patterning to these results. A similar situation is evident for blade maximum width and maximum thickness. Width is highly variable, with the exception of blades from the bottom unit at Umleang. High variability is shown for maximum thickness in all assemblages.

Turning to measurement of r^2, Table 7.4, it is clear that little relationship exists between flake length and width, with the exception again of pieces from the bottom unit at Umleang. (A value of 100 indicates a perfect positive or negative correlation between observations). With respect to blade segments, maximum width and maximum thickness exhibit a comparatively high correlation only for Unit 1 at the Pisik School site. As with data provided by V, it is apparent that we are generally dealing with a medium to high level of variability in most assemblages. Little evidence exists of a highly systematic production routine, which is perhaps not surprising in the light of the results obtained from examination of core pieces (above)

Point Morphology

Highly routine production does not therefore appear to have characterised blade reduction in any of the assemblages examined here. What of the products of manufacture? A routine way of carrying out the final shaping of implements could be undertaken even within the context of a relatively unsystematic mode of reduction. I have already alluded to this in Chapter 4, in which I described how most retouched points, with the exception of tanged pieces from Umleang, were manufactured by first completely retouching one side of the blade before proceeding to modification of the other sides. Figure 7.10 illustrates two pieces from Sasi with this form of preliminary unifacial retouch, and Figure 7.11 points in more advanced stages of reduction. At Sasi some deviation was apparent from this pattern however, as illustrated by one piece with multilateral retouch (Figure 7.12). Clearly, production was not altogether undertaken to a standardised reduction sequence.

As mentioned previously, Antcliff (1988) has observed that a large proportion of retouched points from Emsin have almost equilateral triangular cross-sections. This is evident from examination of both medial and distal segments (Figures 7.13 and 7.14) The significance of this is that it demonstrates the production of a standardised implement type. In the absence of unbroken points in any of the Lou assemblages, an examination of the sectional shape of pieces may therefore be a fruitful method for elucidating morphological homogeneity.

Table 7.5 sets out calculations of *V* for maximum width and maximum thickness, by retouch category. Too few point segments were recovered from the Pisik School site to enable meaningful comparison, so this assemblage will be excluded from the following discussion. I treat the Emsin assemblage as one unit as this material was probably deposited over a short time interval (Chapter 6), while units within Umleang have been combined into two broad divisions for the sake of providing a larger stratigraphic sample. Those points from Umleang with retouch restricted to a tang are not included. Also excluded are two point distal segments from Sasi with 100% retouch cover, four points from Umleang Units 1,2,3 and Units 4,5,6 with 75-99% retouch, and one point from Umleang Units 1,2,3 with 100% retouch. Ascertaining coefficients of variation and determination for such small samples would obviously be meaningless.

The data in Table 7.5 demonstrates little uniformity exists in either maximum width or maximum thickness for any assemblage, a pattern similar to that for unretouched blade segments (above). A wide cross-sectional size range is obviously present in all three point assemblages. However, greater uniformity is evident from calculation of r^2 values (Table 7.6). In terms of point segments with more than 75% retouch coverage, this shows a high correlation between maximum width and maximum thickness for the 110 pieces from Emsin and seven from Umleang. Particularly significant is the high value for those 56 Emsin point segments with 100% retouch coverage, demonstrating a near perfect association between maximum width and thickness. Clearly, knappers at this locality were manufacturing points to a specific cross-sectional shape, although these were not uniform in terms of cross-sectional size (above).

Figure 7.15 provides a graphical illustration of the relationship between maximum width and maximum thickness. For simplicity, data on all points from each site are included, irrespective of the degree of retouching or stratigraphic provenance. A narrow distribution is shown for points from Emsin in comparison with those from Sasi and Umleang. Most Emsin points possess maximum width measurements between approximately one and one and a half times their maximum thickness values. The median is just under one and a quarter times the maximum thickness. For Sasi the range for most points is between one and two and a half times maximum thickness, and for Umleang between one and a quarter and three and a quarter times the maximum thickness. Respective medians for the maximum width are one and three quarters and twice the maximum thickness. The exceptionally wide point segments in the Umleang assemblage are pieces with most or all of their retouching restricted to a tang.

The relationship between maximum width and thickness, sectional shape, and orientation of retouching are set out in Figures 7.16 - 7.18. Points in all three assemblages which possess retouching over less than 25% or between 25% and 75% of their surface area exhibit a wide size/shape range. Points with greater than 75% retouch coverage display a relatively restricted cross-sectional shape distribution and exhibit higher correlation between maximum width and maximum thickness, as shown by high r^2 values on the graphs. In comparison with pieces from the other two sites, extensively retouched points from Sasi again show a low statistical association between width and thickness. However, there does appear to be a general pattern at Sasi of manufacture to an equilateral sectional shape, as with Emsin but unlike

Umleang. The difference is that the shaped Sasi points are distal pieces shaped for functional requirements, i.e. to form a sharp weapon tip.

The most striking difference between the assemblages is in a focus on the production of different point types at each locality. At Sasi only 5.3% of point segments are entirely retouched, and these are distal pieces of both trapezoidal and triangular sectional shape. The emphasis at this site was apparently on the manufacture of relatively lightly modified points of no specific predetermined sectional shape. With regard to Emsin, 33.7% of point segments are entirely retouched. Many are medial and proximal segments, reflecting a manufacturing sequence dedicated to the almost exclusive production of triangular sectioned points. By comparison, only one point segment at Umleang is entirely retouched, a distal piece (Figure 7.19b). A distinctive point type at Umleang is the tanged form. Tanged pieces were recovered from throughout the Umleang sequence and, except for retouching to form the tang, are either unmodified or possess only minimal flaking (see Chapter 6).

In summary, an examination of point morphology revealed significant inter-site differences in the extent of morphological standardisation. Points from Sasi demonstrate little association between maximum width and maximum thickness, as well as little homogeneity in terms of cross-sectional shape. The later Emsin assemblage by contrast has evidence of more intensive retouching to produce equilateral, triangular points. As with Sasi, these were made to a wide range of sizes. The Emsin evidence can be contrasted with the much smaller but contemporaneous Pisik School point assemblage (Figure 7.20). In this assemblage a trend to the manufacture of equilateral sectioned points can be argued, but large pieces such as found at Emsin are absent. The impression obtained from examining the single entirely retouched point segment from the Pisik site is that it is more crudely manufactured than many Emsin examples; retouching is overapplied, resulting in a thin and narrow piece of irregular appearance (see Figure 6.4). At Umleang the most extensively retouched (>75% scar coverage) points are triangular. These continued to be made until late prehistory, but constitute only 5.9% of the total assemblage. In this site three quarters (76.2%) of pieces possess less than 50% retouch cover, compared with 61.2% at Sasi and only 35.6% at Emsin. The relatively low proportion of extensively retouched pieces in Umleang indicates that many points were never intended to be heavily modified. This is certainly true for the tanged points, which make an appearance in the earliest occupation of the site. The synchronous production of both tanged and untanged points suggests a diversification of manufacture at Umleang, contrasting the more standardised production undertaken at Emsin.

PRODUCTION FOR EXCHANGE?

The scale of retouched point production varies immensely between the four Lou sites examined in this chapter. Point making was a minor component of occupation activity at Pisik School. Only small scale *in situ* manufacture was carried out during all occupation episodes at Umleang, although Unit 1 activity may have involved preparing obsidian for supply to a separate, unidentified workshop. Far more intensive manufacture was carried out at Sasi and Emsin, but this could have been accommodated by local requirements over the medium term. Examination of obsidian procurement patterns and manufacturing methods revealed nothing which would contradict the conclusion that production was undertaken to satisfy local demand and perhaps a low level of exchange.

Variability in point manufacture was found between the four localities. Sasi points are both trapezoidal and triangular in sectional shape, with no strong correlation between width or thickness. A different production strategy appears at Emsin, one in which points were made to an equilateral triangular shape. This was achieved through the application of extensive and skilfully executed secondary retouching. Few points were recovered from the contemporaneous Pisik site to enable spatial comparison, but the single entirely retouched piece bears little resemblance to those from Emsin. This could be an indication that at this time the skilful production of standardised points was restricted to specific communities, although obviously much more work is needed to establish synchronic patterns of manufacturing behaviour. Occupation at Umleang involved the production of a different point type. This is a tanged form with minimal or no retouching. Manufacture of this type took place alongside the production of presumably untanged points, of which only a few are extensively modified triangular pieces resembling the Emsin type.

The presence at Emsin of triangular points exhibiting a remarkably uniform cross-sectional shape provides unquestionable evidence of the work of a skilled artisan or artisans. Earlier, subsequent and perhaps contemporary manufacture on Lou does not display a similar level of implement shaping. An argument could be made that this high degree of standardisation represents the outcome of routine production for regular trade with external consumers. However, assuming that production purely for trade is correlated with attempts to decrease the amount of time and energy devoted to manufacture, then the application of extensive point retouching can be viewed as an inefficient use of time, if the desire was to maximise production output. It seems unlikely that this was a response to functional considerations as ethnographic accounts testify to the effectiveness of minimally shaped spearpoints, while experiments by Pope (1923) using obsidian-tipped arrows show that the inherent cutting properties of glass make extensive shaping functionally unnecessary. These functional considerations also call into question the necessity of the extensive retouching present on the less homogenous points at Sasi.

A plausible explanation for the presence of extensively retouched points in the Sasi, Emsin and Pisik sites is that this artefact type was a social marker for either the producer or ultimate consumer. Weapon points can contain encoded information which identifies the manufacturer or end user to other communities. For instance, an ethnographic study of variation in San (Kalahari) projectile points found a close association between stylistic attributes of point morphology and linguistic group boundaries (Wiessner 1983:272). Points from Lou, and apparently also some from southwest Manus, may therefore have been extensively shaped for an "heraldic function" (Glover and Presland 1985:186), not because particular forms conferred any great advantage during combat (other than perhaps psychological). I would go so far as to suggest that some points, particularly the larger specimens in Emsin, were never intended for a strictly functional role but as prestige items, possibly trade valuables.

The blades of obsidian-tipped weapons used and traded in historic times were notable for the absence or minimal use of shaping (Chapter 3). The closest prehistoric parallels to these are found at Umleang, particularly in the tanged type. The appearance of a tanged form marks a transition from an early blade technology to one typologically resembling that encountered at contact. Technological simplification could be a response to a number of factors, including (1) an increase in demand resulting in a need for greater production efficiency, (2) production by individuals who lacked the requisite skills, or perhaps rights, to manufacture finely worked points, and (3) stochastic stylistic variation. Providing a definitive choice between these possibilities will only be achieved by examining more point assemblages from other dated contexts above the Rei ash layer. However given the information we currently have, the last two propositions appear the least plausible. Occupation at Umleang extended over perhaps 750 years and it seems unlikely that during this time an adherence to the same point forms was maintained for reasons of knapping skill, rights of manufacture, or an unchanging "mental template". This is particularly so when consideration is given to the differences which are present over a temporal span between Sasi and Emsin of less than 800 years, and a 500 m spatial distance between Emsin and Pisik School.

A case can be made that the appearance of tanged points at Umleang reflects a simplification of production in response to a situation which developed some time after the Rei ashfall. This change saw points beginning to be "consumed" (utilised or traded) at a far higher rate than previously. Support for this explanation of change is found in Wiessner's study of San spearpoints, in which it was discovered that expedient items with a short manufacturing time and uselife contain little if any *stylistic* content (Wiessner 1983:260). One implication of change in retouched point style on Lou is that at some time after the period bracketed by the age range 1722-1329 BP (the radiocarbon range for the Rei ashfall) ethnographically recorded patterns of warfare involving the large-scale use of obsidian tipped weapons became established in the archipelago. Although there is no direct evidence from Umleang for point manufacture for more than local requirements, the appearance of more easily produced tanged points has obvious implications for the possible reorientation of production toward large-volume manufacture.

CONCLUDING REMARKS

This examination has shown that there is no evidence in any of the four sites for a level of highly systematised, large-volume production which might be expected among full-time specialists. At Sasi and Emsin there is at most an indication of production for occasional exchange, and indeed all of the points recovered from these two sites could be utilised by local producers. Umleang represents a transitional phase in Lou Island blade technology between the period when extensively retouched points were manufactured at Sasi, Pisik School and Emsin, to the nineteenth century production of heterogenous, minimally modified blades. The presence of tanged point segments in all levels at Umleang demonstrates that this more expedient type has prehistoric origins and that manufacture persisted up until the nineteenth century. However, by the time the first anthropological expeditions were made to Lou at the end of that century regular blade production and obsidian mining seem to have ceased (Chapter 3).

Technological simplification can be viewed as a response to a need for more cost-effective production following an increase in demand. The arrival of European traders may have initiated change from spears and other weapons with retouched points of the kind present in Umleang, to more economically produced large, irregular primary blades attached to intricately decorated shafts, which represented the valuable part of the implement to traders (Torrence 1993). Similarly, the appearance of a tanged point technology in the period between the abandonment of Emsin and first occupation of Umleang demonstrates a prehistoric change took place to simplified, cost-effective production. I suggest that this was a direct result of an increased demand for weapon points. There is a limit to how much economy of production can be attained through simplification however, and eventually further increases in output can only be derived by spending more time on production. Eventually this will give rise to craft specialists, individuals or communities who depend on their speciality for at least part of their livelihood.

PART FOUR: COMMENTARY AND DISCUSSION

CHAPTER 8
SYNTHESIS: A CHRONOLOGY OF OBSIDIAN USE IN THE ADMIRALTY ISLANDS

THE OBSIDIAN SEQUENCE

This chapter summarises the sequence of obsidian use in the Admiralty Islands. To facilitate this I have divided the sequence into four periods, illustrated in Figure 8.1.

EARLY PERIOD (c13,800-12,600 BP to 7000-5000 BP)

Our entire knowledge of the Early Period comes from Phases III and IV of the Pamwak sequence (Chapter 4). Clearly this is a limiting factor in deriving any broad interpretation from the material. Whether or not the evidence revealed at Pamwak is indicative of a regional pattern awaits the discovery of further sites of this age on Manus.

Evidence from Pamwak shows that obsidian began to be used and distributed in the period 13,786-12,627 BP. Prior to this cherts, presumably obtained from local stream deposits, were utilised for unmodified flake tools. The chronological depth of this chert technology is unknown, but may extend back 10,000 years before the appearance of obsidian, on the basis of an age/depth extrapolation of the Pamwak deposits. The sudden and virtually complete replacement of chert with obsidian in the terminal Pleistocene marks a major shift in lithic resource procurement. For the first time people were utilising stone available outside the local site catchment and moving this material around the landscape.

A strong candidate for the source of the first obsidian transported to Pamwak is the Pam Islands. On available bathymetric and geological evidence it seems unlikely that the larger Pleistocene Manus landmass was connected to land now present as the two small islands constituting the Pams. Watercraft must have been used to access obsidian. Today the Pam Islands are 35 km from Manus but at the time of lower late Pleistocene sea levels a water crossing of approximately 20 km would be needed, still a significant distance.

A number of possibilities can be advanced for the terminal Pleistocene appearance of obsidian in Pamwak; (1) obsidian carried inland by hunter-gatherer or hunter-horticultural groups (Spriggs 1993) was totally "consumed" before they arrived at inland localities such as Pamwak, (2) obsidian-bearing islands may have simply not existed before the terminal Pleistocene, and (3) the appearance of obsidian reflects the first development or introduction of watercraft sufficiently seaworthy to make regular water-crossings between the Pam Islands and Manus. On current knowledge of rates of sea level rise and an assumption of minimal tectonic uplift, at various times during the terminal Pleistocene Pamwak would have been somewhere between 6 km and 10 km from the coast. This represents no more than half a day's journey inland, which is an insufficient distance to account for the total consumption of obsidian cores before arrival at the shelter. With regard to the second proposition, there is a possibility that obsidian deposits were formed by volcanic activity at the very end of the Pleistocene. The geological composition of Lou, Pam Lin and Pam Mandian indicates a late Pleistocene or early Holocene origin for these islands. However, at least two obsidian "sources" were utilised by the late Pleistocene occupants of Pamwak; one (Source X) possibly deriving from one of the Pam Islands and the other from Lou. It seems rather unlikely for compositionally discrete obsidians from different islands to be coincidently formed in the same geological instant, while the period before was marked by a complete absence of obsidian.

This brings us to the possibility that the appearance of obsidian is associated with the development or introduction of watercraft capable of making regular two-way crossings between Manus and the southern islands of the archipelago. In connection with this, recognition must be made that at least two episodes of voyaging to Manus had taken place by the end of the Pleistocene, one of which may correspond with the first appearance of obsidian in Pamwak (Fredericksen et al. 1993:151). Note must also be taken of recent proof of regular Pleistocene voyaging between New Britain and New Ireland (Summerhayes and Allen 1993). In connection with the issue of maritime capability, it must also be said that the Pleistocene settlement of Manus did not follow the trend for the rest of western Island Melanesia of colonisation of intervisible islands (Irwin 1992:214). Clearly, Pleistocene peoples in this part of the world were more adept mariners than previously supposed, an adaptation undoubtedly related to a need to navigate along coastlines and between neighbouring islands.

When obsidian appears in the Pamwak sequence it almost entirely replaces locally occurring cherts. At no stage was the flow of this material sufficiently disrupted to necessitate a reversion to the sole use of local stone. A significant feature of obsidian use at Pamwak is that none was obtained from deposits in southwest Manus. There is no geological information on the Manus deposits and their discovery has come about only through archaeological research. We therefore have no direct information on the age of the deposits. The absence of southwest Manus obsidian in the Pamwak assemblage may mean this source was formed or became accessible late in the prehistoric sequence. Perhaps this occurred in the latter part of the Holocene by which time access to obsidian from Lou and the Pam Islands had become formalised within a system of inter-community exchange.

The Early Period is marked by two major changes in lithic technology. One involves the appearance of unifacially retouched discoidal and blade-like flake implements manufactured of pitchstone. At least some in Pamwak shelter may have been cached, presumably for intended future use. A number were reworked or resharpened. These tools must have formed a component of the toolkit of hunter-gatherer or hunter-horticultural groups which frequented the shelter at this time. The presence of such implements demonstrates that the late Pleistocene occupants of Manus possessed the capability to prepare cores, remove both equilateral and blade-like flakes, and undertake skilled percussion retouching to manufacture implements of a fairly uniform shape. Such a technology is unknown from anywhere else in Island Melanesia at this time, although less refined retouched tools have been reported from a Pleistocene context on New Britain (Pavlides 1993). There are morphological parallels with contemporaneous tools from the Malaysian/Island Southeast Asian region (e.g. Anderson 1987), but I see no obvious reason to ascribe the appearance of retouched pitchstone implements to an external source. These probably represent an indigenous innovation. The appearance of pitchstone tools in the Pamwak sequence may have been associated with a change in the way in which the shelter was used, perhaps involving a greater frequency of visits.

A second technological change occurs with the appearance of edge-ground stone tools and *Tridacna* shell adzes. The presence of axes in terminal Pleistocene deposits demonstrates forest clearance or other heavy woodworking activity was carried out near the shelter. Spriggs (1993) has, partly on evidence from Pamwak, concluded that the possibility of Pleistocene agriculture in Island Melanesia should not be dismissed. The presence of edge ground axes at Pamwak could very well be related to gardening activity. Shell adzes make an appearance later in the sequence, between the early and mid Holocene. These implements are more likely to have been used in woodworking than tree felling or other agricultural activity. Their appearance is associated with the deposition of a mangrove swamp midden and, given this marine focus at the shelter, the possibility is there that the adzes were used in canoe construction.

MIDDLE PERIOD (7000-5000 BP to 3500 BP)

This period embraces Phase II of the Pamwak sequence and the time of main occupation at Peli Louson shelter. The bulk of the evidence comes from Pamwak as the investigation of Peli Louson was too limited to enable the collection of an adequately large assemblage to facilitate meaningful quantitative analysis. Again this raises the limitations of extrapolating patterns revealed in one site to the wider region.

The early/mid Holocene witnessed a significant change in obsidian source use at Pamwak. The almost exclusive use of Source X obsidian gave way to the importation of obsidian from Lou and especially the Pam Islands. As previously stated, Source X was probably located on or near the Pam Islands so it appears as if a shift took place in the exploitation of deposits on these islands. This may have been brought about by Source X deposits becoming increasingly difficult to access, perhaps through rising sea levels or a period of volcanic or tectonic activity. A pattern of emphasis on Pam Islands obsidian was also revealed by characterisation of obsidian from mid Holocene contexts at the interior shelter of Peli Louson. Exactly why more Lou obsidian is not present in Pamwak and Peli Louson at this time is unclear given that Lou is far larger than either of the Pams, and is closer to Manus. One possibility is that in early and mid Holocene times Lou was much smaller and perhaps more volcanically unstable than today. Geological information shows that the island did not arise from a single major volcanic event but during the course of chronologically separate eruptions by a number of volcanoes (Johnson and Smith 1974:335).

Analysis revealed an increase in the size of flakes in Pamwak between the Early and Middle Periods. This, I have argued, reflects a decrease in the need for raw material rationing as obsidian became more freely available. I attribute this to both a progressive increase in the volume of obsidian being transported to Manus and rising sea levels transforming Pamwak into a near-coastal locality. The presence in early to mid Holocene deposits of *Tridacna* adzes and *Trochus* fishhook blanks in association with a dense shell midden certainly indicates a change in emphasis to a marine-oriented economy. Coastal populations with direct access to cross-water obsidian sources would have relatively little need to conserve obsidian. A fuller examination of change in patterns of obsidian use between terminal Pleistocene and mid Holocene times is obviously required by investigation of other localities.

A tendency toward increased "bladedness" in obsidian flakes between Early and Middle Periods was revealed at Pamwak. Although the proportion of elongate flakes is too low (9%) for this to be termed a blade industry, the trend toward more blade-like pieces during this time does follow a pattern present in Australia and many islands of Southeast Asia (Bellwood 1985:203-204). The only suggestion of a blade technology in Island Melanesia at this time is a 4100-3500 BP stemmed tool industry in the Talasea region of New Britain (Fullagar 1993:22; Specht et al. 1991:286-287; Torrence 1992:116; Torrence et al. 1990:460-461). An increase in the proportion of elongate flakes in the Pamwak assemblage may be due to functional considerations, blades have a longer cutting edge than square-like flakes. However, a possibly associated explanation is that this is tied to an increase in the availability of obsidian. The importation of large cores or blocks would facilitate blade manufacture.

LAPITA PERIOD (3500 BP to c2500 BP)

The Lapita Period is poorly represented in the Admiralty Islands. Although this has been cast as something of a paradox in the prehistory of Island Melanesia (Allen and White 1989:135-136) the most parsimonious reason for this situation is simply that very little comprehensive fieldwork has been carried out in the Admiralties (McEldowney and Ballard 1991). Aside from excavations on Lou, where the Lapita horizon may be buried under metres of volcanic ash, the only investigations where more than small scale test pitting has been undertaken are those at Kohin cave and Pamwak rockshelter. It is therefore not surprising that diagnostically Lapita sherds have thus far been recovered from only two localities - Kohin and the Mouk site (Chapter 7).

In comparison with pre-Lapita occupation at Pamwak and Peli Louson, Lapita levels in both Kohin and Mouk contain evidence of a substantial increase in the use of Lou obsidian. Obsidian in Lapita contexts at Kohin demonstrates an almost equal reliance on Lou and Pam Islands material (55% Lou). Lapita-associated obsidian at the Mouk site also shows a significant presence of Lou material (40%), despite the close proximity of the Pam Islands. This raises the question of whether an increase in the use of obsidian from Lou was connected with the advent of the Lapita phenomenon. If this shift did occur pre-Lapita it took place no more than 1500 years before this period, on the basis of the calibrated date for Peli Louson. Significantly, the post-3500 BP initiation of obsidian distribution beyond the Admiralties involved the transfer of predominantly Lou obsidian. Although no unequivocal conclusions can be drawn from current evidence, a correlation between the onset of Lapita and a greater emphasis on obsidian from Lou is a distinct possibility.

Contrasting this change in source emphasis is the apparent minimal technological change between the Middle and Lapita Periods. The proportion of elongate flakes increases from 9% in Middle Period occupation at Pamwak to 15% in Lapita levels at Kohin. However, elongate flakes are absent from the Mouk Lapita assemblage, demonstrating that this flaking technique was not universally present in all sites occupied during any one time horizon. The issue of identifying variation between synchronous stone tool assemblages from different localities is obviously an important one, but one which will only be addressed by large-scale excavation at a number of contemporaneous sites (Sheppard 1993:135).

There is continuity between Middle and Lapita Periods in the use of percussion to manufacture undiagnostic, generally unretouched obsidian flakes. This pattern of producing "amorphous" flakes is the same as that for most Lapita flake assemblages elsewhere (Allen and Bell 1988:97). More formalised retouched tool forms have however also been identified in Lapita associated contexts (Torrence 1992:116; Sheppard 1992). Torrence (1992:116) has suggested that the presence of stemmed (tanged) tools in pre-Lapita and Lapita deposits at Talasea '...represents continuity of a concept from one period to the next and consequently argues against replacement by a new group of people'. Nevertheless there are significant differences in the absolute number and size of tools between the two periods at Talasea. Similarity in expedient flaking technology has been used in support of an argument for cultural continuity between pre-Lapita and Lapita phases in the Admiralty Islands (Kennedy 1983:120). However, simple unmodified flake tools are present in various chronological and situational contexts throughout Melanesian and are of very limited value in addressing questions of ethnicity or cultural relatedness. A number of commentators have plausibly argued that the general absence of chronological diversity in flake technologies of the Southeast Asian/Melanesian region reflects the relatively minor importance of flaked stone implements in tropical environments, where their main function was likely to have been the maintenance of wooden tools (Hutterer 1977:56-57; White 1977:22). A strong argument can be made that continuity in unretouched flake production between Middle and Lapita Periods represents a similar technological response to comparable functional requirements.

POST-LAPITA PERIOD (c2500 BP to 200 BP)

The post-Lapita Period incorporates Phase I of the Pamwak sequence, upper excavation levels at Kohin and Mouk, occupation at Father's Water, occupation of Sasi, Emsin and Pisik School, and the levels of Umleang below the Unit 1 mine upcast.

For many sites an increasing reliance on obsidian from Lou is exhibited for the period after 2500-2000 BP. The Father's Water assemblage, which I have argued falls within this time frame, is composed virtually entirely of Lou material (Wekwok or Southeast Baun subsources). The same is true for obsidian analysed by Ambrose and colleagues from post-200 BP deposits on Hus Island (Ambrose et al. 1981a:14). At Kohin the proportion of Lou obsidian increases from nearly 55% in Lapita levels to 75% in post-Lapita deposits. For Mouk the increase is from 40% to 54%, which is a significant rise considering the proximity of the Pam Islands. Obsidian in post-Lapita levels at Pamwak remains down, at 47% Lou. However, the presence of a small amount of Source X obsidian in these recent deposits suggests that some mixing between post-2000 BP and earlier deposits has taken place, so the picture for Pamwak is not entirely clear.

The post-Lapita period exhibits no significant inter-assemblage variability in flake size, with the exception of the Mouk site which possesses generally larger pieces. This can be accounted for by the close proximity of Mouk Island to obsidian deposits on Lou and the Pam Islands. I have suggested that this proximity facilitated easier access to obsidian, and promoted less economical use of obsidian in comparison with localities on Manus and Los Negros. Whether the apparent ease of access to obsidian by the inhabitants of Mouk was due simply to a shorter voyaging distance, or because these people had closer social and/or economic links with the Lou and Pam Islanders is a question which awaits further research on the southern islands of the archipelago.

A chronological association of retouched blades with the post-Lapita period is implied by the appearance of this artefact type to post-Lapita levels in Kohin shelter and the Mouk site. Striking similarities exist between the Kohin and Mouk examples. The presence of proximal reduction indicates that they were probably intended to be hafted. A spear or projectile point function is likely for these. The apparently widespread occurrence of retouched blades, examples of which were recovered from three of the four post-Lapita assemblages examined, suggests that their production and use was not restricted to obsidian-producing islands at this time. There are however significant differences between assemblages. Retouched blades from the Mouk, Kohin and Pamwak sites are much smaller than those from localities on Lou. Greater similarity exists between the Lou blades and those recovered from undated contexts on southwest Manus, where obsidian also occurs in natural deposits. What this may show is that although the technique for retouched blade production was widespread throughout the Admiralties, the manufacture of large intensively retouched pieces was restricted to localities where obsidian was found.

As recounted above, elongate flakes are present in Lapita and pre-Lapita contexts in the majority of the assemblages examined, while retouched discoidal flake tools and blade-like pieces were recovered from Pleistocene deposits in Pamwak. An argument could therefore be made that retouched blades represent a development out of an earlier flake technology. One problem with this proposition is that retouched discoids disappear from the Pamwak inventory by the early Holocene. An alternative possibility, in light of evidence from Sasi for contact with metal-using cultures to the west, is that blade technology appeared via migration or diffusion into the archipelago.

A number of Island Southeast Asian flake traditions could be posited as potential antecedents to the Admiralties industry. Two examples are the Maros tradition of Sulawesi, dated to around 4600 BP (Glover and Presland 1985), and the tanged points of Timor, introduced to that island in the period 5000-4000 BP (Glover 1986). There may be a direct lineal association between all the mid Holocene retouched blade technologies of this region. Harry Allen (1991:44) has made a case for the mid Holocene southward diffusion of retouched points and microliths out of the East Asian region into Island Southeast Asia and northern Australia. However, if these Southeast Asian industries are to be posited as progenitors of the post-Lapita Admiralties retouched blade technology, then it must be explained why it took at least 2000 years to diffuse to the archipelago, particularly if we accept the hypothesis for migration from the west around approximately 3500 BP. A late Holocene unretouched blade industry recorded for the Philippines (Coutts and Wesson 1980) is chronologically a better ancestral candidate, but similarities with the Lou Island points are only passing.

If diffusion or migration is to be advanced as an explanation for the post-Lapita appearance of retouched blades in the Admiralty Islands, then an origin in the Melanesian region must also be considered. Most Melanesian flake assemblages include a proportion of elongate or blade flakes (e.g. Specht and Koettig 1981), but true blade assemblages are relatively uncommon. Nevertheless they do occur. One of the first observations on a retouched blade assemblage in Island Melanesia was made by Chowning and Goodale (1966) on material recovered from the Kandrian region of

New Britain (see also White 1982 for comments on this assemblage). On the basis of morphological/typological similarities Shutler and Kess (1969:138) postulated an Island Southeast Asian origin for the Kandrian technology. Nash and Mitchell (1973) discovered a retouched blade industry on southern Bougainville which includes pieces bearing a remarkable similarity with those at Umleang on Lou. For the New Guinea mainland, tanged flaked blades have been occasionally discovered in the Highlands (Allen 1970; Christensen 1975). These are stylistically quite different to those in the Admiralties or elsewhere in Island Melanesia.

None of these assemblages has been dated so their chronological relationship to the Admiralties blade industry is unknown. However, stemmed tools from Talasea are present in both Lapita and pre-Lapita contexts (Specht et al. 1988; Torrence 1992; Torrence et al. 1990). Pavlides (1993:57) has recorded two chert "stemmed" tools in the Kandrian region, with an associated date of 3760 BP. It must be said however that these implements possess only a passing resemblance to the implements described by Chowning and Goodale (1966), so this date may not be applicable to their material. A chronological gap of some 1000-1500 years therefore exists between the retouched stemmed tools of New Britain and the technologically similar Admiralties blade industry. Direct diffusion of this technology from New Britain seems unlikely. Nevertheless, the possibility remains of an introduction from elsewhere in Island Melanesia. Particularly tantalising are strong similarities with the undated Bougainville blade assemblage. However, if technological diffusion is to be invoked as an explanation for the presence of retouched blades then an introduction into Bougainville from the Admiralties provides a more robust scenario. Support for this view comes from the presence of Admiralty Islands obsidian and at least one retouched point in post-Lapita contexts in the northern Solomons (Chapter 3).

At least an occasional flow of ideas and perhaps people into the Admiralties could be envisaged after 2500 BP. The presence of a bronze artefact in the 2100 BP Sasi site certainly demonstrates some form of contact existed with Southeast Asia at this time. There is however no evidence for an external introduction of a retouched blade industry. A more likely explanation is that this represents an autochthonous post-Lapita innovation. This raises the question of why this development occurred when it did, particularly given the long sequence of obsidian use in the Admiralties, including the manufacture of retouched tools in the Pleistocene. Functional considerations cannot provide the full answer as perfectly adequate spears and arrows can be fashioned without obsidian points, while retouching is not required to produce an effective obsidian weapon. Clearly, some other factor must have contributed to the appearance of extensively retouched points like those recovered from the Sasi and Emsin sites. This may very well be associated with post-Lapita demographic changes.

Although Lapita is poorly represented in the Admiralty Islands there is no reason to assume that the Melanesian-wide pattern of Lapita settlement on small offshore islands and coastal localities will not also characterise this archipelago. It is conceivable that the introduction of new domesticated animals and cultigens enabled these islands to support a population density far higher than attainable in pre-Lapita times. Some smaller islands, such as Mouk, may have had a permanent human presence only after the advent of Lapita. Evidence is accumulating that the Lapita/post-Lapita period saw a more intensive use of the landscape (Gosden 1992), as revealed by a massive increase in soil erosion over this time (Gosden 1994:28-29). One conclusion which can be drawn from the picture painted by Gosden is that a dramatic rise in population density occurred in the post-Lapita period. This could be expected to lead to the formation of new social groupings and a realignment of territorial boundaries. In Chapter 7 I presented an argument that stylistic attributes (size, shape, regularity) of obsidian points at Sasi and Emsin contained information which denoted status or group affiliation. It is plausible that communities on Lou, and probably also the Pams and southwest Manus, expressed their control over obsidian deposits and knowledge of skilful knapping by the manufacture of extensively retouched obsidian weapon points. I am suggesting that communities with direct access to obsidian developed obsidian technology as a way of demarcating group identity as much as producing functional implements. This evolution evidently proceeded along with the appearance of new styles of pottery making and decoration (Ambrose 1991a), which may be another reflection of the emergence of new social groupings in the Admiralty Islands after 2500 BP.

A "devolution" in point technology is apparent by at least 750 BP. Change to simplified production is reflected by the appearance of minimally retouched tanged blades in the earliest deposits of the Umleang site. I have argued that this evident simplification of manufacture relates to a need to increase the volume of production in response to an increase in demand, which apparently took place between occupation of Emsin (sometime in the period between 1920 BP and 1319 BP) and the first occupation of Umleang (760-700 BP on hydration dates). An obvious explanation for an increase in the demand for weapon points is a rise in warfare, probably resulting from demographic changes in the last millennium of prehistory. A similar scenario for increasing inter-group hostility has been proposed by Lilley (1991b:168) for the Duke of York Islands.

RECENT PERIOD (200 BP to 50 BP)

In early historic times obsidian, along with numerous other commodities, was exchanged throughout the Admiralty Islands by specialised Titan-speaking maritime traders. Voyages were made beyond the archipelago to the Mussau group, the New Ireland area, and the northern coast of New Guinea. These were probably trading voyages, but there is no record of whether obsidian was one of the commodities conveyed (Chapter 3). Obsidian was apparently regarded as economically useful but was not accorded any special or prestige significance. Although most obsidian was probably transformed into simple flake tools, large blade flakes were also manufactured. These were employed as spear and other weapon points in what seems to have been a state of constant warfare throughout the archipelago.

Lou Island is universally recorded as the main obsidian source during this period. It is on this island that we might therefore expect to find evidence of specialisation in the manufacture of retouched obsidian weapon points. Unfortunately, the regular manufacture of obsidian tools had ceased by the late nineteenth century, when the first observations on obsidian production were made. Nevertheless information gleaned from documentation of oral accounts reveals the former presence of a task-demarcated production system under the control of "chiefs", who controlled the obsidian mines on the island. There was a social restriction on manufacture. Certain members of the community, probably members of particular lineages, were specialist blade and point manufacturers. Ethnography however provides no information on whether blade manufacture was restricted to Lou, or a small number of "production centres" scattered among the islands of the archipelago. There is information that obsidian blades as well as blocks were traded from Lou, so evidently at least some communities did not fashion their own weapon points.

Umleang is vital because the sequence from this site provides the bridge between prehistoric and historic production. The presence of minimally retouched tanged blades in this site demonstrates that the trend toward simplification began well before European contact, as discussed above. Artefacts of this type are present throughout the sequence, including the upper Unit 1 which is probably associated with early historic activity. The five point segments exhibiting the most extensive retouching are restricted to Unit 2 and below. One explanation for this is that the production of extensively modified blades ceased soon after regular European contact. From this time on only tanged and minimally shaped weapon points were made. A documented post-contact rise in socio-economic instability and warfare, as well as demand from European traders, may well have induced this change.

CONCLUDING COMMENTS

In this synthesis of obsidian use in the Admiralty Islands I have highlighted a number of important events. The first is the initial use of obsidian on Manus. This occurred in the terminal Pleistocene and involved regular cross-water transport from a likely Pam Islands source. The second event saw a marked increase in the use of obsidian from Lou Island, which occurred sometime between the mid Holocene and the appearance of Lapita. Arriving at a more accurate date must be a prime objective of any future research. Although only touched upon in this thesis, a third significant occurrence is the first transfer of obsidian beyond the Admiralties archipelago. This is unambiguously associated with the Lapita period and after, and possibly continued into early historic times. The fourth event in the sequence is the appearance of a retouched blade technology after 2500 BP. No "diffusion centre" is apparent in either Island Southeast Asia or Melanesia so, on current evidence, this appearance can be best explained as a local development. The fifth significant occurrence is a progressive change in blade manufacture on Lou, from the production of extensively modified pieces to the appearance of simplified tanged pieces after occupation of the Emsin and Pisik sites. Tanged retouched blades recovered from Umleang provide a direct link with the minimally retouched spear and dagger points observed in the Admiralties at early European contact.

In the concluding chapter I examine the sequence of obsidian use in the context of the development of trade and craft specialisation.

CHAPTER 9
PATTERNS IN GLASS

A major topic of discussion in Melanesian archaeology has been the association between historic Melanesian economic specialisation and prehistoric systems of production and distribution. I identified three broad models which, either implicitly or explicitly, have been suggested as providing explanations for this relationship. To recap from Chapter 1, these are:

(1) A model developed by Kirch (1990) which posits the appearance of economic specialisation with the advent of Lapita. The model states that Lapita communities were socially stratified and for the few centuries following their migration to western Melanesia maintained social cohesion by engaging in the long distance exchange of prestige goods. Eventually this system was transformed into numerous localised exchange networks linking egalitarian but economically specialised communities.

(2) A scenario which has been advanced by Ambrose (1978) in which little direct relationship is seen to exist between Lapita exchange and historically recorded specialist traders and producers. Instead Ambrose proposed that historic specialisation arose out of more generalised systems by Austronesian colonists adapting to their new environment and merging with earlier non-Austronesian residents. No suggestion is made of evolution toward ever more complex and specialised systems.

(3) A model formulated by Allen (1984a) as an explanation for changes documented by a number of researchers for the south Papuan coast. In this model the appearance of pottery-using long distance traders is seen as the precursor to historic specialisation. Over time the long distance exchange system experienced "disruptions" which saw networks becoming more localised and production progressively focussed on a smaller number of communities. The model proposes that an increase in the overall complexity of trade accompanied this spatial contraction.

Increasing complexity led to greater instability, which eventually resulted in the collapse of trade systems. Each period of collapse led to a new trade system at a level of complexity slightly higher than that of its predecessor, resulting in an overall increase in the complexity of trade systems through time. This gave rise to the localised but highly specialised economic situation observed historically.

In the introduction to this thesis I suggested that all three models are limited by the fact that observation is restricted to at most the last 3500 years of the prehistoric sequence. In the light of firm evidence of Pleistocene habitation in a number of the islands of western Melanesia, we are left wondering what part preceramic populations had in the development of economic specialisation. I have argued that without knowledge of this earlier phase of prehistory we are not in a position to determine the significance of variation in patterns of production and distribution in the late Holocene. What is required is a long view of prehistory, in which observation beyond the ceramic boundary is incorporated into any explanatory hypothesis. To address this criticism I have carried out a study of the production and distribution of obsidian in the Admiralty Islands from the late Pleistocene through to the historic period.

PRE-LAPITA DEVELOPMENTS

By the late Pleistocene/early Holocene all the intervisible islands of the Admiralties archipelago had probably been explored. Manus was certainly settled by this time but whether the smaller islands of the archipelago were permanently inhabited remains at present an open question. Information from the small excavation on Mouk suggests that the islet was first settled by a Lapita population, although more work needs to be undertaken to address this issue. It is clear however that the resources of offshore islands were utilised and distributed to communities on Manus, as evidenced by the appearance of obsidian in terminal Pleistocene deposits at Pamwak shelter. This material almost totally replaced locally occurring stone in Pamwak, which suggests that whatever type of distribution system facilitated the movement of obsidian to Manus was sufficiently developed to ensure that there was never a serious constriction in supply. The geographic extent of obsidian distribution within the Admiralties at this time is not known, given that Pamwak is the only Pleistocene site so far investigated in the archipelago. However, by at least the mid Holocene it is likely that obsidian was distributed throughout Manus. This is evident from the presence of obsidian at Peli Louson shelter, situated in the interior-most part of Manus.

The picture for the terminal Pleistocene and early to mid Holocene is sketchy and badly in need of additional information. Nevertheless what can be said is that the early part of this long period probably witnessed the development of the regular maritime transport of commodities such as obsidian. This distribution was restricted to the archipelago; thus far we have no evidence for the transport of obsidian beyond the Admiralties before 3500 BP. The system in place before that time was apparently entirely focussed on the local scene.

Looking beyond the Admiralties it is clear that other localised production and distribution systems were in place before the appearance of Lapita. The Pleistocene movement of obsidian between New Britain and New Ireland (Summerhayes and Allen 1993) is proof of very early maritime transport and communication links between neighbouring islands. Production of retouched flake tools before the appearance of pottery is evident not only for Manus but also New Britain (Torrence 1992), although here these appear only a few centuries before the onset of the Lapita period.

THE ADVENT OF LAPITA

The Lapita horizon is marked in the Admiralties by the appearance of pottery and the first transport of obsidian beyond the archipelago. A third change may involve an increase in the amount of Lou obsidian distributed within the Admiralties *vis a vis* obsidian from the Pam Islands source. Unfortunately gaps exist in the cultural sequence of the archipelago so this indication of a temporal change in source use awaits verification from future research. There is a stronger case for stating that most Admiralties obsidian distributed beyond the archipelago originated from Lou, with the interesting exception of the Mussau Group where half the obsidian originated from the Pam Islands.

The Lapita period in the Admiralties therefore saw major changes in the scope of obsidian distribution, as well as possibly a reorientation in source use. It is clear that a momentous change took place in the distribution system at approximately 3500 BP. Could this be an indigenous development out of a pre-existing localised distribution network, which had already been in existence for more than 10,000 years? There is no reason why the watercraft and navigational skills required for undertaking successful return journeys between distant islands could not have been developed within the Admiralties, or the wider Bismarck archipelago. But the fact remains that in Island Melanesia the onset of the Lapita period is characterised by the simultaneous appearance of pottery manufacture, probably new types of portable artefacts (Green 1991), domesticated animals, and apparently a change in settlement patterns (Spriggs 1991b:308). This points to the diffusion or introduction of a whole suite of new cultural attributes into this region at around 3500 BP, concomitant with a huge geographic expansion of distribution . Although the appearance of some of these traits could be explained by a sudden widening of trade networks from the Bismarcks to encompass the wider Melanesian/Island Southeast Asian region, an explanation such as this does not account for the sudden appearance of a full-blown pottery technology (not just pots) or the archaeologically instantaneous arrival of Lapita throughout the Bismarcks, including the sparse evidence from the Admiralties. In my view the Lapita phenomenon can be most parsimoniously interpreted as a migration by a maritime-adapted coloniser group.

The predominance of Lou obsidian in the external distribution network and the possibility of an increase in its importance in internal distribution suggests that Lou Island played an important part in Lapita settlement of the Admiralties. This period may have been associated with the first permanent occupation of Lou, although any evidence of this will be buried beneath metres of volcanic tephra. A scenario could be envisaged in which the smaller islands of the archipelago were first settled by ceramic-using groups, perhaps because they possessed the requisite economic base to enable successful colonisation of small islands. How would these newcomers interface with the pre-existing inhabitants who, after thousands of years of moving obsidian and doubtless other commodities around the archipelago, must have evolved their own sophisticated trade and exchange network.

Pre-adapted specialist Lapita producer/traders as modelled by Kirch would, at least initially, probably maintain their separateness from an indigenous system. We could therefore expect to see two contemporaneous but distinct production and distribution systems in the Admiralties at approximately 3500 BP; one servicing local demand and one maintaining social connections between widely separated communities. Although the Admiralties data are at this stage not sufficient to adequately test this proposition, it is worth reiterating the possibility of a change from the use of mainly Pam obsidian in pre-Lapita contexts to Lou and Pam obsidian with the advent of Lapita. If this suggested association is proven from future research then a case can be made for the involvement of Lapita colonists in local trade, which is contrary to the Kirch hypothesis and more like the scenario envisaged by Ambrose.

The Kirch model also posits that Lapita colonists were specialist producers of "valuables", such as highly decorated pottery and shell armbands. The scarcity of Lapita sherds so far recovered from the Admiralties provides no support for the concept of an arrival of specialised pottery producers, although, as maintained in the previous chapter, this apparent paucity may be a distorted picture resulting from the limited amount of excavation undertaken. This negative evidence can however be interpreted another way. If, as suggested by Kirch (1990:124), communities within island groups manufactured specific products for input into the Lapita trade system then the argument could be made that the focus of production in the Admiralties was not on ceramics but other commodities, of which obsidian would be an obvious candidate. The Lapita obsidian evidence reviewed in this thesis however gives no indication of specialist manufacture. The production of undiagnostic flakes in Lapita levels at the Mouk and Kohin sites represents a technological continuation of the obsidian industry found in pre-Lapita horizons at other sites in the Admiralties. This pattern of technological continuity is also demonstrated for the Talasea area of New Britain, where the production of retouched obsidian tools has been show to span both pre-Lapita and Lapita horizons (Torrence 1992). All-in-all the advent of Lapita appears to have had minimal impact on stone flaking technology in Melanesia (with the possible exception of the appearance in some regions of very simple "gravers" [Sheppard 1993:134]).

THE ORIGINS OF SPECIALISATION

I have argued that the first indication of the manufacture of obsidian artefacts for exchange is found in the point workshops of Lou. These date to the period 2100 BP and after. The fact that retouched obsidian points have not been found in Lapita contexts anywhere inside or beyond the Admiralties suggests that this artefact form is a post-Lapita innovation. The early retouched point forms at Sasi, Emsin and Pisik School were, I have suggested, embedded with stylistic information which denoted status or group affiliation. No evidence was found for large-scale production for exchange. Nevertheless at Sasi and Emsin retouched points were overwhelmingly the major obsidian artefact type produced, which would not be expected in a general living area where a range of obsidian implements would normally be manufactured and discarded. Occasional exchange could certainly be entertained from the evidence at Sasi and Emsin. The presence of a bronze artefact in the Sasi site illustrates that the Admiralties were integrated within a distribution system which may have extended far to the west, as well as eastward. I do not see production at Sasi and Emsin as providing evidence of economic specialisation but there is a suggestion of less intensive prestige-good production, particularly in the Emsin assemblage. This is chronologically out of step with Kirch's model, in which the origins of specialised production are considered to be associated with the Lapita phase. The picture for the Admiralty Islands could be viewed as more in keeping with models proposed by Ambrose and Allen.

The claim for a progressive reduction in the areal extent of distribution after the arrival of pottery users as proposed by both the Kirch and Allen models is not strongly supported by the picture revealed in the external distribution of Admiralties obsidian. Although the Watom site shows a decreasing use of Lou obsidian through time, this is not demonstrated for other sites in the northern Bismarck region (Green and Anson 1991:177-178). Neither is this supported by data from the Mussau group, where Admiralties obsidian came to dominate over that from Talasea (Kirch et al. 1991:157). The continuation of external contact into the historic period is revealed in ethnographic accounts of expeditions from the Admiralties to the Mussau group and the north coast of New Guinea (Chapter 2). The argument can be made that there was actually no geographic contraction in direct trade/exchange, but that a readjustment took place in indirect down-the-line trade resulting in some obsidian sources dropping out of particular systems (e.g. Talasea from the Mussau system). A post-Lapita disruption in the external or internal distribution of Admiralties obsidian cannot be observed in the evidence, a fact which lends no support to Allen's growth and collapse model. In contrast, the flow of obsidian both from and within the archipelago reflects the existence of remarkably durable trade/exchange networks.

The post-Lapita external distribution of Admiralties obsidian may have been integrated within an entirely different system to intra-archipelago distribution (as I have argued above for the Lapita period). This is apparent in the scarcity of retouched tool forms distributed beyond the Admiralties; despite the common occurrence of Admiralties obsidian in the northern Bismarck Archipelago only two retouched blade pieces have been recovered in this general area (Chapter 3). No retouched pieces have been found on the Mussau Islands although there is a post-Lapita predominance there of Lou and Pam obsidian. We know that obsidian-tipped weapons were widely used in the Admiralty Islands in early historic times and I have previously suggested that at least some retouched pieces from prehistoric contexts on Lou may have been traded. A situation may therefore have existed in which obsidian blades and retouched points were circulated within the Admiralties archipelago while mainly cores were exported, for the eventual production of "amorphous" flakes. The major question here is whether this apparent dichotomy in production for trade reflects either a situation where manufacture for previously far ranging trade networks became reoriented to the local scene, as Kirch and Allen would argue, or a situation resulting from the blending of indigenous originally pre-Lapita trade systems and developments which had their ultimate origins in the Lapita period, as Ambrose might posit. This is difficult to answer at present but I would again stress that there is no evidence from the admittedly poorly represented Lapita period in the Admiralty Islands of a precursor to the blades or retouched points which have been recovered from sites dating to 2100 BP and later.

The hypothesis I advanced in this thesis is that it is only with the manufacture of minimally retouched weapon points at the Umleang site that we have the first indication of the large-scale production which marks the advent of specialised manufacture for trade. The change from finely retouched to expedient obsidian blades must have occurred sometime within the period between the abandonment of Emsin and occupation of Umleang, i.e. before approximately 750 BP but definitely after 1920 BP. I have argued that this change was a result of a need to intensify production in the face of increasing demographic pressure and a concomitant escalation of warfare. Obsidian point production therefore became reoriented from the artful manufacture of pieces imbued with a culturally meaningful stylistic dimension to the making of pieces in which functional considerations were of prime importance. Control over the dissemination of knapping skills within the community may have also come to be replaced by strict control by particular community members over the right to extract obsidian.

This picture of a post-Lapita change toward community-specific large-scale production can be encompassed by all three models, although the scenario painted by Ambrose has no implicit concept of directionality. Whether this change was part of a trend toward increasing social "complexity" as suggested in Allen's model is worthy of further investigation. I consider that it certainly went hand in hand with the rise of craft specialisation, as defined in the ethnographic sense of regular community-specific production for trade. However, other measures of increased social complexity as set out by Allen, such as flexible social organisation and efficient maritime communication, may be found to predate the development of craft specialisation, perhaps in some cases by many hundreds of years.

SUMMING UP THE EVIDENCE

Models for the development of historically recorded Melanesian economic specialisation have assumed that the arrival of pottery-using people initiated the sequence of events which ultimately gave rise to the ethnographic pattern of community specific production and inter-island trade. I questioned how this assumption could be made without taking into consideration the possibility of influence from preceramic economic patterns. A major aim of this thesis was to redress this imbalance by extending our observations beyond the ceramic boundary.

The information presented here demonstrates that at least one major aspect of specialisation, regular maritime trade or exchange, has a venerable history in the Admiralty Islands. The Pleistocene inhabitants of this archipelago were regularly moving obsidian, and doubtless other commodities, from the southern islands to the Manus mainland. Obviously much more information is required on this early period, which is represented by only one site. Indeed, the chronology and direction of change in the Admiralty Islands sequence as a whole deserves far more archaeological attention. Nevertheless, the evidence assembled in this thesis was sufficient for a critical examination of the Kirch, Ambrose and Allen models. In terms of the Admiralties obsidian evidence all models were found to be deficient in one way or another, although the Kirch scenario appears to be least supported by the data.

In common with the models proposed by Ambrose and Allen, I see the development of economic specialisation occurring after the appearance of pottery. The prime mover for this was probably demographic change induced by the Lapita introduction of new subsistence techniques, which allowed permanent colonisation of smaller islands. Initially the pre-Lapita distribution system would have accommodated these settlement changes but with a gradual increase in population density, particularly in economically optimal areas, production and distribution underwent a transformation. By at least 2000 BP communities had become more sedentary (refer Torrence 1992:121) and particular groups had come to have direct control over spatially localised raw materials from which they began to produce stylistically distinctive manufactured goods, thereby proclaiming their distinctiveness from other producers. In the case of obsidian this saw the appearance of extensively retouched blades on Lou, which were probably as much social markers as functional weapons. To communities outside obsidian producing areas they may have possessed a special prestige value. At some time between 1920 BP and approximately 750 BP minimally retouched blades resembling those encountered at contact appear in the Lou sequence. I have argued that the change to this artefact form was a response to a rapid increase in production to cater for a larger consumer marker. It is this time, I suggest, that witnessed the first developments toward the formation of historic patterns of economic specialisation.

Turning to the wider picture, the upper end of the time range for the origins of specialisation in the Admiralty Islands obsidian industry is still a few centuries earlier than the time economic specialisation is thought to have appeared in coastal areas of the New Guinea mainland (Allen 1985; Irwin 1978b; Lilley 1991a). This may show a pattern in which the development of specialised economies followed the same general course throughout the region, but occurred at different times in different places. The latter is not surprising considering that after Lapita the economic focus was on various local systems which evolved largely independently of one another. The reason for the presence of a similar developmental trajectory over such a wide area is a more complex issue, but it may be that we are dealing with a number of different pathways toward historic specialisation rather than a situation of unilinear evolution. Such inter-regional comparison is premature however as we are still a long way from understanding change within local systems. Further archaeological fieldwork in study areas such as the Admiralty Islands is required before we will be in a position to fully comprehend the relative influence of preceramic economies, introduced innovations and environmental parameters on the development of economic specialisation in Melanesia.

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