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Chapter 1

Introduction: the archaeology of island societies

Patrick V. Kirch

Island societies have always provided fertile intellectual terrain for the nurturance of anthropological theory. Well before anthropology had been codified as an academic discipline, the accounts of Bougainville, Banks, Cook, and other explorers to the 'South Seas' inspired philosophical debates in the salons of Europe as to the nature of human society, and of the 'social contract'. The real impact of islands on anthropology, however, came with the initiation of systematic ethnography. It was in the Trobriand Islands of western Melanesia that Bronislaw Malinowski worked out many of the fundamental principles and methods of modern ethnographic fieldwork. Not only did the isolation of island societies render them enclaves for the documentation of 'primitive' cultures, but their very boundedness seemed to make them almost the perfect unit for the 'structural-functionalist' approach to ethnographic description and analysis. Sir Raymond Firth's classic monographs on the Tikopia exemplify the role of island societies in the development of the structural-functionalist paradigm of mid-century social anthropology. Then, too, the developing psychological approaches of Margaret Mead and Gregory Bateson found a ready arena of application in small island communities such as Samoa and Manus, where differing cultural ethos could be neatly contrasted.

The resurgence of an evolutionary paradigm within anthropology in the 1950s and 60s also drew upon the island theme. Synthesizing frameworks for political evolution, such as those of Elman Service (1967) and Morton Fried (1967), drew upon Polynesian examples as the virtual 'type' for a major evolutionary stage, the 'chiefdom' or 'ranked' society. Marshall Sahlins (1958) mined the Polynesian ethnographic literature to produce an elegant argument for the diversification of social structures through a process of 'adaptive radiation' to varied ecological conditions. The *control* provided by island societies was essential to this kind of theoretical structure (Goodenough 1957). Goldman (1970) used the same ethnographic corpus to produce a contrastive theory of Polynesian social change in which inherent status rivalry provided the engine of change. The range of island political systems inspired yet another theoretical paradigm of wide application, the 'big man–chief' distinction proposed by Sahlins (1963). One may also cite the role of island data in the development of ecological perspectives (e.g., Rappaport 1968; Fosberg 1963), of theories of exchange (dating as far back as the classic essay of Mauss 1923), and recently, in the movement toward an 'anthropology of history' (Sahlins 1983).

This admittedly sketchy historic overview makes the point clearly enough: island societies have long provided inspirational material for the advance of anthropological method and theory. But where, in all this, have archaeology and prehistory figured? The answer – hardly at all, at least,

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until quite recently. The history of archaeology amongst the Pacific islands is a curious one, and bears a brief synopsis as background to the papers which follow in this volume.

With the problem of cultural origins and 'migration routes' monopolizing early twentieth-century ethnography in the Pacific, one might have expected archaeology to have dominated the scene. Instead, it took on a distinctly secondary role, relegated to the descriptive cataloging of surface monuments and stone tools. As various scholars have noted (e.g. Danielsson 1967; Kirch 1982, 51–2), a set of unwarranted assumptions were responsible for the underdevelopment of archaeology in the study of island societies. Among these were assumptions of shallow time depth, lack of significant stratification, and most importantly, the absence of ceramics or other stylistically varied artifacts which could readily supply the basis for relative chronology and areal comparison.

This situation was dramatically reversed after World War II, when a small group of pioneer excavators (Gifford in Fiji, and later, Yap and New Caledonia; Spoehr in the Marianas; Emory in Hawai'i) quickly dispelled the prevailing, unwarranted assumptions that had held back the development of island archaeology. Libby's invention of radiocarbon dating played a part here, too, with the empirical demonstration of substantial time depth for island settlement. However, despite the suggestions of a few prehistorians that archaeology could now contribute directly to the study of island *societies* and their change over time, the early post-war era continued to be dominated by issues of cultural origins and migrations. Not until the mid-60s, and on into the 1970s, did island archaeologists begin to tackle issues beyond those of defining cultural origins and outlining local phase sequences (Kirch 1982, 70–3).

Over the past fifteen to twenty years, however, the conduct of island archaeology has changed dramatically. Perhaps because the nagging old questions of origins and 'migration routes' have now been met with at least a general model (even if arguments still rage over minutiae), and because the basic time–space sequences for a substantial number of Pacific islands have been established (Bellwood 1979; Jennings 1979; Kirch 1982), island archaeologists have broadened the scope of their inquiries to address such issues as variation in prehistoric subsistence economies, the adaptation of technology and settlement pattern to contrastive environments, the development and intensification of production systems, the modification of island landscapes and biota by human populations, the analysis of trade and exchange between island communities, and the reconstruction of former social structures through the use of settlement pattern, mortuary, and other data.

One area in which archaeology is making a significant impact is that of the description as well as explanation of long-term change in island societies. As noted earlier, the explanations offered for variation and differentiation in island societies have traditionally been promulgated by ethnographers (e.g. Burrows 1939; Sahlins 1958; Goldman 1970), who based their theories of diachronic process (warfare, adaptive radiation to local ecology, status rivalry, etc.) on the comparative analysis of synchronic ethnographic descriptions. To be sure, the analytical control inherent in the island world – where a variety of societies can be shown to have descended from a common historical ancestor – does permit such comparative ethnographic exercises, and these have indeed been a fruitful source of theories or models for the evolution and transformation of island societies. The problem with such theories, however, is precisely that they are not amenable to independent testing and verification on the same corpus of ethnographic materials, without succumbing to logical tautology. Only archaeology can offer the direct, material evidence for social change on which theories of evolutionary or historical process can be tested. Archaeology, of course, is not restricted to a secondary role of theory testing, for the material evidence of prehistoric change itself contributes directly to theory building.

This volume is a sampling of some current archaeological efforts to address problems of long-term change in island societies. The approaches range from the strongly evolutionary and ecological in basic orientation, to those which have been inspired by recent Marxist discussions of contradiction and dominance in social formations, or of the role of ideology in structuring material culture. Though eclectic in orientation, the papers are united by a common goal of bringing the material evidence of archaeology to the problems of understanding social change in island settings.

Aspects of island societies

The essence of islands is discreteness, that is, their bounded and circumscribed nature. This essential characteristic has prompted more than one anthropologist to speak of islands and island societies as 'laboratories' (Suggs 1961, 194; Sahlins 1963; Clark and Terrell 1978; Kirch 1980; Friedman 1981, 275). Historian O. H. K. Spate echoed this theme in describing the insular Pacific as 'so splendidly splittable into Ph.D. topics' (1978, 42). Certainly the boundedness of island ecosystems and insular societies is one of the great advantages offered by the Oceanic region for controlled studies of prehistoric change. Yet the laboratory analogy can easily be pushed too far, especially if boundedness is confused with *closure*. Too often it has been assumed that because islands are discrete and isolated, their societies have developed as closed systems, a facile but frequently unwarranted assumption. More will be said on this matter of closed and open systems shortly.

A corollary of boundedness, particularly on smaller islands, is *limitation* of resources. Space (especially arable land) is the most fundamental of these limited resources, but water, isotropic stone, clay or other materials for ceramics, edible flora and fauna, and a host of other necessities may be in scarce supply or totally absent on any island. Competition for limited resources is not surprisingly a dominant theme in explanations for the evolution of island societies (e.g. Burrows 1939), and is considered by several of the papers to follow.

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Gumerman, in particular, considers the alternate strategies of competition and cooperation in situations of limited resources.

Another property of oceanic ecosystems makes them especially intriguing for tracing the long-term interactions between human societies and their environmental settings. This is the 'extreme vulnerability, or tendency toward great instability when isolation is broken down' (Fosberg 1963, 5), particularly following upon human colonization. Thus, the evolution of any island society must be tracked not only in terms of changing demographic and social structures, but in the context of a frequently dynamic ecosystem and varying resource base. The evidence for human-induced environmental change on Pacific islands has rapidly accumulated over the past decade (Kirch 1984, 135–50). This theme is echoed by several papers in this volume, most strongly by Spriggs, who demonstrates the massive deforestation and erosion of Aneityum Island by early Austronesian colonizers. The late prehistoric transformation of both Easter Island and Hawai'ian societies, however, are also linked with human-induced environmental change, as Stevenson and Hommon note.

Along with isolation, one aspect of islands that has contributed to the 'laboratory' analogy is the seemingly endless recombination of environmental attributes. Amongst the approximately 7500 islands in the inner Pacific (excluding island Southeast Asia) is represented virtually every imaginable combination of climatic, geologic, hydrologic, edaphic, and biotic variables. High islands range in size from near-continental New Zealand to diminutive Nihoa or Anuta; the sub-Antarctic Chathams contrast with tropical Samoa; atolls can be found with every possible lagoon configuration; and so forth. It was precisely this environmental variation that Sahlins (1958) found so enticing in developing his theory of social stratification in relation to the distribution of resources.

So far, we have mainly considered those aspects of island *environments* that render them attractive theatres for the study of long-term social change. But the great advantage of the inner Pacific for such pursuits lies in the demonstrable common cultural origins of its myriad bounded societies. Excepting parts of New Guinea and certain adjacent islands, all of the indigenous populations of the Pacific islands are or were members of the widespread Austronesian language family, which itself attests to their cultural affinity. The societies of certain regions, of course, are more closely related than others. The Polynesian societies, for example, can be demonstrated (linguistically, archaeologically, and genetically) to have diverged from a common ancestral society beginning about 1000–500 BC (Kirch 1984). Likewise, the societies of Eastern Micronesia probably have a common origin in the southeast Solomons–north Vanuatu region, of about the same time depth. The important point is that Oceania offers sets of *phylogenetically related societies*, distributed over a widely varied range of discretely bounded ecosystems. Thus, for example, closely related Eastern Polynesian societies which diverged from a common ancestral group no more than 1600 years bp successfully occupied a spectrum of islands including atolls, high islands, and upraised coral islands in tropical, subtropical, and temperate climates. Such groups of genetically related societies offer marvellous opportunities for controlled comparisons, a situation exploited by Green in his reconstruction of the Ancestral Polynesian settlement system, and also by Rolett in his interpretation of turtle petroglyphs.

Recent approaches to social archaeology in Oceania

The papers which follow in this volume are a fair representation of the environmental and ethnographic diversity of Oceania, with a geographic range including Melanesia, Micronesia, and Polynesia (Fig. 1.1). As well, they offer a sampling of the variety of approaches currently being applied in the archaeological investigation of island societies. To close this brief introduction to the volume, I offer a few comments on these diverse approaches.

Spriggs has tackled the southern half of an extensive east Melanesian archipelago – Vanuatu (formerly the New Hebrides) – the archaeological record of which is known only in the barest outlines (so spotty had been the previous survey work in this region that southern Vanuatu was regarded as 'aceramic' until Spriggs' most recent expedition rapidly demonstrated the absurdity of that claim). The long-term goal in his work is to understand the social dynamics of a region with several ethnographically known societies all of which are presumed to have descended from a common founding culture. As a basis for formulating research strategy, Spriggs has made use of controlled comparisons of the 'endpoint societies' to generate a series of working hypotheses on social dynamics. As noted earlier, this exploitation of the advantages offered by a set of phylogenetically related societies is common to many current Oceanic studies, and is utilized also by Green and Rolett (this volume). Drawing the results of initial archaeological work on Aneityum and Tanna together with his ethnohistorical materials, Spriggs offers a preliminary model for the divergent development of social systems in the Tafea region. He argues that social dynamics will be explained not in simple causal terms (such as those of population pressure or ecological constraint), but rather as a complex dialectic between social and ecological relations. For example, while Spriggs' archaeological work on Aneityum clearly shows the role of environmental change in the development of large-scale irrigation systems, it is also evident that the limiting factor in agricultural intensification was the availability of labor, itself a socially defined relation of production.

The large Fijian archipelago to the east of Vanuatu (Fig. 1.1) attracted some of the earliest archaeological excavation in Oceania (by E. W. Gifford in 1947). Perhaps because these islands lie at the interface between the classic ethnographically defined regions of 'Melanesia' and 'Polynesia', discussions of Fijian prehistory have always been couched in episodic terms of 'migrations' and cultural 'replacements'. Hunt has found such conventional culture-historical explanations for prehistoric change in Fiji wanting. In particular, he points to the emphasis on a single body of material – ceramics – and

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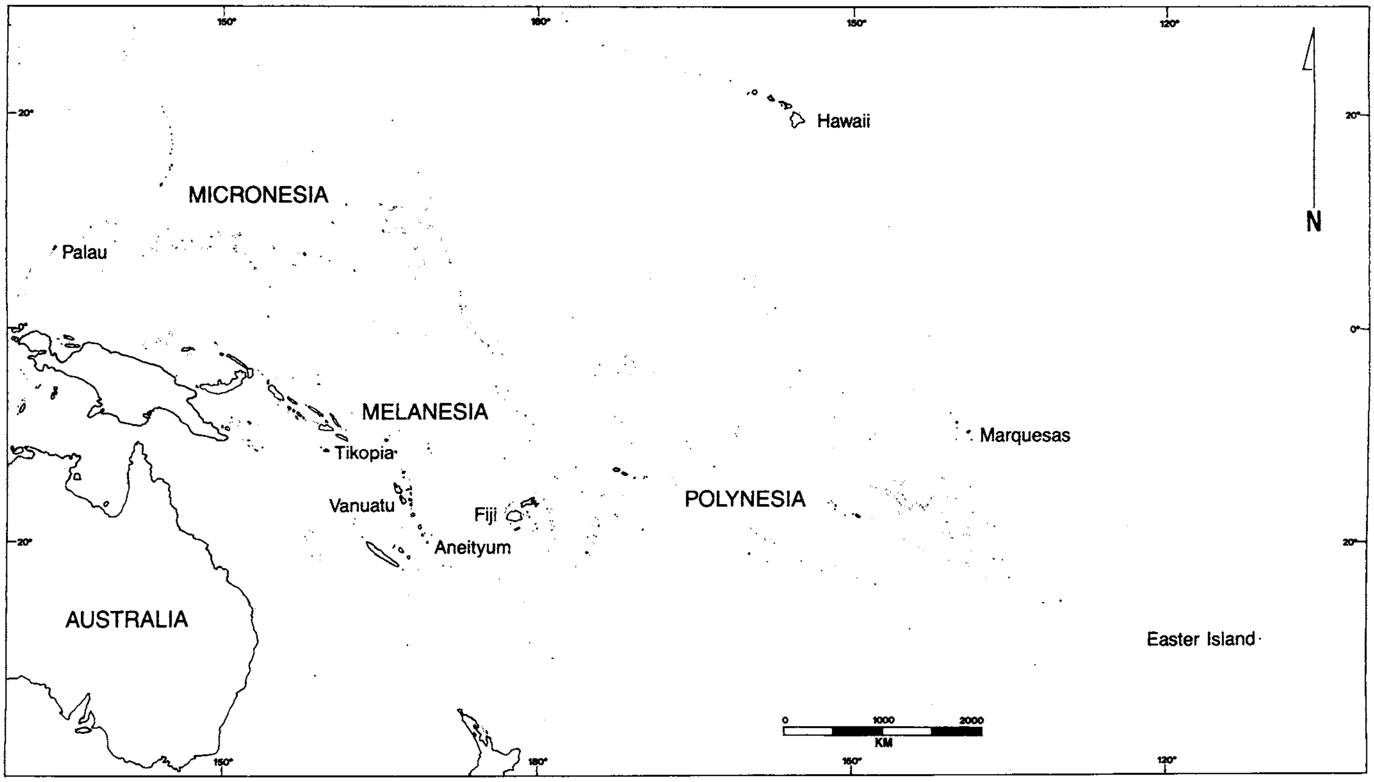

Fig. 1.1. The Pacific Region, indicating the locations of island societies considered in this volume.

on the tendency to extend patterns of stylistic change in ceramics as 'explanations' for large-scale culture change. A careful analysis of the ceramic evidence from the Yanuca rockshelter demonstrates that quite different patterns of quantitative change can be obtained depending upon the selection of stylistic or 'functional' attributes. Without denying the reality of population movements or diffusion in the southwestern Pacific, Hunt suggests how a processual model of prehistoric change in Fiji might be constructed.

In the third contribution, I turn to one of the most anthropologically famous Oceanic communities, Tikopia, for an assessment of the notion of island societies as closed systems. This idea that the evolution of island societies can be accounted for largely if not wholly in terms of internal processes of change has been implicit in much ethnographic as well as archaeological work on island societies, and has often been explicitly advanced under the rubric of island 'laboratories'. Tikopia offers an instructive case, for on the strength of Firth's structural-functionalist analyses, its people are as self-contained as one could imagine. Yet both the ethnohistoric and archaeological data leave no doubt as to the frequency of external contacts in Tikopia prehistory, including both incorporation into now-defunct regional exchange networks and the repeated arrival of drift-voyage immigrants. Rather than being extraneous to the analysis of social change, the elucidation of such external relations proves to be a vital key in an historical understanding of the structure of modern Tikopia society.

Gumerman focusses on the Palau Islands of western Micronesia, notable for their hierarchical social system as well as for their archaeological vestiges of intensive agriculture. He has made one of the characteristic aspects of islands, resource limitation, a central element of scrutiny in a model that focusses on the role of competition and cooperation. In particular, a simple game theory model of iterated 'Prisoner's Dilemma' is used to suggest that the most appropriate strategy in an island environment with limited resources may be one of competition. It can be further argued that a hierarchical social order offers certain advantages in such a competitive situation.

As noted earlier, the island societies of Polynesia have long been known to form a discrete phylogenetically-related group, descended from a common ancestral community. The last four papers in this volume are concerned with this region, and demonstrate some of the possibilities for analytical control which Polynesia offers. Green is not concerned with any particular island group, but rather with an attempt to reconstruct certain aspects of the 'Ancestral Polynesian' society itself, namely the components of its settlement system. The importance of such a task clearly lies in delineating the baseline against which subsequent change in the variety of Polynesian islands can be assessed. To accomplish this goal,

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Green outlines a tripartite approach using lexical reconstruction, controlled ethnographic comparison, and archaeological evidence. Although Green's paper focusses on a narrow domain of Ancestral Polynesian culture, the approach is expandable to virtually any other aspect of culture and society, and provides a powerful tool for establishing the baseline from which subsequent social systems derived.

It has often been suggested that Hawai'ian society represented an apogee of socio-political evolution within Polynesia, and the late prehistoric Hawai'ian system has even been described as an 'archaic state'. A wealth of archaeological data accumulated from a variety of sites over the past thirty years now permit a diachronic analysis of Hawai'ian social evolution, as Hommon attempts. Hommon pays particular attention to the chronometric assessment of evidence for 'inland expansion' and for the formation of the pattern of territorial units which typified the contact-period socio-political system. His model suggests that population growth combined with the establishment of extensive inland agricultural complexes after about AD 1400 led to the formation of these self-sufficient territorial units, and to the disintegration of an ancestral pattern of corporate kinship units. By AD 1600 attainment of high political office and the establishment and defense of boundaries were no longer solely expressions of the kinship structure, but were increasingly manifestations of the power monopoly of the newly established chiefly *class*. This sundering of the Ancestral Polynesian kinship structure and its replacement with a fundamentally different kind of political system based on (among other things) a power monopoly and class endogamy demonstrate the degree of social transformation possible in isolated island settings over even relatively short time spans (e.g., less than two millennia).

The Easter Island case considered by Stevenson provides a fruitful comparison with Hawai'i, since both societies diverged from a common East Polynesian ancestral community probably no more than 1500–2000 years ago. Stevenson approaches the problem of socio-political change by focussing on the ritual structures termed *ahu*, renowned for the large stone statues they were constructed to support. As in many societies with corporate lineage organizations, the Easter Island *ahu* were constructed by corporate descent groups, each occupying a radial territorial unit analogous to the Hawai'ian *ahupua'a* examined by Hommon. Using the method of obsidian hydration dating, Stevenson has established a chronological sequence for *ahu* construction along a 9 km long section of the southern coast of Easter Island, during the period from AD 1300 to 1864. An early phase of rapid construction of single-lineage *ahu* was followed by a period of increased socio-political integration reflected in the construction of multiple-lineage centers at more or less regular intervals along the coast. The presence of four major socio-political groups within the study area is suggested by the spatial arrangement of *ahu*. The subsequent replacement of image *ahu* with 'semi-pyramidal' interment structures reflects yet another phase of significant socio-political change, possibly associated with demographic stresses and environmental deterioration.

This volume's final essay takes up a theme of considerable debate in contemporary archaeology – namely, whether the 'recovery of mind', or the reconstruction of prehistoric cognitive patterns is an attainable archaeological goal. Rolett addresses this issue through the application of controlled iconographic analysis of a set of Marquesan turtle petroglyphs. His study is noteworthy not only because it is a first attempt to apply iconographic methods in Polynesian archaeology, but because it infuses new life into the study of petroglyphs. These rock carvings have long attracted archaeological attention in Oceania, but attempts to deal with them have usually been either purely descriptive, or have uncritically used petroglyphs as a basis for linking island cultures in grand migrationist reconstructions. Rolett is concerned not only with the iconographic analysis of the Marquesan turtle glyphs, but with their archaeological context, which proves critical to their structural interpretation. Furthermore, he makes use of the model of phylogenetically related cultures within Polynesia in order to set his pan-Polynesian turtle petroglyph comparisons in a systematic framework. His tentative interpretation of the symbolic content of the Marquesan turtle petroglyphs is a highly plausible one, meshing neatly with the ethnohistoric evidence. While Rolett's analysis is a trial foray into an area of much theoretical contention, in my view it augurs well for continued efforts in this direction.

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Chapter 2

Landscape, land use, and political transformation in southern Melanesia

Matthew Spriggs

The southern islands of Vanuatu (formerly the New Hebrides) form the administrative district of Tafea, an acronym referring to the five inhabited islands of the area – Tanna, Aneityum, Futuna, Erromango and Aniwa (fig. 2.1). They are currently under investigation by *The Southern Vanuatu Culture History Project* which follows on from research conducted by the author on the island of Aneityum in 1978 and 1979. Prior to that research little archaeological work had been conducted in southern Vanuatu.[1]

The languages of the three main islands of Tafea (Aneityum, Tanna and Erromango) form a distinct Southern Vanuatu subgroup of Oceanic Austronesian (Lynch 1978), while the inhabitants of the two small islands of Futuna and Aniwa speak a Samoic Outlier language of the Polynesian subgroup (Clark 1978). Prior to the adoption of this intrusive language within the last millennium it can be presumed that the languages of these two islands were related to the Southern Vanuatu subgroup. At European contact in the late eighteenth and early nineteenth centuries the islands of Tafea were linked by a regional exchange system with considerably more contact between them than any one island had with places outside the group.

Settlement of Tafea (indeed of all of Vanuatu) probably first took place about 3500 bp during the 'Lapita expansion' of population from the Bismarck Archipelago area and out across the southwestern Pacific as far as Tonga and Samoa (Spriggs 1984). Since Lapita colonization the cultures of the region have changed and diverged and it is the explanation of these transformations which the current project seeks to investigate. The environments of the several islands of Tafea offered different challenges and opportunities to their human settlers because of contrasts in geology, soils, and water resources. After discussing these, I shall focus on Aneityum as a detailed case study. This island is the only part of Tafea where a rudimentary prehistoric sequence has yet been established, based mainly on evidence of geomorphological and land use changes. In order to assess these changes, a reconstruction is given of Aneityumese society at European contact (circa 1830). This is followed by a discussion of the interplay of land use changes and suggested changes in socio-political structure.

The wider project will consider the Tafea 'regional system' as a whole. Similarities and differences between the several islands can be brought out by a study of the 'endpoints' provided by European contact history. These endpoints are the result of differential socio-political transformation from a presumed single founding culture, processes whose archaeological investigation has only just begun. As a first step in this direction a tentative reconstruction of Tannese social structure is offered for comparison with Aneityum. Historical and archaeological investigation of the other islands of Tafea are too little advanced for further comparison at this stage,

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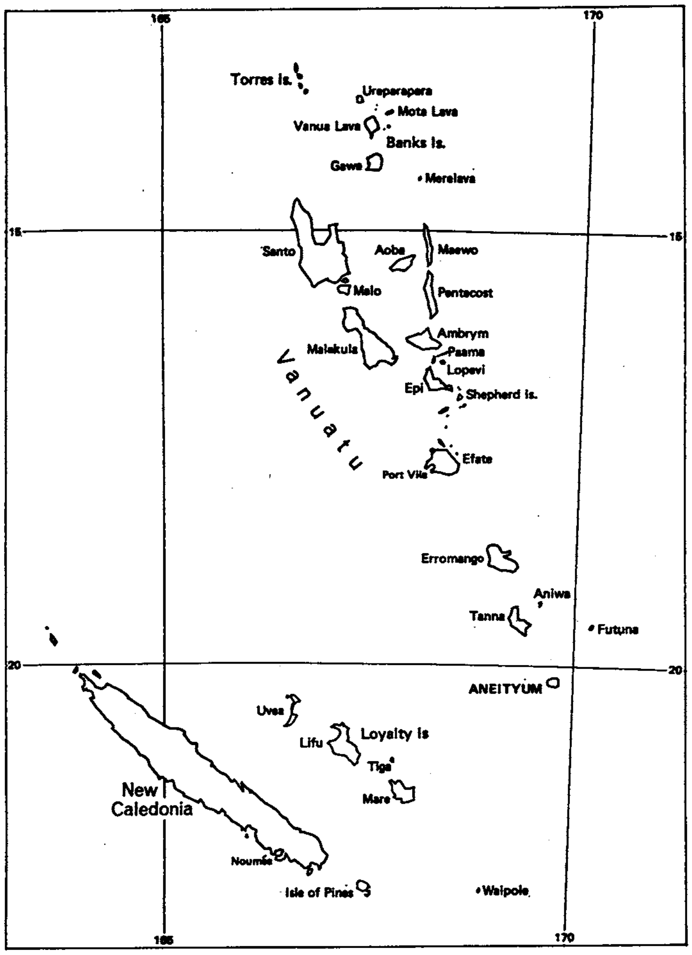

Fig. 2.1. Map of Vanuatu and New Caledonia.

but analysis will be extended to them in the future. The present study should thus be seen as a preliminary statement of Southern Melanesian social dynamics, certainly not as the last word.

Island environments of Tafea

The islands stretch from 18°37′ S to 20°16′ S with a mean difference in temperature between Aneityum and Erromango of only 1°C. This far south of the equator there is some seasonality of climate, with a wetter, hotter period from January to March and a drier, cooler period from July to October. Three climatic zones can be recognized on all islands except the low island of Aniwa: windward, perihumid and leeward (Quantin 1979, 2–3).

Below 500 m on the windward slopes exposed to the south and east, mean annual rainfall is between 2000 and 3000 mm (2290 mm for Anelcauhat on Aneityum, 2822 mm for Potnarevin on Erromanga). The second zone, the perihumid, is found generally above 500 m. It is more constantly humid, being close to saturation most of the time. The ridge crests are high enough to induce orographic rainfall and Quantin (1979) suggests that rainfall in this zone is probably above 4000 mm annually and the temperature cooler by 2–3°C. As the highest point of Aniwa is only 42 m this zone is not present on that island. The western slopes and particularly the northwest of the islands have a leeward climate with mean annual rainfall of 1600–1800 mm (1643 mm for Lenakel on Tanna, 1740 mm for Noumpon on Erromango) and a more marked seasonality. Tafea is in a belt of frequent tropical storms and hurricanes, generally between December and March. Hurricanes tend to affect the north coasts of islands more severely.

Many of the watercourses of Aneityum and the southern mountainous areas of Tanna are deeply dissected and perennial, although only those of Aneityum appear to have produced significant alluvial plains. On leeward Aneityum, however, between Uche on the south coast and the Aname river on the north coast only two rivers are perennial. In the limestone areas of Tanna surface water quickly drains and many of the rivers cease running during prolonged spells of dry weather. On Erromango there is a predominantly radial pattern of drainage but when rivers reach the limestone fringe they are often diverted and as a result they become bottle-necked with only one coastal outlet serving large networks of tributaries. This limestone fringe constricts the buildup of alluvium at river mouths and creates a ‘flushing’ effect in periods of high rainfall when areas of coastal alluvium are often eroded in floods. Futuna has near vertical slopes and run-off is rapid. On this island perennial water occurs only as seepages at the contact between the limestones and the underlying volcanics. Aniwa has running water only after heavy rain (Carney and McFarlane 1979, 1; Colley and Ash 1971, 12).

Climate and geology together influence the soils and vegetation of the islands. Aneityum is a high island formed from two coalesced Pleistocene volcanoes. It is 160 km^2 in area and its highest peak is at 852 m. There is one small area of late Pleistocene or Holocene raised reef and quite extensive areas of recent alluvium in part overlying reefal materials laid down at or near present sea level. The soils reflect this simple geology, but climatic zonation and human influence have complicated the picture. Eighty-eight per cent of the soils are strongly leached ferrallitic soils (ferralsols and cambisols) of poor to moderate fertility while the other main soil type (about 9% of the area) is that of the alluvial soils, the most fertile on the island.

Tanna is considerably larger, 572 km^2 with its highest point at 1084 m. Again it is basically volcanic in origin, although the vulcanism of the southeast is considerably more recent, continuing today with the continuously active cone of Yasur volcano. Ash enrichment of soils on the island is important in maintaining their fertility. Along the west coast is a strip of recent raised reef, backed by older Pleistocene reef which is also found in many river valleys. In the northern part of the island are found extensive older raised limestones and Pliocene volcanics. From near the northernmost point of

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the island along the east coast to just north of Waesisi is a coastal fringe of raised beach deposits, with alluvium in the larger river valleys. The interior of the northern two-thirds of Tanna presents a relatively flat plateau while the southern third gives a much more dissected appearance. The soils of Tanna are predominantly andosols (65% of land area) of variable fertility. Most important of these is a type of mollic andosol found on the central plateau and lower windward slopes which is very fertile and covers nearly 26% of the land area. Eutric lithosols cover a further 25% of land area and are very infertile (Quantin 1979, 51–2).

Erromango (902 km^2) has a Plio-Pleistocene volcanic core with peaks up to 886 m. Much of the island is fringed by a series of raised limestone terraces up to 300 m in altitude and representing a third of the total area of the island. Along the east coast of the island some of this raised reef was uplifted in the later Holocene period. Areas of alluvium occur at the mouths of some of the major rivers, particularly in the Cook Bay area. As on Aneityum the majority of the soils are ferrallitic (78%), with eutric lithosols covering a further 12% of the area and alluvial soils only 3% (Quantin 1979).

Although Futuna is only 11 km^2, its high central plateau has an average altitude of 500–600 m. Seventy per cent of its surface area is limestone, overlying Pliocene volcanics. There is a coastal fringe of recent raised reef. Nearly 45% of its soils are useless eutric lithosols, with a further 39% of ferrallitic soils varying in fertility, and other, minor limestone-derived soil types making up the rest of the island. Aniwa is even smaller (8 km^2) and in contrast is a low island, 42 m maximum altitude. Apart from the tuff deposits on its central plateau it is a raised reef island. Ferrallitic soils (cambisols) have developed on the tuffs (nearly 53% of the area) while the other soil types all derive from reefal deposits.

Quantin (1979, 53–4) has rated the soils of these islands for agricultural potential from most fertile (type 1) to little or no potential (type 5). Although he is rating for modern potential rather than taking account of traditional agricultural methods his work serves as a useful guide in comparing traditional agricultural production of the islands (table 2.1). There has been considerable human influence on the vegetation and soils of these islands. This will be examined in detail below in relation to the Aneityum case study where human impact affected not only vegetation but also led to an increase in land area through erosion and deposition.

The Aneityum case study – a transformed environment: humans and hurricanes

The vegetation over nearly the whole of Aneityum (fig. 2.2) immediately before human colonization was probably dense forest except in some swampy areas (Schmid, 1975, 335; Hope and Spriggs 1982). By the time of European contact, however, the island presented a very different appearance:

> As you coast along in a boat you observe three belts or zones, in many places pretty well defined, which we may name the alluvial or arable, the sterile, and the woody. The first lies along the shore, is flat, and consists of a dark, rich soil. As it furnishes a great proportion of the food, most of the natives are found on it. Here flourish luxuriantly the Cocoa-nut and bread-fruit trees, with taro, bananas, sugarcane etc. The second or sterile is of larger extent, and can be best seen. In some places there is no vegetation, nothing but red earth. On the most of it, you find grass, ferns, and a few stunted trees . . . . The woody belt occupies the summit and centre of the island. (Copeland 1860, 346)

The 'red earth' refers to the eroded ferrallitic soils of the slopes. Clearance of the original forest for gardening or other purposes would have had different results in the wetter south and east than it would in the drier north and west. In the windward zone a more woody regrowth is usual after burning, and forest regeneration takes place quite rapidly (Quantin 1979, 9). The leeward zone constitutes a more stressful environment and burning of the forest here would have tended to give rise to a succession of more open vegetation types. Forest regeneration in this zone would have been much slower and could have been easily interrupted by further burning.

The burning off of forest for cultivation would have resulted in the formation of savanna vegetation. When not

Table 2.1. *Quality of soils in Tafea (After Quantin 1979)*

Quality	Erromango		Tanna		Aneityum		Futuna		Aniwa	
	Area (km^2)	%	Area (km^2)	%	Area (km^2)	%	Area (km^2)	%	Area (km^2)	%
1	104	11.5	219	38.3	7.5	4.7	1.5	13.6	4.2	52.5
2	102	11.3	94	16.4	6.4	4.0	0.9	8.2	1.8	22.5
3	297	33.0	44	7.7	28.0	17.5	3.7	33.6	–	–
4	247	27.4	69	12.1	91.6	57.2	–	–	–	–
5	152	16.8	146	25.5	26.5	16.6	4.9	44.6	2.0	25.0
Total	902		572		160		11		8	

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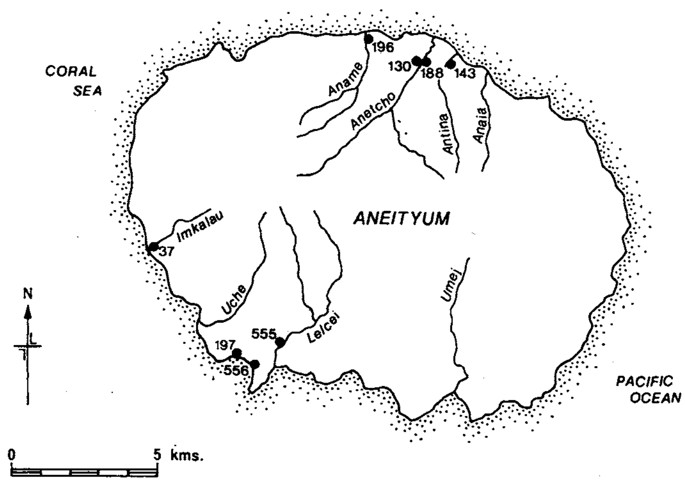

Fig. 2.2. Map of Aneityum, with sites mentioned in the text.

regularly burned this would tend to be replaced by forest once again. Under repeated burning, however, *maquis* scrub would develop, with open, unvegetated areas subject to erosion. Extensive degraded pyrophytic savanna areas are found as well in the north and west of Tanna and Erromango, and even on the northern side of Futuna. Vegetation consists of *Miscanthus*, *Chrysopogon*, and *Imperata* grasses.

Once serious degradation of the vegetation and soils had begun, the economic value of such areas to the inhabitants would have decreased. Fire control may have become less strict when burning off garden areas in the valley bottoms, thus allowing fires to burn freely upslope to the ridges. A further major factor inhibiting forest regeneration after initial burning would have been the devastating hurricanes which affect the region. The northern and western sides of the island bear the brunt of the wind and rain, as attested by historical reports. It is precisely in these areas that the most eroded landscapes are found.

The extremely high runoff associated with hurricanes and other periods of exceptional rainfall would have led to greatly accelerated erosional processes and the strong winds would have damaged regenerating vegetation. On land recently cleared by fire for agricultural or other purposes, or in areas of open anthropogenic vegetation created by regular burning, rates of erosion would have been much higher during hurricanes than in forested areas. The interplay between human interference with the vegetation and natural catastrophic events can be clearly seen at work in this situation. Once serious erosion had begun, the process would have been cumulative and with removal of soil occurring at much faster rates than that at which weathering of the substrata could renew it, the soils could never recover. Erosion certainly occurred in the wetter windward side of Aneityum but to a lesser extent. Between 1848 and 1918 at least thirty-three hurricanes affected Aneityum. The occasional strong earthquake could also cause slope instability.

Deposition of the products of erosion has created the extensive alluvial plains at the mouths and along the valleys of the three main rivers on the island (the Lelcei, Umej and Anetcho rivers) and also at the mouths of many of the smaller streams. These plains are at their most extensive in the north where the Anetcho and several smaller rivers empty into a lagoon protected by an extensive fringing reef. The largest alluvial plains occur below the most eroded slopes, on the coast most affected by hurricanes.

The rivers cutting through these plains reveal in their bank sections traces of past agricultural systems in the form of stone walls and plot boundaries and stone-lined drains, up to 2 m beneath the present ground surface. Deep soil profiles are often revealed in the river banks and former topsoil layers can be traced extending along the river sections sometimes for hundreds of metres – up to four such horizons can often be distinguished, each buried by alluvial material deposited in flash floods associated with major storms in the past. In some places up to 300 m from the current coastline, coral reef platforms are revealed in the river bed at or very close to present sea levels and are considered to be mid–late Holocene in age.

Analysis of these sections and other geomorphological evidence allow us to establish a three phase model for human–environmental interaction on the island (see also Spriggs 1981, chapter 5). A brief summary is given below (see fig. 2.2 for locations of sites discussed in the text):

1. *Human arrival and initial sedimentation*

When the sea reached its present level at about 6000 bp, stream downcutting would have been halted and the valley floors would have begun to silt up, leading to marshy valley bottoms with the streams meandering through them subject to frequent changes of course in response to heavy rainfall. A natural succession in the valley bottoms over time, caused by siltation of the valleys and some attendant progradation of the coastline, would be from marsh to meadow and eventually to forest. Thus when people arrived on the island, at about 2890 ± 60 bp (ANU-2421B), many of the valley floors may have been too swampy to be cultivated easily, as well as being prone to flooding. In addition, the coastlines at the valley mouths may have been in some cases a kilometre or more inland of their present location. The early inhabitants may have concentrated agricultural activities on the hillsides near the coast in order to utilize both marine and terrestrial resources with the minimum of effort. The sequence from the coastal Anauwau swamp (Site AT556) suggests clearance of the adjacent hillsides and accelerated erosion beginning at initial settlement (fig. 2.3; cf. Hope and Spriggs 1982).

It seems plausible that some areas of swamp were used for growing taro, perhaps with small canal-fed irrigation systems in upstream valley floor areas. Many of the largest areas of swamp, however, those on the coastal flatlands against the hillside or immediately adjacent to the beach, have developed above Holocene reef deposits and may have come

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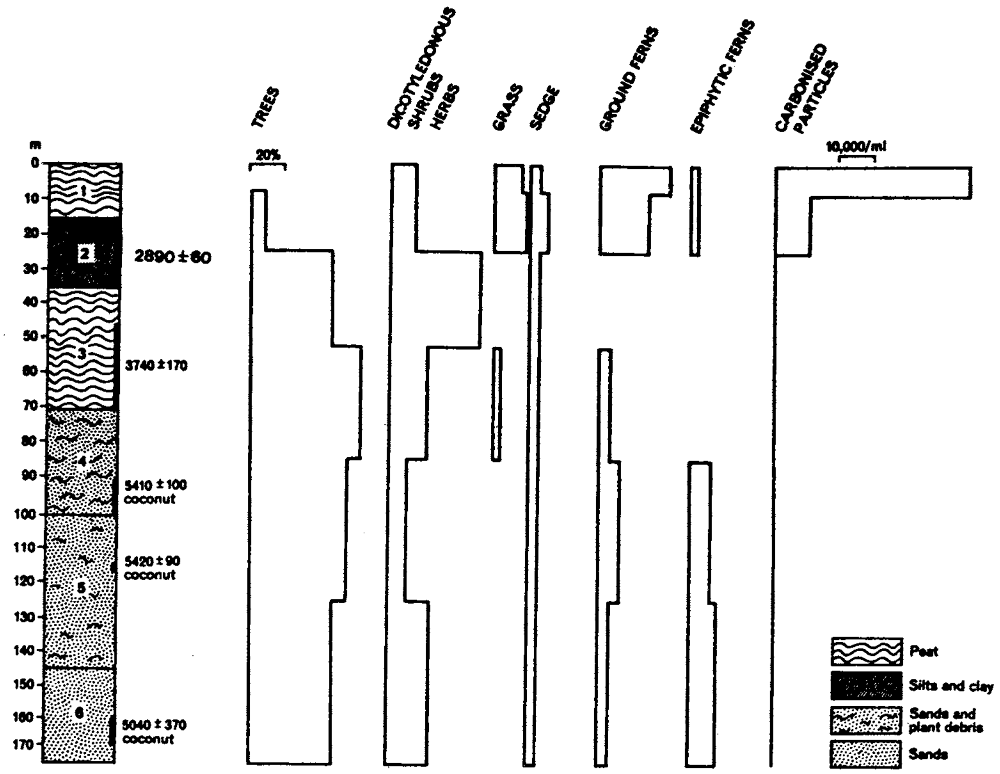

Fig. 2.3. Summary pollen diagram from Anauwau Swamp, Trench 1.

into existence only in the last few hundred years as coastal progradation was accelerated. Previous to this, many of them would have only been small seepages at the base of coastal cliffs or small springs on the beach.

At Imkalau (AT37) there is evidence of initial sedimentation on the valley floor during the period 2180 ± 80 bp (ANU-2188), and then a break in alluvial deposition of nearly 1000 years. This may reflect serious degradation of the hillslope garden areas soon after initial occupation and subsequent abandonment of the area because of its now marginal agricultural value. Changed circumstances a thousand years later, possibly representing population expansion or other forms of pressure on resources, led to the re-occupation of the area perhaps initially with a focus on offshore reef resources. In the Lelcei valley (AT555) in-filling was underway by about 1720 ± 150 bp (ANU-2367) with gardening on the slopes of a volcanic promontory on the east side of Anelcauhat bay leading to erosion and the creation of a colluvial apron at the base of the promontory some time before 1830 ± 70 bp (Beta-7676).

2. *The move on to the valley flats*

Erosion caused by the combined effects of people and the elements was not totally deleterious in effect. It is true that it stripped the hillsides near the coast of much of their soil and vegetation and rendered them useless for gardening, but these hillside soils would have been of low fertility and needed extensive terracing to fit them for any sustained form of cultivation. On the other hand, the alluvial soils created in the valley bottoms and coastal plains are the most fertile on the island. They are deep and well-drained and, unlike the case of some of the extremely narrow valleys elsewhere on the island, sunlight hours at the wide valley mouths and on the coastal plains are optimal for crop growth, with a cropping time shorter than further up the valleys. Similar processes of alluviation also occurred in all the other smaller valleys of the island.

On the north coast, where much more massive erosion has occurred, the evidence for human interference with the landscape is generally more deeply buried, and basal dates from river sections at best relate only to the last 1000 years or so. At Aname (AT196) there is evidence for substantial valley in-filling and progradation of the shoreline since about 570 ± 90 bp (ANU-2360) and 2.5 m of alluvium has been deposited over large areas of the Aname floodplain since that time. In the Anetcho valley such in-filling had already begun to occur by 1000 BP. In the Antina valley the datable sequences do not go back so far, but the major phases of valley in-filling there have certainly occurred within the same time scale. At Aname (AT196, RS2) there is evidence for burning in the catchment by about 1650 ± 290 bp (ANU-2361) but no evidence for accumulation of alluvium on the valley floor at that time, when the shore at this point was some 300 m inland of its present location.