Archaeology in Samoa – the Pulemelei Investigations

AUTHORS

Antoine de Biran
Finder Exploration Pty Ltd., Perth, Australia. antoinedebiran@hotmail.com

Geoffrey Clark
Research Fellow, Archaeology and Natural History, Australian National University, Canberra ACT 0200, Australia. geoffrey.clark@anu.edu.au

Helene Martinsson-Wallin
Associate Professor, Department of Archaeology and Osteology, Gotland University, Visby, Sweden. helene.martinsson-wallin@hgo.se

Tui Atua Tupua Tamasese Taisi Tupuola Tufuga Efi
Deputy Head of State of Samoa; Adjunct professor Te Whare Wananga o Awanuiorangi, The Maori University at Whakatane, New Zealand. tttuaefu@lesamoa.net

Paul Wallin
Associate Professor, Department of Archaeology and Osteology, Gotland University, Visby, Sweden. paul.wallin@hgo.se

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Archaeology in Oceania accepts original research from 500 to 40,000 words long in the fields of archaeology and human biology.

Archaeology is considered to include both prehistoric and historic time periods, as well as studies of modern material behaviour. Human biological studies of both ancient and modern human populations will be considered, especially if they are directed towards anthropological rather than biological problems. We aim to encourage the reporting of basic data as well as discussions directed towards particular problems, though in the former case the relevance and importance of the material must be clearly stated.

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Website
http://www.arts.usyd.edu.au/publications/oceania

Email
oceania@arts.usyd.edu.au

Address
Archaeology in Oceania
University of Sydney (H42)
116 Darlington Road
NSW 2006 Australia

Phone/Fax
Phone 61.2.9351.2666 Fax 61.2.9351.7488

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Preface

HELENE MARTINSSON-WALLIN

"*E mana'o i le vao, ae, fefe i le aitu*" [We want the forest, yet fear the Spirits] is a Samoan proverb used by Malama Meleisea (1980:21) to describe the contradiction between the development of the society (social progress) and traditional culture in Samoa. Since Samoa is a chiefdom and kinship based society the oral traditions are of great importance and intimately tied to titles/genealogies and land. Meleisea (1980:27) indicates that when the Europeans (see Krämer 1994) first came to Samoa they were very interested to find out the 'original' or 'most ancient' version of Samoan oral traditions. Interest has continued to focus more on the 'traditional' Samoan society than on the modern one, which has become heavily influenced by European lifestyle and values. Meleisea suggests (1980:27) that this has created a confusion between history and culture in Samoa that has to be sorted out. He is of the opinion that Samoans think of their 'culture' as something ancient instead of something you live today, and so the 'culture' has to be protected so the uniqueness is not 'lost'. However, culture is something that is lived and changing and cannot be lost in our ever-changing world. Every new meeting could be seen as a challenge where we have to negotiate and validate our identities (Meleisea 1980:28; Goffman 1967). This is in contradistinction to history which consists of events and traditions from the past that actually can be lost if not protected or documented (Meleisea 1980:28).

Archaeology deals with the investigation and classification of the pre-historical and historical material remains, with the aim of documenting and protecting and preserving historical cultural values. Archaeology is a young science in the Pacific area, developed mainly by non-Polynesians since the 1950's and onwards (Emory *et al.* 1959; Heyerdahl and Ferdon 1961; Gifford 1951; Gifford and Shutler 1956; Kirch 2000). Archaeologists concern themselves with the actual material expression of past actions. This expression and its relation to the natural and cultural landscape is described and investigated through mapping, photographs, drawings and various analyses usually based in the natural sciences. To preserve and discuss the results in reports and publications or restore and preserve the remains on the actual site is often the final goal. The prehistoric material culture in Samoa is represented by traces in the form of monuments, pottery, stone and bone tools and skeletal remains found in ancient settlements. Such remains have so far not attracted any major attention among Samoans due to limited knowledge about the prehistoric tangible heritage, but also because of the greater significance of the intangible heritage.

Prior to archaeological research, traditional history comprising genealogies, legends and mythology provided the evidence or explanations for the origin, migration and structure of the past and contemporary Samoan society. Archaeology is also used to explain and investigate origins, and social change. Archaeologists investigate and describe past material culture and then often draw conclusions about past living societies with the aid of analogies and comparative methods based in traditional history, linguistic models and ethno-historical data (Kirch and Green 2001).

Archaeological research has so far been rather limited in Samoa and confined mainly to areas comprising of freehold or government land (Green and Davidson 1969, 1974; Jennings and Holmer 1980; Jennings *et al.* 1976, 1982; Martinsson-Wallin *et al.* 2003, 2005. A mistrust of archaeology is common and, as far as I understand it, this fear is founded mainly in the possibility that archaeology might prove the oral traditions wrong, which eventually could lead to losing rights to land and titles. Considering the colonial past, when Samoan lands were alienated and there was constant negotiation and re-negotiation concerning titles and land among the Samoans, this fear is understandable. The past material cultural remains are probably also seen as dangerous since they have been, and therefore still are, intimately associated with pagan gods and spirits and often situated in the forest. Thus, ancient remains are generally regarded as unimportant and potentially dangerous. However, the importance of material remains as identity markers and active agents in social relations in contemporary Samoan society is evident and can be seen for example in the high value placed on Samoan fine mats and orator staffs and whisks (Krämer 1994:26).

Archaeological investigations in Samoa started with Jack Golson and Wal Ambrose in 1957 and archaeological programs have been carried out under the leadership of Roger Green and Janet Davidson in 1963-66 (Green and Davidson 1969, 1974) and by Jesse Jennings in 1974-75 (Jennings *et al.* 1976, 1982, Jennings and Holmer 1980). These investigations have created a foundation for a general outline of Samoan prehistory. The archaeological investigations a so far have focused mainly on 'Upolu and American Samoa. On the island of Savai'i the archaeological research prior to our investigations at Letolo and the Pulemelei site was confined mainly to field surveys and surface finds. The outline and framework for archaeological research and understanding of Samoan prehistory was set by the investigations in the 1960's and 70's, but the pre-mound phase, which roughly dates to the first millennium AD, has been called the "dark age" by Janet Davidson (1979:94). The mound building tradition, along with the rise of the Polynesian chiefdom, and the Diaspora to the East, are events still poorly understood and show us the need for further archaeological research to be carried out in Samoa.

The archaeological investigation of the large Pulemelei mound, and adjacent structures at Palauli, on the Letolo plantation situated in the south east part of Savai'i was carried out by us to illuminate some of these issues. These structures were subjected to archaeological excavations and remote sensing during September 13–October 10 2002, July17–August 15 2003, and June 7–July 16 2004. The investigations have been carried out mainly as a collaborative research between Drs. Helene Martinsson-Wallin and Paul Wallin from the Kon-Tiki Museum Institute for Pacific Archaeology and Cultural History/Gotland University and Dr Geoffrey Clark, University of Otago/Australian National University. The collaboration has been a natural one considering our background and previous research interests of monumental architecture in East Polynesia and settlement archaeology in West Polynesia. The archaeological investigations at Pulemelei mound were initiated from the outside, but during the investigations the support and interest from the local community, plantation owners and scholars from the National University have increased. The research has involved students, participants from the local community and collaboration with the plantation owners and subsequently resulted in an educational exchange between The National University of Samoa and Gotland University in Sweden.

Our archaeological investigation at Letolo has focused on an extensive set of prehistoric stone and earth structures of which the most substantial is the Pulemelei stone mound with base dimensions of c. 65x60 m and a maximum height of c. 12 m. Pulemelei mound is thought to be one of the largest stone mounds in Polynesia. Prior to the investigations very little was known about the age and use of this prominent mound, which forms a central place in the extensive prehistoric settlement on Letolo plantation on Savai'i. Previous surveys and general mapping of the area has been used in a discussion concerning the prehistoric settlement pattern in Samoa (Jennings *et al.* 1982:88). A broad range of research issues including both development of method and theoretical issues regarding the mound building tradition and settlement sequence on Savai'i and Samoa and their relation to West Polynesian prehistory have been addressed. Remote sensing methods, for example the use of georadar analyses, have been applied and refined during the course of the excavation. A chronological discussion has placed the Pulemelei excavation results in the wider Samoan pre-historical context and a relational archaeology using multivariate statistics has been applied to the investigation of the Letolo settlement pattern.

The research issues and aims of the Pulemelei project were to date and refine the stylistic and construction sequence of monuments at Pulemelei and provide an important set of data for understanding prehistoric societies in the Central Pacific, as well as the chronological and stylistic relationships of Samoan monuments and those in West Polynesia. Tracking the development of monumental architecture in West Polynesia is important because monuments are linked with the rise of complex chiefdoms, intensified forms of food production and an increasing frequency of long-distance voyaging, which is coincident with the main phase of colonisation in East Polynesia. The specific investigations at Pulemelei mound add to research in terms of the specific and general understanding of prehistoric monumental architecture, the development of complex chiefdoms, and migration processes.

The specific aims of the investigations at the Pulemelei site have been:

1. To provide a radiocarbon chronology for the major monuments at Letolo plantation and obtain detailed stylistic information for field monuments through excavation, mapping and remote sensing.
2. Determine the function of monuments through geophysical and archaeological investigations, combined with an analysis of traditional and historical sources relating to past occupation in this area.
3. Compare Samoan monuments with those in Tonga and East Polynesia to see whether the development of monumental architecture in the Pacific was linked or represents independent traditions of field monument constructions.
4. To focus on developing an opportunity for education of indigenous students and student exchange to provide a platform to increase the interest among authorities and local people about the prehistoric monuments. This has been done to inspire interest in the historic cultural heritage and cultural resource management and create or extend a form for cultural tourism.

The majority of the specific research aims are dealt with in different articles in this special issue of *Archaeology in Oceania*. During our research at Pulemelei area we especially came to appreciate the importance of creating a platform for a general understanding and appreciation of the historical cultural heritage among the Samoan community. The need for local education in archaeology and cultural heritage managements was obvious. The opportunity to initiate an educational exchange between us, representing a small island community university in Sweden, Gotland University, and the Centre for Samoan Studies at the National University of Samoa was made possible through a Linnaeus–Palme exchange grant from SIDA (The Swedish International Development Agency) in 2005. This exchange has introduced archaeological courses at NUS within the Samoan studies program. The exchange also includes Samoan teachers of social anthropology and history giving lectures at Gotland University and Samoan students participating in field schools in Sweden. Both through the Linnaeus-Palme exchange and the Minor Field Study grants, also sponsored by SIDA, the Swedish students have learnt more about cultural heritage and immaterial and material values in Samoa. This experience has allowed the students to reflect on western values concerning how to view the past and our heritage. The educational exchange introducing archaeological courses at the National University of Samoa and programs directed towards sustainable cultural heritage management are important steps in the indigenous reclama-tion of Samoan prehistoric material culture, as well as generating a general appreciation of these issues. A documentary film project and public seminar under the title *Folauga mai anamua* (The voyage to the past) as well as a small exhibition on ‘what is archaeology’ was prepared by the first Samoan students of archaeology within the course HAR 101. These have raised awareness of the need for archaeology and importance of cultural heritage manage-ment of historical sites.

How to look upon the meaning, content and views about culture and cultural heritage is culturally bound and should be understood within a relevant context. When two worlds meet there is a risk of cultural clash, but also hope for cultural compromise that could be of common benefit. Within an ever-changing world there is a need to negotiate and validate identities. Identity/belonging is not a static mono-dimensional quality but should rather be seen as multi-dimensional and variable. To try to harmonize views gained from traditional or oral history with views from modern scientific method to reach at understandings of past actions is a challenging effort. Some people contend such an attempt is vain and see this as a threat to traditional views and values. Others welcome such an effort as an opportunity to widen the knowledge frame about themselves and others, both in the past and the present society, as well as across cultural and religious borders. To bridge over the ‘spoken’ indigenous knowledge and the ‘scientific’ archaeological theory and method are possible ways to broaden views of the past to be incorporated in present Samoan society. Maybe the archaeological point of view and the traditional history could be allowed to ‘sit together on the same Samoan mat’. A cultural heritage concept including the knowledge of the historical material expression could possibly be gained and incorporated when expressing the culture of Samoa.

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Fa’aifetai lava, Soifua.
Samoa, 13 June 2007

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In search of Tagaloa: Pulemelei, Samoan Mythology and Science

HON. TUI ATUA TUPUA TAMASESE TAISI TUPUOLA TUFUGA EFI

Abstract

This article touches upon views gained from traditional or oral history together with views of modern scientific method to reach at understandings of past actions. The text presents an emic view concerning the Pulemelei mound and a ceremony carried out at the site in 2003. It is an edited version of papers presented at Auckland University in 2003 (Tamasese 2003) and at the inauguration of an exhibition at the Kon-Tiki Museum in 2004, which featured the results of the archaeological excavations at Pulemelei mound in 2002-2004.

In search of Tagaloa: Pulemelei, Samoan mythology and Science

I want to begin my paper on the search for Tagaloa with a quote from Thor Heyerdahl (1998):

> And both the wind and the people who continue to live close to Nature still have much to tell us which we cannot hear inside university halls. A scientist has to distinguish between legend and myth and make use of both.

Thor was one of the few scientists I know that actively engaged in an attempt to do this and to do so in a way that afforded our peoples and our knowledge respect and dignity.

Pulemelei and the archaeological excavation

In September 2002, the first archaeological excavations at Pulemelei began under the supervision of Drs Helene Martinsson-Wallin and Paul Wallin (Kon-Tiki Museum) and Dr Geoffrey Clark (ANU). The Pulemelei site is made up of several mounds. The principal mound was excavated during 2002-2004. When the excavation reached foundation level and the near approaches were cleared, the spectacle of what was exposed was awesome. It invited re-assessment.

In terms of the Samoan landscape, the Pulemelei mound seemed to me to be overwhelmingly large and high. One of the smaller mounds on elevated ground to the North gave a commanding view of the top level of the principal mound. Another platform on the Southern slope and the other stone platforms nearby each incited wonder and curiosity. Even more curious was the pathway from the East.

The pathway or *auala* in Samoan, is significant in Polynesian culture. Our funeral rituals are called *auala* or *the pathway*, meaning the pathway to *lagi (heaven)* or Pulotu (the underworld) (Pratt 1977; Mosel and Hovdhaugen 1992). From the top of the mound one has a good view to the South and it is possible to trace a "pathway" linking Manono, Apolima and Upolu islands. In early 2003 bush and trees hid this "pathway". However, today the "pathway" is clearly visible, thanks to the clearings made by the hurricane in January 2004. Whilst at the top of the principal mound one can not help but reflect on the strategic and navigational value of such a view for our ancestors.

Making connections: Polynesian mythologies, genealogies and science

In early 2003 I invited two Maori friends, an anthropologist Dr Pita Sharples, and Rev Morris Gray, former Head of the Maori Dept at the University of Canterbury, to visit Pulemelei. We climbed the path to the Pulemelei complex and to the top of the large Pulemelei mound, where we seated ourselves on flat slabs of stones.

Shortly after, Morris stood up, walked inwards, stopped when he reached the middle, threw his arm out and pointed to the ground: "Down in the bottom in the ground level is buried an *ariki*" he said. He seemed like someone who was, as we say in Samoan, *ua ulu i ai le agaga*, meaning 'possessed'. "I know this place" he continued, "this is where our people came from. My family emblem is the *wheke* (octopus) and this mound is a legacy of the *wheke*. And, there are in this environment definitive markings which underline the sacred figure of eight".

Morris's reference to the *wheke* and the figure of eight impacted on me because the river that flows through the plantation on which Pulemelei is sited has eight waterfalls. He did not know this at the time. "There are links between this mound and the skies, the sun, the moon and the stars", he proclaimed. "There is a link between this mound and the pathway". The astronomy of this, he suggested, was what enabled the Polynesia Diaspora.

He then called to the plantation manager, "Where does the sun rise?" The plantation manager responded, "You are facing the direction of the sunrise". Morris was standing directly in front of the principal pathway to the top of the mound, suggesting that the pathway pointed to the direction of the sunrise. He turned to me and said, "I ask for your leave to address our forbears in chant". When given, he began to chant. At the bottom of the mound we saw the Samoan people down there instinctively stand. I pondered on this, on why they stood for a Maori chant. When the chanting was over, he walked towards me and said, "If there's going to be an archaeological excavation, in all likelihood they will come across human remains. In that case we require a purification ritual". In searching for why and how we should conduct the purification ritual at Pulemelei I became fascinated by the suggested links between Pulemelei and Tagaloa. Thus began my search for Tagaloa.

In search of Tagaloa: moving between mythology, genealogy and science

In the cosmologies of most Polynesian peoples Tagaloa is the senior anthropomorphic god. He is pre-eminent in Samoa and Tonga and is the pre-existing Creator in Tahiti. In East Polynesian cosmology, he is equal with other first order gods (Marck 1996).

The fact that important founding ancestors attained the status of gods is evidence that, for Polynesian peoples, Tagaloa was a very important founding ancestor. The correlation for Polynesians between biological origins (Cavalli-Sforza *et al.* 1994) and language (Pawley 2002) and culture is one therefore founded on genealogy and mythology. The fact that the name and status is so widespread suggests that he was part of Polynesian tradition from an early stage. For Polynesian peoples Tagaloa is more than a tradition: Tagaloa is mythology, history, culture and heritage. In contemporary Samoa, Samoan culture, its lands and chiefly titles are ultimately founded on mythology, a mythology which links back to Tagaloa (Stair 1896, 1898; Krämer 1994).

Tagaloa in Samoan/Polynesian mythology

In the Tagaloa mythology, the earth is the consequence of the Big Bang i.e. the separation of *Lagi* (heaven) and *papa* (rock) and human life originates from germs (*ilo*) (Andersen 1928). The Tagaloa thesis could be viewed as closer to the scientific explanation of evolution than what is said in biblical texts.

In Samoan/Polynesian mythology *Tuli* (Pacific Golden Plover, *Pluvialis fulva* a winter migrating bird), Tagaloa's messenger, was sent down to earth and discovered the Samoan islands. Here he introduced varieties of plants and trees. After Samoa, the plovers did the same for Tonga and Fiji. Then the plovers, by Tagaloa's commands, designated the figure of Man from germs and they were sent to populate these three islands (Fraser *et al.* 1891)

The Tagaloa regime is well recorded in Samoan oral history, especially its fall. To this day, it is commemorated by the chant at a chief's funeral: *Tulouna a le lagi ma le lagi ma le lagi*! The orator chants the honorifics (*fa'alupega*) of each of the nine heavens. When the orator reaches the honorifics of the ninth heaven, a member of the deceased family will intervene and invite them, i.e. orator and party, into a residence as official mourners. The chant is their passport into residence.

In the ninth heaven, Amoa the daughter of Tagaloa intervened on behalf of her father and offered herself in marriage in order to spare her father and his personal entourage from the wrath of the victor Lu Fasiaitu. This intervention is commemorated by the Samoan proverb: *faalava le Amoa* (meaning 'intervention by Amoa').

The causus belli was the theft of Lu's sacred chickens by Tagaloa's people. The discovery of the sacred chickens is commemorated by the Samoan proverb, *E ufiufi atu lava tama'i moa ae 'io 'io mai*, meaning the attempt to hide the chickens under the kava bowl was given away by their cry. Lu's sacred chickens meaning *Sa Moa* became the name of the islands (Krämer 1994:9; Turner 1884:10-15).

Lu became the first Tui Atua. According to the Samoan Tui Atua and Tui Aana traditions, the Tagaloa inheritance was divided amongst the progeny of the union between Tui Atua Lu Fasiaitu and Amoa; this provided for the separate inheritances of Tui Atua, Tui Aana, Tui Manu'a, Tui Tonga and Tui Fiti.

There is no Tui regime in the Hawaiian, Tahitian, Aotearoa or Rapanui traditions. The suggestion is that they migrated before the fall of the Tagaloa regime. In those traditions, there are several references to Savai'i (Hawaiki), Manono, Upolu, Tutuila, Manu'a, Tonga and Fiti and even To'elau and no mention of Samoa. This suggests that the name Samoa is more recent.

Along the line of genealogical reasoning, Tui Atua, Tui Aana, Tui Manu'a, Tui Tonga, Tui Fiti are of equal ranking. Notably within this list there is not yet any specific reference to a Tui Samoa of equal ranking or of contemporaneous origin. When the missionaries arrived in Samoa in 1830, Samoa, as a distinct political entity included only Savai'i, Apolinia, Manono, Upolu and Tutuila – not Manu'a. In 1900, Manu'a, by colonial design, was joined to Tutuila (however, Manu'a only acceded after considerable colonial pressure in 1904). The joining has no basis in Samoan historical precedent.

In sum, within the Tagaloa mythology, Man originates from the union between *lagi* (heaven) and *papa* (rock). Because of this genealogy, Man shares divinity with the sun, the moon, the stars, the sea and the land. The core symbols of the Tagaloa religion are celebrated linguistically in words like *'ele 'ele* (earth) and *palapala* (mud) which are also words for blood; and *fatu* meaning rock, which is also the word for heart. To underline the links across Polynesia, the placenta which is *whenua* in Maori, is also their word for land; *fanua* in Samoan is used in the same way to refer to both land and placenta. Also, the umbilical cord is similarly named, i.e. *puke* in Maori and *pute* in Samoan, these (both placenta and umbilical cord) are buried ritually in the earth. Rituals are a direct link to mythology, to Tagaloa (Andersen 1928).

Mythology in Samoan rituals: Faalanu, Liutofaga and Fono ma Aitu

Faalanu

Mythology in Samoan rituals returns us to Pulemelei. Why did we need to do a purification or *faalanu* ritual? The answer is: because whenever *tapu* (sacred bond) is broken, you have to ask for pardon. Moreover, the respectful reference to the dead is *tua 'a o loo tofafa i tia* which is reference to "forbears who are sleeping in their graves". When you dig graves, you are disturbing the sleep of the dead and you have to ask pardon.

I want to underline the point about asking pardon. The word for purification in Samoan is *faalanu*. Literally, it means cleansing by asking pardon (Pratt 1977). I was a member of a Samoan party which visited Whakatane in New Zealand in 2003 and was taken by our host Pouroto to an old Maori *pa* dating from the late twelfth century. On our way back, one of our party saw an *avaava-a-aitu* plant or in Maori *kawakawa*, and she said "I want to pluck some leaves". Another of our party said, "No you shouldn't. This is *tapu* ground and you have to ask Pouroto's permission." She then asked permission and so Pouroto launched into a chant which is *faalanu* before we could pluck leaves. You are breaking *tapu* in plucking leaves and therefore you have to ask for pardon.

Furthermore, when you cut down a tree, the word in Samoan is *oia*. The word *oia* is derived from the word *oi* which means cry in pain presupposing that the tree suffers pain and a tree has a life and a soul (Pratt 1977). The core of Samoan spiritual life is the *tapu* relationship between Man and his environment. The greatest threat to Man's survival today is the threat to the ozone layer. Sometimes one wonders whether the solution of the ozone problem is recognition by Man of the *tapu* relationship between Man and trees, Man and rocks, Man and rivers, Man and the sea, Man and the elements. Thus, in Polynesian belief, before breaking *tapu* Man must reflect on the break to that spiritual bonding.

Liutofaga

The next question was, if we were to find human remains, what are we going to do with them? In other words, what are the appropriate processes and/or methods for dealing with the remains? We concluded that it would be the process for a secondary burial, in Samoan *liutofaga*. *Liutofaga* means changing the resting quarters (Pratt 1977). In Samoa, one of the essential ingredients for performing *liutofaga* would be sandalwood and sandalwood leaves. This is evidenced in the Samoan, word for funerals *falelauasi*, meaning the house that is lined with sandalwood leaves. Sandalwood, like incense, is one of the essences of Samoan culture, particu1arly Samoan spiritual culture. Fire is another core ingredient. The ritual making of fire is a direct inheritance from the Tagaloa mythology where Tiitiiatalaga brought fire from the underworld for the use of Man (Hovdhaugen 1987:52; Turner 1884:209-211). The purification ritual thus involved the ritualistic lighting of flares, bonfires and asi wood fires – all symbolic of the Tagaloa mythology.

Fono ma Aitu

The purification ritual had associated rituals. Putting together the purification ritual itself was as much a search as was the sequel (Stair 1896, 1898; Turner 1884; Krämer 1994). There were three sequel rituals: the *fono ma aitu* (conference with the spirits), *lolo sa* (making of holy oil) and *sami lolo* (making of containers for the oil).

The *asi* or sandalwood leaves and wood which were presented at the purification ritual, were carefully stored for the sequel rituals. Here I will only account for the *fono ma aitu* (conference with spirits) ritual.

The ritual, like most of the old religion religious rituals, is oriented to the sunset and sunrise. In the Tagaloa mythology, the Sun is not only a source of energy but also one of the principal progenitors of Man (Frazer *et al.* 1891). The hours of the day are measured by what is known in Samoan as *itula* the 'side of the sun' i.e. the line which divides the shade and the sunlight. The setting of the sun is welcomed by the crickets, so we say, the time when the crickets cry, *tagi alisi*. Midnight is when the *alii o le po*, a sweet-smelling flowering plant, opens its petals and pervades the night air with a strong fragrant perfume. Morning is welcomed by the chickens, thus their honorific *faailo ao*, herald of the morning. Day and night are mythological husband and wife who, like life and death, are one and equal. The beginning of day, as is the beginning of night, invites spiritual contemplation.

At twelve noon, the principal participants begin their fast. The principal participants, i.e. the four conferees who take up the four main posts in the house, the two *matuatala* and the two *pepe*, i.e. the two main posts on the side and the two main posts on the front and the back, break their fast at midnight.

A little after six, just before sunset, the big wooden drum, *lali* or *logo*, tolls eight times symbolizing the eight tentac1es of the octopus which is the earthly manifestation of divinity. This is the signal for the people inside the house to rub wood, *si'a*, which is the ritual way of making fire (Figure 1). After making fire, sandalwood oil in burners were lit inside the house then the blinds, *pola*, were put down (save one at the back entrance). When sandalwood fires outside the house were lit, a flare was taken to the *malae* i.e. the open ground in front of the house, and bonfires were lit. This was the signal for the procession to begin. The procession was led by an orator dressed in *tapa* cloth and wearing a pandanus necklace. He held a long speaking staff and chanted the marriage chant which is a prayer that man's desires will marry God's intentions. He was followed by the four principal participants wearing head-dresses, necklaces or '*ula* and skirts made from sandalwood leaves. They in turn were followed by a support group which included the Tuaefu Methodist pastor. When they reached the house, each of the four principal participants was given a pierced green de-husked coconut. Each of the principal participants took up their designated posts inside the house. The support group dispersed except for those individuals assigned to ensure the fires kept burning throughout the night.

At exactly midnight, the *lali* or *logo* tolls eight times again. This is the signal for the 'ghosts' to then proceed from the *malae* to the *fale*/house. Half of the 'ghosts' bodies are painted black. As they walk along, they mimic the cry and the manner of dogs, woodpigeons, the *ve'a* (the bird whose cry is supposed to be the signal for death) and owls. There is a belief that the ‘ghosts’ incarnated themselves in these animals. When the two ‘ghosts’ reach the *fale*, they enter and drink the green coconuts after which they would then retire from whence they came.

When the ‘ghosts’ withdraw, it is time to break the fast. Specially-prepared food known as *sofesofe*, which is sliced taro or yam sprinkled with coconut cream and covered with taro, banana and breadfruit leaves are tied with scraps of skin from the *fau* tree and baked in the *umu* (Samoan oven).

As the sun begins to rise, emissaries are sent to the *fale* to find out whether the coconuts have been drunk. When it is found that they’ve been drunk, they return and report using the ritual call: *Ua talia le Atua le fanoga* (The gods have heeded our prayer).

A procession heads for the *fale*. It is headed by an orator who is traditionally garbed and chanting marriage chants. The procession includes the Methodist pastor. The call for marriage acknowledges the marriage between the old religion and the new. On reaching the house, the procession enters single file through the opening at the back. The Methodist pastor then says a prayer. After the prayer, the blinds of the house go up. This is followed by a kava ceremony. After this is the distribution of sandalwood and sandalwood leaves (which are the essential ingredients in making holy oil), between the four separate households. A specially prepared breakfast marks the official end of the ritual.

We had to search for the ritual because even though the *fono ma aitu* was the most common ritual of prayer seeking the gods’ blessing for an undertaking in the old religion, the last time they were known to be performed was in the late 1890s. One of the principal participants, Joe Annandale, a director of O.F. Nelson Properties Board said: “The experience was awesome and one of the most spiritual in my life”. For Polynesians, each of these rituals is directly informed by mythology.

Juxtaposing mythology and science

How can we place our respective knowledge about Pulemelei together to find common purpose in creating general understandings? And, how can we do this without questioning the integrity or legitimacy of one or the other? I am not sure. What I am sure of is, however, that I would like to begin to try. Allowing the excavation at Pulemelei was one step in that direction.

Figure 1. Lighting the *si’a* during the ceremony at Pulemelei in 2003. Avia, Latu Ageli, Simi (bottom). (Photo Sebra Film, Bengt Jonson)

Current readings of the Lapita evidence point to settlement of Fiji, Tonga and Samoa c. 3000 years ago. Similarly, settlements in the Marquesas are scientifically dated 300-600AD; Hawaii as 650-850AD; and New Zealand (Aotearoa) as 1000-1200AD. Clearly the origin of the Polynesian diaspora would have to be placed in Fiji, Tonga or Samoa and nomenclature suggests that Savai'i is the mythological Hawai'i, Havai'i or Hawaiki. In any case the dates make for interesting comparisons alongside the preliminary dates received thus far from the Pulemelei excavations. That is:

1. Between 150BC and 200AD, settlement activities featuring earth ovens, Polynesian plainware pottery and stone tools have been found..
2. Between 200-700AD no activities have been detected so far.
3. A re-activation phase with settlement activities in the form of earth ovens is seen during 700-1100AD.
4. During 1100-1300AD the Pulemelei mound was probably constructed and used.
5. 1400-1600AD there were other significant [human] activities in the area.
6. 1700-1800AD the Pulemelei site was abandoned and/or lost its importance.

To me, such scientific evidence seems to echo the mythological history I cited earlier. The question remains thus: is it possible to connect mythological and archaeological evidence? Or was Thor Heyerdahl mistaken? If he was not, the quest remains how we are to determine the connection.

In searching for answers, I find that the Maoris of New Zealand/Polynesia are making, in my view, the most significant contribution to this quest. Their attempt to negotiate Maori lore alongside Western legal terms I find a wise start. Justice Eddie Durie, (former head of the Waitangi Tribunal and current member of the NZ Law Commission) in his paper, "Will the settlers settle?" shows how all aspects of culture interrelate to comprise a coherent system. I believe that the Maori initiative will in time be accorded the highest accolades not only by the *fanauga* but by the world.

Early 2003, I began building at Vaialua in Samoa a cultural research and restoration centre known as the *Afeafe o Vaetoefaga* (Figure 2). In September 2003, I visited Te Whare Wananga o Awanuiorangi, the Maori University at Whakatane (New Zealand). Here I was awarded an adjunct professorship. Awanuiorangi is the best-known Maori research and restoration centre in New Zealand and internationally. We, that is Awanuiorangi and *Afeafe o Vaetoefaga*, are committed to mutual cooperation for promoting common goals. One of these goals is to find ways to collectively share in this quest. Further understanding the juxtapositioning of mythology and science is, therefore, in our view part of that quest.

Figure 2. Presentation of the Pulemelei project at the *Afeafe o Vaetoefaga* in 2004. (From left; Geoffrey Clark, Helene Martinsson-Wallin and Tui Atua Tupua Tamasese Taisi Tupuola Tufuga Efi. (Photo Helene Martinsson-Wallin)

In search of Tagaloa – the legacy

I want to conclude with a comment on the legacy of Tagaloa. In searching for Tagaloa, I am searching for the legacy. When I said to Morris that we needed to consult about the purification rituals at Pulemelei, it literally meant we had to search and research into our spiritual culture. Christianity has effectively demonised the legacy of our Samoan ancestors to a point where their rituals, liturgies and beliefs have been rejected and spurned. Ironically, Christianity is today doing an about-face. In the latter part of the twentieth century, Christianity has acknowledged the deep spirituality of indigenous religious culture and is strenuously trying to find an accommodation. This seems reminiscent of the mythological attempt by the siblings to separate and after separation, to unify *lagi* (heaven) and *papa* (earth). The point is that the search for Tagaloa is the search for our human legacy.

I believe that the findings from Pulemelei will provide useful information that will help address many questions about the connections between traditional mythology and contemporary society. Already the carbon-dating has opened avenues to new insights and perspectives. It also opens visions of *soo* (connection or connecting) between the Polynesian *fanauga* – from Hawaii to Tahiti to Rapanui. All, I hope, can gather one day at a connection festival at Pulemelei to celebrate common heritage.

I want to end by reiterating the quote by Thor Heyerdahl (1998) used at the beginning of this talk. I reiterate it for in it, I believe, is the legacy of our collective futures.

> And both the wind and the people who continue to live close to Nature still have much to tell us which we cannot hear inside university halls. A scientist has to distinguish between legend and myth and make use of both.

Faafetai, Soifua.

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Samoan Archaeology: A review of research history

HELENE MARTINSSON-WALLIN

Abstract

This paper describes the history of archaeology carried out in the Samoan islands. Two archaeological programs under the leadership of Roger Green in the 1960s and Jesse Jennings in the 1970s have laid a firm foundation for the understanding of Samoan prehistory from an archaeological point of view. Subsequent research in American Samoa has also added to this knowledge. This review describes some of the major findings of settlements, mounds and artefacts and discusses the contributions of archaeological research in Samoa and points towards important theoretical and methodical issues for future research.

The setting of sights in Samoan archaeology

The Samoan Islands occupy an especially revealing place in Pacific history. They lie at the very edge of Lapita expansion as it is currently known, yet they have often been considered, on both traditional and archaeological grounds, as the locality of origin for subsequent Polynesian expansion. Archaeological research to date in Samoa has been rather limited. The research has focused mainly on establishing a general framework of prehistory with efforts directed at locating different sites and field monuments and investigating their temporal status. During the initial research, discussion on cultural chronology was focused on the shift from Lapita to plainware pottery and the abandonment of pottery altogether. The development of monumental architecture has been discussed only briefly (Davidson 1974a:228-30) Renewed archaeological investigations and a further discussion of such issues from a theoretical and comparative standpoint are seen as important.

No robust cultural chronology was worked out for Samoa during initial research but changes seen in the material culture and settlement pattern were discussed in a narrative way (Green and Davidson 1969a; 1974a). Subsequently, Roger Green (2002) suggested a cultural chronology for Samoa much in line with the one worked out by Burley *et al.* (1995) for West Polynesia as a whole (Table 1).

A search for origins, especially of the Polynesian 'homeland', has been a dominant paradigm for archaeology in the central Pacific region. The discussion has centred largely on the early Lapita settlement and its dispersal and the subsequent development of Ancestral Polynesian Society in West Polynesia (Kirch and Hunt 1993). The distribution, after initial settlement, of Samoan adzes from Fiji to central Polynesia suggests extensive interactions, which by late prehistory seems to have involved marriage alliances and the exchange of sandalwood and red feathers amongst other communities (Clark 2002, 2004:35-6).

Lapita Period: (Eastern and Western) c. 3100-2500 BP
Plainware Period (Ancestral Polynesian Society)
c. 2500-1700 BP (Samoa) c. 2500-2000 BP (Tonga except Niuatoputapu)
Aceramic period (Dark Ages) c. 1700-1000 BP (Samoa), 2000-1000 BP (Tonga)
Monumental Building Period c. 1000-250 BP
Historical Period c. 250 BP

Table 1. West Polynesian Cultural Chronology (after Burley 1995).

Previous archaeological research and the natural setting

The Samoan chain of islands is today divided into the independent state of Samoa (formerly known as Western Samoa) and American Samoa (a United States territory) (Figure 1). The former consists of the large volcanic islands 'Upolu and Savai'i, the two smaller islands Manono and Apolima between them and a few offshore islets beyond the Southeastern point of 'Upolu. The latter includes the larger island of Tutuila with its offshore islet Anunu'u and a group of smaller islands under the name of Manu'a, (Ofu, Olosega and Ta'u Islands). The Samoan islands are of volcanic origin and essentially are mountains and ridges sitting on the Pacific plate just north of the Tonga-Kermadec trench. The larger islands in the west are older than those to the east. Volcanism is most recent in the east where Ta'u (American Samoa) dates 100,000 BP. The oldest flows on 'Upolo and Savai'i are the Fagaloa and Salani respectively. Fagaloa volcanics may be of Pliocene origin (5.3-1.8 million years ago) and Salani are probably late Pleistocene (1.8 million-10,000 years ago). The Mulifanua flow is presumed to be between 10,000-40,000 years old, the Lefaga flow is post-Pleistocene, the Puapua flow is mid-Holocene (c. 5000 years old), and the Apo flows are from the historic period with its last eruption in the beginning of last century (Kear and Wood 1959). Volcanic activity covered part of the north coast of Savai'i during extensive eruptions in 1905-1911. These were devastating to the contemporary society but the

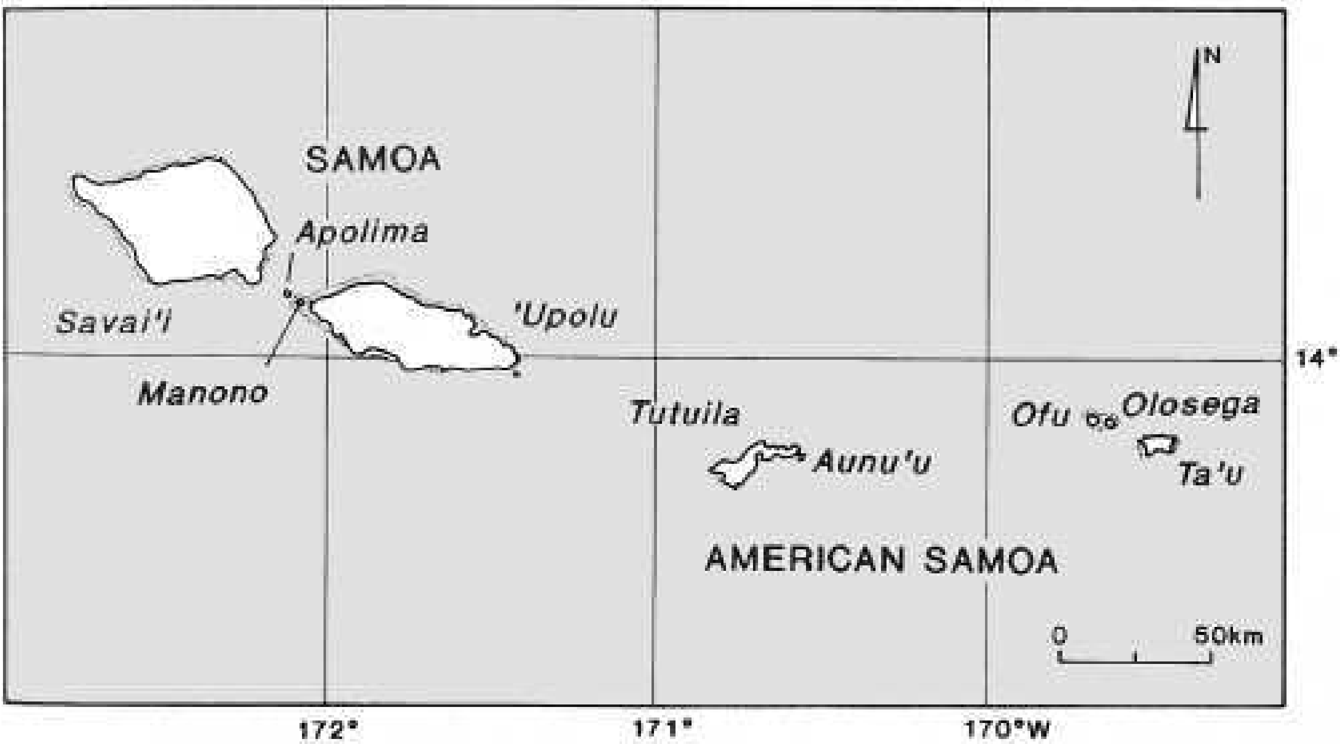

Figure 1. Samoa and American Samoa.

lava flow also probably destroyed or covered many archaeological sites.

Most Samoan soils are derived from *in situ* decomposed parent rock and places with alluvial soil are few. They can be found on 'Upolu near Apia and in the Falefa district. Two sand types are found, the Tafaamanu at 1.52 m elevation and Nu'utele at 4.57 m elevation. These are probably dated to the late Holocene and have previously been interpreted as remnants of higher sea levels than at present (Jennings 1976:5). According to calculations presented by Dickinson and Green (1998) the Samoan islands are subsiding at the rate of 1.4 mm/year. This suggests that the oldest sites (which are considered to have been located close to the sea shore) in Samoa might well be located up to several meters below their original position relative to sea level. This agrees with the underwater find of the earliest site so far, Mulifanua on the West side of 'Upolu, the only Lapita site known in Samoa (Jennings 1974; Green 1974b, 2002; Leach and Green 1989). However, the tectonic conditions and complex geology of the Samoan islands seem to vary and are not yet fully understood (Clark 1996:446). There have also been indications of early sites being found buried under colluvial/alluvial deposits some distance inland (Clark 1996:449).

One of the first accounts concerning historical material culture in Samoa was published in an article on 'Earthmounds in Samoa' (Thomson 1927). It mentioned that earth mounds were probably the remains of past residences of important chiefs and recorded two big mounds close to the village of Vailele and two smaller ones close to Mulifanua and Leulumoega (Thompson 1927). In 1944 Freeman featured plan drawings of the Vailele earthmounds in the same journal (Figure 2) (Freeman 1944b). These first accounts of monumental architecture in Samoa described the sites in general terms and no scientific excavations were carried out. Freeman also described other types of cultural remains and refers for example to a site called *O le fale o le fe'e* (the house of the octopus) situated close to the Soaga stream in the inland area above Apia on 'Upolu (Figure 3). This site was mentioned and visited by the missionary Stair in 1845 and Brown (1907) described it as an ellipse of giant stone columns (Freeman 1944a:121). The site was subsequently visited by Buck in 1928 and by Freeman in 1940-43, and the latter carried out a minor excavation at the main stones (Freeman 1944a:129). The interpretation of the ring of stone pillars is that it could have been a place of worship of the war god Fe'e, who has been associated with both a powerful god from Fiji and the Tagaloa myth from Manu'a (Freeman 1944a: 129, 133, 136). Freeman also explored caves at Falemaunga and Seuao and these were revisited and investigated by Golson and Ambrose in 1957 (Freeman 1943, 1944c, Golson 1969a:19).

Buck mentions (1930: 321-2) that cairns of un-worked stones were graves and that one other type of mound was designated to snare pigeon (*tia seu lupe*), which was mentioned as a chiefly activity. Similar types of pigeon snaring mounds were also reported from American Samoa but under the name of *tia 'ave*. Abandoned villages with house platforms, walkways and raised rim ovens as well as strongholds and fortifications in the inland areas were also reported (Wright 1963:91-4; Golson 1969a:15-18).

Besides the minor excavations by Freeman in the 1940s the first serious attempts to carry out archaeological excavations was made by Golson and Ambrose in 1957

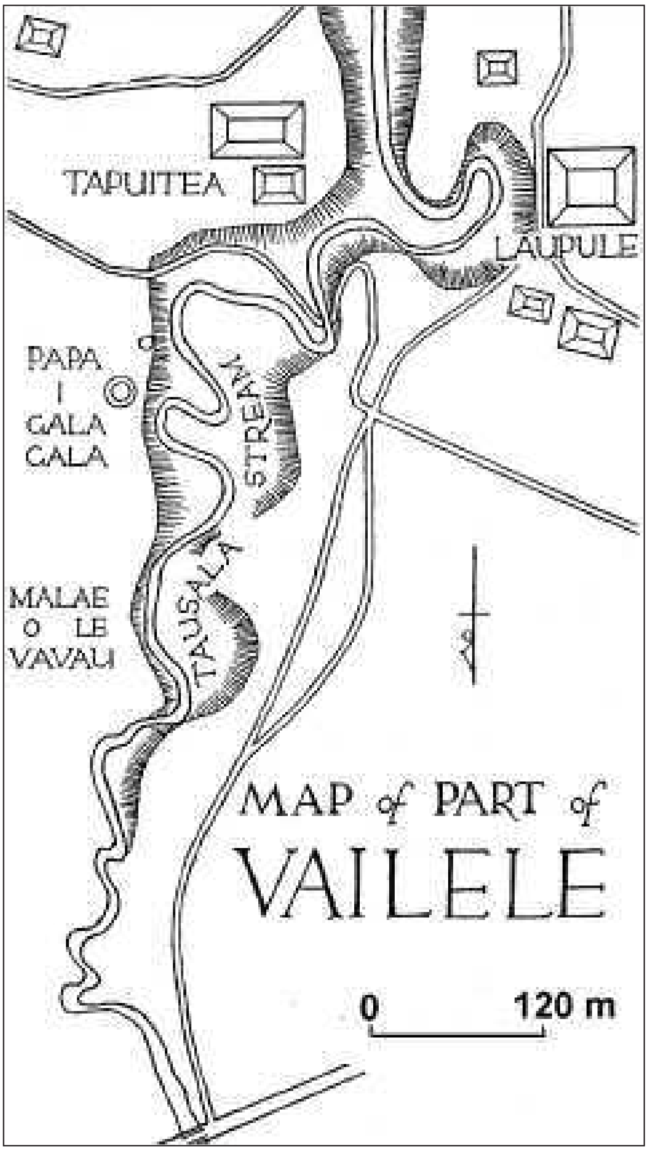

Figure 2. Plan of the large mounds Tapuitea and Lapule at Vailele (after Thompson 1928).

(Golson 1969a, 1969b). They surveyed and excavated sites on ’Upolu. One of their excavations was made in a sea bank at Ti’avea village, which exposed a number of layers of human occupation. These were not dated. As mentioned above, two cave sites (Falemaunga and Seuao) were also visited and investigated. An occupation in the latter was dated by a charcoal sample to 240±50 BP (Golson 1969a:19), but traditional history dates this occupation about 19 generations ago, approximately in the 15th century. A stone heap situated on a prehistoric settlement in the inland area of Aleisa was also excavated, but no finds were made and it was considered to be an agricultural clearance heap. The most extensive excavations were carried out in a large, partly bulldozed mound on the coast at Vailele (SUVa-1). Here several occupation layers were uncovered, the earliest of which featured plainware pottery (Golson 1969b:108-13).

Subsequent to Golson’s research, an archaeological program was initiated by Roger Green and Janet Davidson

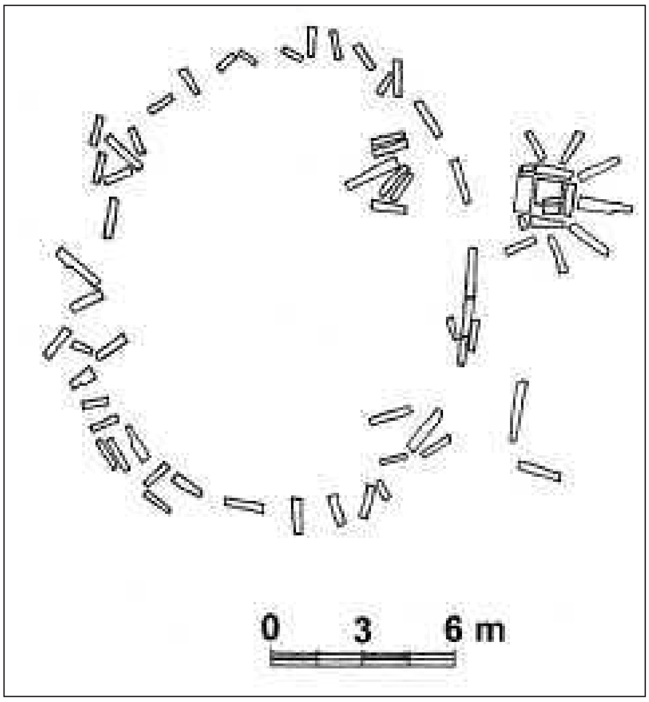

Figure 3. Map of ‘*o le fale o le fe’e*’ (after Freeman 1944).

from the University of Auckland. This extensive excavation and survey program was carried out under their leadership between from 1963 to 1967 (Green and Davidson 1969a, 1974a). This was followed by another campaign led by Jesse Jennings from University of Utah in 1974-1978 (Jennings and Holmer 1980; Jennings *et al.* 1976, 1982). These excavations and surveys and subsequent investigations in American Samoa have provided a firm foundation for an outline of Samoan prehistory from an archaeological perspective (Davidson 1979; Green 2002; Hunt and Kirch 1988; Kirch and Hunt 1993; Clark and Herdrich 1993; Clark and Michlovic 1996; Clark *et al.* 1997; Clark 1996).

Although largest in land area (1820 km^2), and according to traditional information an important political centre in the past, relatively little is known about prehistoric Savai’i. Archaeological knowledge of Samoa has centred so far largely on ’Upolu and the smaller islands of American Samoa. However, extensive surveys were carried out on Savai’i by Buist and Scott (1964-1966) which included mapping the large Pulemelei mound at the Letolo plantation (Buist 1969:34-68; Scott 1969:69-90). Large parts of the extensive prehistoric settlements at Sapapali’i and the Letolo plantation were subsequently surveyed by Jackmond in 1977-78. These surveys, combined with surveys and excavation results from the prehistoric inland settlement at Mt Olo on ’Upolu, have been used by Jennings in discussions concerning the prehistoric settlement pattern in Samoa (Jennings *et al.* 1982).

Green and Davidson’s team excavated and mapped house platforms and terraces, fortifications and earth mounds on ’Upolu both close to the sea shore and at inland locations (Appendix, Figure 4). They showed that most earth mounds were house platforms and that some of the investigated structures contained several layers of stone floors,

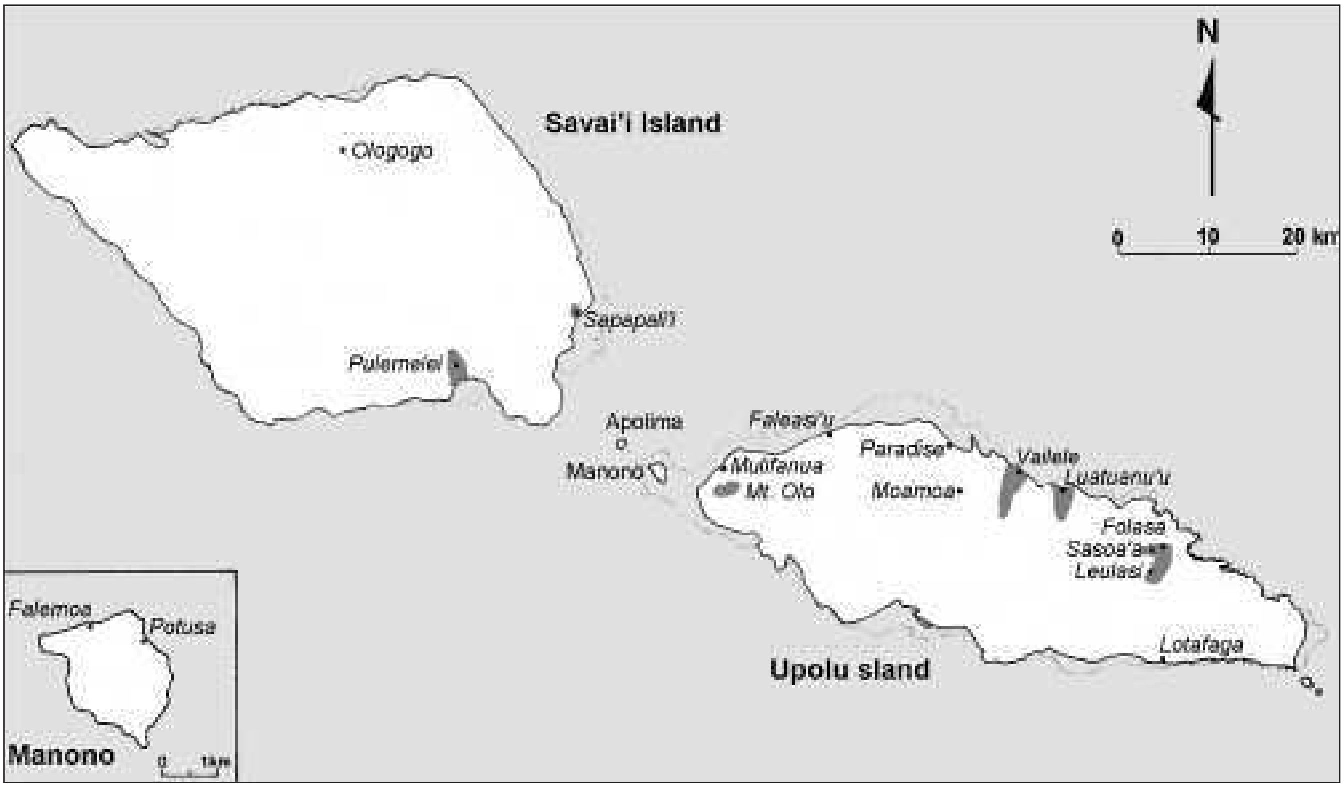

Figure 4. Upolu and Savai'i with archaeological sites.

indicating several phases of house construction, while some appeared to be the result of a single phase of construction (Golson 1969b:108; Green 1969a, 1969b; Terrell 1969:158; Davidson 1974a:227).

Besides excavations, Green and Davidson's team made extensive surveys and since investigated areas covered a variety of natural and cultural settings a relatively good understanding was reached of prehistoric settlement patterns in Samoa. The major discoveries were that prehistoric settlements were found both inland and along the coast and that pottery was manufactured and used in the early settlement phases. In historic and present day Samoa the main bulk of settlement is found by the coast. A shift in the settlement pattern is indicated during the contact phase, probably caused by a population decline, as well as by better opportunities for trading with Europeans (Davidson 1979:102).

An occupation layer featuring pottery was discovered under a large earth mound close to the coast at Vailele by Golson in 1957. Further excavation at this site by Green confirmed occupations with pottery dated within the range 2150±100-1660±80 BP (Figure 5). Both thin fine tempered wares and thicker coarser tempered wares were found and, according to Green, the fine ware was replaced by the coarse ware and the ceramic tradition ceased to exist after the 3rd–4th century AD (Green 2002:136-7). This stratigraphic pottery sequence was demonstrated also at the inland settlement at Sasoa'a in Falefa Valley in early occupations dated to 1840±100–1800±80 BP. The inland area also showed later occupation phases with curb-outlined oval to rounded houses placed on modified earth terraces (McKinlay 1974:13-35). Under or in the vicinity of some of the houses at Sasoa'a and Folasa human burials were found in shallow pits (McKinlay 1974:23, Ishizuki 1974:26) (Figure 6). The remains have not been dated. Excavations by Davidson at the coastal site of Lotofaga also indicated that humans had been buried in the vicinity of the ancient settlement (Davidson 1969b:230).

A study of a large stone mound (c. 44x35x12 m) at Sa'anapu was made by Epling and Kirk in 1972. No excavations were carried out and they claimed that no information concerning its age and use was drawn from traditional history. When visited in 2005 and 2006 this mound was overgrown but the large dimensions were apparent, and according to our informants it was a *tia seu lupe* (pigeon catching mound) and that another stone mound in the vicinity was the 'spotters' mound (personal communication orator chief Lauvi Isaako). Walls and heaps of stones, which probably indicate settlements, could be seen in the area and Epling and Kirk indicate that the monument was located at the edge of a taro plantation (1972:86). Close by is situated the cave of Seuao, which also was visited in 2006 when traces of a paved walkway and fire places could be seen. The cave was investigated by Golson in 1957 (1969a:19) and settlement activities were dated to c. 240±50 BP.

Trevor Hansen in Green and Davidson's team was the first archaeologist who identified pottery at the Mulifanua site (Green 1974b:170-1). This was further investigated by Jenning's team and associates who found a multitude of sherds at this first, and so far the only known, Lapita site in Samoa. They also surveyed remains of old settlement

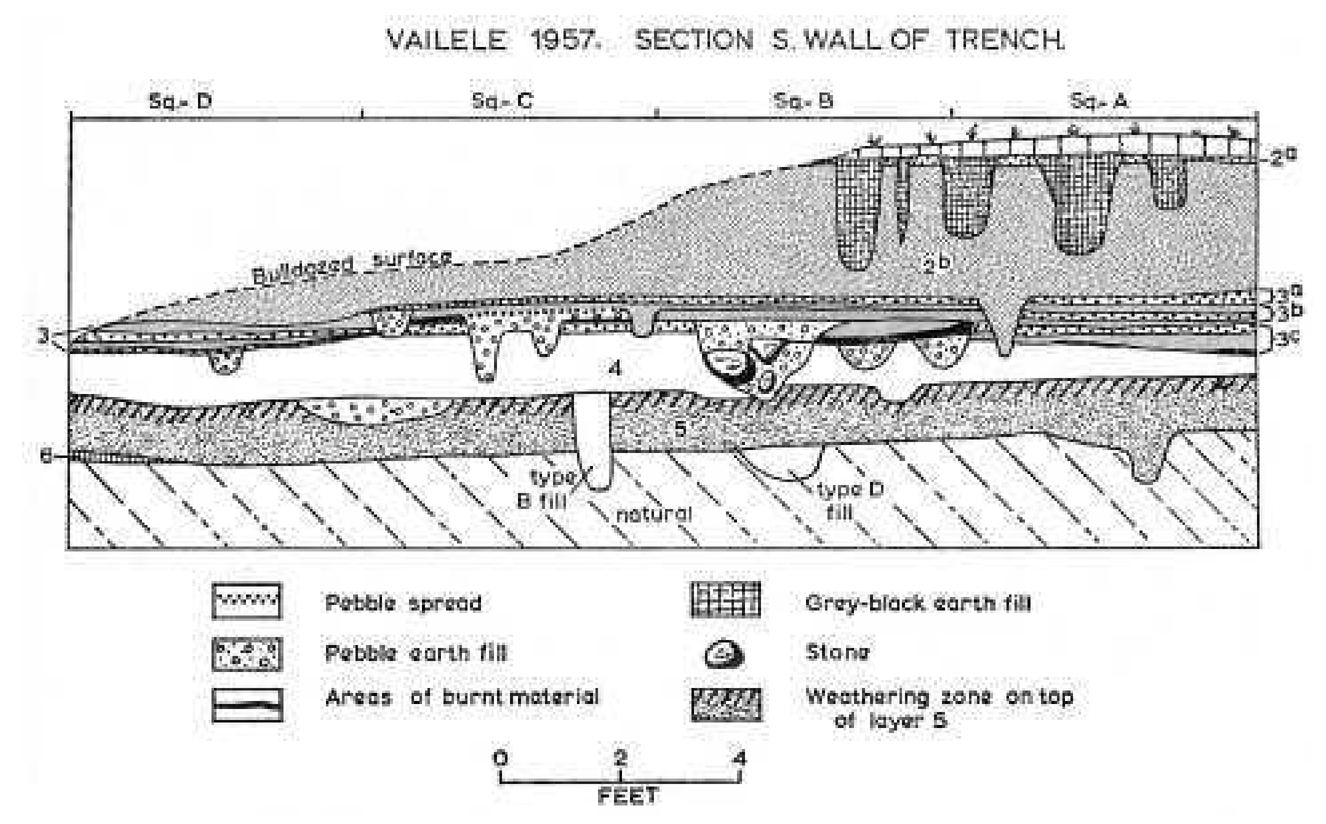

Figure 5. Excavations at the Vailele earth mounds (after Green and Davidson 1969a fig. 48).

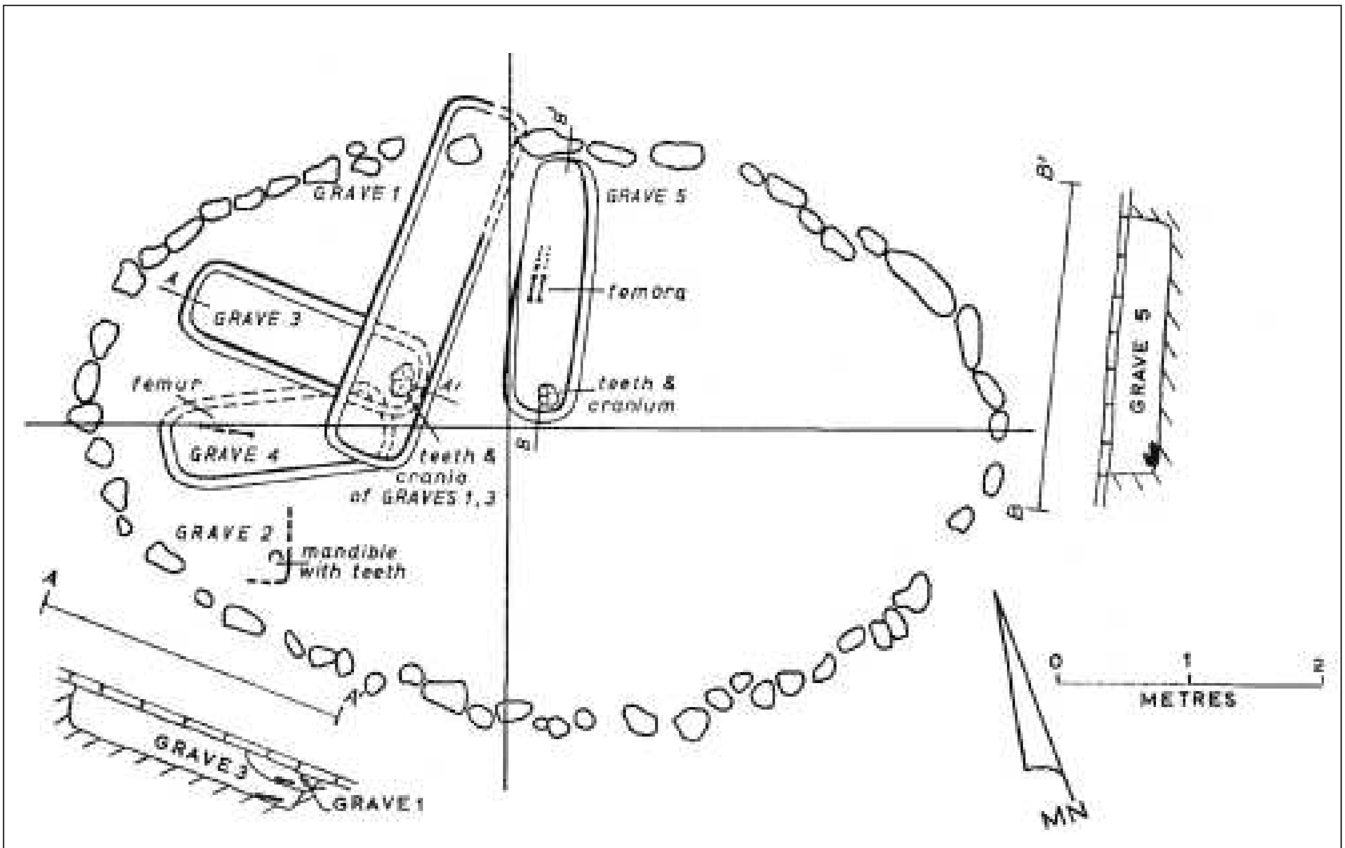

Figure 6. Plan of burials under a house at Folasa (after Green and Davidson 1974a fig. 26).

complexes at Mt Olo on the northwest side of 'Upolu and excavated some stone platforms, including a 'star mound', and house platforms at this site (Holmer 1976:23-8). They excavated two beach sites on Manono and carried out surveys and mapped settlement complexes on Savai'i (Appendix, Figure 4). The largest of the latter was in the Letolo plantation.

The discovery of the Mulifanua Lapita site by Hanson and the detailed study of prehistoric settlement patterns in the investigations by Jennings (Figure 7), confirmed Green's and Davidson's results about early Samoan settlement patterns, which indicated occupations both inland and at coastal locations and the use of pottery. Investigations of abandoned inland settlements showed that the villages consisted of household units (referred to as HHU) featuring a few house platforms limited by fences, walls and/or walkways (Figure 8). The outline of the settlements seems to have been quite consistent over time at least in the late prehistoric and protohistoric settlement phases.

Subsequent excavations in American Samoa uncovered early sites with plainware pottery, for example at the To'aga site on Ofu (Manu'a) and the 'Aoa site on Tutuila (Kirch and Hunt 1993; Clark and Herdrich 1993), confirming the pattern of early pottery manufacture discovered by Green and then Jennings, and its general trend from fine to coarse wares.

Renewed efforts concerning archaeological excavations in independent Samoa were not made until the investigations of the large Pulemelei mound at the Letolo plantation on Savai'i in 2002-2004 (Wallin *et al.* 2002; Martinsson-Wallin 2003, 2005; Martinsson-Wallin *et al.* 2003, 2005). Detailed accounts of these excavations and their implications are found in other articles in this publication.

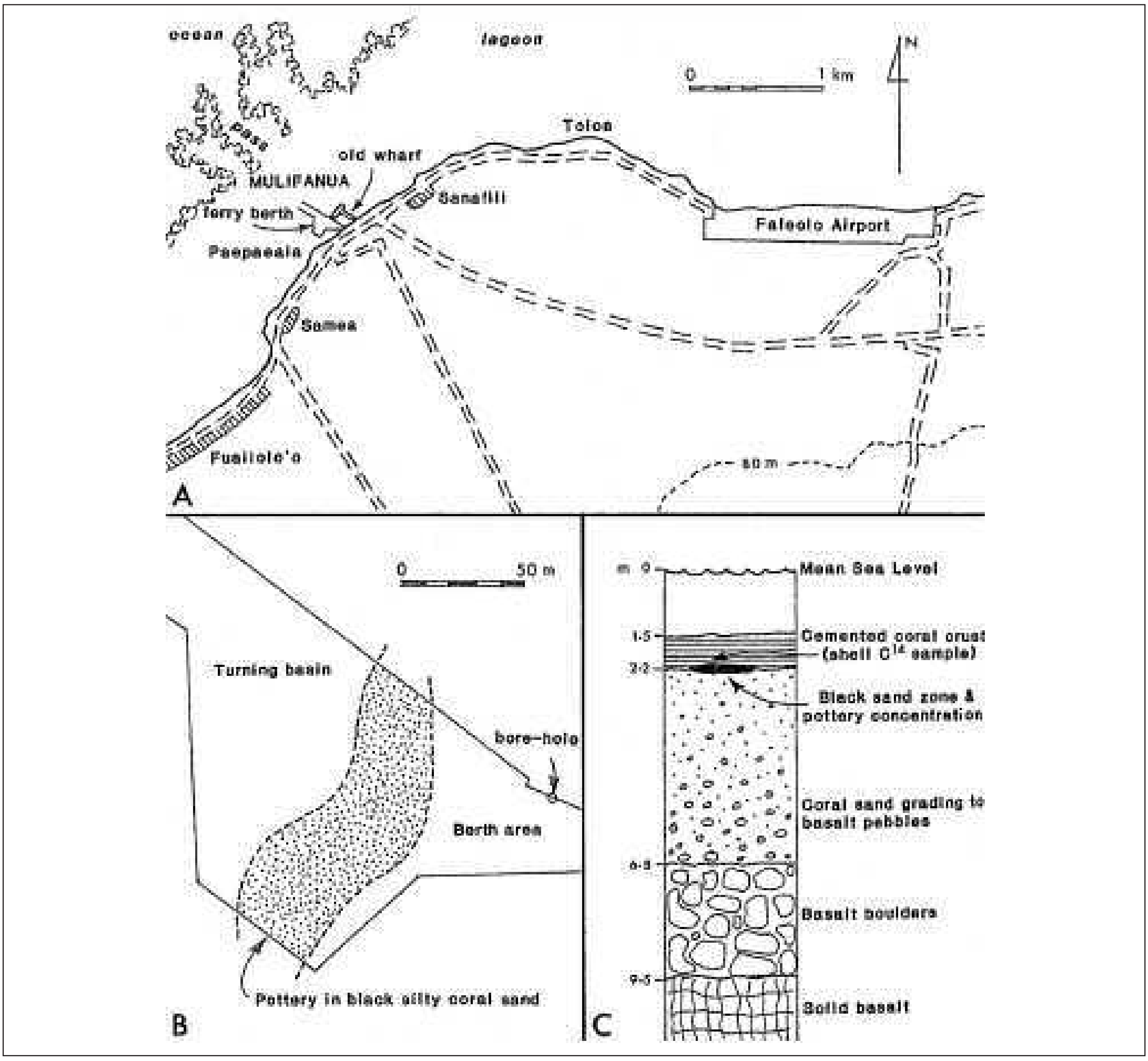

Figure 7. Mulifanua site (after Green 2002).

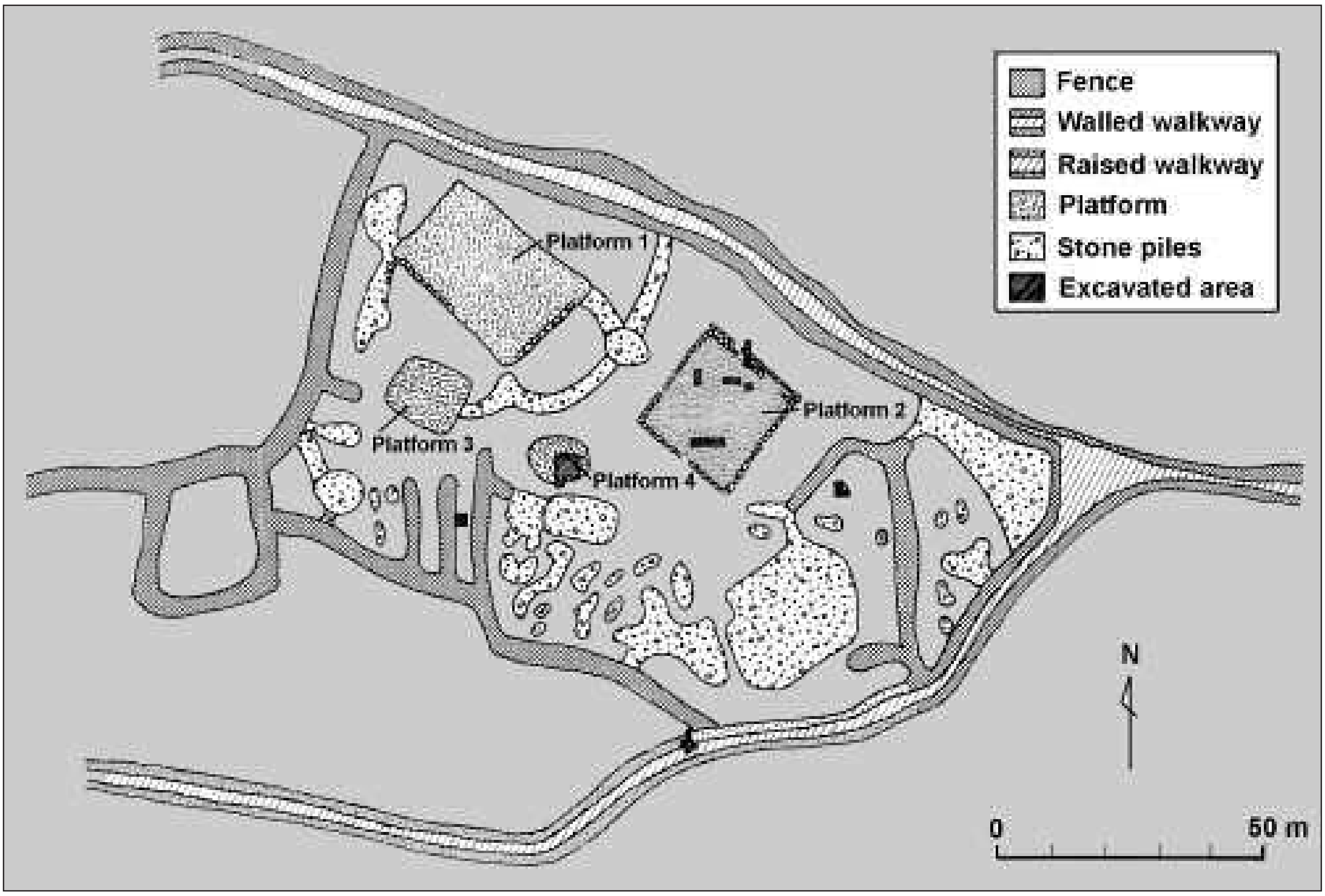

Figure 8. An example of a Samoan household unit (HHU) from Apulu at mound Olo (after Jennings *et al.* 1980 fig. 34).

Field monuments and finds

The survey and investigations in the 1950's by Golson and Ambrose described field monuments as graves, pigeon mounds, house platforms, villages, strongpoints, circular pits with raised rim, walls and rows (agricultural evidences) and roads found in Apia district, the alluvial flats around Falevao and in the Vaigafa and Fagatoloa valleys (Golson 1969a:14-20). Further researches by Green and Davidson and associates (1969, 1974) and Jennings and associates (1976, 1980) have shown that the most prominent field monuments in Samoa are mounds of stone and earth (mainly confined to Savai'i and 'Upolu). Holmer divides this category into platforms, star mounds and stone piles (Holmer 1980:13-16). Other archaeological remains seen above ground consist mainly of walls, roads, fortifications, terraces (residence and agriculture), and raised-rim stone ovens (*umu tī*). The walls and roads have been further divided by Holmer into fences, raised walkways, walled walkways and trenched walkways (Holmer 1980a:13-17). Raised platforms and mounds have been interpreted as mainly for occupation (Davidson 1974a:228-30). Larger mounds of earth and stone were interpreted as house foundations for distinguished chiefs, but it is also reported that these were sometimes erected as god houses as well (Davidson 1974a:229). According to Davidson, the mounds were mainly rectangular in plan, and evidence from traditional history indicated that the peak periods of occupation of these large mounds were in the sixteenth and seventeenth centuries (Davidson 1974a:232). The origin, function and use history of large mounds in Samoa has been examined through oral traditions, ethnohistorical accounts and limited excavation. Oral traditions, particularly genealogies and ceremonial salutations (*fa'alupega*), reveal a link between large mounds and high-status individuals (Freeman 1944b; Asaua 2005). Ethnohistorical accounts written in the 19th century suggest that monumental platforms were house foundations built with communal labour when senior lineages were joined by marriage (Stair 1897:111-2), or were the base of god houses (*fale aitu*) where the principal chiefs of a community met (Hougaard 1969b:254; Davidson 1974:229; Holmer 1976:49). Excavation has shown that some earth mounds over 30 m in length at Vailele on Upolu Island were house foundations constructed in a single phase, while others contained a non-residential submound, which was later expanded for residential use (Green 1969c:151; Davidson 1974a:226).

According to Davidson (1974a:227) there were 27 star mounds reported on 'Upolu but subsequent surveys have located over 50 such sites (Clark 1996:433). Eight star mounds are reported on Savai'i, three on Ta'u and one on Manono. The star mound at Manono with its large dimensions (30,5x30 m) and twelve arms has been referred to as the "star house" (Davidson 1974a:228). Around 80 star mounds (*tia 'ave*) have been reported on Tutuila (Clark 1996:433). These structures have been interpreted as pigeon snaring mounds and excavations both by Green's and Jenning's teams suggested this type of feature was late (Peters 1969:221; Holmer 1976:25; Hewitt 1980a:41). These structures are also interpreted as late features on Tutuila and Ta'u (Herdrich 1991:390; Clark 1996:453). Structural analyses by Herdrich have shown variety in their shape but similar locations in the landscape. He has interpreted star mounds in a symbolic way and suggests that their location, on ridges or mountain tops and in the inland bush, shows a proximity with the supernatural (1991:405). Herdrich suggests further that variety in shape represents association with different gods (1991:409).

Three ovens with raised rims were excavated by Green's team and referred to by Davidson as *umu tī* ovens (Green and Davidson 1964:39). According to her these ovens were probably community ovens for cooking *tī* root, which was used as staple food (*ibid*:39). Subsequently several raised-rim ovens, interpreted as *umu tī*, were excavated by Jenning's team (Janetski 1976a, Jackmond 1980). According to Carson the use of all raised-rim ovens as *umu tī* ovens is not certain. A number of factors have to be considered to confirm this interpretation, including the size of the oven, the amount of burned combustible fuel, type of wood used, heat-induced alteration of surrounding soil and the condition of component heating stones (Carson 2002:349). The raised rim ovens are found throughout Polynesia, but the *umu tī* most likely originated in Samoa or the Fiji-Tonga-Samoa region (*ibid*:359). Radiocarbon dates of *umu tī* ovens range from c. 1100AD up to modern times (*ibid*:357). Based on ethnographic evidence the *tī* plant (*Cordyline fruticosa*) was cooked at high temperature in order to be caramelized, and through this metamorphosis it may have contributed to ritual ceremonies (Carson 2002:347, Buck 1930:136 and Ehrlich 2000:371-400). The raised-rim ovens in Samoa generally show dates that range between the 12th to 17th centuries. It is very likely that the larger ovens of this type with large amounts of combustible fuel were used to cook the *tī* root (Green and Davidson 1974b: 214-5, Table 23; Davidson 1974b:184; Jackmond 1980:53; Jennings 1980:7, Table 2). Large mounds and large raised-rim ovens could be interpreted as a sign of a high status settlement and/or as community house areas. Large mounds and large raised-rim ovens are however absent in American Samoa (Clark 1996:452).

Amongst other field monuments, fortifications or defensive walls are found mainly in the interior. Two types are evident on 'Upolu, the earthwork ditch and bank or series of same across a ridge, and other walls of stone (*Pa Tonga*). However, Green has recently suggested that the latter served as demarcations of territorial divisions between inland and coastal districts and not as defensive structures (Roger Green pers. comm. March 2005). The fortification structures are described as both ancient and recent (Scott and Green 1969:209). Traces of ditches and banks and defensive scarps found in Tutuila in connection to settlements and star mounds on hilltops and ridges have been interpreted as part of fortified complexes by Best (1993). The presence of such structures might reflect large-scale warfare and/or increasing stratification. However, their temporal status, function and use need to be investigated further.

Among artefacts, adzes comprise the major category. Those collected from Samoa have been found in excavations and as surface finds. A typology was worked out by Green and Davidson (1969b:21-32) on the basis of previous classifications by Buck (1930) and Suggs (1961). The criteria are based on the finish of the adze surface, its cross-section, different angles, and whether it is thin or thick (Figure 9). Ten types were classified on the basis of these criteria and the type definitions and figures are found in Green and Davidson (1969b:21-32). Type I (Figure 10a) is the most common and type II is also rather common (both with quadrangular cross section). According to Green and Davidson it was difficult to establish a firm temporal sequence but type IV and V (Figure 10b) were rare finds in surface collections and type IVa was present at two early sites featuring pottery (Green and Davidson 1969b:32). They report that all types except VIII and IX appear to be present in early levels, but no strong conclusions could be reached in regard to the temporal status of the various types. Subsequent detailed studies by Green concluded that type V plano-convex and type I trapezoidal section adzes occur in early West and East Polynesian contexts but type I continued to be used later. Other types that occur in later prehistory are II, IX/X (Figure 10c) and VI (Green 1974a:253-67). The chronology of the types of adzes found in subsequent excavations is not clear, but the most common is type I, which occurs throughout the prehistoric sequence (Hewitt 1980b:136-7). Subsequently a re-assessment of Samoan adzes and a new classification has been worked out by Helen Leach but so far unpublished. Her classification considers additional technological aspects (Ms. and personal communication Helen Leach November 2006).

Nearly all Samoan adzes are made from olivine basalt

Flaked and partially ground finish							Fully ground finish	
Quadrangular cross-section			Rounded		Triangular		Quadrangular section	
Back > front		Front > back	Back flat		Apex up	Apex down	Back > front	
Thin	Thick	Thin	Thin	Thick			Thin	Thick
I II[1]	IX	IV	Va	Vb	VI VII[2]	VIII	III	X

Figure 9. Classification system worked out by Green and Davidson 1969.

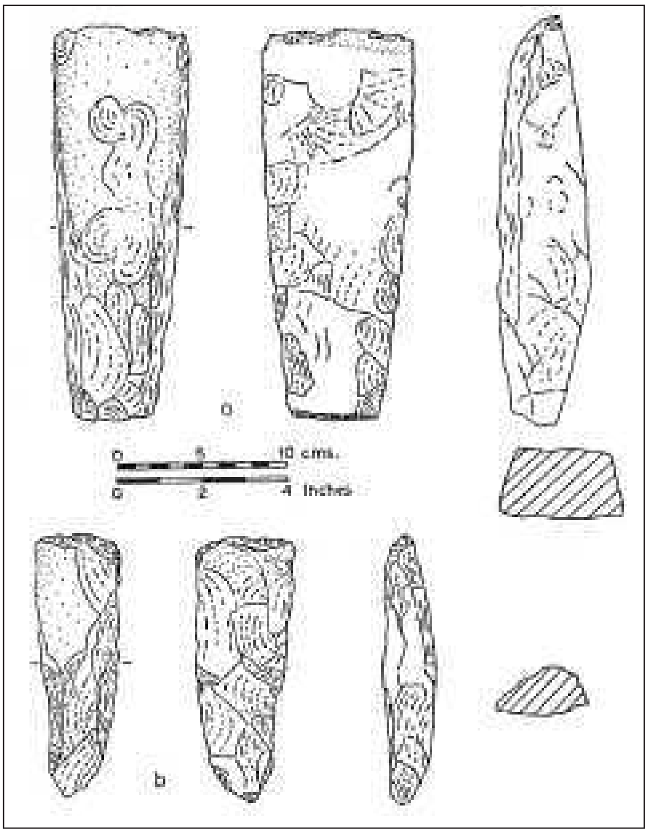

Figure 10a. Type I adzes (after Green and Davidson 1969a fig. 3).

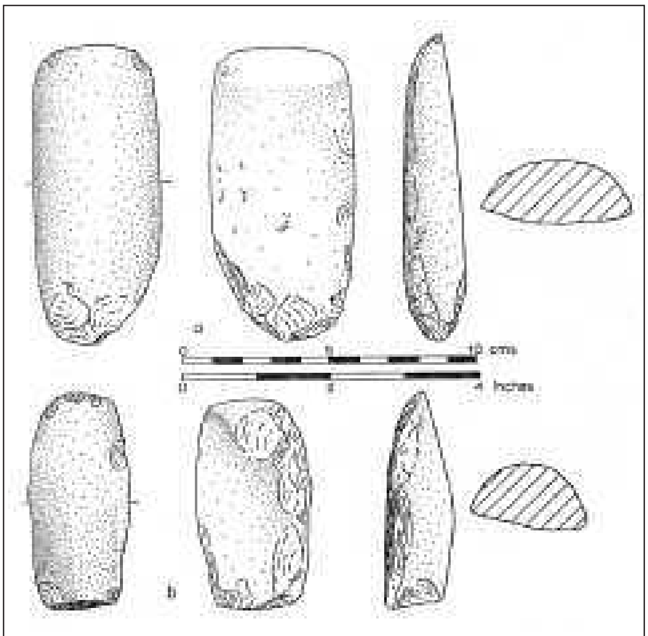

Figure 10b. Type V adzes (after Green and Davidson 1969a fig. 7).

(Leach and Green 1989:323). A large number of quarry sites have been found on Tutuila (Leach and Witter 1990; Clark 1996:453). Quarry sites could possibly also be found in Samoa but this needs further investigation. The good quality

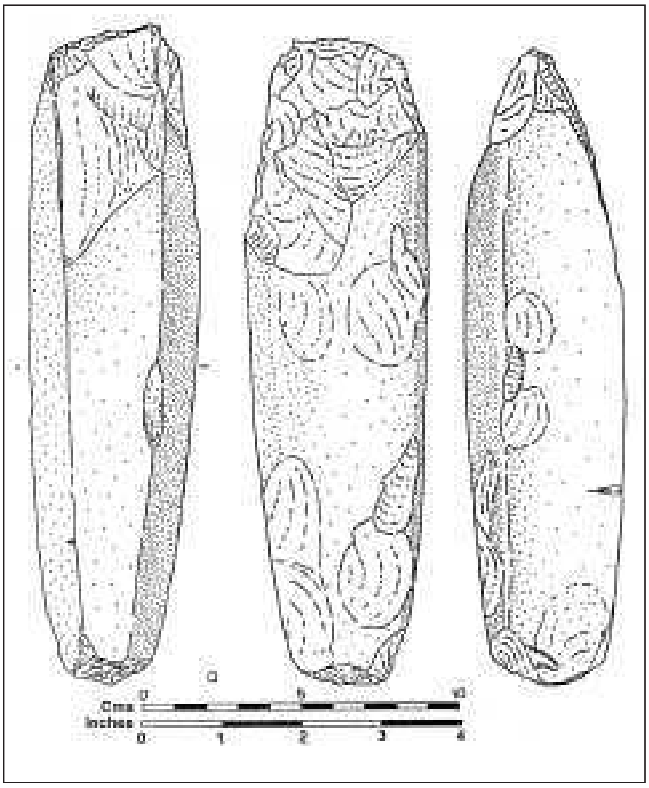

Figure 10c. Type X adzes (after Green and Davidson 1969a fig. 12).

of basalt found in the current quarry site at Malefono plantation in Sale'imoa ('Upolu), and the remains of an abandoned quarry site in the area paired with finds of grinding groves for adze polishing/sharpening and old settlements could indicate a prehistoric use as a quarry site (personal observations March 2006). Adzes of fine-grained, black basalt found at the coastal site called Jane's camp have been subjected to chemical analysis and appear to be of local origin (Smith 1976b:70). Subsequent geochemical analyses including adzes and stone samples from the Tataga Matau quarry in American Samoa, point to stone being used to manufacture some of the Samoan adzes from c. 2200 BP onwards (Best *et al.* 1992:57-8, 65). Other adzes seem to be locally made or imported from elsewhere. Two adzes were found from the early site at Mulifanua and one showed hammer-dressing, which is not a common characteristic in later Samoan adzes. This is more common in Tongan adzes and adzes made of non-olivine basalts. Based on this and the geochemical analysis Green suggests that the adze with hammer-dressing from Mulifanua is more similar to the East Lapita adze form and probably arrived by inter-island transport (Leach and Green 1989:323). The other adze was reported as more typical of Samoan adzes of early type V, but both types occur within the Lapita tradition (Leach and Green 1989:326). Geochemical analyses on adzes from the To'aga site have demonstrated that 50% of the adzes and other artefacts with polished surfaces originate from Tataga-matau on Tutuila but non-polished and unground flakes were from local stone (Weisler 1993:185). Geochemical analyses of Tataga-Matau, Malaeloa and the Maloata quarries in Tutuila show that the basalt has different composition at these sites. When compared with adzes found on ’Upolu at least one adze was indicated to be made from stone found in the Malaeloa quarry, but the other five adzes from ’Upolu did not match any of the investigated quarry sites (Winterhoff 2004:237).

Another important find category is pottery (Table 2). Lapita pottery was found at the early Mulifanua site. The decoration on the sherds indicates that they belong to the eastern Lapita tradition but the pottery is considered to be locally made (Dickinson 1974:180). However, according to Green, one piece originated in Fiji (1996:122). Over 4000 sherds, of which c. 5-7% were decorated, were found in the dredge tailings from the submerged site (Leach and Green 1989:321; Green and Richards 1975:312).

Three other sites on ’Upolu produced an abundance of pottery categorised as plainware (Table 2). The sites in American Samoa are the To’aga site on Ofu (Manu’a), ’Aoa site on Tutuila and the Alega site on the offshore islet (Hunt and Erkelens 1993:123-149).

Locations	**Sherds (no.)**
Coastal sites (Upolu)	
Jane’s Camp SU-fl I	1642
Vailele/Suga mound SU-Va I	401
Vailele/Suga mound SU-Va 4	229
Inland sites (Upolu)	
Sasoa’a SU-Sa 3	5925
Leulasi SU-Le 12	31
Leulasi SU-Le 3	2
Coastal sites (Manono)	
Potusa SM17-1	155
Falemoa SM17-2	754
Coastal site (Apolima)	
Apolima Site	7

Table 2. Samoan sites with pottery.

According to stratigraphic evidence, thin fine ware preceded a coarser type of ware. Green concludes that pottery is rare after the 2nd century and had ceased manufacture completely by 500-600AD (Green 1974a:248). The ceramic-bearing occupational layers on the To’aga site at Manu’a have been dated from 1250BC to the first 200-300 years AD (Hunt and Erkelens 1993:124). According to Clark (1996:145), there is no uniform abandonment of pottery on the Samoan islands and results from excavations at the ’Aoa site on Tutuila show an extended time range of pottery use even after 500AD and maybe as late as 1350AD. However, when assessing radiocarbon dates from West Polynesian sites Anita Smith concludes that it “is not possible to ascertain …[the chronology for pottery disappearance]… from the present available data” (Smith 2002:180).

The Samoan pottery (based on the Sasoa’a pottery) was categorised by Green on the basis of: 1. Colour, texture and treatment of sherd surface. 2. Finer variations within the three main categories of temper and 3. By sherds that fitted together, especially using pieces of rim. Most of the vessels were considered as belonging to rounded bowls and the thick coarse ware vessels were divided into nine different categories, with bowls mainly ranging between 30-40 cm in diameter. This ware type is almost always associated with a simple flat rim of an open bowl. The thin fine ware is divided into ten categories ranging from 10-40 cm in diameter. This type includes a broader variety of rim forms. The vessels have been interpreted as drinking cups, kava bowls and cooking jars. Quantifying analyses on pottery were subsequently carried out by Smith (1976a) and refined by Holmer (1980b). By undertaking a principal components analysis using a range of variables Smith showed that the early Lapita ware and the later plainware were generally homogeneous in character (Smith 1976a:92). However, two distinct types of plainware (thick and thin ware from Jane’s camp, Falemoa and Mulifanua) were noticed in the assemblages but no distinct pattern concerning temporal or spatial intra- or inter- site distribution could be seen (Smith 1976a:92). The variety of vessel shapes became restricted with time (Smith 1976a:94). Further research by Holmer (1980b:108) derived seven statistically defined types of Samoan ceramics (Holmer 1980b Figure 41), and showed that Samoan pottery was developed from Lapita types. The pottery from the To’aga site in American Samoa has been analysed extensively and the result of the microanalyses show that most of the sherds were manufactured from local material, except the red-slip pottery which is exotic and represents inter-island exchange (Hunt and Erkelens 1993:146). A relative change over time from thin ware to thick ware is indicated, but both thick and thin ware are represented at To’aga in the early occupation phase and the decline of thin ware occurs over time (Hunt and Erkelens 1993:147).

Amongst other portable artefacts of interest, a few obsidian flakes have been found in both early and later contexts on ’Upolu at Sasoa’a, SU-Sa 3 (one core) (McKinley 1974:33), at Vailele SU-Va 4, (74 pieces) (Terrell 1969:168-9) and at Lotofaga, Su-Lo 1 (1 piece) (Davidson 1969b:250). The obsidian was analysed and considered as deriving from a source in Samoa, possible in the Fagaloa valley (Ward 1974:167-169; Terrell 1969:169). Two pieces of chert found from early contexts at SU-Sa3 and SU-Le12, could be imported (Green 1974a:267). Obsidian flakes found at the To’aga site are suggested to be local as well (Kirch 1993:165).

Basalt flakes are very numerous. According to Green the majority seems to be waste from adze making and their primary use as tools is not very likely (Green 1974a: 266). However, some re-used flakes from polished adzes show use-wear and were probably used as scrapers or cutting tools. Ethnohistoric accounts show that tools such as scrapers, cutters, graters, peelers and drills were made of perishable material such as wood and bamboo (Green

1974a:268). Finds from coastal sites indicate that shell has been used for such tools as well (Green 1974a:268; Smith 1976b:71). At the few investigated coastal sites there are surprisingly few finds of fishhooks as well as a low frequency of fish bone recovered and only a few files, mainly made of sea urchin spines and coral (Davidson 1969b:245-6; Smith 1976b:73). Smith concluded that the discovery of a shell ring along with a branch coral file, worked bone and *Conus* shell scrapers in an early deposit at the coastal Jane's camp site, SU-Fl1, showed a resemblance to the early Tongan tool kit. The To'aga site showed a similar tool kit to the coastal sites on 'Upolu and Manono, but a larger number of *Turbo* shell fishhooks was recovered there (Kirch 1993:160-1).

Green and Davidson suggest that archaeological evidence shows that portable objects associated with early occupation layers in Samoa originated in the Lapita tool kit. This is especially obvious concerning the adzes and the plainware pottery (Green 1974a:275). However, in her review of non-ceramic artefact assemblages from West Polynesia, Anita Smith concludes that the small quantity of material studied limits interpretations concerning both spatial and temporal intra- and inter-site comparisons (Smith 2002:164).

Chronology and settlement pattern

Thanks to the archaeological program by Green and Davidson, Jennings *et al.*, and subsequent research in American Samoa, a foundation for the understanding of prehistory in Samoa has been established. The first Lapita site at Mulifanua was dated to c. 2850-2700 BP (Jennings 1974:176; Leach and Green 1989:319-20; Petchey 2001: 65-6). Plainware pottery sites were found and dated to c. 2300-1650 BP by Green and Davidson (1974b:214-6). Green and Davidson indicate that sometime after the eleventh century AD, mounds serving as residential platforms occurred (1974b:224). Jennings (1980:5), also showed that stone structures such as raised pathways, star mound and large earth ovens probably used as *umu tī* occurred from c. 600 BP.

In regard to the settlement pattern Davidson (1974a:243) concluded that 'throughout the known Samoan sequence, Samoan houses have been oval in shape, with river gravel floors and associated stone pavements' (1974a:243). Settlements are indicated both at the coast and inland, and earth ovens have been used. Fortifications have been present for at least 1500 years and re-use of habitation sites occurred with time. House pavements on terraces have occurred throughout the known sequence, but high stone and earth mounds for occupation or as platforms for god houses seem to be confined to the last millennium (Davidson 1974a:243). Associated with the large mounds are ceremonial roads and stone walls. Star mounds are unique to Samoa and American Samoa and are associated with this later settlement pattern featuring large mounds (Davidson 1974a:227, 243). According to Jennings and Holmer, evidence from ethno-historical and archaeological records shows that a stable long term settlement pattern could be established, as follows:

1. A few individual house platforms and a cooking area made up a household unit (HHU). This unit was usually separated from other units by walls or walkways with a possible garden area within the enclosure (see Figure 8).
2. Several household units clustered made up a *pito nu'u* (village ward) and within this area it was a larger platform which is indicative of a chief's dwelling.
3. These *pito nu'u* made up a *nu'u* (village) with a *malae* (village green) and a *fale tele* (community house) (Holmer 1980c:93; Davidson 1979:99).

Similarities between the prehistoric inland settlements at Mt Olo on 'Upolu and at Letolo and Sapapali'i on Savai'i are indicated. These settlements have also been compared with a modern coastal settlement of Fa'aala on Savai'i, which showed a similar pattern. According to Jennings *et al.* (1982:86) a stable social organisation can be inferred. However, a change in the settlement pattern can be seen in late prehistoric times when the majority of the inland settlements were abandoned. A rapid and far reaching change in the redistribution of the settlements to the coastal region was probably caused both by a population decline in connection with European contact and the introduction of Christianity (Green 2002:148). Despite these changes, Davidson also argues that there is no evidence for any major changes in the social organisation (1979:102). The prehistoric settlement pattern in American Samoa differs from Samoa and only a few small occupations are found in the rugged inland areas and no large mounds or raised-rim ovens have been found (Clark 1996:452).

Theoretical framework and research issues

The theoretical framework and research issues concerning Samoan archaeology are located primarily within a culture historical framework that has been founded on understanding the development of settlement patterns over time. Initial research in Samoan prehistory did not divide it into well defined intervals; rather it was seen as representing an aperiodic cultural succession (Green 2002:127). Green and Davidson's research (1969-1974) has been mainly descriptive and representative of a narrative approach. Explanations of the material culture and patterns observed have been drawn largely from ethnohistoric records with comparisons of the material culture to that in other Polynesian island groups. The long-term project conducted by Green and Davidson was part of a program on Polynesian Culture History developed at the Tenth Pacific Science Congress in 1961. A valuable aspect of the research is their publications (1969, 1974) of descriptive data from the various excavations, which created and still is a substantial knowledge base about Samoan prehistoric material culture. Other general aims of their initial research were, to provide an outline and summary of research in

Samoan prehistory, to create a prehistoric sequence for the island group, to make a typology of the principal structural forms and their functions, and to discuss Samoa and its position in Polynesia. Based on Golson and Ambrose's initial work and some general ideas concerning Polynesian middens and fishing gear, six specific goals were outlined. The new data obtained during their excavations caused Green to reformulate some of the problems and projects. To obtain a better understanding of change in the settlement pattern over time it was considered important to find additional pottery-bearing sites and earth mounds, as well as to investigate fortifications, and sample beach middens. In his retrospective view of settlement pattern studies in Samoa, Green suggests that the changes in the settlement should be placed in a four stage periodic framework (Green 2002:127). This is: 1. The period of the Decorated Lapita ceramics; 2. Settlement patterns during the period of Polynesian plainware ceramics; 3. The interval for which settlement pattern evidence is extremely limited ("the dark ages"); 4. Settlement patterns between 1000 and 200 years ago (Green 2002:134-46). To understand changes in the cultural landscape Green also looks at the changes in the natural landscape (Green 2002:128-34).

Subsequent research by Jennings was mainly conducted as a survey and testing program with the aim of locating additional Lapita sites aside from Mulifanua. The theoretical foundation for the research was not explicit. Influences from the positivistic and functional-processual research of the 'New Archaeology' are indicated through the use of statistical analyses on ceramics and settlement features. Holmer writes the following concerning the interpretation of the Sapapali'i settlement:

> Although slight variations in terrain aided in separating the survey area into wards, the topography of Ward A does not differ enough from that of Ward B to explain the differences that exist in the density of platforms and walkways, or HHU size. The differences, therefore, are probably attributed to factors such as differential preferences in ward organization or possible prestige or wealth'(Jackmond and Holmer 1980:151).

When researching the To'aga site in American Samoa a central concern was to reconstruct Ancestral Polynesian Culture as a dynamic and changing configuration (Kirch and Hunt 1993:2). To understand the substructures of technology, economy, settlement patterns, and socio-political organisation of the society it was important to obtain a foundation to study subsequent developments. The objectives were to establish a temporal framework for Manu'a, to determine the environmental changes during the period of human occupation, to reconstruct certain aspects of Ancestral Polynesian Culture, to find explanations for ceramic change in Western Polynesia, and to look at the role of inter-island exchange through portable material culture such as ceramics and adzes. The research approach can be described as both culture-historical and processual.

At present the main bulk of archaeological research in the Samoan Islands has been conducted within the established temporal framework of prehistory. The change from decorated Lapita pottery to plainware pottery has been central to the discussion. The analyses of ceramics indicate that they represent the same tradition and that they are probably locally made. The current view of the main events of Samoan archaeology is, in summary: 1. Initial arrival/settlement of people to Samoa c. 2850 years before present; 2. The development of the Ancestral Polynesian Culture c. 2500-1800 BP; 3. The rise of the chiefdom, and development of mounds and interactions (with Tongans, etc.) c. 1000 BP – present; To move beyond this and discuss the prehistoric material culture in more dynamic ways is seen as important for future research. Issues relating to the rise of the Polynesian chiefdoms and the origin and development of monumental architecture are of particular importance.

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Appendix. Excavated archaeological sites in Samoa.

Island	Site identification	Type of site	Coast/ Inland	Comment
Upolu	Ti'avea	Midden	C	Excavated in 1957 (Golson 1969b), sea bank containing post holes and evidence of cooking and burning
Upolu	Aleisa	Stone wall	I	Excavated in 1957 (Golson 1969b), interpreted as agricultural stone heap
Upolu	Falemaunga caves	Cave habitation	I	Collection of charcoal in 1957 (Golson 1969a), from midden on built up stone platforms
Upolu	Sa'anapu, Seuao Cave	Cave habitation	I	Collection of charcoal in 1957 (Golson 1969a). Date to 240±50 BP
Upolu	Vailele; SU-Va 1	Mound/habitation layer	C	Low earth mound excavated in 1957 (Golson 1969a), 1963-64 (Green 1969b). Six habitation layers. Pre-mound use with pottery c. 1st century. Subsequently used as house mound.
Upolu	Vailele; SU-Va 2	Mound/habitation layer	C	Low earth mound, excavated in 1964 (Green 1969c). Pre-mound agricultural activity, house mound c. 12th century.
Upolu	Vailele; SU-Va 3	Mound/habitation layer	C	Low earth mound, excavated in 1964 (Green 1969d). Single phase construction. Several occupations. Initial occupation c. 11-12th centuries.

Island	Site identification	Type of site	Coast/ Inland	Comment
Upolu	Vailele; SU-Va 4	Mound/habitation layer	C	Low earth mound, excavated in 1964, 1965, and 1966-67 (Terrell 1969). Several occupation layers. Pre-mound use with pottery c. 1st century BC-5th century AD. Subsequently used as house mound.
Upolu	Vailele; SU-Va 38	Mound	I	Excavated in 1966 (Hougaard 1969a). Several occupational layers. Pre-mound activity dated to 5th century.
Upolu	Lotofaga; SU-Lo1 A, B, C	Midden	C	Excavated in 1964 (Davidson 1969b). Finds of occupations and burials. Activities dated to c. 12th-13th century.
Upolu	Luatuanu'u; SU-Lu 41/ SU-Lu 21	Fortification	I	Excavation in 1966-67. Boundary area between two districts. Dates from c. the 5th century and the 18th century (Scott and Green 1969).
Upolu	Luatuanu'u; SU Lu 21	Oven close to earthen terrace	I	Excavated in connection to detailed survey at Luatuanu'u in 1966-67 (Davidson 1969a).
Upolu	Luatuanu'u; SU-Lu 53	Star mound/ earthen terrace	I	Excavated in 1967 (Peters 1969). Star mound is post-occupation but early use of the area c. 100 BC was indicated.
Upolu	Moamoa; SU-Mo 1	Mound	I	Destroyed mound excavated in 1966 (Hougaard 1969b).
Upolu	Sasoa'a; SU-Sa 1, 2, 3	House terraces	I	Excavated in 1965 and 1966 (McKinlay 1974, Green 1974c). Long term use. Early settlement with pottery dated to c. 1st-2nd century.
Upolu	Folasa; SU-Fo-1	House terrace	I	Excavated in 1967 (Ishizuki 1974). Activities detected from the 6th century and up to historic times.
Upolu	Puna; SU-Lam 1	House mound	I	Excavated in 1967 (Hansen 1974). Dates from 12th-16th century.
Upolu	Leuluasi; SU-Le-12	House platform	I	Excavated in 1967 (Davidson and Fagan 1974). Long term use. First occupation c. 1000 BP.
Upolu	Leuluasi; SU-Le-3	House platform	I	Excavated in 1967 (Green and De Nave 1974a). No dating.
Upolu	Te'auailoti; SU-Te-1	House platform	I	Excavated in 1967 (Green and De Nave 1974 b). No dating.
Upolu	Sasoa'a: SU-Sa-15	Oven	I	Excavated in 1967 (Davidson 1974c). Interpreted as an *umu tī*. No dating.
Upolu	Vaimaga; SU-Va-3	Oven	I	Excavated in 1967 (Davidson 1974c). Interpreted as an *umu tī*. Dated to c. 800-600 BP
Upolu	Vaigafa; SU-Vg-54	Oven	I	Excavated in 1963-64 (Davidson 1974b) recent dating.
Upolu	Te'auailoti; SU-Te-5 locality B	House	I	Excavated 1967 (Green 1974d) no dating.
Upolu	Mulifanua; SU-Mf	Submerged settlement	C	Earliest site (c. 2850 BP) on Samoa found in 1973 (Green 1974b, Jennings 1974), featuring Lapita pottery.
Upolu	Mt Olo; The Cog site SUMu-165	Star Mound/ Council platform	I	Excavated 1974 (Holmer 1976) and 1977 (Hewitt 1980c). Probably date to c. 16th-17th century.
Upolu	Mt Olo; Crocked palm; SU17-369, SU17-370, SU17-367, SU17-366, SU17-328	House platforms/ garden plot and raised walkway	I	Excavated 1977 (Lohse 1980b). No dates. Human remains in one platform.
Upolu	Mt Olo; Tausagi complex; SU17-175-180, 526, SU17-176, SU17-179	House platforms/ walkway and fence	I	Excavated 1976 (Holmer 1980d). No dates. A few thin pottery sherds found in the area. Probably a community house area

Island	Site identification	Type of site	Coast/ Inland	Comment
Upolu	Mt Olo; Apulu HHU: SU17-477, 483, 486, 484, SU17-485, SU17-478, 482, SU17-446	House platforms, rock mounds, fence and walkway	I	Excavated 1977 (Holmer 1980e). Dates indicate pre-mound/ platform activity to 8th-9th century and later settlement activities from the 11th and 16th centuries. A few pottery sherds were found in the area.
Upolu	Mt Olo, Tutia and Misi; SU17-177	House platform	I	Excavated 1977 (Holmer 1980f). No dates but different platform technique.
Upolu	Mt Olo; Fiapito; SU17-4, 3	House platforms	I	Excavated 1977 (Holmer 1980g). No dates but possible a community house.
Upolu	Mt Olo; Ten points; SU17-552, SU17-548, SU17-549	Star mound /walled walkway, oval clearing	I	Excavated 1977 (Hewitt 1980a). A dated sample from pre star mound context point to a 3rd-4th century activity.
Upolu	Mt Olo; Tulaga Fale; SU17-90 SU17-91, SU17-88, SU17-89	House platforms	I	Excavated 1977. Possibly a community house. A dated sample of pre-platform context points to an activity from the 8th-9th centuries.
Upolu	Mt Olo; Ma'a Ti; SU17-128	Oven	I	Probably excavated 1976 or 77 (Jackmond 1980). Interpreted as an *umu tī*. A dated sample suggests this oven is from the 16th-18th century.
Upolu	Mt Olo; GreenTi; SuMu-48	Oven	I	Excavated 1974 (Janetski 1976a). Interpreted as *umu tī*. A dated sample suggest this oven to be from the 17th century.
Upolu	Mt Olo; Janet's oven; SuMu-188	Oven	I	Excavated in 1974 (Janetski 1976a). Interpreted as *umu tī*. A dated sample suggest this oven to be from 18th century.
Upolu	Paradise Site; SUVs-1	Settlement	I	Excavated 1974 (Janetski 1976b) in Apia. The site featured pottery.
Upolu	Faleasi'u (Jane's camp); Su Fl-1	Midden/settlement	I	Excavated 1974 (Smith 1976b). Early sites featuring pottery. Dated samples on shell and charcoal suggests occupations in a range from c. 400BC-600AD.
Manono	Potusa; SM17-1	Midden/settlement	C	Excavated 1974-75 (Jennings *et al.* 1976). A dated sample suggest an occupation between
Manono	Falemoa; SM17-2	Midden/settlement	C	Excavated 1974-75 (Lohse 1980a). Dated shell and charcoal sample suggest occupation between c. 330BC-600AD. Pottery was found.
Apolima	Apolima	Settlement	C	Excavated by 1968 (Peters 1974). No dates but a few pottery sherds.
Savai'i	Pulemelei; SS-Le 1, SS-Le 2	Mound/settlement/ oven	I	Excavated 2002-2004 (Wallin *et al.* 2002 Martinsson-Wallin *et al.* 2003, 2005). Early settlement 1st century. Early mound phase 11th century, Oven interpreted as *umu tī*.
Savai'i	Sapapali'i; SS-Sp 15	Oven	I	Excavated in 1965-66 (Buist 1969). A sample dated to 750+-80. Interpreted as *umu tī*.
Savai'i	Ologogo; SS-01-B-16	Rectangular pit	I	Excavated 1965-66 (Buist 1969). A dated sample to 210±100.
Savai'i	Sapapali'i; SS-Sp-13-91	Oven	I	Excavated in 1976-77 (Jackmond and Holmer 1980). A dated sample c. 500 BP interpreted as *umu tī*.
Savai'i	Sapapali'i; SS-Sp-13-127	?	I	Excavated in 1976-77 (Jackmond and Holmer 1980). A dated sample c. 545 BP.

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Monumental architecture in West Polynesia: origins, chiefs and archaeological approaches

GEOFFREY CLARK and HELENE MARTINSSON-WALLIN

Abstract

In West Polynesia, monumental structures with a volume ≥ 2500 m^2 include mounds of earth or stone that in traditional history were used to house or bury chiefs, as well as being the focus of ceremonial and religious activity. We review archaeological theory about the initiation of monumental architecture and examines how chiefly and high-status activity might be identified. Large structures with monumental dimensions often have a complicated construction history that spanned several centuries indicating change to the social structure, particularly the power of elites. As a result archaeologists need to develop ideas that relate episodes of architectonic change to alterations in the prehistoric socio-political system.

Complex societies are associated worldwide with monumental architecture, making the examination of massive structures integral to the study of the origins and development of socio-political complexity (Childe 1949; Peebles and Kus 1977; Trigger 1990). In Polynesia the hierarchically organized chiefdoms encountered by early European visitors displayed substantial variation in their size, organization and degree of stratification, as well as sharing fundamental features denoting a common origin (Sahlins 1957; Kirch and Green 1987). Such socio-political similarities and differences were manifested in the settlement landscapes of island groups, which often contained examples of monumental architecture made in earth, stone or a combination of the two (Kirch 1990; Graves and Green 1993).

This paper examines the origins of monumental structures in West Polynesia (Figure 1), and reviews archaeological approaches to the study of massive structures. These include methods for assessing chiefly power from the evidence offered by large constructions, and how the study of monumental architecture might inform us about the development of late-prehistoric societies in the Central Pacific. Our approach draws on literature from Polynesia and other parts of the world, and illustrates conceptual perspectives on the study of monumental architecture, using examples from Samoa, particularly the Pulemelei mound, and Tonga, with which we are familiar. The review demonstrates the way in which different readings of monumental architecture, each containing a

Figure 1.
Fiji-West Polynesia.

range of inbuilt assumptions, can be created for complex structures like the Pulemelei mound, and the importance of archaeological data to examine their validity.

Several factors have been used to explore variability in Polynesian socio-political institutions and they provide a context for understanding the development of monumental architecture. They include the productivity of island environments (Anderson and Walter 2002; Ladefoged 1992), the population growth cycle (Kirch 1984), and the nature of the ancestral political system (Kirch and Green 2001).

The nature of island environments clearly sets limits on the level of social complexity able to be supported by a Neolithic technology. Sahlins (1958) and Goldman (1970), for example, noted in their synchronic analyses of Polynesian chiefdoms that the least stratified societies came from resource-poor coral atolls that were unable to support large populations and where large-scale architecture was absent (see also Adler and Wilshusen 1990).

The attainment of large, high-density populations in much of Polynesia has been argued by Kirch (2000:307-11) to follow some form of logistic pattern, in which high rates of initial growth eventually slowed as human numbers began to exert various kinds of pressure. In island ecosystems with plentiful productive resources, particularly arable land, population size and density could reach levels where intensification of the political, economic and social systems comprising a chiefdom were expressed in monumental construction.

In addition to the demographic trajectory, political development was shaped by the social divisions and architectonic features of an Ancestral Polynesian Society (APS), hypothesized to be located in West Polynesia about 2200-1900 BP, and transported by colonists to East Polynesia (Kirch and Green 2001:79). The basic principle of ranking or status rivalry between junior and senior members of a group, and between junior and senior branches of a lineage in APS has been described as: “the structural germ that could give rise to hierarchy again and again once societies increased in size” (Kirch 2000:322).

These factors provide a historical framework for understanding pathways to socio-political complexity in Polynesia, but are less compelling when considering the emergence of monumental architecture. This is illustrated particularly by different timescales for the origins of monumental structures in West Polynesia and East Polynesia.

The islands of Tonga in West Polynesia have a combined land area of only 700 km^2, and were colonized at 2900 BP by Lapita groups (Burley and Dickinson 2001). The population size relative to the amount of arable land (the ‘full-land’ situation, see Kirch 1984: 222) was probably reached at 2300-1700 BP (Green 1973; Kirch 1984:222-3), yet monumental architecture emerged on Tonga, and on the nearby but much larger archipelago of Samoa, only after some 2000 years of prehistoric occupation at 1000-800 BP (Burley 1998; Green 2002). By comparison, East Polynesia was probably colonised by 1200-700 BP (Anderson and Sinoto 2002; Anderson 2005), with monumental structures constructed within 200-500 years of initial settlement on several islands, including Rapa Nui/Easter Island (Martinsson-Wallin and Crockford 2002), Hawaii (Kolb 1994) and New Zealand (Sutton *et al.* 2003). The coincidence in the timing of human arrival in East Polynesia and emergence of monumental architecture in West Polynesia suggests that the ‘structural germ’ of social complexity taken to East Polynesia came from the already stratified chiefdoms of West Polynesia (Smith 2004; cf. Kirch 1990:207). The rapid development of monumental architecture and other forms of social intensification in East Polynesia may result, therefore, from the political systems present in West Polynesian society 1000 years ago. If that is the case, the archaeological manifestation of early complex societies in West Polynesia – their community patterning and monumental architecture – is crucial for understanding the nature of chiefly power and authority taken by colonists to East Polynesia. Our focus on monumental architecture is also based on a common finding that massive structures frequently had complicated life-histories, involving change in their size, shape and function (Stevenson 2002; Graves and Sweeny 1993). This implies that the cultural meaning of monumental architecture was not invariant in the past – nor is it in contemporary settings (Holtorf 1999; Martinsson-Wallin 2004; Wallin 2004) – and such changes may indicate socio-political perturbation in the development of Polynesian chiefdoms that is not evident in linguistic reconstructions or recorded in ethnohistorical accounts. Archaeological approaches to examining the historical complexity of chiefdoms from their architecture are required, therefore, since it is clear that social organization has not remained static in West Polynesia during the last 1000 years (Kirch 1984:286; Herdrich and J. Clark 1993:60; Kolb 1994).

Background

The area usually referred to as West Polynesia includes Samoa, American Samoa, Tonga, ’Uvea and Futuna, which were all colonized by Lapita people some 2900-2800 years ago. Rotuma and Niue can also been included, although archaeological evidence suggests they may have been settled later at 2000-1000 BP (Figure 1). ‘Monumental architecture’ is a term that can potentially include all substantial built structures and features in a landscape, but is preferable to ‘monument’, which implies a structure that has a purpose to evoke memory (Elliott 1964). In Polynesia the distinction between ‘monument’ and ‘monumental architecture’ has significance for understanding the spatial structure of chiefly societies, with the distribution of monuments demarcating a territorial boundary, whereas monumental architecture can mark the central place of a descent group (Kirch 1990; Burley 1996; Shepardson 2005). There is no agreed method for gauging whether a prehistoric structure has ‘monumental’ proportions, and scale is often assigned relatively, by comparison of area or volume (Buist 1969; Davidson 1974; Kirch 1988; Spennemann 1989; Anderson and Walter 2002, see below).

A functional division can be made between types of monumental architecture linked to production (field systems, terraces, fish ponds, quarries), infrastructure (roads, wall, canals, docks), and defence (fortifications, defensive walls and ditches), and special-function monumental structures, such as temples, elite habitations and burial places (Trigger 1990) – the focus of this paper. In post-processual conceptions of landscape, infrastructure, production and defence structures have symbolic significance, yet special-function monumental sites were frequently the locus of intense socio-political activity, particularly when located within a ceremonial precinct or community settlement.

There have been relatively few in-depth archaeological studies of special-function monumental architecture (as defined above) in West Polynesia, although a number of structures have been surveyed and interpreted in the light of ethnohistorical and subsequent ethnographic information (Burley and J. Clark 2003). The following is a necessarily brief overview of special-function monumental structures, particularly large platforms/mounds, in West Polynesia.

Tonga and Samoa

In Tonga, large mounds associated with burial (*langi, faitoka, malae*), pigeon snaring (*sia heu lupe*) and sitting/resting/public audience (*'esi*) have been examined by McKern (1929), Kirch (1980, 1988), Spennemann (1989) and Burley (1996). All large mound structures are linked to the traditional chiefly system (Burley 1998), and: "display hierarchical distributions that correspond to the political hierarchy itself" (Kirch 1990:218).

Large house mounds are rare in Tonga, and the largest earth mound in Samoa, and probably West Polynesia, known as Lapule, was according to traditional history associated with the despot Tupuivao (ca. 1615-1640AD), who is said to have built his house on the mound (Freeman 1944; Green1969a:102). Lapule and other nearby earth mounds have not been excavated, but several large mounds investigated at Vailele revealed they were built in several phases, with a change from non-residential to residential use (Davidson 1974:226). Other large mounds of stone and earth have been reported on Upolu at the Mulifanua Plantation, Leulumoega and Sa'anapu'u (Epling and Kirk 1972), and on Savai'i (Buist 1969). The mound at Mulifanua is connected with the chief Tuifa'asisina (ca. 1625AD), and the Leulumoega mound is thought to be the house foundation of the chief Tuia'ana Tamalelegi used ca. 1550AD (Krämer 1994:646). The Pulemelei mound on Savai'i has also been identified as the house platform of the high chief Lilomaiave Nailevaiiliili (Asaua 2005:85) at ca. 1670AD.

Pigeon mounds were constructed in Samoa as well as Tonga and 'Uvea, but have a distinct 'star' or 'cog' shape in plan view, unlike the rounded forms of Tonga and 'Uvea (Herdrich and Clark 1993; Sand 1998; Burley and J. Clark 2003). However, a sub-mound in the SU-Va-1 mound at Vailele contained a large central depression suggestive of some Tongan pigeon snaring mounds (McKern 1929:21; Green 1969b:126). Unique monumental structures are the O le fale o le fe'e (the house of the octopus) in Samoa, described by Macmillan Brown (1907) as an ellipse-shaped structure of massive stone columns for the worship of the war god Fe'e (Freeman 1944:121), and the Ha'amonga-'a-Maui trilithon in Tonga, said to have been built by the 11th Tui Tonga, Tuitatui (McKern 1929).

Beyond the main archipelagos of Tonga and Samoa there are substantial stone foundations recorded on 'Uvea and Rotuma. On Futuna and Alofi monumental architecture consists of recent defensive structures, including hilltop forts with stone enclosures and ditch and bank features (Kirch 1976:49).

'Uvea

The largest monumental structure on 'Uvea is made of basalt stones and is associated with the Kalafilia title of Tongan origin. The Kalafilia mound at Utuleve has an estimated volume of ca. 30,000 m^3 (Sand 1993). Inside the Tongan fort of Kolonui is the basalt stone foundation mound of Talietumu (7000-9000 m^3), which has an access ramp flanked by watch positions and remains of a ceremonial house platform at one end of the central mound. (Sand 1993, 1998). Burial mounds up to 30 m in length and 3 m high, containing burial vaults made with large slabs of basalt or beach rock, are recorded mainly in the south of 'Uvea, and in oral traditions these are attributed to be the burial places of Tongan title holders (Sand 1993, 1999).

Rotuma

Large stone house foundations (*Fuag Ri*) have been recorded in the Noatau district of Rotuma by Parke (1969). The two biggest have an estimated volume of 1000-1150 m^3. The largest mound known as Kine He'e (sepia of the cuttlefish) was built of volcanic boulders and is around 3 m high, with an estimated volume of some 6000-9000 m^3. The mound has four entrance ways aligned to the cardinal points, and according to tradition was the house of a giant chief. Ladefoged (1993:245-251) surveyed and excavated the mound and obtained a radiocarbon determination of 120 ± 60 BP on charcoal found in association with secondary burials. An earlier visit to the mound by Parke (1969) reported house foundations outlined with coral sand. Huge cemetery mounds constructed of beach sand also exist, and a radiocarbon date on human bone excavated from the Risunu mound (Rot 2-9) had an age of 1000 ± 100 BP (Shutler 1998). In tradition, this area was the first to be settled by Tongans and beach rock slabs were used in funerary construction on Rotuma as well as Tonga and 'Uvea (Parke 1969; Shutler 1998).

Niue

On Niue earthen enclosures up to 1.5 m high and 10-60 m in length are of uncertain function. Most stone platforms/ mounds are relatively small, but a mound called Falepipi has an approximate volume of 1800 m^3 (Trotter 1979). Investigations suggest that most stone/earth filled mounds were built late in prehistory, and possibly as a result of Tongan influence. However, pigeon-snaring platforms of dry laid stone may have been introduced from Samoa (Anderson and Walter 2002:161).

To summarise, special-function monumental architecture in West Polynesia is a late development, dating to the last 800-1000 years, that has its strongest expression in Tonga and Samoa. Ethnohistorical and traditional testimony has been important for understanding the function of substantial structures in relation to chiefly activities, but given a tendency for such structures to achieve their final dimensions from multiple construction events, and the extensive rearrangement of indigenous societies due to warfare, the impact of introduced disease, and changes to native belief systems from missionary and colonial influence (Green 2002; Sand 2002), neither the origin nor the function(s) of monumental architecture should be expected to be fully documented in oral and textual accounts (Graves and Sweeny 1993:108).

Origins of monumental architecture

Unintended beginnings

The impressive dimensions of monumental architecture, whether measured by size, weight, volume or labour, suggest social organization and planning for a specific purpose. An intriguing possibility, however, is that monumental architecture was an unintended outcome of constructing relatively modest but permanent structures that became points of reference for future action, resulting in the reorganization and stratification of social space. Joyce (2004) has argued that in Formative Mesoamerica a change to building in less-perishable materials gave rise to structures with improved architectural durability, allowing societal differences to be manifested in mound construction, reconstruction and elaboration. In other words, monumental structures that we perceive today as having been purposefully designed for a special function associated with the power of elites could be an unforeseen outcome of a simple innovation of building in durable materials by non-elites.

In West Polynesia, and adjacent archipelagos including Fiji and New Caledonia, relatively permanent foundations for domestic and non-residential structures were mainly constructed during the last 1000 years, representing an obvious socio-political ‘footprint’. Whether this marks a significant shift in community settlement patterns, as is commonly asserted (Sand 1993; Smith 2004), has been difficult to address because evidence for prehistoric structures that were presumably made in perishable materials will naturally be harder to detect archaeologically. Nonetheless, Joyce’s (2004:8) point that: “it is difficult to be comfortable with the assumption that from the beginning ... monumental architecture was fully realized”, is appropriate to keep in mind when investigations of monumental architecture record accretionary development.

Materialized ideology

Earle and colleagues take a different approach and argue that the construction of monumental structures and other major human alterations of the landscape was, and is, an effective non-literate means of materializing the ideology of a dominant group by expressing relatively non-ambiguous messages of power (Earle 1997; DeMarrais *et al.* 1996:17). Social power is derived from materialization by promoting the objectives and ideas of elites at the expense of competing groups who lack the labour and/or materials to construct large-scale structures. By controlling the transformation of a society’s abstract ideas into concrete forms that are politically exploitable, materialized ideology can be used to acquire traditionally recognized forms of power – economic control and military force (Talley 2004). Monumental architecture is a structured venue for the production and transmission of ideas, traditions and belief systems, which Earle (1997:4-5) refers to as ‘routines of compliance’ as they emphasise and legitimise the power of leaders. As ceremonial and political centres, monumental architecture provides a venue for practising other forms of materialized ideology like integrative, and exclusionary, social events (feasts, dances, funerals, key points in the agricultural calendar, chiefly induction, etc.), and the display of exotic objects and icons that express vertical power relations. Implicit in the idea that a key role of monumental architecture is to unambiguously signal political power and authority is that social messaging by architectonic symbols becomes effective when population size and density reach a level where direct communication between leaders and a population is no longer effective. Thus, materialized ideology shares with ‘thermodynamic’ explanations the idea that monumental architecture represents the control of human energy by, and for, political leaders (Peebles and Kus 1977; Trigger 1990).

Differences in scale, social complexity and the institutional form of power relations can account for variation in the materialization of monumental architecture and other expressions of ideology, which can be examined archaeologically (DeMarrais *et al.* 1996:20). Monumental architecture in West Polynesia manifests a noticeable difference in structure clustering that indicates the scale and extent of political centralisation. The clearest example is the concentration of large burial mounds linked to the Tui Tonga title at Lapaha and associated structures (canoe dock, fortifications). Within a 30 hectare area, there are ten monumental structures that have a construction volume of 2500 m^3 or more, along with a ceremonial plaza (*malae*), and about a third of the chiefly centre area appears to have been reclaimed, representing a huge labour investment on top of that put into monumental structures (Clark *et al.* 2006). At Lapaha political evolution was materialized by separate burial mounds of paramount lineages, showing the tendency for power in Tonga to follow a dynastic pathway, with large-scale ceremonies conducted in front of the sepulchres of paramount chiefs (Kirch 1990).

Some grouping of monumental architecture is also evident in Samoa, where there are three large earth mounds, at Lupule and Tapuitea on Upolu, which each have a volume >2500 m^3, whereas at Letolo the Pulemelei mound is surrounded by mounds/platforms and other structures with significantly smaller volumes (Jennings *et al.* 1982: Figure 2; Asaua 2005). From a materialized ideology perspective, the reduced clustering of monumental architecture in Samoa and the absence of significant massive burial structures point to a very different political structure to that in Tonga, suggesting that power in Samoa was less centralised and was dedicated towards local or regional control, rather than inter-archipelago or archipelago expansion, as in Tonga. Under these conditions, the relative instability and poor cohesion of large socio-political formations in Samoa precluded establishment of a dynastic political system.

Environmental productivity

Variation in environmental productivity and resource diversity is a common feature of insular landscapes, which, in tandem with population growth, has been frequently implicated in the generation of monumental architecture (e.g. Sahlins 1955; Peebles and Kus 1977; Sanders and Webster 1978).

In cultural evolution models, highly productive environments support larger populations, which can be marshalled to construct large visual symbols of chiefly dominance and community land rights. A correlation between monumental architecture and highly productive environmental zones (anthropic and/or natural) has been suggested in Hawaii from the distribution of *luakina heiau* on Molokai and *heiau* on Maui (Kirch 1990:217; Kolb 1994), but is less convincing for some Maori *pa* (Irwin 1978: Figures 4 and 10). However, the overall distribution of *pa* in New Zealand matches with the horticultural land suitable for sweet potato cultivation (Sutton *et al.* 2003), and the modest prehistoric monuments of Niue were also located in areas with fertile agricultural soils (Walter and Anderson 2002:50). On Rapa Nui, Stevenson (2002) examined the distribution of ceremonial monumental architecture (*ahu*) and argued, however, that social/religious considerations may have influenced the construction and location of *ahu* more than environmental or resource factors. This view supports previous research results on the Rapa Nui ceremonial sites by Martinsson-Wallin (1994). Social/ religious considerations regarding monumental architecture in the Society Islands have also been suggested by Wallin (1993).

In West Polynesia the Vailele earth mounds and the Pulemelei mound of Samoa were constructed in pockets of agriculturally productive land (Ward and Ashcroft 1998). The chiefly centre of Lapaha in central Tongatapu contains a spectacular concentration of monumental burial mounds (McKern 1929). The prehistoric productivity of central Tongatapu is difficult to assess, although more than adequate food production is suggested by population densities 3-4 times higher than elsewhere in historic, and probably also in late-prehistoric, times (Roscoe 1993:121). On 'Uvea the Kalafilia mound was built in a horticultural area which had evidence for having been intensively gardened in prehistory (Sand 1993).

This equation links the origins of monumental architecture with the need of growing populations to assert territorial ownership of highly productive areas. Alternative explanations lie in evolutionary ecology and superfluous behaviour.

In evolutionary ecology, intergroup aggression is more likely to occur when the distribution of food resources is relatively stable and predictable, since a group may be able to gain the food resources of its neighbours at a potentially lower cost than would be needed to increase the local production base. This might occur in areas where the most productive resource patches were reaching their actual or perceived capacity, and where the labour investment needed to bring secondary or peripheral zones into production is disproportionate to anticipated food yields. On Rotuma Ladefoged (1993) found that the *sau*, a chiefly position that had influence over the whole island, was dominated by eastern chiefs from districts with the lowest terrestrial productivity for growing taro, yams and tree crops. It was hypothesised that on Rotuma successful aggression followed by supra-district integration benefited elites, who instigated intergroup hostility by gaining access to more productive environments (Ladefoged 1993). Monumental architecture thus served to symbolise the hegemonic dominance of one district over others, and the densest concentration of monumental architecture should be associated, therefore, with less productive districts whose chiefs profited from integration, rather than with areas of high resource productivity. Cherry (1978) also proposed that monumental structures are the result of integration, and are more likely to be built during a period of initial social change and the establishment of a common ideology.

Graves and Sweeney (1993) outline the concept of superfluous behaviour, which they suspect is involved in the origin of monumental religious architecture in Polynesia. In evolutionary archaeology, superfluous activity can be defined as human energy expended on acts that do not immediately contribute to food supply, reproduction or storage, and which persist because they reduce risk under conditions of resource uncertainty. For agricultural groups in fixed territories of uncertain productivity, the construction of religious architecture directed energy that would otherwise be employed in intensifying economic production and population expansion (cf. Sahlins 1955). By building monumental structures, the potential 'risks' of expansion – the potential loss of resource rights and increased likelihood of inter-group aggression – can be avoided. Under the superfluous behaviour model, the earliest types of monumental architecture should occur in localities experiencing the greatest environmental perturbation, and persist in areas experiencing moderate variation in average food production (Graves and Sweeney 1993).

The association between environmental productivity and monumental architecture in West Polynesia requires the historical ecology of late-prehistoric environments to be measured, and anthropogenic outputs distinguished from natural yields.

Migration and diffusion

An enduring theme in Polynesia is that the movement of people and ideas is responsible for the origins of monumental architecture (Spriggs 1988). Smith (2004) has recently expanded on this theme, asking whether the earliest field monuments in the Pacific result from widespread interaction between eastern Melanesia and Polynesia at 1000 BP. It is difficult to evaluate the effects of unspecified interaction and culture contact in relation to the spread of monumental architecture, and there is little information about the uptake of different types of monumental structure by prehistoric societies. For instance, which types of monumental architecture (production, infrastructure, defence, special function) are more likely to be adopted by a society than others, and in what circumstances?

Significant episodes of culture contact involving the substantial transfer of people and ideas, however, could clearly be influential in the establishment of monumental architecture, as attested historically in Polynesia by the construction of churches and cathedrals after missionary endeavours changed indigenous belief systems (e.g. Watters 1958:15). In West Polynesia the expansion of Tonga in late prehistory under, according to tradition, a relatively centralised political system, was accompanied by monumental structures – more in line with a view of massive architecture supplying a concrete statement of colonial power relations (Kirch 1990). Monumental architecture was made in distinctive Tongan forms on Rotuma, 'Uvea and several parts of east Fiji, including Lakeba and Kabara (Smart 1965; Best 1984), with materials such as quarried beach rock for mound facings and burial vaults. Not only did Tongans construct 'traditional' structures, such as burial mounds and pigeon snaring mounds, but on 'Uvea Tongans built new types of monumental structure, including fortifications and large house foundations, using the locally available basalt (Sand 1993). For instance, the largest earth mounds recorded by McKern (1929:97,100) at the chiefly centre of Lapaha on Tongatapu had an area of only 500-1000 m^2, whereas the Kalafilia mound on 'Uvea, made of basalt stones, has an area almost four times larger.

While migration and colony emplacement can lead to the transmission of monumental architecture to new environments, it is necessary to keep in mind that the new social and environmental circumstances at destination can stimulate change in the size, form, material and function of monumental structures.

Measuring chiefly power

The scale and distribution of monumental architecture has been used to reveal vertical relations within past societies, and the prehistoric settlement pattern to identify the type of chiefly organization (Renfrew 1974; Bradley 1984; Kirch 1988, 1990). Integral to such approaches is an assumption that the dimensions of domestic and monumental structures result, at least in part, from the relative rank of users/occupants (but see Kirch 1980), and the spatial arrangement of settlement structures reflects the relationship between different socio-political groups. It can be employed to reconstruct the settlement hierarchy, at times employing emic social categories (Kirch 1988; Green 2002; Asaua 2005).

In West Polynesia extensive mapping of prehistoric settlements in Samoa has recorded the dimensions of numerous mounds/platforms. Several measurements have been used to identify large-scale structures. Buist (1969) reported 'large' mounds with maximum base dimensions of 30.5 m to 61.0 m and a height of 2.4-3.0 m, while Jennings *et al.* (1982) used a basal area of 750-1000 m^2 to distinguish 'large' mounds from small-to-medium sized mounds. Using a sample of measured platforms/mounds from Letolo on Savai'i', Asaua (2005:45) increased the basal area of the 'large' category to a size of >1300 m^2 and a structure volume of 4500 m^3. However, many of the volume calculations reported by Asaua (2005:62) – including that of Pulemelei, given as 37,433 m^3 – are inflated, as they do not account for the reducing effects of slope (land and structure walls), nor for the smaller size of the top platform in multi-level structures. Revised volume estimates taking into account these factors suggest the largest mounds in Samoa are Lapule (earth), with a volume of ca. 45,000 m^3, followed by Tapuitea (earth), at ca. 20,000 m^3, and Pulemelei (stone), at ca. 17,000 m^3.

In Tonga Spennemann (1989) calculated fill volumes for *langi* burial mounds at Lapaha on Tongatapu, with the largest having basal areas greater than 2500 m^2, and a volume of up to ca. 16,000 m^3. In contrast, Kirch (1988) measured monumental architecture on the small Tongan island of Niuatoputapu and found the largest mounds (unfaced) had basal areas of only 1000-1300 m^2, with the volume of the largest mound estimated at 2500 m^3. In relative terms, structures with a volume of 2000-2500 m^3 are considered here to have monumental proportions in West Polynesia, with a few much larger examples in Samoa, Tonga, 'Uvea and Rotuma in the range of ca. 10,000-45,000 m^3.

Volume and basal area estimates can be transformed to provide a proxy measure of the mass and energy required to build monumental architecture, and of the power of chiefs to command labour (Kolb 1994). The relationship between mass-energy calculations for monumental architecture and chiefly power is complicated, however, by several factors.

First, when monumental structures were built in several phases an equation transforming structure volume into the number of labour days required for construction, and from this the ability of a chief to maintain and command a sizable workforce, is no longer valid. In the case of Mississippian mounds, for instance, researchers had assumed that mound volume represented either the duration of mound use or the size of the labour force recruited by chiefs. Analysis showed that 10-40% of Mississippian mound volume could be explained by duration alone (Blitz and Livingood 2004). If a component of large mound size/volume is a consequence of duration-of-use, then it may be misleading to use monumental architecture to infer political relations and the relative power of leaders, as in the settlement hierarchy approach. Changes and additions to ceremonial monumental architecture is evident on Rapa Nui and the Society Islands (Wallin 1993; Martinsson-Wallin 1994). It is probable that each phase of structure change, use and re-use is tied to a specific historical context.

Second, in West Polynesia measurements of monumental architecture can generally only estimate the mass/energy/labour needed to construct the foundation of a structure and not that which has gone into an edifice built of perishable materials erected on the foundation. Reconstruction of the roof structure of the great kiva at Grass Mesa village in Mexico, indicate it weighed 227 metric tons and was a more 'monumental' structure than the surviving pit foundation (Adler and Wilshusen 1990:138). The Samoan guest house (*fale tele*) was the most elaborate village building and was constructed on a foundation volume of under 1000 m^3 (Watters 1958:12). Relatively modest foundations in terms of their basal area and volume might have had built on them structures which in their size, materials and degree of artistic elaboration (for example intricate lashings) exceeded the energy/labour output expended on prosaic earth and stone foundations which have monumental proportions.

Third, while ethnohistorical and traditional sources explicitly link the most recent use of monumental structures to leaders and chiefs, including Tongan *langi*, Hawaiian *heiau* and Society Island *marae*, there have been few attempts to distinguish archaeologically the function of large mounds, and whether they were public buildings, burial sites, high status residences or had some other function. Green (1969b) identified debris (post holes, ovens, charcoal, stone tools) in the most recent levels of several mounds at Vailele in Samoa to infer a final residential function, but the function of non-residential submounds in several medium-sized mounds (Va-1, Va-2, Va-38) could not be determined, nor was it possible to distinguish whether the residential debris from larger-than-average mounds differed from that of smaller mounds, which could provide an independent means of associating high-status individuals with monumental architecture (e.g. Kolb 1994).

Identifying chiefs

The absence of domestic remains at monumental architecture indicating preparation, consumption and storage of food is one indication of a non-residential function, but it does not by itself specify chiefly/elite activity. In Hawaii Kirch (2004) found the orientation of temples (*heiau*) was not random and was keyed to astronomical and landscape phenomena, which in turn suggested a connection between temples and particular deities. The specialised religious-astronomical function implied by building orientation indicates use by high status priest-chiefs (see Peebles and Kus (1977:443) and Trubitt (2000:680) for a linkage between monumental architecture, calendrics and high status individuals).

The orientation of monumental architecture is a useful extension of mass-energy measurements and it highlights the architectonic qualities of structures built primarily for a formal versus a residential purpose. The orientation of monumental architecture in West Polynesia has not been examined in depth, but in Samoa several of the largest mounds, including Pulemelei, have their longest axis oriented east-west, and the Kine He'e mound on Rotuma is also aligned to cardinal points. Formalized activity associated with chiefs and leaders emphasizes the cultural gap between upper and lower classes, and can be recognised by the spatial patterning of architecture, which separates and constrains different sorts of activities (Kolb 1994:530; Lesure 1999).

Employing this perspective, the Pulemelei mound has sunken entrance passages that constrain access to and from the mound, while the height of the top platform restricts the activities able to be observed from the ground. Surrounding features also point to the segregation of specific behaviours, including large pavements arrayed on the south, east and west entrance sides of the mound (but not on the 'high' north side), a large ceremonial *Tī* oven, and the physical and visual connection between the North mound and Pulemelei. These structures appear to have a specialised ancillary role in activities taking place on the top platform (Martinsson-Wallin, Wallin and Clark, this volume).

Monumental architecture and sociocultural transformation

An inescapable issue in the archaeological examination of monumental architecture is how to relate the often complicated history of structure development to an equally dynamic prehistory of socio-political change. Unilinear explanations tend to view monumental architecture as an outcome of elite power during the progression toward socio-political complexity. The development of a monumental structure represents, in these analyses, the increasing concentration of power by leaders (Trigger 1990:127). For example, Kolb's (1994) nuanced study of Hawaiian *heiau* identified a two-stage process where the struggle for territory led to the construction of large public monuments, an activity which bound elites and commoners together in a common ideology. As the process of political centralization continued, elites shifted their political strategy from the control of corvée labour used in temple building to the production of food and material items used in the chiefly religious economy, centered on increasingly complex temple structures.

If the rise of complex societies is figured in the construction and social use of monumental architecture by chiefs/elites, then the abandonment of massive structures, in unilinear models, suggests simplification of prehistoric social structures or even socio-political collapse.

Consistent with this view is that the toppling and abandonment of the colossal *moai* statues on Rapa Nui has been seen as a catastrophic change to the social order. This interpretation also has some support from indigenous traditions (Kirch 1984, 2000). However, archaeological research and ethnohistorical records indicate that destruction should be viewed as a continuous process with several *huri moai* (statue toppling) phases, the last of which was the most pronounced and is identified with ideological change (Martinsson-Wallin 2000:53). Rather than society-wide collapse, the purposeful destruction of monumental architecture in termination rituals is relatively common, and can signal a shift in the location of political power within a society, as well as a change in the religious-ideological basis of authority (Mock 1998; Stross 1998).

The demise of the Cahokia chiefdom of the Mississippi River Valley at 1250AD is also inferred from a decline in mound construction, and the end of temple building on Malta at 2500BC has been seen as a calamitous socio-political break. In both instances, archaeologists have subsequently found evidence for the continuity of these complex societies, despite a shift away from the construction of monumental architecture (Bonanno *et al.* 1990; Trubitt 2000). Kolb (1994) also found that the amount of labour expended on Hawaiian temples was greatest early on, and then declined, despite the subsequent increase in the power of chiefs and the larger size of socio-political formations in Hawaii.

The existence of socio-political complexity that is independent, to some extent, of the construction and use of monumental architecture suggests a significant change in the expression of political power. Binary or dual-processual models of political development have monumental architecture not as the sole product of chiefs and elites, but rather as the materialization of a communal political strategy, which can alternate with the monopolization of power by elites.

Dual political strategies

Renfrew (1974) attributed monumental architecture to a particular form of political strategy, distinguishing between 'group-orientated' and 'individualizing' societies to explain differences in the archaeological remains of the chiefdoms of prehistoric Europe. Group-orientated chiefdoms were marked by kinship affiliation, impressive public works, large architectural spaces for communal ritual, no evidence in either the mortuary practice or the settlement pattern for social domination by particularly powerful individuals, and suppressed economic differentiation. In individualizing chiefdoms, power was achieved by the accumulation of personal wealth, the consumption of elaborate prestige goods made by attached specialists, and frequent warfare (see also Feinman 1995:268). Monumental architecture in group-oriented chiefdoms took the form of relatively open public structures and spaces, whereas elite residences and elaborate burial structures were symptomatic of the high status of leaders in individualizing chiefdoms.

Trigger (1990) also briefly considered the possibility that types of monumental building might indicate differences in the form of political power. He suggested that in terms of energy expenditure, a focus on temple building might represent the need for an upper class to consolidate a hierarchical political order. Palaces equate with the growing concentration of power in the hands of a paramount lineage headed by a high chief or king, and large amounts of energy spent on royal burials represented the highest form of centralized power (*ibid*:128).

Dual-processual theory focuses on the different strategies of leadership in complex societies, and contrasts 'corporate' with 'network' strategies (Blanton *et al.* 1996), which share similarities with Renfrew's group-orientated, and individualizing, chiefdoms. In the corporate strategy political power is controlled by clans or lineages, and leaders stress group cohesion and interdependence through construction of monumental public structures and large-scale public ceremony, which create and emphasize a cognitive model of social solidarity. The political economy is based on the intra-group collection and redistribution of staple foods, and for this reason the corporate political economy is frequently associated with productive agricultural areas.

In the network model, individual leaders attempt to consolidate and increase their power by controlling the production and exchange of prestige goods, which are used to assemble local and non-local networks of followers. Control of prestige items is fundamental to the manipulation of personal connections in the network strategy. Complex social systems can develop, therefore, in marginal environments, where the potential for agricultural intensification is limited. Ancestral ritual legitimates the control of society by a small number of highly ranked individuals, and monumental architecture, such as statuary, sumptuous mortuary structures and elite residences, promotes the power of individual leaders.

West Polynesia's archaeological record has not yet reached a point where the signature of network versus corporate political strategies can be extracted, but there is growing evidence for substantial interaction in the Central Pacific in the last 1000 years. Archaeologists have examined the long-distance transfer of prestige goods (Best *et al.* 1992; Clark 2002), while anthropologists and historians have examined the inter-archipelago movement of high-status marriage partners (Kaeppler 1978; Gunson 1997).

Such selective approaches, although useful in reconstructing facets of late prehistoric social interaction, tend to mask the overall nature of socio-political complexity in West Polynesia. This is evident when considering relations between the two-best documented archipelagoes of Tonga and Fiji.

In Table 1, the extent of late-prehistoric contact is outlined using ethnohistoric, ethnographic and archaeological information. By category, most material culture items, plants and animals and skilled/high status individuals were taken from Fiji for use in Tonga, whereas built structures were transferred or instituted by Tongan arrivals to east Fiji. The pattern is evidence for a strong Tongan presence in the region that would be difficult to reconstruct from the archaeological record alone, as most of the material items would not have survived or be identifiable as imports, and the relatively small number of Tongan structures in east Fiji could result from the relocation or exile of Tongan groups, rather than from economic interaction sanctioned and commissioned by a central authority in Tonga as asserted in tradition (e.g. Gifford 1929).

Item	Direction	Source	Estimated Date (AD)	Reference
People				
Marriage partners	Fiji to Tonga & Tonga to Fiji	Ethnographic	1640-	Gifford 1929:34; Reid 1977:7-8
Carpenters	Tonga to east Fiji	Ethnographic	1640-	Young 1982:35
Warriors	Fiji to Tonga	Ethnohistoric	1790-1840	Derrick 1950:293
Ceremonial attendants	Fiji to Tonga	Ethnographic	1300, 1600	Gifford 1929:65
Structures				
Fortifications	Tonga to east Fiji	Archaeology	1100-	Best 1984:658
Beach rock quarrys	Tonga to east Fiji	Archaeology	1750-	Smart 1965; Best 1984:46
Faced burial mounds	Tonga to east Fiji	Archaeology	1650-1750	Smart 1965
Canoe building ‘village’	Tonga to east Fiji	Archaeology	1650-1800	Smart 1965
Plants and Animals				
Dog	Fiji to Tonga	Ethnohistoric	1770-1780	Beaglehole 1967b:144-145
Pig	Tonga to Fiji	Ethnohistoric	1770-1780	Beaglehole 1967a: 958-959
Parrot	Fiji to Tonga	Ethnohistoric	1790-1800	D’Entrecasteaux 2001:189
Sandalwood tree	Fiji to Tonga	Ethnohistoric	1790-1800	Labillardière 1800: 177
Material Culture				
Stone adzes	Fiji to Tonga	Ethnohistoric	1790-1800	D’Entrecasteaux 2001:189
Canoes	Fiji to Tonga	Ethnohistoric	1790-1800	Labillardière 1800:138
Sail mats	Fiji to Tonga & Tonga to Fiji	Ethnohistoric	1800-1810 &1840-1850	Martin 1981:190; Williams 1982:94
Sandalwood	Fiji to Tonga	Ethnohistoric	1790-1810	Labillardière 1800:177; Martin 1981:351
Red feathers	Fiji to Tonga	Ethnohistoric	1770-1780	Cook and King 1784:375
Pottery	Fiji to Tonga	Ethnohistoric	1770-1780	Beaglehole 1967a:958-959
Beaded baskets	Fiji to Tonga	Ethnohistoric	1770-1780	Bayley in Kirch 1984:239
Decorated bark cloth	Fiji to Tonga & Tonga to Fiji	Ethnohistoric	1770-1780 & 1800-1810	Beaglehole 1967a:164; Martin 1981:190
Spears and clubs	Fiji to Tonga	Ethnohistoric	1770-1780	Beaglehole 1967a:958-959
Mats	Fiji to Tonga & Tonga to Fiji	Ethnohistoric	1770-1780 & 1840-1850	Bayley in Kirch 1984
Sinnet	Fiji to Tonga & Tonga to Fiji	Ethnohistoric	1800-1810 & 1840-1850	Martin 1981:190; Williams 1982:94
War bows and arrows	Fiji to Tonga	Ethnohistoric	1800-1810	Martin 1981:68-69
Whale tooth ornaments	Tonga to Fiji	Ethnohistoric	1800-1810	Martin 1981:359
Stingray spear points	Tonga to Fiji	Ethnohistoric	1800-1810	Martin 1981:190
Inlaid clubs	Tonga to Fiji	Ethnohistoric	1840-1850	Williams 1982:94
White cowrie shells	Tonga to Fiji	Ethnohistoric	1840-1850	Williams 1982:94

Table 1. Interaction between Fiji and Tonga from archaeological, traditional and ethnohistorical sources.

The import of prestige goods and weapons from east Fiji to Tonga, evidence for strategic marriages among chiefly families, and frequent recourse to warfare appears to fit a network strategy (Blanton *et al.* 1996). It is still uncertain whether early political development in Tonga was different to that recorded by Europeans in the 18th century as seems likely, or whether corporate and network strategies alternated through time. The earliest Tongan involvement in east Fiji, for instance, might have involved construction of a massive fortification on Lakeba Island at 1100AD (Table 1), substantially predating the extraction of products and people from Fiji in the proto-historic era.

At the Pulemelei mound (Clark and de Biran, this volume), a geophysical study suggested a hiatus between the building of a large unelaborated base platform and the addition of the paved top platform and the construction of features such as entrance pavements and sunken access ways. The base platform has an approximate area of 3000 m^2, compared with the substantially smaller top platform area of 1300 m^2. The reduction in area and the increased elevation of the top platform appears to have emphasized exclusionary, rather than corporate, power. Traditional records, although meagre, link the final use of Pulemelei to the high chief Lilomaiava Nailevaiiliili, but archaeological evidence does not yet indicate a final residential use for Pulemelei, as Green (1969b) observed about several earth mounds on Upolu. Further investigation of the buried surface of the base platform is required to show whether it was used for communal events, consistent with a corporate political structure.

Conclusion

Monumental structures are important archaeological sites because they can contain in compressed form details of a culture's socio-political development. As the above review illustrates, there are diverse opinions about the origin of monumental architecture, how chiefly power is represented by large constructions, and whether change in the production and use of massive structures reflects perturbation in the prehistoric socio-political system. These are major issues in Pacific prehistory, as the archaeological record of the past 1000 years shows the existence of complex societies in Polynesia as well as in islands outside Polynesia (e.g. Fiji, New Caledonia, Kosrae, Pohnpei), and their emergence has implications for understanding the development of chiefdoms and states in other parts of the world (Kirch 1990).

In Polynesia a rich ethnographic and ethnohistoric corpus has informed understanding of monumental architecture (Kirch 1990; Wallin 1993; Martinsson-Wallin 1994; Stevenson 2002; Graves and Sweeney 1993). When subjected to archaeological investigation, however, large mounds and structures have frequently been shown to be multiphase constructions which contain evidence for change in the type and intensity of social use over several centuries or more (Wallin 1993; Martinsson-Wallin 1994; Trubitt 2000; Joyce 2004). For these reasons, the relatively narrow time depth of proto-historic sources may not accurately describe why a monumental structure was built, nor the full set of activities associated with it during prehistory.

Archaeological survey in Samoa, for instance has shown that the late-prehistoric settlement pattern was transformed following European arrival and a major population decline from introduced diseases (Green 2002). Prehistoric villages had a dispersed form, with habitations distributed from the coast several kilometres inland. Settlements also contained chiefly structures such as rare 'monumental' earth and stone mounds, star mounds, and ceremonial ovens (Herdrich and J. Clark 1993; Carson 2002). These structures were not present, or else were uncommon, in the nucleated coastal villages recorded from the 1830s on (Watters 1958), which were organized around a community space (*malae*) up to several acres in extent, itself difficult to identify in prehistoric settlements (Jennings *et al.* 1982).

Substantial change to the prehistoric Samoan settlement pattern, as manifested by the loss of chiefly architecture, suggests the presence of a political system which operated differently to that recorded in the 19th century. Previous analyses of social space identified continuity in the organization of Samoan households and in the structure of the community from the late prehistoric to the historic, but there is little reason to propose that shifts in political power would result in substantial change to household dimensions or the domestic division of social space (cf. Davidson 1974:236). For example, Jennings *et al.* (1982) analysed recent and prehistoric settlements on 'Upolu and Savai'i and concluded that social organization was stable during the past 500-600 years, but acknowledged that large mounds probably dating to the 16th and 17th century marked the "acquisition of considerable political power by a few individuals" (*ibid*:92), an opinion also formed by Green (2002:145).

In our view, the archaeological study of monumental architecture is an indispensable tool for identifying prehistoric political developments, such as the hypothesized accumulation of power by individuals in Samoa. Monumental structures are frequently seen as an outcome of particular environmental and demographic conditions, or as a statement of power made by leaders on their own behalf. In West Polynesia there is also substantial evidence for the spread of monumental architecture by migration and culture contact. A Samoan tradition, for example, records that when Langi, the daughter of the Tui Manu'a, Tonga Fusifonua, asked how she was to be known in Tonga her father replied that in order to establish her status and spiritual authority she should: ' "Make a mound and sit and face the Tongan people" that the Tongan people may know she sits from high above' (Gunson 1997:145).

Diachronic perspectives, such as dual-processual theory, that consider the development of monumental architecture over centuries in terms of socio-political process are still few in number, and detailed palaeoecological records to evaluate the correlation between environmental productivity and monumental architecture have yet to be established.

Our investigations at the Pulemelei mound have begun to gather archaeological data to understand a single example of Samoan monumental architecture, and we stress that it is premature to evaluate current evidence solely in terms of dual-processual theory, or as the expression of materialized ideology.

It is reasonable to argue, for instance, that mound building materializes chiefly power in West Polynesia, but we must then also ask how chiefly power was expressed in the previous two millennia before the emergence of a cultural tradition in which power and rank were manifested by earth and stone structures? Was it through the construction of larger-than-average structures that because they were made entirely in perishable materials have, to date, remained archaeologically invisible? Or, was early chiefly power largely expressed by portable material culture, particularly prestige products, consistent with elements of Renfrew's (1974) individualizing chiefdoms and the network strategy proposed by Blanton *et al.* (1996)?

Whatever the answer, monumental architecture is a non-portable, relatively permanent, and highly visible type of archaeological 'artefact' that continues to attract a cultural response well after the demise or transformation of the individuals and society that constructed and used it. Unlike most utilitarian and domestic archaeological remains, monumental architecture has embedded in its structure information about the nature of prehistoric socio-political organization. Archaeological approaches to extract such details require not only the accumulation of large amounts of data, but also an appreciation of the alternative theories by which monumental architecture can be interpreted. Testing the alternative with multidisciplinary evidence, particularly that from archaeology, palaeoecology and palaeodemography is now needed to refine our understanding of socio-political development in West Polynesia.

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The Excavation of Pulemelei Site 2002–2004

HELENE MARTINSSON-WALLIN, PAUL WALLIN and GEOFFREY CLARK

Abstract

This paper describes the results of archaeological excavations in the Pulemelei mound on Savai'i, thought to be the largest freestanding stone structure in Polynesia, in 2002-4. These excavations comprise the first large-scale archaeological investigation of a monumental complex in Samoa. We examine the chronology and function of the large mound and other structures.

Prior to our investigations, the Pulemelei mound and other prehistoric features in the Letolo plantation had been surveyed, and used to interpret Samoan demography and settlement patterns in the late prehistoric period (Jennings *et al.* 1982; Scott 1969; Green 2002; Asaua 2005). The extensive survey of prehistoric remains at Letolo plantation by Gregory Jackmond in 1977-1978 recorded more than 3000 features, including 1059 stone platforms, roads, along with stone fences and walkways, earth ovens and refuse piles (Jennings *et al.* 1982: 87-93, see Wallin, Martinsson-Wallin and Clark, this publication, Figure 1). The Pulemelei mound in traditional history had been suggested to be a *tia seu lupe* (pigeon snaring mound) and/or the residence of the chief *Lilomaiava Nailevaiiliili*, who is suggested by Krämer (1994:243) to have lived 25 generations ago (ca. 1650-1680AD).

Previous researchers have noted: "four stone seats each with a conch shell" on top of the Pulemelei mound (Asaua 2005:82), and Scott (1969:82) reported the: "original informants suggestion that these [stone cairns] were receptacles or pedestals for large shell trumpets (*foafoa*)". A local tradition records that the mound was the residence of gods and spirits (*atua, aitu*), who were called back to the mound each night by the sound of a shell trumpet (Pulenu'u Toluono Pene, Vailoa village, pers. comm. 2006). A fragmentary shell trumpet (*Cassis* shell) was found beneath stones on the upper platform during cleaning of the mound in 1965 (Figure 1). A spire of *Triton* shell was also found on the smaller North mound (Scott 1969:86). During Scott's mapping (1969:80) ten stone cairns were found on top of the Pulemelei mound, but when the mound was re-mapped by us in 2002 about 40 cairns were recorded. The low cairns were removed during geophysical survey of the mound in 2004, but soon afterwards several cairns were set up. Workers from the local village who assisted in our investigations also brought shell trumpets to the Pulemelei mound.

Prior to our initial investigations in 2002, there was limited archaeological knowledge about the Pulemelei mound, particularly its age, function, and relationship with adjacent prehistoric structures. Our project also focused on understanding the social context out of which a mound building tradition emerged, and the cultural connections among the prehistoric societies in Fiji-West Polynesia. To investigate the origin and development of large mounds in Samoa archaeological excavation, remote sensing and detailed mapping were made at the Pulemelei mound during three field seasons from 2002 to 2004.
The investigations had the following aims:

1. Determine the chronology and construction sequence of the Pulemelei mound and adjacent structures by archaeological investigation.
2. Examine the development and meaning of monumental architecture at the Letolo plantation, and contrast Samoan monuments with those from other parts of West Polynesia.
3. Provide archaeological fieldwork and cultural heritage training for Samoan and overseas students, particularly the management of monumental sites impacted by tourism.

Figure 1. Shell trumpet (*Cassis*), found among stone rubble on the top of mound in the 60s. Auckland Museum.

In this paper we focus on the first of these aims by presenting and discussing basic information about the archaeological investigations made at the Pulemelei site.

Mound building

The trend toward mound building in Samoa is apparent among other islands in West Polynesia during 1100-1700AD (Davidson 1979: 95; Green 2002). Contact and interaction between islands in West Polynesia is suggested by prehistoric material remains, and is evident in ethnohistorical accounts and traditional history (Clark 2002; Barns and Hunt 2005). However, the material expression is not homogeneous and differences among the late prehistoric landscapes of West Polynesia reflect the contingent cultural and environmental context on each island, and the specific influence of external interaction among island groups (see Clark and Martinsson-Wallin, this publication).

In Samoa, large house mounds of stone and earth are found on Savai'i and 'Upolu, but are rare or absent in American Samoa (Buist 1969:39; Davidson 1974:225-7; Clark 1996:452). Results of archaeological excavation and examination of traditional history suggest that large mounds – like those at Vailele on 'Upolu – had a residential function, and may have been constructed as early as 1100AD, with continued use until ca. 1800AD (Green and Davidson 1974:219). It is also possible that Samoan mound building was influenced by intermarriage and war with Tonga (Kirch 1984:238-42). Jennings *et al.* (1982:92) suggest that the Pulemelei mound was built in the 17th century, as large mounds investigated at Mt Olo were likely to date to this period. Traditional records indicate that large mounds could have several functions including pigeon snaring, house foundations and ceremonial use (Scott 1969:87-90; Tamasese 2003, 2004). It has also been suggested that large Samoan mounds might be chiefly burial structures similar to the Tongan *langi*, but Davidson (1974:229-30) concluded that burials mainly occurred in shallow pits under, or, close to house foundations, and the raised mounds were residential units for high chiefs or were foundations for religious structures.

The Letolo site survey of prehistoric structures made by Jackmond (1977-78) has been used previously to analyse the distribution of prehistoric remains, particularly stone mounds, in order to reconstruct the Samoan settlement pattern. Results showed that settlement at Letolo was similar to that reported at Mt Olo on 'Upolu and Sa'papaili on Savai'i, although being slightly larger in extent. According to Jennings *et al.* (1982:87-92) the Letolo settlement consisted of five village 'wards' (*pitonu'u*), each of which comprised a cluster of two-to-five large platforms near a primary walkway and 50-75 household units enclosed by walkways and fences.

Site setting

At Letolo plantation in Palauli district the large stepped mound known as Pulemelei is situated about 1.5 km inland from the coast at ca.100 m above sea level (Figure 2). It has the base dimensions of ca. 65 m by 60 m and a maximum above ground height of ca. 12 m. The plantation extends from the coast ca. 2.5 km inland to ca. 250 m above sea level (asl) on the south coast of Savai'i, and is bounded to the east by the Faleata River and on the west by the Seugagogo River.

The Letolo plantation is owned by the Nelson extended family, and in the past has been a copra plantation. The land is currently used for cattle grazing, but there are plans to develop the area for tourism in the future. According to Vailoa village the freehold plantation land is considered to be village land, and there have been several disputes between the plantation owners and the *matai* of Vailoa over

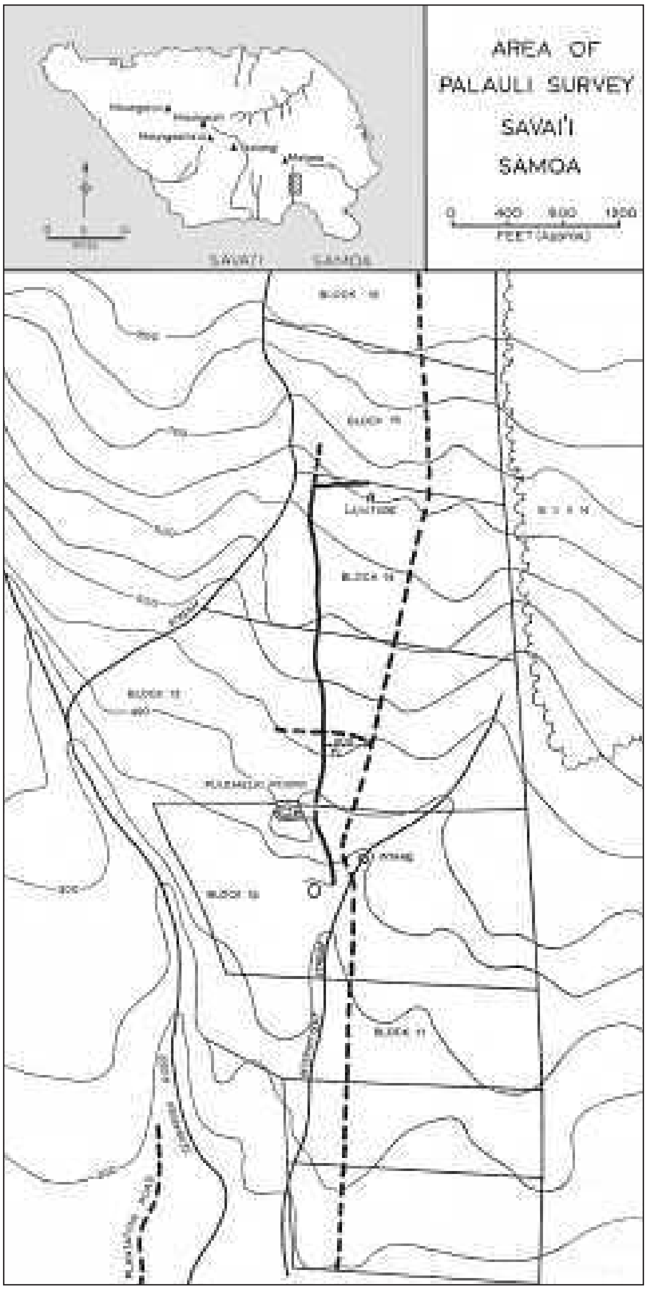


Figure 2. Letolo plantation and location of Pulemelei mound.

the years. Ownership of the Letolo plantation is the subject of a current court case. Since plantation activities ceased in the 1980s a thick growth of secondary tropical vegetation has covered most of the plantation, but the Pulemelei mound and the Afu Aau (Olemoe) waterfall on the property are two of the main tourist attractions on Savai'i, and these are cleared and managed periodically.

Archaeological investigations 2002–2004

The archaeological investigation of the Pulemelei mound involved collaboration between academics (Helene Martinsson-Wallin, Paul Wallin, Kon-Tiki Museum Research Institute and Geoffrey Clark, Australian National University) and Samoan land owners represented by the board of the Nelson Corporation. Fieldwork was carried out during September 13–October 10 2002, July 17–August 15 2003, and June 5-25 2004. Preliminary results from the excavations have been presented in several reports and papers (Wallin *et al.* 2002; Martinsson-Wallin 2003, 2005; Martinsson-Wallin *et al.* 2003, 2005). Additional excavation carried out at Letolo in March 2006 is reported elsewhere (Martinsson-Wallin *et al.* 2006).

The 2002 field season concentrated on clearing and mapping the Pulemelei mound, which was covered in a thick growth of tree and scrub vegetation, with several small test excavations made around the base of the mound. An area of ca. 20,000 m^2 was cleared of vegetation during investigations (Figure 3 a, b, c). In Scott's (1969: 81) initial

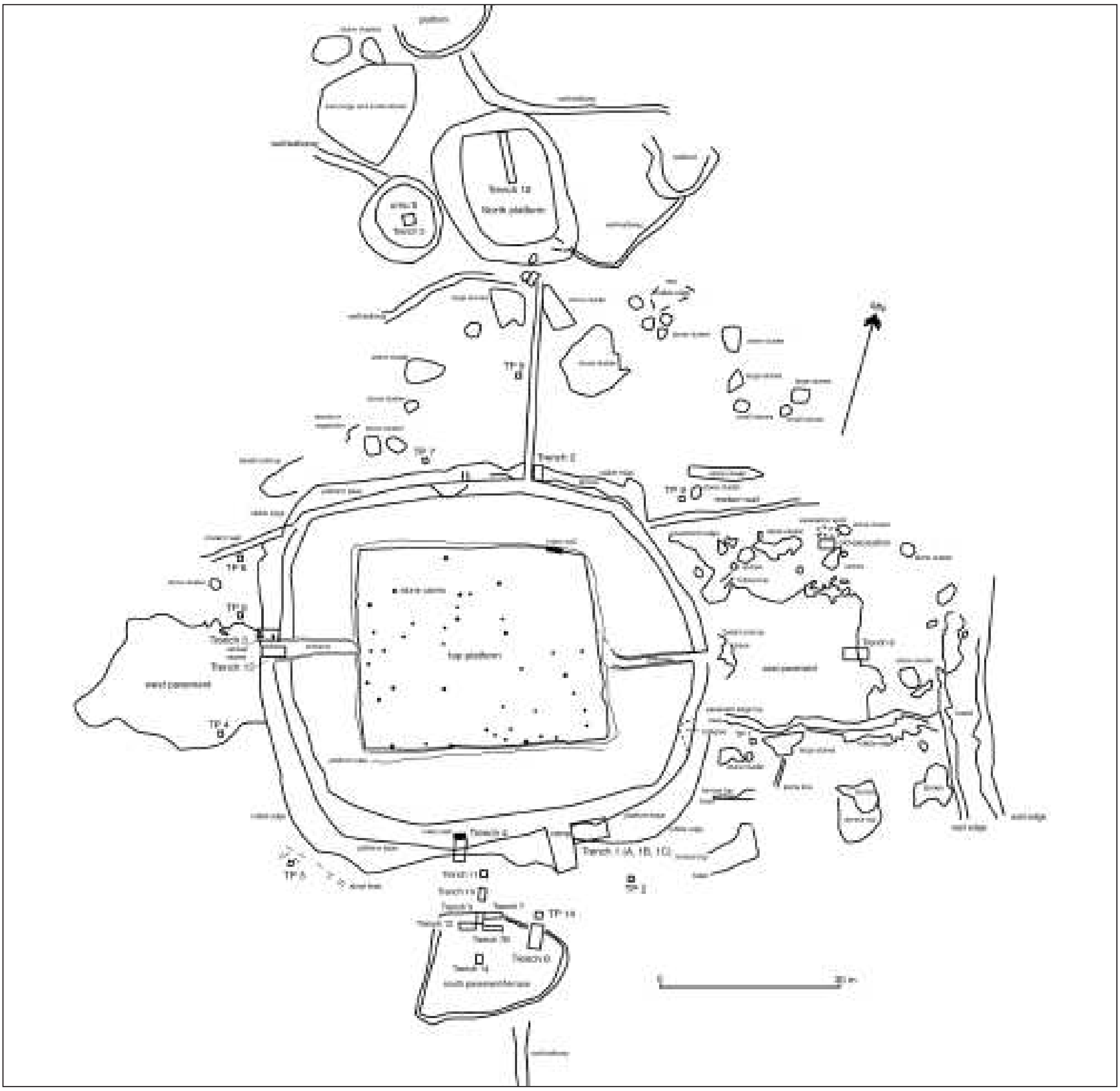


Figure 3a: Pulemelei mound and surrounding features.

Figure 3b: North-South Section of Pulemelei and North mound; 3c: East-West Section of Pulemelei and East platform.

description of the Pulemelei mound made in 1965, he noted that its shape was essentially unaltered, with only a minor amount of stone collapse as a result of tree fall. Photos of the mound taken between 1965 and 2002 (in addition to photographs of the mound published by Green and Davidson (1969a), plus additional slides and photographs provided by Roger Neich, Peter Bellwood and Arne Skjølsvold) show that some parts of the mound have experienced substantial deterioration, particularly platform corners and wall sections of the base platform.

Description of the Pulemelei mound

The Pulemelei mound consists of a lower base platform on which was built at least two smaller platforms. Of the two smaller platforms the main structure is the top platform. Overall, the prominence of the base platform and top platform give the mound a stepped or two-tiered profile. Detailed mapping of the Pulemelei mound suggests it was constructed, however, in three distinct steps (Figure 4). The first step was the construction of the base platform with a level surface, and a higher wall on the south side than on the north side, due to the prevailing ground slope. A second step was then placed on the surface of the base platform, on top of which the third and final top platform was constructed. The base platform of the Pulemelei mound is 65 m along the east-west axis and 60 m along the north-south axis. The smaller top platform is 41 m along the east-west axis and 32 m along the north-south axis. The entire mound was made from natural volcanic stones that are locally abundant, and no worked stones were identified in the mound.

The stone rubble along the edges of the mound is extensive, but in some areas where ramps or supporting walls were constructed the original walls of the mound have been preserved. The foundation of the base platform was outlined by placing a line of tabular basalt slabs upright in a shallow trench dug into the ground surface (Figure 5). The rectangular foundation outline was then filled by stacking the basalt slabs horizontally on top of the foundation stones until the base platform reached a height of 3-4 m on the south side. As a result of dry stone construction, the platform walls have sides slightly angled away from the vertical.

Above the base platform the stones slope inward, but it could not be determined if there had been one or more additional steps, or if there was a single sloping surface from the base platform to the base of the top platform. Along the south side of the mound just below the top platform there was evidence of a small step, but a corresponding feature was not seen on the north side. The top platform consists of a rectangular area paved with small water-rolled stones, and

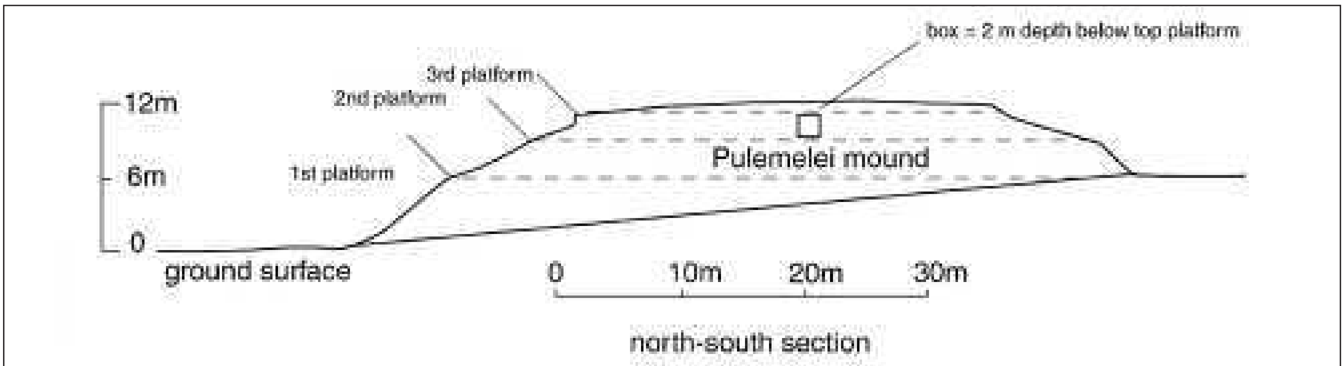


Figure 4. Detailed North-South Section of Pulemelei mound indicating three construction stages.

likely represents the final construction event. On the east and west side of the mound there are two sunken entranceways, which provide access to the top platform.

Extensive stone outfall caused by structure instability, tree growth and human activity is evident on all sides of the mound. The base platform originally had near vertical sides, but the second platform may have had slightly slanting sides. Due to subsequent wall collapse the sides of the base platform now appear to be steeply sloped. There has been relatively recent removal of stone from the mound to build fences on the east and northwest side of the structure (Figure 6). However, the entranceways on the east and west side of the mound, and the ramp on the south side, were probably constructed after the base platform was built, and indicate alteration of the Pulemelei mound in the past.

Other structures in the vicinity of Pulemelei mound

About 50 m to the north of the Pulemelei mound, and connected to it by a wall or raised walkway, is a smaller mound, we have called the 'North mound' (Figure 3a). The North mound is orientated north-south and has a base that is ca. 30 m long and 24 m wide. The top of the mound is ca. 20 m by 12 m, and the mound surface is uneven and

Figure 5. The foundation structure and original wall of first platform on the South side (Photo Paul Wallin)

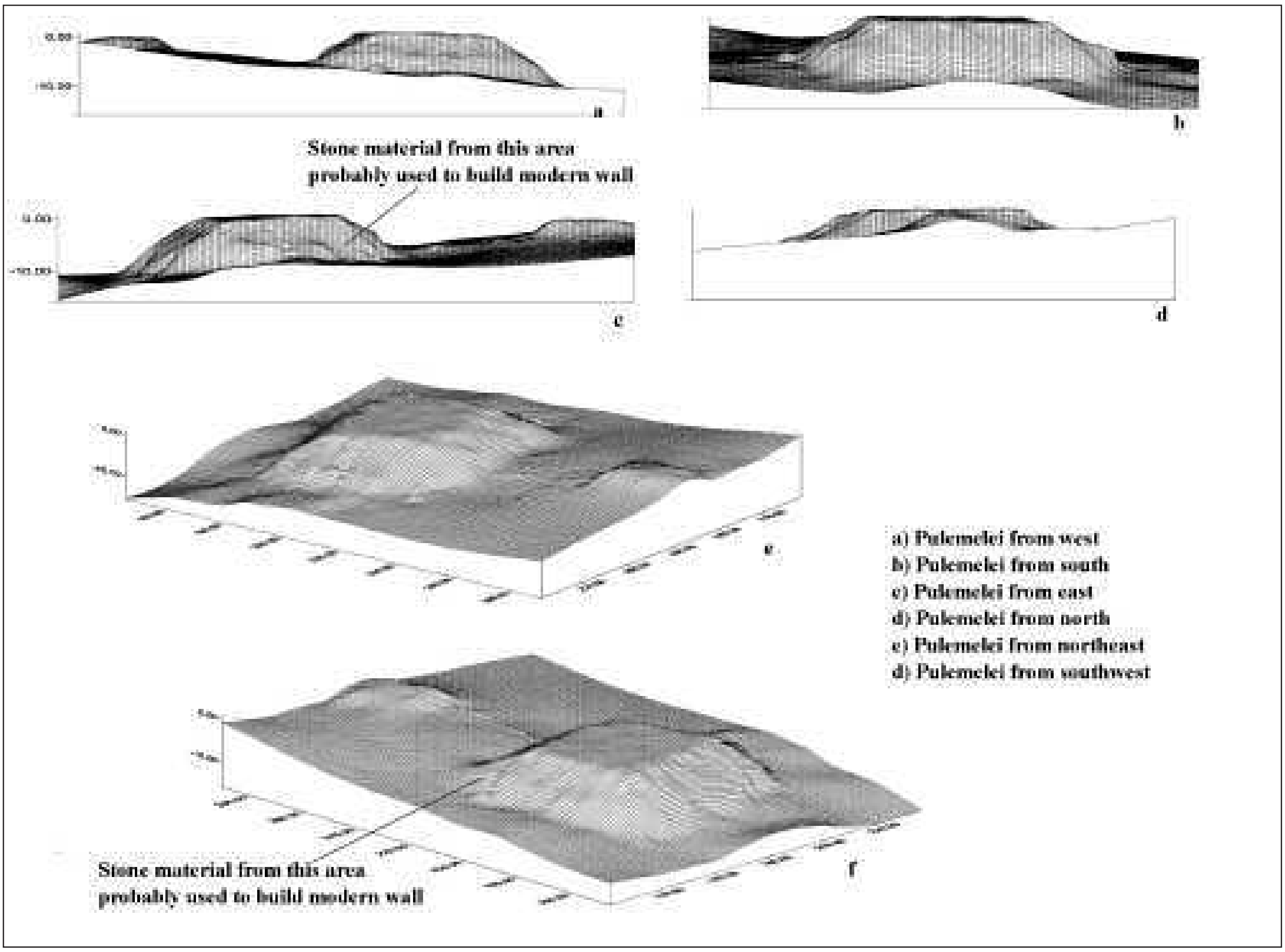


Figure 6. 3-D reconstructions of the mound.

appeared unpaved. During excavation, small water-rolled stones were found close to the mound surface. Due to tree root growth and collapse the paved surface of the North mound has been extensively disturbed. This has not occurred to the same degree on the Pulemelei mound due to more frequent vegetation clearance of the top platform, and the greater height and distance of the mound from surrounding vegetation. On the south side the North mound is ca. 2-3 m high and on the north side it is ca. 0.5 m high. The height difference is due to the slope of the ground surface, which slopes down toward the south. There are several pits on top of the North mound that are probably caused by tree collapse. Just west of the mound there is a raised rim oven with an exterior diameter of ca. 12-13 m (Figure 3a).

There are an additional 60 features around the Pulemelei mound that have been mapped and described. These features consist mainly of stone heaps, stone walls, large boulders and small platforms (Figure 3a). One of the stone heaps (F 12) was excavated in the 1960's (Scott 1969:82) and the trench could still be seen in 2004, and another stone heap (F 40) was excavated by us. The stone heaps were thought in the 1960s to mark graves, but no human remains or cultural material were found in excavations below the stone piles, and they most likely represent clearance of surface stones.

The east entrance to the Pulemelei mound is located in an area of level bedrock, with a pavement of smaller stones continuing 25 m eastward. The east pavement has an asymmetric edge, and with its concave sides somewhat resembles a star mound platform. However, stone scavenging for plantation fences may have altered the pavement shape. About 15 m to the east of this pavement is a walled road (*fua i ala*). On Jackmond's survey map the walled road continues upslope several hundred meters to the north, where his survey ended. Toward the northeast corner of the Pulemelei mound a modern stone fence connects to the mound, with another modern fence at the northwest corner, which continues westward some 60 m. Stones from the mound and nearby prehistoric structures have probably been used to build this fence.

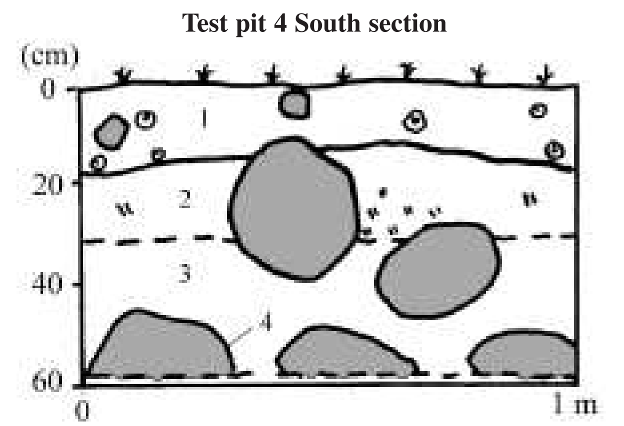
The west entrance to the Pulemelei mound also has an irregularly shaped pavement, but there was insufficient time to fully clear and map it. At the southwest corner of the Pulemelei mound there is a wall or raised walkway, which continues some 60 m to the west. On the north side of Pulemelei is a wall/raised walkway ca. 1 m wide and 0.5 m high, which connects the base platform of Pulemelei with the North mound. This north wall/walkway is joined to another walkway that continues to the west side of the North mound for about 30 m. Midway between the North mound and the Pulemelei mound, and a few metres to the east of the connecting wall, is another pile of stones about 7-8 m in diameter. Near the end of the north wall/walkway is a cluster of large basalt boulders. Similar boulders are found along the north edge of the east pavement near the entrance to the Pulemelei mound. According to the Savai'i-based geologist, Warren Joplin, these large boulders have likely been moved from the riverbed. Such stones have probably been placed intentionally, and might have special significance. To the south of the Pulemelei mound is another pavement area, which was identified as a house platform by Scott (1969:80).

Excavations

Nine test pits, (each 1 m^2) were initially excavated around the Pulemelei mound and the North mound in 2002. One test pit close to the Pulemelei mound had a buried earth oven, and single ceramic sherds were found in two test pits, indicating early human activity in the area (Wallin *et al.* 2002). A total of fourteen test pits and sixteen trenches have been excavated, with a total excavation area of 112 m^2 (Figure 3a).

Excavation showed that the thickness of the soil deposit varied around the Pulemelei mound, with outcrops of surface bedrock at the east entrance and to the northeast of the mound. At the west entrance the soil depth was over 1 m, but in general the soil around the Pulemelei mound was ca. 60 cm in depth. A natural volcanic outcrop to the south of the mound has probably experienced some levelling of the top soil and been used in the past as a house platform, although all of the postholes mapped by Scott (1969) could not be identified in our investigations.

There is a simple sediment stratigraphy around the mound (Figure 7). The surface layer was a brown-yellowish humus soil mixed with silty-clayish loam 5-10 cm thick. Under this was a dark brown-to-yellow brown silty-clayey loam, with some rounded water-rolled and natural volcanic stones. This layer varied in thickness from 20 to 30 cm and contained scattered charcoal, which was found in almost all excavations. Below this was a dark yellow-brown silty-clayey with natural stones. Near the bedrock the sediment contained more clay. The bedrock was generally found at ca. 60 cm below ground surface.



1. Brown/yellow-brown vegetative soil with roots.
2. Yellow brown fine soil with scattered charcoal and river stones mixed with natural volcanic rocks.
3. Yellow brown fine soil with natural volcanic rocks.
4. Volcanic rock bottom.

Figure 7. Typical stratigraphy in the area (TP 4).

Excavation at Pulemelei mound

To investigate the construction of the Pulemelei mound one test pit and six trenches were excavated next to the mound walls at various places around the base platform (TP 1, Trench 1, 2, 3, 4, 13, 16) (Figure 3 a). The excavation trenches revealed the foundation slabs and dry stone wall of the base platform on the south, west and north side of the mound (Figure 5). The foundation stones of tabular basalt were found in Trench 1, 2, and 13, and they varied in size ca. 70-100 cm in greatest length. On the east side of the mound, the volcanic outcrop was used as the wall foundation. One earth oven and scattered charcoal occurred at the foundation level, and two earth ovens were recorded at a depth below the foundation stones, but outside the mound perimeter. An earth oven was also identified under the base platform in Trench 13 (Figure 8 a, b).

Test pit 1 and Trench 1 excavated at the monument foundation level close to the south side of the base platform, uncovered an earth oven and some scattered charcoal. The earth oven is dated by sample (ANU-11891) and scattered charcoal by sample (Wk-13864) (Table 1). A charcoal concentration recovered close to the monument foundation level on the west side in Trench 2 is dated by sample (Wk-13865) (Table 1). An earth oven found in Trench 1 on the south side ca. 35 cm below the foundation level is dated by sample (Beta-172928) (Table 1), and charcoal samples from two earth ovens on the west side of the mound in Trench 3 and 13, also stratigraphically below the monument foundation level, and just outside and under the mound, are dated by two samples (Wk-13869) and (Wk-16640), respectively (Table 1). Trench 4, excavated on the south side of the mound, did not penetrate to the monument foundation stones due to possibility of wall collapse.

Trench 16 was excavated to investigate the construction of the top platform. The stratigraphic sequence disclosed a top layer ca. 10-15 cm thick of small water-smoothed stones (*'ili'ili*), with larger stones and a sparse and discontinuous deposit of silty-clay to a depth of ca. 60-80cm. At this depth the water-smoothed stones became more prevalent again and at ca. 1.0 m larger stones and silty-clay were again recorded. When clearing the mound of vegetation the roots of several large trees were removed from the top platform. In doing so, a charcoal concentration was found at 60 cm below the top platform. The sample (ANU 11890) (Table 1) was sandwiched between two stones and did not appear to be fragmented charcoal that had infiltrated from the platform surface (Figure 9).

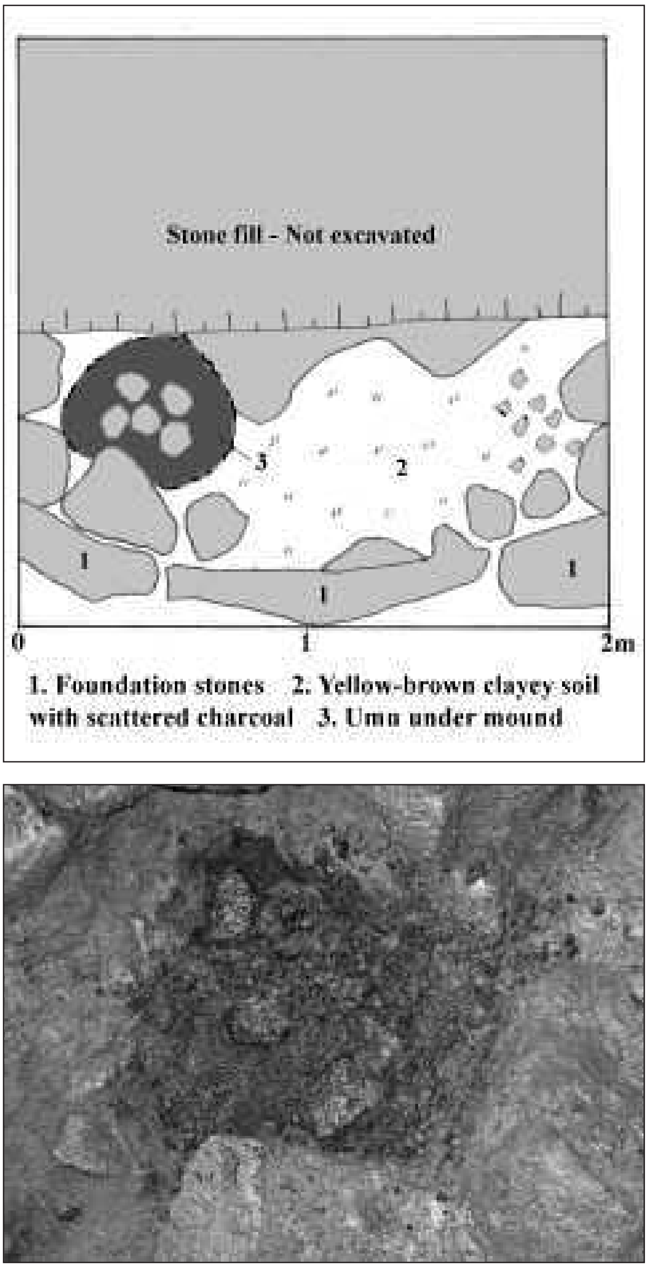


Figure 8. a: Plan of hearth under the mound and foundation stones (Trench 13);
b: Photo of the hearth. (Photo Helene Martinsson-Wallin)

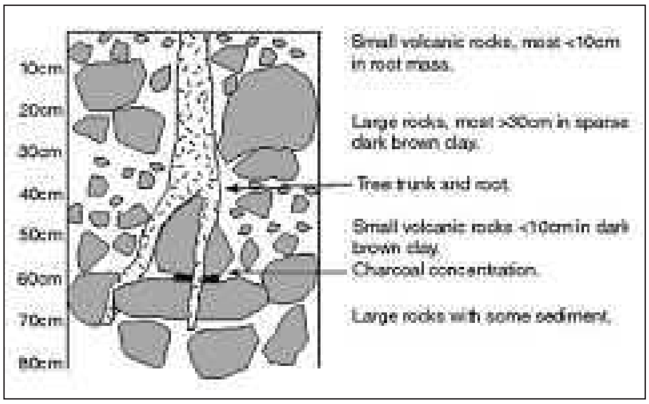


Figure 9. Section of top platform with tree stump and charcoal.

Excavation of the Umu tī, and the North mound

Jackmond's survey map showed a large raised-rim oven to the west of the North mound. Trench 5 was opened to study the structure, which confirmed it was a large earth oven with a size and morphology consistent with an *umu tī* oven (Figure 10). The Trench 5 excavation was 2 x 2 m, and was

SITE	LAB. NO.	AGE B.P.	AGE (1 SIGMA)	AGE (2 SIGMA)	FIND CONTEXT
SS-Le-1	Wk-13866	372±43	AD 1496-1521, 1536-1626	AD 1462-1637	Pulemelei, Umuti, Trench 5
SS-Le-1	ANU-11890	310±90	AD 1495-1672, 1743-1797	AD 1449-1712, 1718-1813, 1836-1951	Pulemelei mound, top platform
SS-Le-1	Wk-13867	454±46	AD 1437-1500, 1597-1611	AD 1418-1514, 1542-1624	Pulemelei, S terrass/platform, Trench 6
SS-Le-1	Wk-15503	657±34	AD 1313-1358, 1380-1395	AD 1298-1401	Pulemelei, Under N-Mound, Trench 15
SS-Le-1	Beta-177607	680±80	AD 1294-1392	AD 1229-1250, 1260-1434	Pulemelei, N-side c. -20cm, Scattered in Test Pit 6
SS-Le-1	Wk-13865	754±59	AD 1233-1245, 1264-1316, 1355-1382	AD 1219-1391	Pulemelei, Charcoal cons. N-side, Trench 2
SS-Le-1	ANU-11891	780±120	AD 1184-1324, 1344-1389	AD 1042-1092, 1099-1419	Pulemelei, Umu at E-side, Test Pit 1
SS-Le-1	Beta-172927	850±50	AD 1190-1273	AD 1053-1072, 1149-1291	Pulemelei, Charcoal conc. SW side, Test Pit 3
SS-Le-1	Wk-13864	900±43	AD 1054-1060, 1150-1228	AD 1046-1085, 1110-1272	Pulemelei, Charcoal scatter S-side, Trench 1B
SS-Le-1	Wk-16642	955±44	AD 1045-1086, 1108-1121, 1128-1182	AD 1033-1211	Pulemelei, umu at S-side, Trench 10
SS-Le-PT	Wk-15504	992±34	AD 1036-1052, 1076-1148	AD 1023-1162, 1170-1175	Pa Tonga, Letolo plantation Original surface
SS-Le-1	Wk-15502	1134±37	AD 898-921, 944-994, 1009-1011	AD 891-1021	Pulemelei, scattered W-entrance, Trench 13
SS-Le-1	Wk-16640	1135±34	AD 898-920, 945-994	AD 894-1018	Pulemelei, Umu under Pulemelei mound, Trench 13
SS-Le-1	Wk-13869	1157±44	AD 895-927, 934-987	AD 783-788, 814-843, 860-1022	Pulemelei, Umu, W-side, Trench 3
SS-Le-1	Beta-172928	1250±100	AD 709-747, 766-900, 918-961	AD 659-1016	Pulemelei, Umu at S-side, Trench 1
SS-Le-1	Wk-13868	1993±55	AD 1-129	BC 51-227 AD	Pulemelei, Umu at plain ware site, Trench 7
SS-Le-1	Wk-15501	2058±38	BC 45-32 AD, AD 36-52	BC 156-138, BC 113-82 AD	Pulemelei, Umu at plain ware site, Trench 9

Table 1. Radiocarbon dated samples from the excavations at Pulemelei site. All samples are charcoal.

placed inside the rim of the oven. When the oven was cleared of vegetation the outer rim edge could be traced. The size of the oven was ca. 12 m in diameter and up to 1.5 m deep. The stones used in the oven varied in size between 20 cm and 60 cm in greatest length. Burnt vegetation was found among the oven stones, with a particularly concentrated deposit of large amounts of charcoal at the oven base, which was sloping bedrock. A charcoal sample from this deposit at the bottom of the *umu* has been dated (Wk 13866) (Table 1). The *umu* oven stones were blocky and quite large, and some had been weakened by exposure to high temperatures, and broke during removal. At the base of the *umu* the oven temperature had been high enough to oxidize the iron in the basalt stones, which were orange-red in colour. The large *umu* is interpreted as having been used for cooking the root of the *tī* plant (*Cordyline fruticosa*). The high temperature and prolonged cooking period required for *tī* roots necessitated a large-sized oven and significant amounts of combustible fuel (Carson 2002:362). Based on ethnographic evidence the *tī* plant was cooked at high temperature in order to be caramelized, and through this metamorphosis it may have contributed to ritual ceremonies (Carson 2002:347).

The North mound beside the umu *tī* was investigated with an excavation called Trench 15 that was 8 x 1 m in length (Figure 11), and located from near the middle of the north edge of the mound toward the centre of the mound. The excavation showed that the North mound had once been paved with small, rounded stones, as is typical of many Samoan house platforms today, but vegetation growth and tree fall had dispersed much of the pebble surface. The North mound had a central core of large and small stones in silty-clay, while the outside mound edges were entirely of large rock. At the base of the mound there was a thick deposit of charcoal on the volcanic outcrop base. A sample from the base of the mound has been dated (Wk-15503) (Table 1). A basalt adze of Type X, and an adze flake were found in the silty-clay between stones, and had evidently fallen between platform stones in the past.

Excavation of the South ‘house’ pavement

The surface of the south terrace with a stone pavement (Figure 12) was paved with irregular volcanic rocks. Circular depressions on the stone pavement were identified as postholes by Scott (1969: 80), but only one possible posthole was verified during our excavation. Excavation of Trench 6, 7, 7b, 9, 12, 14 (Figure 3a) showed that beneath dark brown topsoil ca. 5 cm thick, there were a pavement

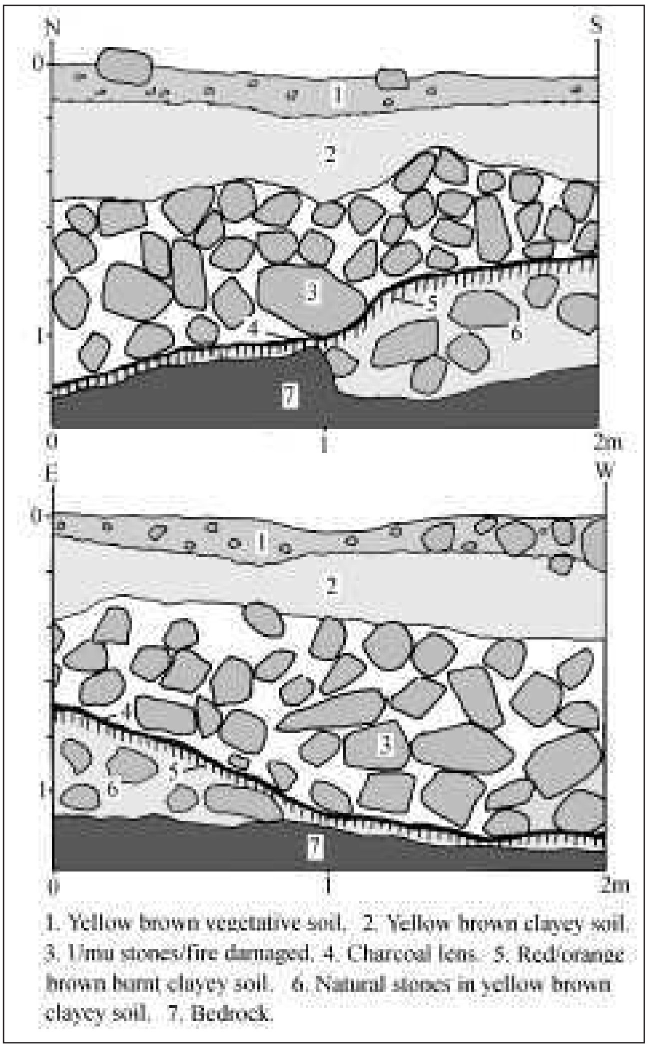


Figure 10. North-South (top) and East-West (bottom) sections of part of *umu tī* in trench 5.

Figure 11. North-South section of North mound. (Photo Helene Martinsson-Wallin)

ca. 20 cm thick consisting of two stone layers and containing stones ca. 10-15 cm in greatest length. Among the pavement stones were some water-smoothed pebbles 5-10 cm in size, which are typically used for paving house floors today. In Trench 7, the edge of a probable house foundation was found. The foundation edge consisted of eight stones that had been vertically placed in an east-west direction near the southern margin of the pavement (Figure 3a). A 'thick' ceramic sherd, fire-cracked stones mixed with charcoal and some water smoothed pebbles, as well as a few stone flakes were associated with this pavement. In Trench 9, a vertical slab and hole is interpreted as a posthole support. A charcoal concentration in the west-central part of Trench 6 has been dated (Wk-13867) (Table 1).

Figure 12. Platform south of Pulemelei with house pavement and earlier settlement activities. (Photo Helene Martinsson-Wallin)

The Pulemelei complex: mounds, house platform and *umu tī*

Taken together the mapping and excavation work provided new information about the age and construction of the Pulemelei mound. The base platform was outlined with vertical stone slabs and then built up by stacking stone slabs horizontally. The vertical foundation slabs in several of the excavation trenches had tilted outward from the weight of the structure, which suggests that the construction technique was unsuited for large structures (Figure 5). If additional platforms were added to the base platform, as seems likely, then the extra weight would have increased the pressure on the vertical foundation stones. Tilting of some vertical foundation stones caused wall collapse higher up the mound, and earthquakes, which are frequent in Samoa, tree growth, and human activity, have all contributed to structure deterioration.

The west entranceway (and probably the east entranceway) appears to have been late modifications to the Pulemelei mound. Excavation of the rubble edge along the base platform on the west side of the mound found water-smoothed pebbles (*'ili'ili*), similar to those used to pave the top platform. We estimate that the pebble surface was roughly level with the top of the base platform. In addition to results from the excavation, ground penetrating radar results (see Clark and de Biran this publication) also suggested the presence of a distinct layer below the top platform, and it is likely that the Pulemelei mound was constructed in several distinct episodes. The first was the building of a large level platform 3-4 m high on the south side that was paved on top with water-rounded pebbles. The presence of silty-clay with the pebbles probably reflects the inadvertent introduction of sediment from human activity. If so, then there is likely to have been a reasonable hiatus between the construction of the base platform and the addition of the smaller overlying platforms. The base platform was higher on the south side and was almost level with the ground on the north side, a platform style similar to that of the North mound (Figure 4).

The excavation and radiocarbon result from the top platform suggests it was a subsequent addition to the mound. The squared shape may indicate a ceremonial function (see Clark and Martinsson-Wallin, this publication), but there was no evidence for postholes that might indicate a temple or god house. However, we acknowledge that given the amount of disturbance evidence of postholes may no longer be identifiable.

Early settlement

Evidence for settlement predating mound building was found to the south and west of the Pulemelei mound, as well as underneath it. The latter two areas were close to each other and they also had similar radiocarbon ages.

On the south side of the mound is a natural terrace with low house platform (see description above) (Figure 12). Beneath this platform the oldest settlement deposit was found, and it was investigated with several trenches (Trench 7, 7b, 10, 12, 14). Under the stone pavement there were at least one occupation layer, and possibly two. The dark charcoal-stained soil in Trench 7 suggested a pit or earth oven. Ceramic sherds as well as a stone cylindrical lug/foot/handle and two grinding stones were found at 30-55 cm depth. Scattered charcoal was present in the trench down to a depth to about 50-60 cm. Below ~ca. 60 cm depth it was evident that the dark soil in the northwest part of the trench originated from a deeper earth oven, which had been disturbed at the top. Large pieces of charcoal were collected from the oven and a polished basalt chisel was also recovered. At a depth of 83 cm a piece of pottery was found inside the earth oven. At the base of the earth oven at 97-102 cm depth there were fire-cracked rocks (10-20 cm in diameter) and abundant charcoal.

Two charcoal samples associated with the earth oven, one from Trench 7 and one from Trench 9 (Wk-13868) and (Wk-15501) respectively has indicated a usage of this area going back at least 2000 years (Table 1, Figure 13). Only a small part of the earth oven was present in Trench 7, and it extended into Trench 9 and Trench 12, were there was also charcoal, fire-cracked stones and a few ceramic sherds. Since probably the major part of oven is to be found outside the excavated areas the true diametre of the oven could not be estimated but it seemed to be larger than 2 metres in diametre.

In Trench 14 the cultural layer below the pavement was thinner (ca. 20 cm) than that found in Trench 7, 9 and 12, and only a few ceramic sherds and basalt flakes were recovered. Trench 10 and Trench 11 (Figure 3a) were excavated to understand the connection, if any, between the evidence for prehistoric activity near the south wall of the Pulemelei mound and that under the south pavement below the house foundation. A posthole and an earth oven were found in Trench 10; a charcoal sample from the oven has been dated (Wk-16642) (Table 1). In Trench 11 there was an abundance of scattered charcoal, but no identifiable features.

The excavations on the south side of the mound revealed human activity prior to the construction of the pavement and house foundation. The dates on the earth oven in Trench 7, 9 and 12, and presence of ceramic sherds point to the area being utilised for settlement 2000 years ago,

On the west side of the mound and under it there were prehistoric remains in Trench 3 and Trench 13 that predate construction of the base platform. Trench 13 revealed vertical foundation stones and under the base platform there were several ceramic sherds, and an earth oven or hearth was dated by sample (Wk-16640) (Table 1) (Figure 8a, b). The remains all necessarily predate mound building, but probably date from different time periods. Vertical stones, possibly a destroyed house foundation, an earth oven dated by sample (Wk-13869) (Table 1), and a few sherds were found in Trench 3 outside the mound perimeters but below foundation level.

Some leveling of the ground surface below the base platform appears to have mixed remains from earlier activity, and most of the ceramic sherds, for instance, are interpreted as being in secondary deposition. For example,

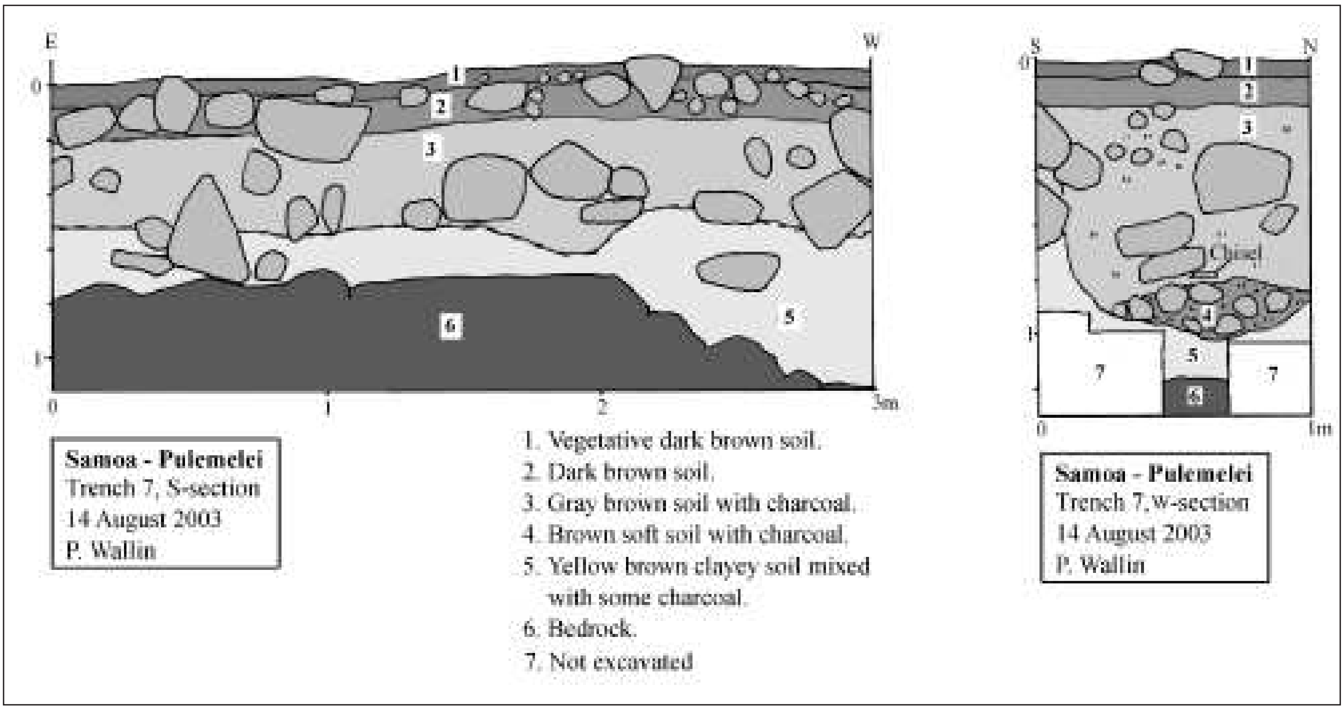


Figure 13. Left: South section, trench 7, showing the house platform in the upper 20 cm; right: earth oven from early settlement activities in West section.

there were only a few small sherds found in several earth ovens, dating to ca. 1000 BP. The radiocarbon dates from Trench 7 and Trench 9 indicate human activity at ca. 2000 BP. Ceramics, the basalt chisel, small grinding stone and part of a stone tool/handle are clearly associated with the early occupation.

Three earth ovens found between the south pavement and Pulemelei mound, and close to the west entrance, as well as from under the mound indicate a second phase of activity prior to mound building at ca. 1200-1000 BP. In most of the trenches there was a layer of scattered charcoal at about 40 cm depth, which may derive from clearing the ground of vegetation before construction of the base platform. We suggest that the initial construction of the base platform of Pulemelei dates to ca. 900-800 BP. A detailed discussion concerning the dating of the mound and its adjacent remains in relation to the chronology of Samoa prehistory is found in another article in this publication (see page 71).

Artefactual remains

The artefacts from the excavations at Pulemelei are sparse and consist primarily of stone tools and ceramic sherds, but nonetheless the assemblage represents the remains of Samoan material culture from some 2000 years of human occupation. The distribution of artefacts is shown in Table 2. The lithics have not been subjected to detailed petrological or chemical analysis, although a larger study including Samoan lithics from excavation and museum collections is planned in the future.

Artefacts	Number
Ceramics	137
Adzes	5
Chisel	1
Grinding Stones	4
Hammer stone	1
Cylindric tool/handle	2
Stone tools/scrapers	4
Worked stones	3
Cores	2
Adze flakes	13
Flakes	47

Table 2. Artefacts found in the excavation.

Lithics

Two adzes (Figures 14a, c), one adze perform (Figure 14 b), and a part of an adze (Figure 18 a), and two hammer stones (Figures 17 a, c) as well a few polished (Figure 18 f, i, g, k, e) and unpolished flakes are temporally associated with mound construction and use. The stone material is a dense fine-grained volcanic stone that has a light grey-green color. According to Leach and Green (1989: 323) most Samoan adzes were made in olivine basalt. The adzes and the preform found in excavations are probably contemporary with use of the Pulemelei mound. In typology the adzes are similar to Types VIII, IX and X (following the typology by Green and Davidson 1969b). The chronology of Samoan adze types is not entirely clear, but the most common is

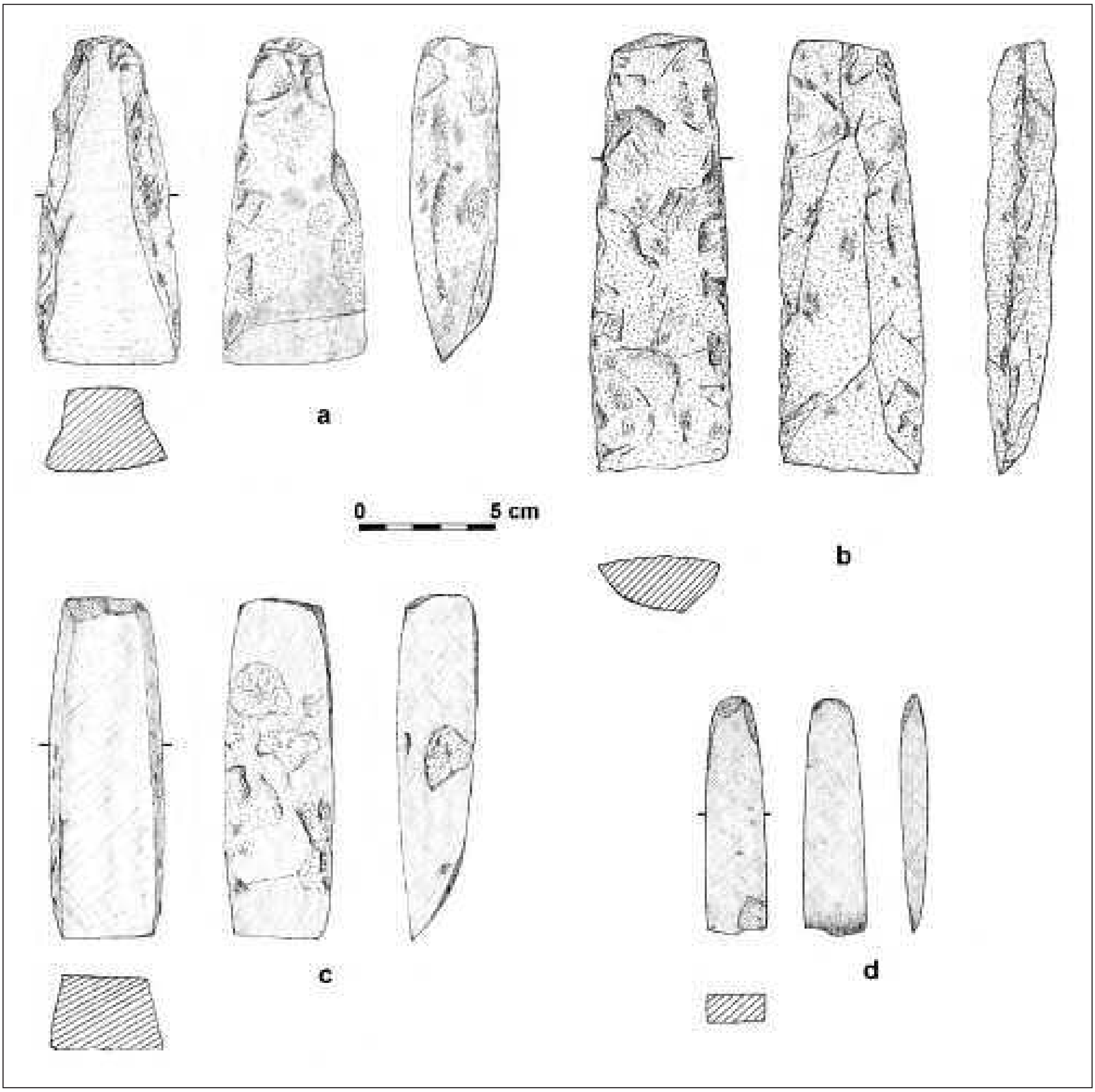


Figure 14. Adzes found in the excavations: a. Type IX , b. Type VIII, c. Type X, d. Chisel.

Type I, which occurs through the entire prehistoric sequence (Hewitt 1980b: 136-7). However, Green (1974a: 253-67) suggests that adze Types II, IX/X and VI are late prehistoric forms. Type V is an early adze type associated with the Lapita settlement complex (Leach and Green 1989:326).

The lithics associated with the oldest settlement under the south pavement were in the vicinity of an earth oven dated to ca. 2000 BP (Figure 13 layer 3). They comprised a chisel (Figure 14 d), the end of a tool/handle (Figure 15a), a small grinding stone (Figure 16b). In the upper level of layer 3 were an elongated abrader (Figure 15b), another part of a separate abrader (Figure 16 c), two basalt cores (Figures 18 l-m), a polished flake (Figure 18 c) and worked stones (Figures 16 a and 17 b,d,e). These might also belong to the earliest cultural deposit. Adze flakes found in association with trench 4 (Figure 18 b), trench10 (Figure 18 h) and trench 13 (Figure18 j) probably belong to the phase of site use dated to ca. 1150 BP that just preceded the construction of the base platform of Pulemelei.

Both the chisel and the flakes appear to have been made from the same type of fine-grained basalt as the adzes. The tool/handle with a round cross-section might be an abrader, or handle of a chisel or pestle. It is made of a dense fine-grained stone, light brown in colour, which is similar to the

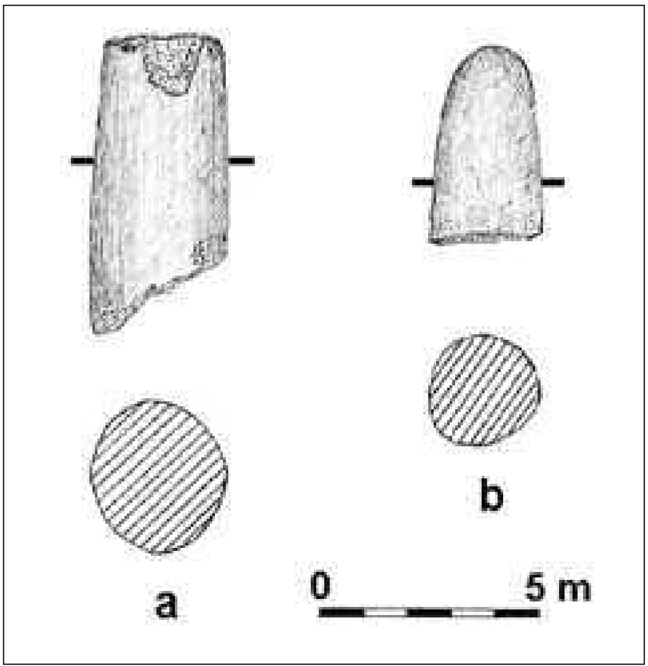


Figure 15. Lithic tools found in the excavations: a. Handle/Abrader, b. File/Abrader.

material used to make the small grinding stone. The tool/handle material also resembles that used to make an abrader which was excavated at Mouth Olo (artefact SU/A 17/111 in Auckland Museum). A scraper tool from Trench 14 is made in a dense fine-grained brown stone, another stone type. The end of a narrow abrading tool made in grey basalt and found in Trench 12, might derive from the same type of stone as some of the flakes. The type of abrading tool is similar to those from American Samoa (David Addison, pers. comm. 2005).

Ceramics

In the excavation there were two main areas with pot sherds. One was the cultural layer under the house pavement south of the Pulemelei mound (Trenches 6, 7, 7B, 9 and 12), where sherds occurred under the pavement between 20 cm and 1 m depth, close to the bedrock. The other area with pottery (Trenches 3 and 13) was close to the west entrance, and under the base platform. The distribution of the sherds in the two areas and the variation in thickness among the sherds are seen in Figure 19. In both areas it has been difficult to establish the connection between earth ovens, stone features, and the pottery, since sediment seems to have been mixed and moved around.

The sherds are highly fragmented with only a few rims and one base sherd recorded. However, most sherds were relatively thin with a medium-to-fine temper (less than or equal to 1 mm in diameter) (Figure 20). A few sherds may have a reddish-brown slip, and some have been fire damaged. The ceramics from Pulemelei, although highly fragmented, appear similar to plain ceramics from the Manono, and Jane's Camp, sites analysed by Holmer (1980: 104-16) and Smith (1976). The temper content is ca. 20%, and the composition of the temper indicates that it probably is locally made at the Pulemelei site (see below). A multivariate statistical analysis of the Pulemelei sherds compared three variables (Table 3, Figure 21), and the results suggested that thin sherds tend to be more fragmented, and were found deeper in excavations than thick sherds. This fits well with the results of

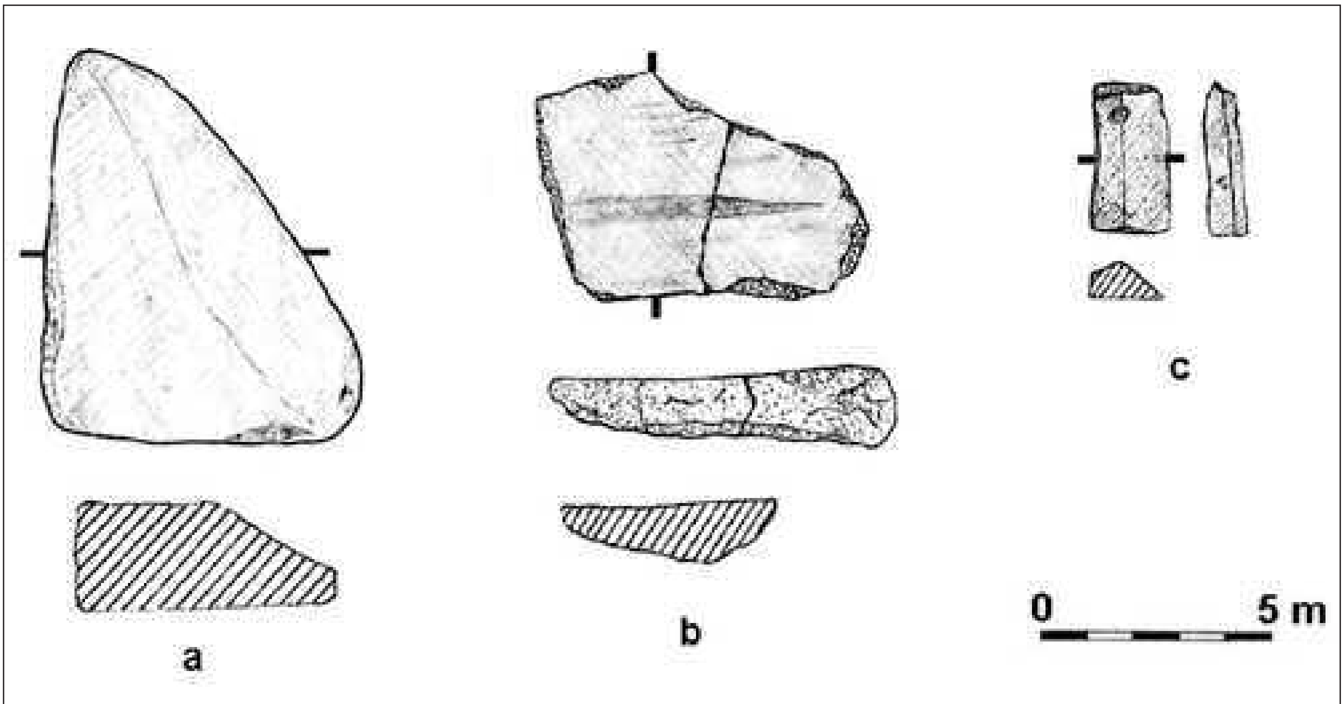


Figure 16. Lithic tools found in the excavations: a. Worked stone, b. Grinding stone, c. Grinding stone (part).

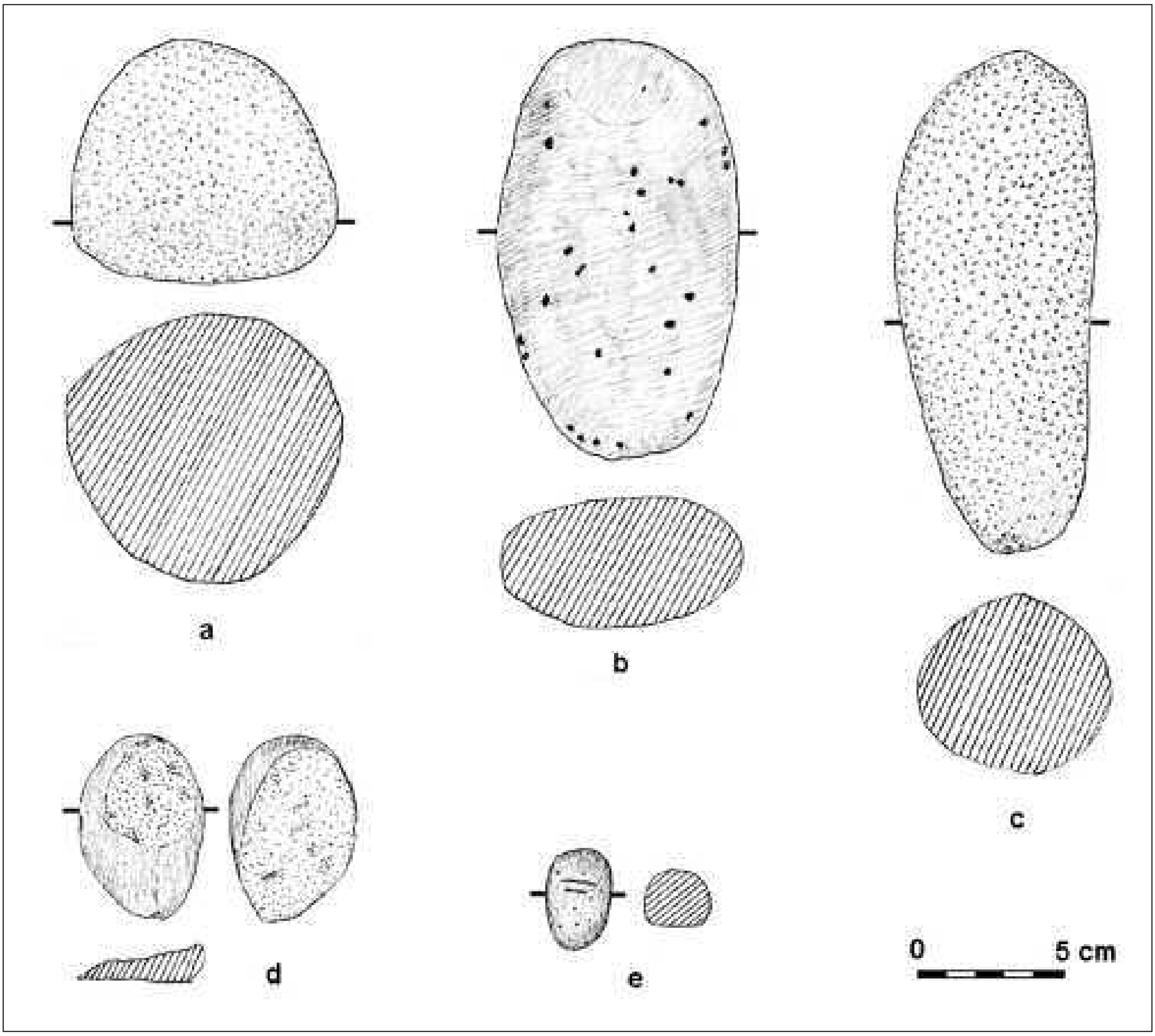


Figure 17. Lithic tools found in the excavation: a, c: hammerstones; b,d: reworked stones.

earlier analyses of Samoan ceramics (Green 1974b: 117-30; Holmer 1980: 104-16; Hunt and Erkelens 1993: 123-56).

Temper analysis

Two ceramic sherds (one from Trench 7b and one from Trench 3) were studied in thin section by William Dickinson (2005). According to his analysis both sherds have tempers of moderately-to-well sorted and sub-rounded to rounded stream sands, composed almost exclusively of basaltic fragments (polycrystalline with dominantly intergranular internal texture typical of olivine basalt). Microphenocrysts in the lithic fragments include olivine and less common clinopyroxene (augite). Rare monocrystalline sand grains of clinopyroxene are also present, as are microlitic lithic fragments (plagioclase microlites set in nearly opaque tachylitic glass) probably derived from chilled lava surfaces or basaltic tephra. Rounded grains of yellowish-to-reddish and partly altered mafic glass from lava rinds or tephra particles also occur sparingly in one sherd. The consistently large size of temper grains (medium to coarse sand) indicates that temper sands were deliberately added by potters to sand-free clay bodies.

The grain aggregates are consistent with derivation from the alkalic olivine basalts of the Salani Volcanics (late Pleistocene to early Holocene) and Puapua Volcanics (late Holocene) exposed upstream in the hinterland of Pulemelei, with the latter source in the Savai'i uplands probably most likely as judged from petrographic descriptions (R.N. Brothers in Kear and Wood 1959).

The sherds are the first from Savai'i to be examined petrographically, and the tempers are distinct from those in sherds from other Samoan islands (Upolu, Tutuila, Ofu).

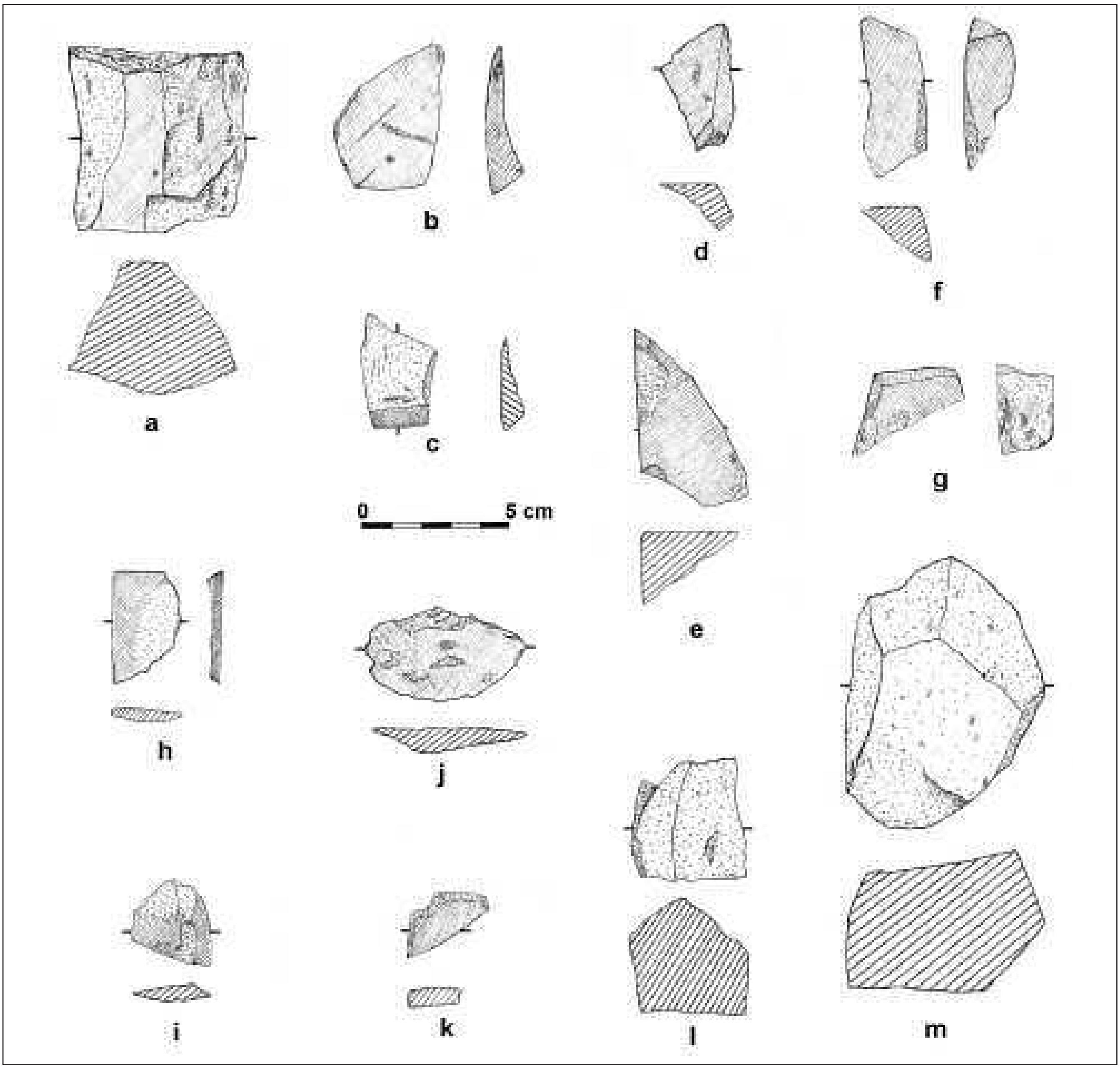


Figure 18. Lithics found in the excavation: a: part of an adze, b-k: flakes from polished adzes (j reused as a scraper), l-m: cores.

All Samoan tempers were derived alike from basaltic or associated trachytic source rocks, but the beach sands, colluvial debris, and crushed rock that served as temper in other Samoan sherd suites are unlike the stream sands used for Pulemelei temper. Natural alluvial temper in selected Ofu (Toaga) sherds (Kirch and Hunt 1993) is both texturally and compositionally distinct from the artificially added alluvial temper sand in Pulemelei sherds. Consequently, the Pulemelei sherd tempers are interpreted as indigenous to Savai'i, and are probably sands collected from channels or banks of one of the nearby stream courses (either Seugagogo Stream or Faleata River), both of which tap Puapua Volcanics in their headwater reaches.

Variable group	Variable
Final Depth	0-20 cm
	21-40 cm
	41-60 cm
	61- cm
Sherd Area	1) 12-176 sq.mm
	2) 177-539 sq.mm
	3) 540-2500 sq.mm
Sherd Thickness	Thin. 4-5 mm
	Medium. 6-7 mm
	Thick. 8-12 mm

Table 3. Variables used in the correspondence analysis of the ceramic sherds.

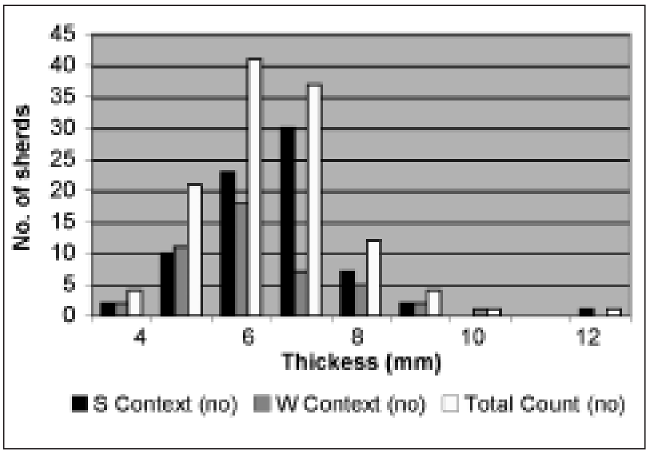


Figure 19. Distribution of ceramic sherds (no.) found in the south and west area and their thickness.

Archaeological assessment of the Pulemelei mound complex

The Pulemelei mound and surrounding prehistoric structures, including the *umu tī* and North mound, have a layout similar, in some respects, to the high-status settlement unit of Tulaga Fale at Mt Olo (Hewitt 1980a: 42-54). Tulaga Fale is a large, low platform (Platform 6) facing a walled walkway, and at the back of the platform there is a raised walkway connecting it to a smaller platform (Platform 7), which in turn is close to a large *umu tī*, called *Ma'a ti*. The large platform at Tulaga Fale is only 90 cm high, although it may have been slightly higher in the past. The Tulaga Fale platform was interpreted as the foundation for a community house (Hewitt 1980a: 50). Platform height is linked to high-status/special function activity, and the higher base platform of the Pulemelei mound suggests a different function from that of Tulaga Fale.

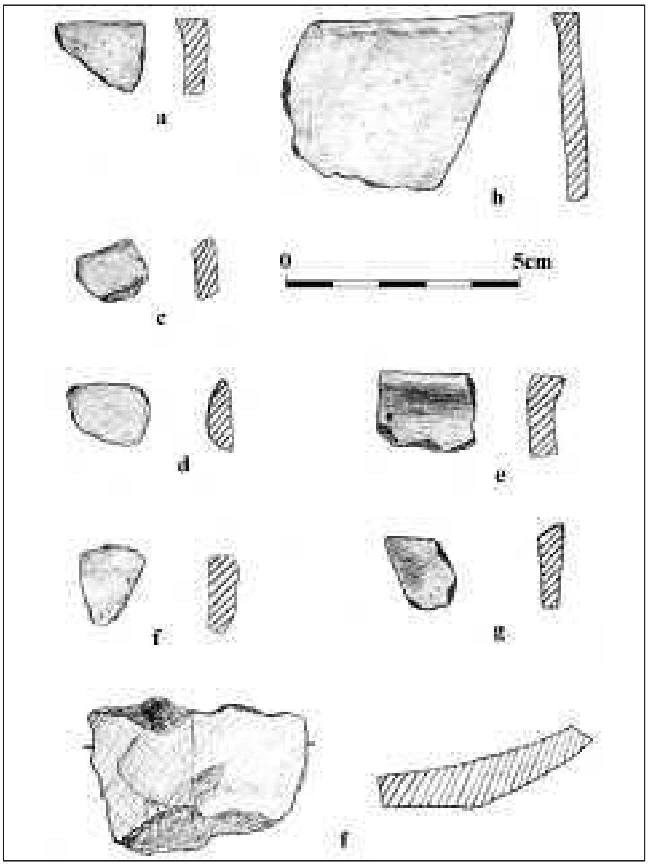


Figure 20. Ceramic sherds: a-g: rims, h: bottom part of vessel.

In addition to the parallels found between the Pulemelei structures and those of Tulaga Fale, there are also

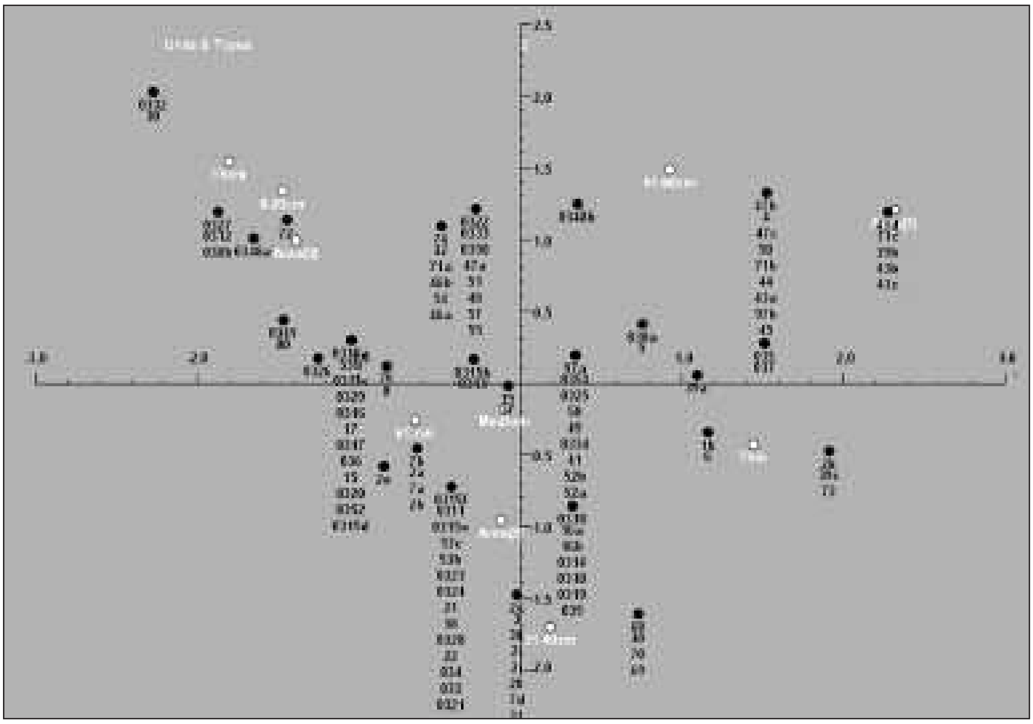


Figure 21. Correspondence analysis based on the variables shown in Table 3.

similarities in some radiocarbon dates. Two dates from the *umu tī* (*Ma'a ti*) at Tulaga Fale had ages of 290 ± 55 BP (UGa 1988) and 440 ± 100 BP (UGa 1987), similar to the determination of 372 ± 43 BP (Wk 13866) on the large *umu tī* beside the North mound at Pulemelei. A charcoal date from a shallow oven/hearth under the Tulaga Fale platform gave a CRA of 1115 ± 75 BP (UGa-1985), almost identical to a dated earth oven found under the Pulemelei mound with a CRA of 1135 ± 34 BP (Wk-16640). However, at Pulemelei there is evidence for a longer history of human occupation, as well as a more complicated sequence of mound construction than was found at Tulaga Fale. Another large structure in the Letolo area subjected to a preliminary investigation was a defensive wall situated between the two river arms ca. 1.5 km upland of Pulemelei mound. The wall is called Pa Tonga and the preliminary investigations indicated an age of ca. 950 BP (Brødholt and Vuijsters 2004) (Figure 22).

The archaeological results suggest at least four distinct phases of human activity at the Pulemelei mound site, which are summarized below.

1. Early settlement phase: 150BC–200AD

The early settlement is to be found on the south side of the Pulemelei mound on a soil-covered natural stone outcrop. Archaeological remains consist of earth ovens, plain pottery and stone tools. The remains are interpreted as likely to indicate a dispersed settlement pattern consisting of scattered households spread through the upper and lower reaches of the Letolo plantation.

2. Pre-mound phase: ca. 200–1000AD

From about 200–700AD there were no dated activities found in the excavations. Towards the second half of the so-called "Dark Age" (see Chapter 5) around ca. 700–1000AD, there was sparse evidence for prehistoric human activity. This consisted of a few basalt flakes and earth ovens on the south and west side of the mound, as well as one earth oven found under the base platform of Pulemelei. It is unclear if there was a genuine hiatus in settlement from 2000–1200 BP, or, as seems likely, the pattern of mobile, dispersed settlement continued in the area, but not in the locations sampled by our excavations.

3. Mound construction: 1100–1300AD

The first phase of mound construction began outlining the sides of the base platform by digging a shallow trench and positioning vertical slabs of local basalt in the trench. On top of the foundation stones the walls of the platform were built by stacking volcanic slabs on top of one another. Considering the large size of the base platform it was most likely a ceremonial venue, and might have been the foundation for a religious structure house or chiefly meeting place. The top of the base platform was probably paved with water-smoothed pebbles, and the presence of a clay and pebble deposit at a depth estimated to be level with the top of the base platform, indicates a period of mound use prior to additional platform construction.

4. Ceremonial efflorescence: 1400–1600AD

Intensification of ceremonial activity from 1400–1600AD is represented by the construction and use of a large earth oven (*umu tī*) near the North mound and the substantial addition of the top platforms to the base platform. These additions elevated the top of the Pulemelei mound 12 m above ground surface on the south side, rendering social activity on the mound top invisible to people at ground level. The east-west orientation of the two entrance stairways also indicates a ceremonial function, as do several other structures such as the ramp-like features on the south and north sides of the Pulemelei mound, surrounding stone pavements (east, south and west sides), and stone walls/walkways, one of which directly connects the North mound with Pulemelei. The top of the North mound is approximately level with the top of the Pulemelei mound, and unlike other areas, has a direct view of the top platform of Pulemelei from the North

Figure 22. Part of the cleared Pa Tonga wall. (Photo Helene Martinsson-Wallin)

mound. Radiocarbon dates suggest that the top platform may have been built 100-200 years after the North mound (see Wallin, Martinsson-Wallin and Clark this publication).

The presence of several pavement zones at the base of the Pulemelei mound and distinct entrance points to the top platform all suggest that between 1400AD and 1600AD social space around the mound was segregated, and that an important function of the Pulemelei mound was to symbolically diminish these differences through the creation of a shared high-status space on the top platform. If so, the ceremonial activity at the Pulemelei mound during this phase might represent an attempt to forge new socio-political configurations. The pavements and structures round the mound perimeter could have been used to acknowledge and separate different groups, while activities carried out on the top platform would have emphasized collective behaviour and group integration. The coming together of the four *Pule* titles on Savai'i, mentioned in traditional history, might represent an event requiring the construction of a structured venue, like the Pulemelei complex, for high-status ceremonial-political action.

5. Complex abandonment: 1700–1800AD

The Pulemelei mound and associated structures, like those in other parts of Samoa, were abandoned in the late prehistoric/proto-historic period, marking a major shift in the settlement pattern (Green 2002). The shift is attributed to the effects of European contact that in tandem with indigenous cultural trajectories, we believe, caused significant change to the Samoan political system.

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Geophysical Investigations at the Pulemelei Mound

GEOFFREY CLARK and ANTOINE DE BIRAN

Abstract

Remote sensing methods – ground penetrating radar (GPR) and cesium magnetometer – were employed to investigate the internal structure of the Pulemelei mound, a large earth oven (*umu tī*) and a smaller stone and earth structure to the north of the large mound. Results suggest that Pulemelei does not contain a burial vault like those built in Tonga, and GPR indicates at least two platform construction events, as well as a small mound-shaped feature at the base of the Pulemelei mound. The use of geophysical techniques on these structures at the Pulemelei site in Samoa indicate they can be applied successfully to other examples of monumental architecture in the Pacific.

Mounds of earth and stone dating to the last 1000 years are a common feature of the Samoan landscape, and while most can be interpreted as the remains of domestic house foundations, a relatively small number with monumental dimensions are an enigmatic component of the prehistoric settlement pattern. Earth mounds with a volume greater than ca. 2500 m^3 are found mainly on Upolu, whereas on Savai'i large mounds were generally built of stone, due to the quantity of volcanic rock from extensive Holocene lava flows. Exceptions are found on both islands depending on the local availability of materials (Buist 1969; Davidson 1974:226), but in the small and precipitous volcanic islands of American Samoa no mounds have been recorded that in size rival the largest structures built on nearby Samoa (Green 2002).

A Tongan origin for large Samoan mounds has been asserted by local informants, inviting a tentative comparison with the tiered, coral-slab faced burial mounds (*langi*) of the Tui Tonga lineage (Golson 1969:14; Davidson 1974:231-2).

No intact stone mounds with monumental dimensions have been excavated, and the Pulemelei mound has been interpreted as a foundation for a god house (Scott 1969; Kirch and Green 2001:251), an elite residence structure (Sutton *et al.* 2003:235; Asaua 2005) that might have been constructed in a single phase (Davidson 1974:226, but see Scott 1969:81), and a ceremonial venue that might contain burials (Scott 1969:90; Tamasese 2003, 2004). Physical investigation of the mound's interior that could shed light on its genesis and purpose was not logistically feasible in the current study and could have diminished the heritage values of the structure, which the local community, land owners and archaeologists wished to preserve. Two non-invasive and non-destructive geophysical techniques were used to examine the volume of the Pulemelei mound below the top platform as well as two associated structures – the smaller 'North mound' and a large underground oven (*umu tī*). This study was the first to use remote sensing techniques intensively on monumental architecture in the Central Pacific (see Sand 1998), and had both specific and exploratory aims as follows:

1. Was there geophysical evidence for cavities or structures in the mound that might represent a burial or tomb, as was known for Tongan *langi*?
2. Did the composition of the mound have an internal structure suggesting single or multiphase construction?
3. How effective were remote sensing methods for investigating typical Samoan archaeological remains such as mounds and ovens?

Petrological and soil environment

Previous archaeological excavations had shown that the petrology, sedimentology and soil characteristics of the area containing the Pulemelei mound could, for geophysical purposes, be divided into eight types of material. The physical properties and distribution of different material types were expected to contrast significantly, and account for most of the variation recorded in remote sensing results. The loose stones found in material types 3 and 5 (see below) were pebbles and boulders of vesicular basalt derived from local bedrock, as was the silty-clay. The sediments were generally damp or wet, except for the non-weathered bedrock and loose stones on the ground surface.

Petrological and pedological materials

1. Silt-clay humic topsoil.
2. Natural silt-clay soil without stone.
3. Natural soil composed of silt-clay and loose stone.
4. Anthropic soil of silt-clay grain size.
5. Anthropic soil made of mixed silt-clay and loose stone.
6. Anthropic rock pile, grain-supported with a predominant air fill.
7. Weathered bedrock (wet/dry).
8. Non-weathered bedrock.

Instrument choice

The resistivity method was not used because of the probability of poor electrode coupling. The gravity method was rejected also due to slowness of data acquisition, and seismic techniques were inappropriate to use on a culturally sensitive site. Electromagnetic methods (to measure conductivity and susceptibility) were considered appropriate for the types of material concerned, but the dimensions of the target features led us to chose ground penetrating radar (GPR) and the magnetic method (termed here 'magnetometry').

Ground penetrating radar

Description of the GPR method is given in Conyers and Goodman (1997), Davis and Annan (1989) and de Vore (1990). In brief, a transmitting antenna sends out a short pulse of high frequency electromagnetic energy, which is recorded by a receiving antenna after passing through the subsurface and encountering materials with different electric and dielectric properties – generally described as reflectors, surface interfaces and object discontinuities. When the emitted energy wave encounters materials with different electromagnetic characteristics, part of the wave is reflected back to the surface where receiver antennas record the return energy, and part of the wave is transmitted downwards (Davis and Annan 1989).

Since its early use in the 1970s, GPR has been increasingly applied to archaeological sites with various degrees of success. For instance, it has been used to image structures within platforms, mounds, pyramids and burials (ARE-USA Research Team 1974; Desmond *et al.* 1993; Llopis and Sharp 1997; Kamei *et al.* 2000; Bevan and Roosevelt 2003; Powell 2004). GPR is also known to penetrate igneous rocks particularly well, and a Pulsekko IV GPR was used in this project to study the Pulemelei mound, North mound and *umu tī* (Figure 1). Due to the large size of the stones used to construct the Pulemelei mound (~ca. 30-60 cm in greatest length), numerous parabola and half-parabola diffraction patterns from energy scattering were expected, even with the largest available antennas. Therefore a wide range of antennas (200 Mhz, 100 Mhz, 50 MHz and 25 Mhz) were used to obtain optimum resolution and penetration.

Buried boulders and/or jointed wall-like boulders are frequently imaged in GPR studies, but but on heir own are difficult to image because of limited radar penetration. When there are too many diffracting boulders, most of the energy sent into the ground by the GPR is scattered and penetration depth is diminished. Thus, GPR imaging *through* a potentially massively diffracting material such as the Pulemelei mound whose volume, except for the sides and top platform, consists of an apparently random pile of vesicular basaltic boulders, has not to our knowledge been previously attempted. If successful, GPR could be used on similar archaeological structures in the Pacific and elsewhere.

Magnetometry

Magnetometry has often been used on archaeological sites to detect magnetic items and structures (Martin *et al.* 1991) that occur within an environment which is relatively non-magnetic compared to the target (Breiner and Coe 1972). Conversely, in supposedly strongly magnetic environments, like the volcanic setting of the Pulemelei mound, magnetometry has been less popular (but see Lipo *et al.* (2006) for similar work in a volcanic setting) even though one of the earliest attempts successfully investigated a South American pyramid that was highly magnetic (Morrison and Benavente 1970). Theoretically and practically, detecting items and structures in a magnetic environment is often feasible, and spatial variation in the magnetic properties of a structure can be used to investigate its internal architecture.

A cesium magnetometer of the gradiometer type (Geometrix G858 with two sensors) was used at the Pulemelei mound. The advantage of a cesium magnetometer compared with a proton magnetometer is that it does not require recalibration to compensate for a spatial change in magnetic field values. This feature is useful since substantial variation in the magnetic field of the basaltic study area was anticipated. The real inclination of the magnetic field at ground level as opposed to that predicted by world models based on higher altitude data (International Geomagnetic Reference Field (IGRF) models) was obtained using a Magnaprobe gimbaled magnetic needle. Magnetic modeling algorithms require this information to allow accurate interpretation of magnetic anomalies.

Survey system

There were 34 stone cairns on the platform surface, including several that had been recorded by the authors in 2002 and 2003, as well as additional cairns constructed in 2004 before the survey began. The stone piles were recorded and removed, along with vegetation and metal trash (corrugated iron, corned beef cans and nails) to improve radar ground-coupling and minimize the number of modern magnetic anomalies.

To obtain systematic radar data for the volume below the top platform of the Pulemelei mound, a string grid 31.0 m x 40.0 m with rectangular 2.0 m line spacing (aligned 344 degrees from MN) was established over the platform surface (Figure 1). The step size between data recording stations was 1.0 m to 0.25 m depending on antenna size (i.e. a quarter of the dominant wavelength) in order to avoid imaging problems due to under sampling (also termed 'aliasing'), with each GPR grid traverse run S-N. The mound sides were unstable and we did not attempt to acquire systematic magnetic and GPR data from other than the top platform. However, individual S-N and W-E median transects were taken over the Pulemelei mound, with the S-N profile starting at Test Pit 14 (Figure 1).

Proper imaging of GPR data requires a velocity model of the subsurface in order to provide a depth scale. This model is often obtained by a Common Mid-Point analysis (CMP).

Figure 1. Plan view of GPR and magnetometer survey grids (shaded) and transects (dashed lines) made at the Pulemelei mound and nearby structures.

In a CMP analysis the wave velocity in a medium is recorded while moving both antennas (receiver and transmitter) equal distances away from a center point (Conyers and Lucius 1996; Conyers and Goodman 1997). CMP analysis gave a ground velocity of about 0.08-0.10 metres per nanosecond (m/ns) within the mound, which is in the lower range of what is expected for this material, possibly due to stone weathering or dampness.

CMP analysis of the silty-clay soil outside the mound gave a ground velocity of about 0.05 m/ns, consistent with common values for silt and clay soils. Only one velocity per GPR profile was used to calculate a depth scale. As a consequence, the depth scale is valid only for certain parts of a given profile with different materials. For example, the depth scale for the GPR profiles over Pulemelei mound at ground level is not accurate, and depth values have to be halved (Figure 2).

For magnetometry, a 1.0 m line spacing and 1.0 m stations were used on the top platform using the GPR grid. The bottom sensor was set 1.30 m above the ground surface with an 0.8 m separation between the top and the bottom sensor.

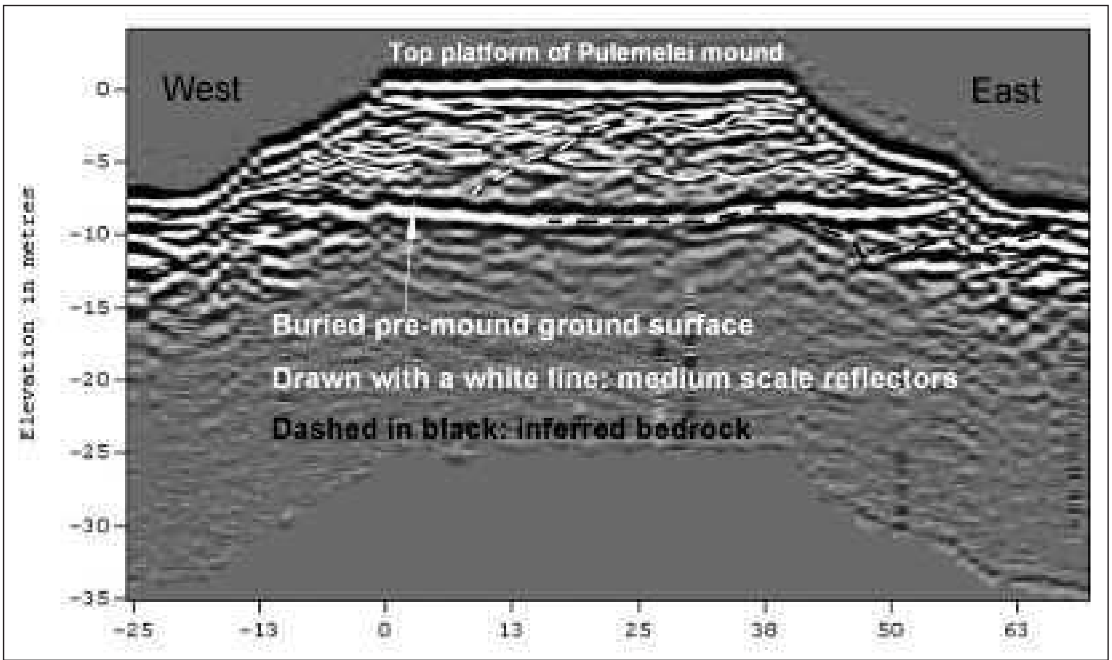
Pulemelei mound: GPR results

Penetration

Penetration was unexpectedly good at all frequencies, with the mound-ground surface interface imaged in all cases. In the soil and bedrock below the mound penetration was even deeper at lower frequencies. This can be explained by the particular ground coupling of the radar antenna with the mound, the petrology and texture of the stone fill, and the unexpectedly small number of diffraction patterns. We consider each factor further below.

Coupling. The surface of the top platform was fairly even and paved with water-rounded pebbles that were smaller than those making up the mound volume. The pebble surface was also devoid of topsoil, or other layers that could have absorbed energy, and/or triggered wave reverberation and lateral variation in coupling.

Petrology and texture of the rock fill. The basalt stones of the mound were strongly vesicular with an estimated 20-40% pore volume. In most places the interstitial volume between boulders was air-filled, providing excellent drainage through the mound. As a result the mound, to radar waves, has very resistive low-contrast electric and dielectric properties, resulting in good wave penetration through the structure. This was seen by the strong reflection at the ground surface (the strongest of all reflectors), compared with weaker reflectors inside the mound (Figures 2 and 3). The strong reflector was caused by the electric and dielectric properties of the wet silty-clay ground, which were opposite to those of the mound.



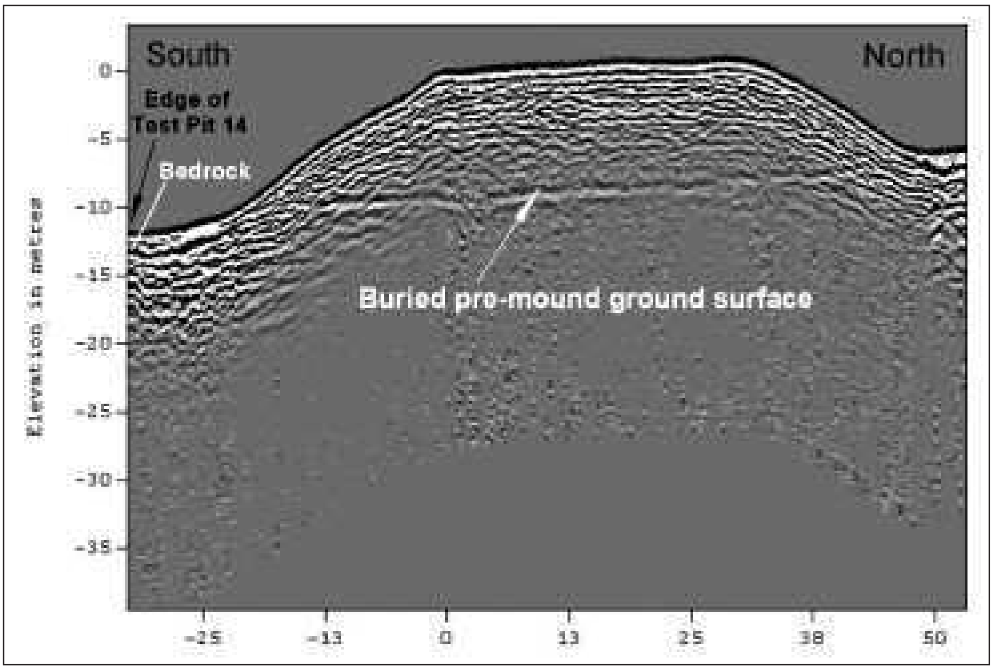


Figure 2. Comparative S-N (100MHz) and W-E (50Mhz) GPR median profiles over Pulemelei mound. The S-N profile starts at Test Pit 14. The 50Mhz GPR electromagnetic waves penetrate deeper below the buried ground surface than the 100Mhz waves, at the expense of vertical resolution. Below the current and buried ground surfaces, the values indicated by the depth scale must be halved to estimate actual depth.

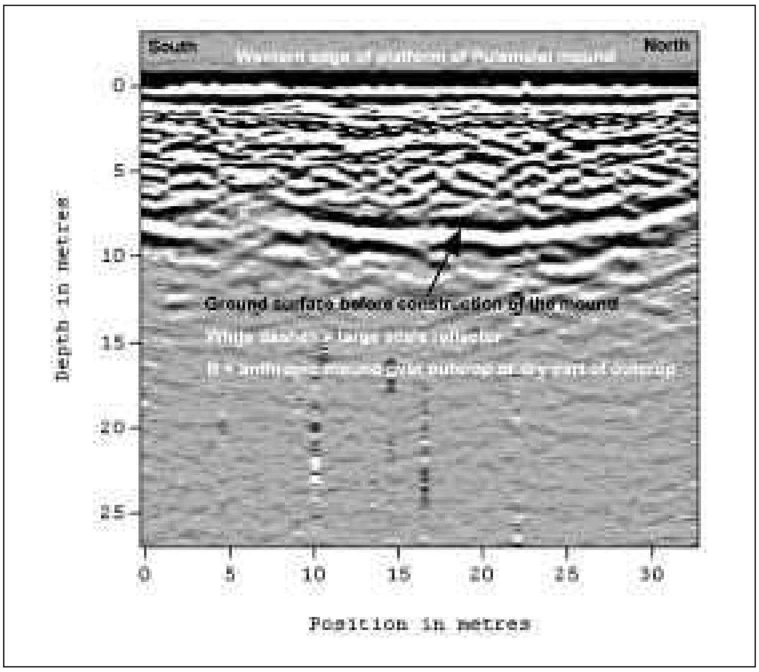


Figure 3. S-N (50Mhz) GPR profile at the westernmost edge of the top platform. The small mound-shape is the most conspicuous feature identified under the Pulemelei mound.

Few diffraction patterns. This was surprising, given the likelihood of considerable diffraction as a result of stone size and stacking. The absence appears to stem from a poorly understood aspect of GPR wave propagation in a structure that in theory should be a massively diffracting material at most of the frequencies used. A tentative explanation is that both diffraction patterns and transmission/reflection patterns occur in the mound. However, if the diffraction patterns caused by scattering are weaker than the transmission/reflection patterns, the mound volume can be imaged. In other mounds built of stone this may not be the case, particularly if the stones were not vesicular or igneous, and the interstitial volume between stones was not air-filled. In such instances scattering and loss of wave energy may be extreme, resulting in lower penetration.

Structure within the Pulemelei mound

Numerous coherent reflectors showed throughout the mound, but all the GPR sections indicate that the texture and petrology of the mound interior did not appear to differ significantly from its exterior. It did not contain vaults or major voids or cavities. There was an interesting small mound-shaped feature at the base of the mound (see below), and a relatively flat large-scale reflector at about 2.0 m below the top platform surface (Figure 3). The 2.0 m deep reflector showed well on western profiles, where it spanned the entire mound from S-N, but was seemingly not present on the eastern side of the mound. The reflector was much weaker than the mound-ground interface and had a normal polarity (three consecutive white-black-white stripes). Typically, such a reflector could represent an abrupt transition to a media with more interstitial air, as from stones that were less packed together or larger, or stones with larger vesicles. It might also result from the use of less weathered stones in the base platform. In any case, the large-scale reflector implies the mound has some construction stratigraphy. It is important to note that although the 2.0 m deep interface appears to be abrupt, it may be caused by the subtle contrast between two materials. If so, the interface may not be readily visible in a small-scale investigation.

There are also medium-scale fairly flat and sometimes very clear reflectors, which suggest that construction of some mound parts was multi-staged. This does not necessarily mean that construction was significantly multi-phased in time. Some reflectors extend under the collapsed mound sides (Figure 2), and may indicate parts of the structure that have not collapsed. Such areas may help to define the original mound shape and extent of wall collapse.

Finally, during the removal of tree stumps on the top platform, a thin and discontinuous deposit of clay and pebbles was recorded at 60 cm, and a ^{14}C date from an associated charcoal concentration returned a date of 310 ± 90 BP (ANU-11890). The clay-pebble layer was not identified in the GPR profiles.

Mound base. The mound-ground interface shows as a striking reverse polarity reflector on the GPR section. Normal polarity is shown by the three white-black-white stripes of the direct wave starting at the surface of the top platform (0 m depth), as opposed to three consecutive black-white-black stripes denoting reverse polarity at the mound base.

The interface between the mound and the ground surface is relatively smooth in the GPR sections, which is consistent with the nature of the ground surface around the mound (Figure 2). The interface is likely to represent a transition from the air-filled igneous material of the mound to the wet clay-soil/weathered-bedrock media below the mound, rather than a mound-bedrock interface, even though archaeological excavations around the base of the mound only recorded a relatively thin soil deposit (40-70 cm in depth) over bedrock.

There was a small mound-shaped feature near ground level below the western edge of the southwestern corner of the top platform (Figure 3). The feature is at least a few meters long, and because of its location, probably extends below the western slope of the base platform. It is associated with a considerable dimming of the main reflector below it, which is outcrop-shaped but of larger size. The dimming indicates a reduced contrast between two materials. Consequently, there are two main interpretations of the mound-shaped feature. It may be a dry part of an outcrop of weathered bedrock, or it could represent an anthropic mound placed against the most conspicuous outcrop of bedrock covered by the Pulemelei mound, which it obviously antedates. Any material drier than the ground surface under the Pulemelei mound could give a GPR image that looks like a 'small mound', and the composition of this feature needs to be determined by physical examination.

Bedrock. Although radar penetration was naturally lower below the ground surface than through the mound, and the low contrast between the reflectors below ground surface made interpretation difficult, GPR imaging of the ground surface and buried ground was successful.

The reflectors below the ground surface suggest an irregular interface between the soil and bedrock (normal polarity) compared with the mound-soil interface (Figure 2). The soil-bedrock reflector is harder to identify unambiguously as the electric and dielectric contrast between the soil and bedrock was weaker than that of the mound-soil. The contrast was blurred by the presence of stones in the soil, the weathering of bedrock, and the presence of water in both soil and bedrock. The bedrock has an irregular structure in places, probably reflecting the shape of lava flows, *in situ* weathering, and differences in water content. At lower frequencies the interface between weathered and fresh bedrock shows very clearly as a deep reflector (normal polarity), probably reflecting variation in water content.

Pulemelei mound: Magnetometry results

The observed value for the inclination of the magnetic field (+10 degrees to horizontal) differs markedly from the predicted IGRF value of -30 degrees. This is significant, as the direction and value of the inclination strongly influences the modeled shape of magnetic anomalies.

Magnetometry of the top platform showed small and medium-scale magnetic anomalies (Figure 4). The small-scale anomalies of shallow origin often corresponded with the position of tree stumps mapped and removed during clearing of the mound in 2000. The shape and distribution of magnetic anomalies does not suggest any obvious man-made structure or void in the mound volume below the top platform, and supports the relatively homogenous internal structure of the mound suggested in GPR results.

The small and medium-scale magnetic anomalies of shallow origin were superimposed on larger-scale anomalies, which derive from variation in buried soil thickness and the shape and orientation of the mound relative to the direction and inclination of the magnetic field.

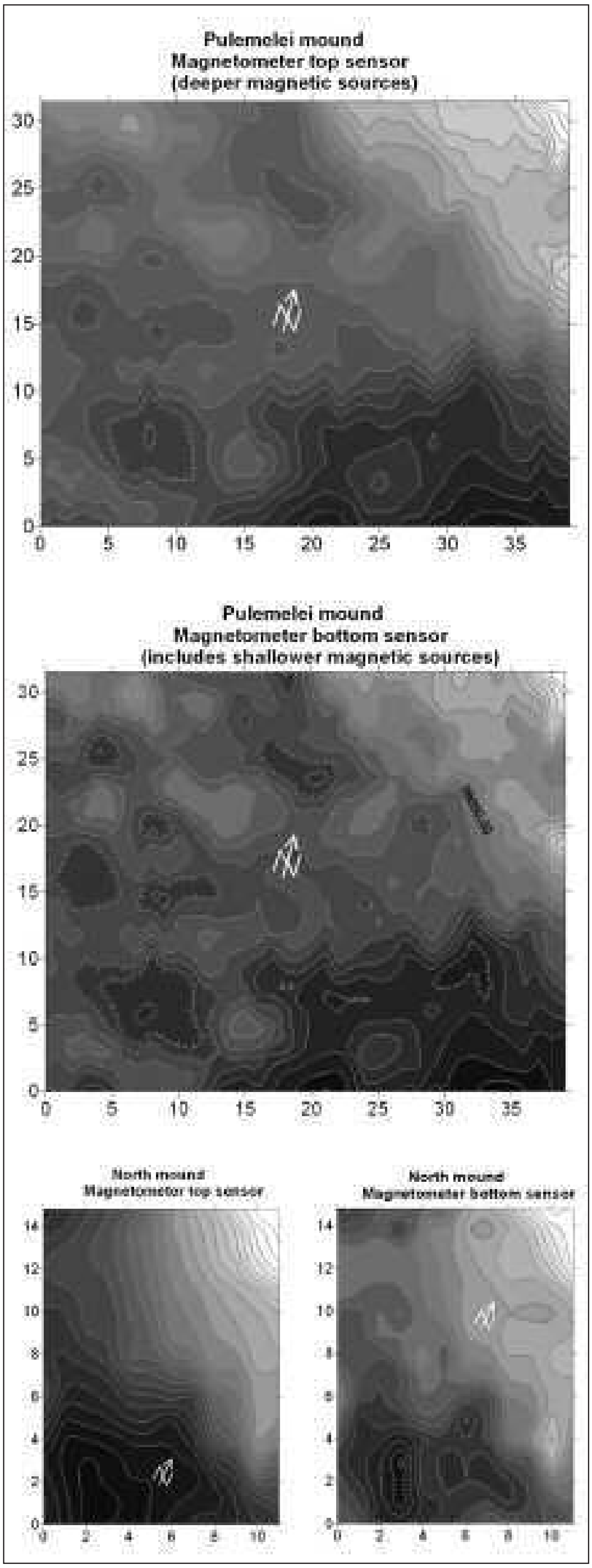


Figure 4. Comparative maps of the magnetic field over Pulemelei mound and the North mound. Note the similarity of the large-scale magnetic trends for both mounds.

North mound

A 11.0 m x 14.8 m string grid with a rectangular 1.0 m line-spacing (aligned 335 degrees to MN) was placed on the top surface of the North mound (Figure 1) with each GPR grid traverse run S-N. For magnetometry, a 1.0 m line spacing and 1.0 m station spacing was used, with the bottom sensor set 1.25 m above ground surface, and a sensor separation distance of 0.80 m. A W-E magnetometer tie-line across the middle of the North mound was also acquired.

The surface of the North mound was heavily disturbed, and it did not have a surface paving of smaller pebbles, as did the top platform of the Pulemelei mound. As a result, GPR ground coupling was expected to be poor, and only exploratory S-N and W-E median GPR sections across the North mound were made. No velocity data for CMP analysis was collected and the velocity data from the Pulemelei mound was used instead.

GPR results

Some coherent reflectors display reasonably well on the GPR profiles, which indicate ground coupling was better than anticipated (Figure 5). The main difference between the GPR sections of the North mound and the Pulemelei mound was the unexpected absence in the former of a clear reflection pattern from the interface between the mound and the ground surface. This means that the change between electric and dielectric properties at the base of the North mound was not as strong as that recorded at the Pulemelei mound. This suggests there was more earth (less air) in the stone fill of the North mound, and/or the North mound was in direct contact with weathered bedrock. Excavation of Trench 15 supported both of these interpretations.

In the W-E section, radar penetration between about X=18 m and X=23 m about the centre of the North mound was deeper than elsewhere (Figure 5). The most likely interpretation was a feature/contact at the base of the mound that was more conducive to radar penetration than the silt-clay/rock mix of the soil and the mound fill. An obvious candidate was an outcrop of bedrock. Subsequent excavation of Trench 15 revealed the mound was built on a bedrock outcrop exposed ca.1.0 m depth below the mound surface.

Magnetometry results

Despite the North mound representing, in geophysical terms, a relatively haphazard pile of magnetic stones, the magnetometry maps were remarkably smooth (Figure 4). Each basaltic stone has its own magnetic susceptibility (a number) and magnetic remanence (a vector). The randomly oriented remanence vectors of stones tend to cancel each other out, while the susceptibility of the stones images the density of magnetic material in the mound.

The bottom sensor was influenced more by the near-surface texture of the North mound than the top sensor. The small magnetic anomalies recorded with the bottom sensor might also reflect from prehistoric or recent fires made on the North mound (a large fire was set on the mound during a ceremony held in 2003). As with the Pulemelei mound, the top sensor recorded smoother anomalies from outcropping bedrock, variation in soil thickness away from the outcrop, and the shape and orientation of the mound (Figure 4).

Umu tī

An 8.0 m x 20.7 m string grid with a rectangular 1.0 m line spacing (aligned 340 degrees from MN) grid was set up over the main area of the *umu tī*, (Figure 1), and included a 2.0 m x 2.0 m excavation called Trench 5. Each GPR traverse

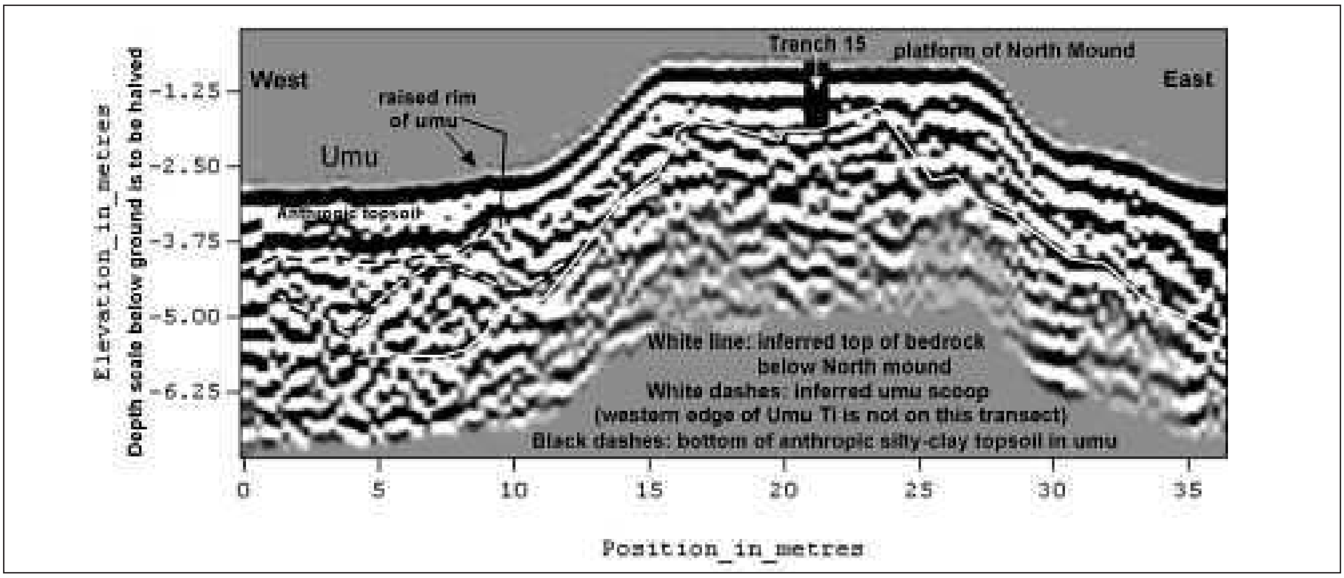


Figure 5. W-E median GPR profile over the North mound and *umu tī*. The excavation was made after GPR profiling. The profile passes 1.0 m to the North of Trench 5 in the *umu tī* and passes the south edge of the Trench 15 excavation in the North mound.

was run S-N. The grid topography and roughly circular outline of the raised rim of the *umu tī* were surveyed with an electronic theodolite (Figure 6). A high resolution antenna (200 Mhz) was used for the GPR survey as the Trench 15 excavation had recorded shallow bedrock at 1.2 m depth. GPR data was collected with a 1.0 m line spacing and 0.25 m station spacing. Tie-lines (W-E) across the middle of the *umu tī* were acquired with the GPR and the magnetometer. For magnetometry, a 1.0 m line spacing and 0.66 m station spacing was used, with the bottom sensor set at 0.70 m above ground surface, and a separation distance between sensors of 0.8 m.

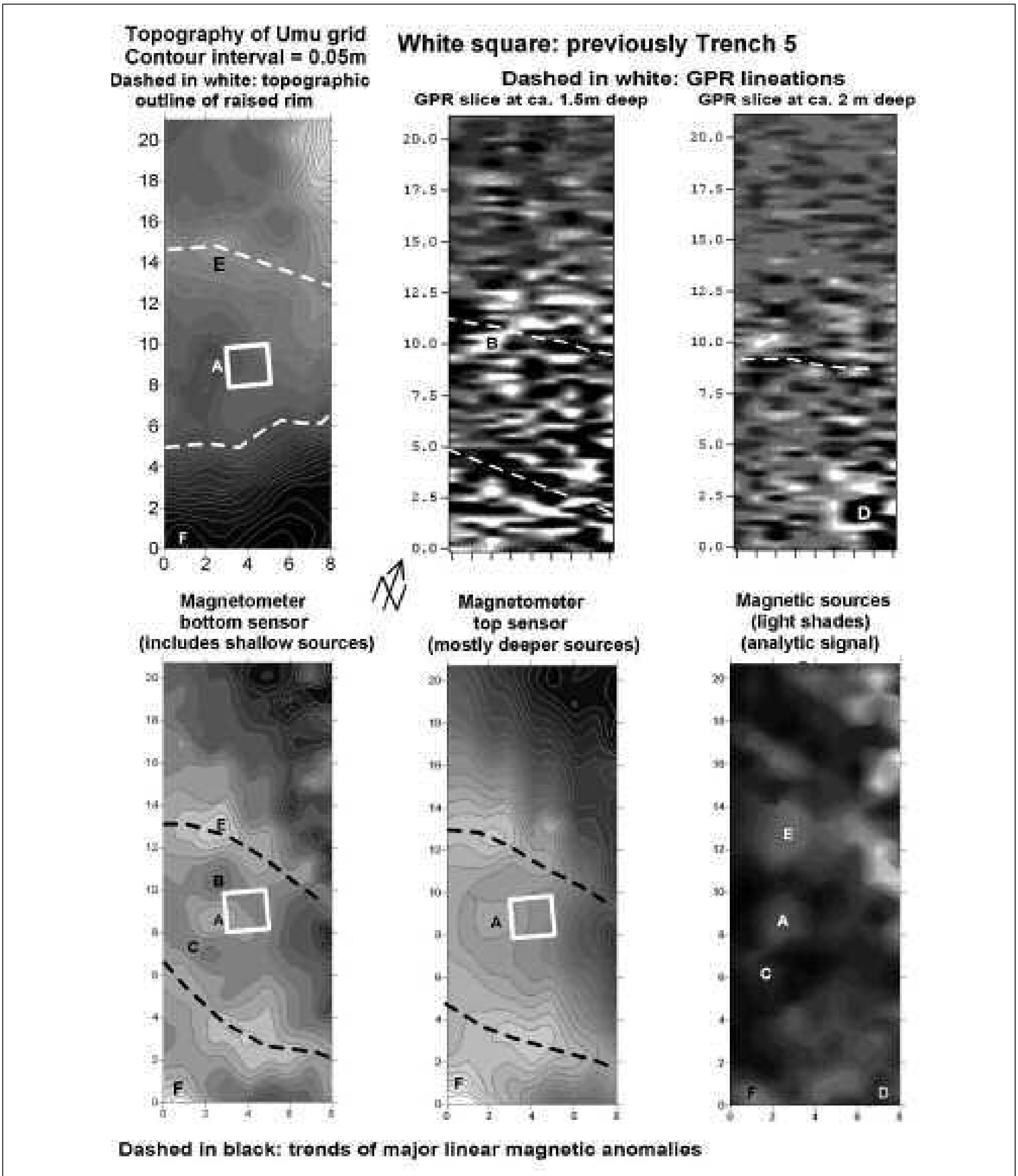


Figure 6. Comparative topography, magnetic field, analytic signal and GPR horizontal slice at the *umu tī* grid. Letters ('A', 'B', 'C', 'D' and 'E') have been given to particular anomalies to facilitate comparison.

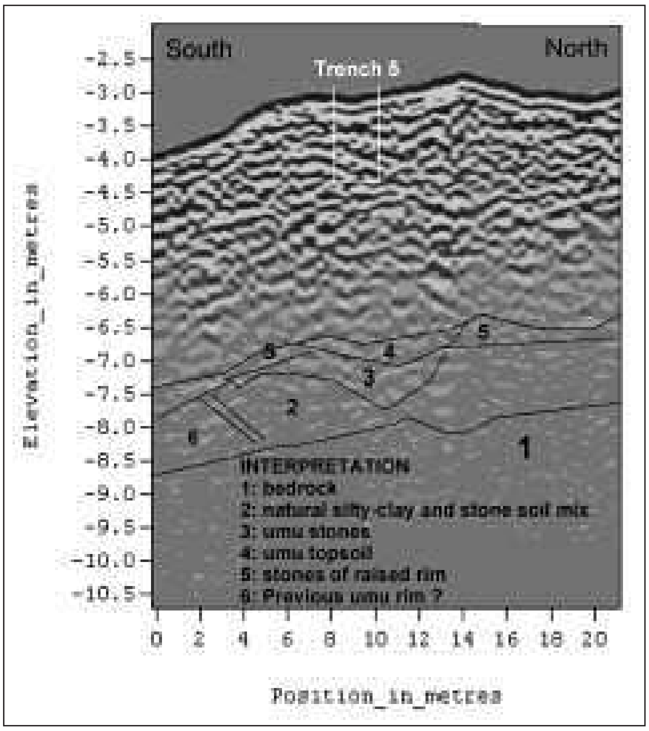


Figure 7. Median S-N 200Mhz GPR profile (on grid) over *umu tī*. It passes across Trench 5.

GPR results

Profiles show a distinct structural layout with reflectors that excavation identified as a ca. 50 cm thick topsoil and silt-clay soil layer, as well as a 'hollow' down to the bedrock base at ca.1.20 m depth (Figure 7). The GPR profiles also showed the boundary between the raised rim stones and the natural soil below the rim (Figure 7), as well as other reflectors that were more difficult to interpret.

The horizontal GPR slices, although somewhat blurred, were consistent with the magnetometry results. They showed that the base of the *umu tī* was significantly offset from the surficial raised rim. This might indicate the *umu tī* has a purposely asymmetrical structure, or that the base of the *umu tī* has migrated laterally from progressive reuse.

Magnetometry results

The magnetometry survey recorded numerous small-scale anomalies in an area of predominantly low magnetic value in the northeast part of the grid (Figure 6). The magnetic lineations clearly relate to the raised rim of the *umu tī*, and suggest that the *umu tī* extends 1-2 m beyond the eastern and western edges of the grid, but the lineations were significantly offset and angled from the raised rim. Magnetic modeling suggests this should not occur if the position of the raised rim reflected the underground structure of the *umu tī*. The map of the analytic signal derived from the bottom and top sensor (Figure 6) confirms the relative complexity of the below-ground structure of the *umu tī*.

About 2.0 m to the west of the Trench 5 excavation there was a small-scale positive magnetic anomaly (marked 'A' in Figure 6), surrounded by two smaller magnetic lows 'B' and 'C'. The corresponding S-N GPR grid profile (not shown) crossed location 'A' suggesting the sides of the *umu tī* were steeper at this position.

One of the S-N GPR profiles and the E-W GPR tie-lines crossed magnetic anomaly 'B'. They identified the location as the lowest point or subsidiary trough within the main *umu tī* 'scoop'. The GPR slices also showed a strong reflector at the location of magnetic anomaly 'B', as well as another strong reflector ('D') near the southeastern corner outside the *umu tī*. Vertical profiles over the 'D' showed a strong horizontal reflector that might simply be a large stone or a deposit of charcoal. In short, the surface shape of the *umu tī* is not centered in relation to greatest oven depth, and the northern and southern edges of the *umu tī* have a different structure from each other, possibly indicating more than one episode of oven use and rim construction.

Discussion and Conclusion

The Pulemelei mound, adjacent structures, and the geological setting of the archaeological remains, were *a priori* unfavourable environments for several kinds of geophysical investigation. Nonetheless, GPR and magnetometry were attempted, since no prehistoric monumental sites had ever been intensively investigated with remote-sensing methods in the Central Pacific, the interior volume of the Pulemelei mound was too large to be examined with conventional archaeological techniques, and the excavation of the mound might have caused damage to the integrity of the structure. The GPR and magnetic surveys provided several unexpected results, including the imaging of the Pulemelei mound from the top platform through to the soil below the mound and down to bedrock, along with new information about the sub-surface composition of the mound.

There is little geophysical evidence in the volume investigated for a large tomb or chamber. There may be a small earth or stone mound beneath the Pulemelei mound but there is no indication of a substantial burial vault. Recent GPR investigations of Tongan *langi* where the Tui Tonga were interred in vaults made of large, finished slabs of beach rock clearly identified subsurface burial structures. There is no limestone or beach rock in the vicinity of the Pulemelei mound that might be used to construct a substantial vault of a size used by the highly-ranked lineages of Tonga. Construction of a rectangular 'coffin-like' structure for interment would be possible with the locally abundant tabular basalt, and is a form of burial structure recorded in Tongan traditions (Gifford 1924:204). Further, a feature of *langi*, and also of contemporary Tongan mortuary practice, is the surface delineation of the burial mound with a deposit of coral beach sand (*patapata*) and basaltic pebbles (*kilikili*), marking the approximate position of the vault/grave, which was covered with a house-like structure. The pebble surface of the Pulemelei mound extended to the edge of the top platform, and the reflector detected with the GPR around 2.0 m depth below the top platform, also covered a large area. In both material type and distribution, the pebble surface on the top platform on the Pulemelei mound differs from that found on Tongan burial mounds. The Pulemelei mound might contain human remains that are difficult to identify, however, with remote-sensing methods – for instance, if there was secondary interment of skeletal elements in mound voids, or inhumation within the mound was followed by vault/cavity collapse.

The internal structure of the Pulemelei mound was relatively homogeneous, and the GPR results did not suggest it was built from the gradual accumulation of different materials, as has been observed for mounds elsewhere (e.g. Blitz and Livingood 2004). Rather, the GPR reflector at 2.0 m depth below the top platform is approximately level with the top of the base platform, and might represent, therefore, a hiatus in mound construction, or a change in structure use after construction of the top platform. In this regard, both Green (1969:137) and Davidson (1974:227) noted that on Upolu some earth mounds were first constructed as 'non-residential', or 'specialised' mounds, and later modified for residential use. The use of 'specialised' mounds is currently unclear, but the Pulemelei mound is another potential example of a non-residential mound that was subsequently elaborated by the addition of a second platform, and probably other features like the eastern and western stairways. A ramp built against the south side of the Pulemelei mound, extending to the top of the base platform, also suggests that a single-level mound was constructed first, before addition of the top platform. Archaeological investigation of the 2.0 m deep reflector layer should clarify whether the base platform had a different function from the top platform, while investigation of the clay-pebble deposit found at 60 cm depth below the top platform is needed to determine whether the top platform was a multi-stage construction.

The effectiveness of the remote-sensing work can be assessed, to some extent, by comparing geophysical results (reflectors and anomalies) with archaeological investigations made in the surveyed mounds and *umu tī*. For example, GPR data indicated that the composition of the North mound was different from that of the Pulemelei mound, and the North mound was constructed of earth and stone on a rock outcrop. In both instances, excavation showed that the geophysical data was accurately recording subsurface composition, which suggests that other GPR and magnetometer observations might also be robust. Although yet to be verified by excavation, remote sensing suggests a small mound may lie under the Pulemelei mound on its western side, the surface topography of the *umu tī* does not accurately reflect its underground structure, and near the centre of the *umu tī* is an unidentified anomaly ('A' in Figure 6).

The decision to undertake a geophysical investigation at an archaeological site needs to considered carefully, since remote sensing is relatively expensive, such study often requires technical support that may not be available on a Pacific island, and remote-sensing work can expend field time and labour that would otherwise be used on archaeological investigation. A GPR and magnetometry survey was commissioned because questions about the composition and function of the Pulemelei mound were unable to be determined by archaeological excavation. The surveys successfully recorded subsurface details of the Pulemelei mound volume, as well as features from a smaller mound and a large earth oven, which can be archaeologically examined with a minimum of disturbance to the structures in the future. The results demonstrate the utility of undertaking further geophysical investigations at appropriate archaeological sites in Samoa and the Central Pacific in the future.

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A Radiocarbon Sequence for Samoan Prehistory and the Pulemelei Mound

PAUL WALLIN, HELENE MARTINSSON-WALLIN and GEOFFREY CLARK

Abstract

We examine radiocarbon dates from Samoan archaeological sites using the fourfold division of Samoan prehistory established by Green (2002). The context of dating samples was assessed to recognize potentially "reliable" determinations in the Samoan ^{14}C corpus. Radiocarbon dates associated with earth and stone structures were identified to one of four phases of construction/use to develop a chronology for the emergence and use of domestic and monumental architecture. The 17 radiocarbon determinations from the Pulemelei mound site were used to generate a local prehistoric sequence for the Letolo area. In general the results parallel the prehistoric sequence for Samoa, but the chronology of the Pulemelei mound demonstrates that monumental architecture in West Polynesia can have a complicated developmental history spanning several centuries.

The first radiocarbon dates from the Central Pacific were obtained from Fiji by Edward Gifford (1951), and it was not until the 1960s that the first ^{14}C determinations from Samoa, on archaeological samples collected by Golson in 1957 (Golson 1969a), showed that Polynesian pottery had an antiquity of at least 2000 years (Grant Taylor and Rafter 1963; Green and Davidson 1965). Subsequent archaeological work resulted in radiocarbon dates from significant investigations published by Green and Davidson (1969, 1974a), and Jennings and colleagues (1976, 1980).

From 2002 to 2004 excavations by the authors at the Pulemelei mound site on Savai'i provided new radiocarbon dates relating to the extensive prehistoric structures and features that had been mapped in the Letolo Plantation in the 1970s (Jennings *et al.* 1982). The radiocarbon results from earlier and recent archaeological projects provide the data to construct a prehistoric sequence, particularly of the last 1000 years when large mounds emerged. We have not included determinations from American Samoa as the prehistoric sequence of the small islands appears to differ from that of Samoa, particularly the absence of monumental mounds, and possibility that pottery manufacture lasted longer in American Samoa than it did in Samoa (Clark 1996; Green 2002).

In previous research Samoan prehistory has been viewed as an aperiodic cultural succession (Green and Davidson 1974a). However, the development of the settlement pattern in prehistoric Samoa, which has chronological connotations, has recently been suggested by Green (2002:134-146).

1. Initial settlement represented by distinctive Lapita ceramics;
2. Settlement patterns during the period when Polynesian plainware was produced;
3. The interval when evidence of the settlement pattern is extremely limited (the so called 'Dark Age');
4. Late prehistoric settlement patterns marked by the construction of earth and stone structures.

Green's settlement sequencing is based on evidence of the use of pottery with patterns/no patterns, use of pottery/no pottery, the apparent absence of settlements activities, and the use of large stone and earth mounds. Tied to the discussion are various dates presented for the changes in the settlement pattern.

To date 89 ^{14}C determinations (Table 1) have been reported for Samoa by Green and Davidson (1974b:214-5), Jennings and Holmer (1980:7-10), and from our investigations at the Pulemelei mound (Martinsson-Wallin *et al.* 2003, 2005; see Martinsson-Wallin *et al.*, this publication). In this paper we outline the Samoan radiocarbon sequence. Following the discussion of radiocarbon dates for Samoa as a whole, we discuss the dated samples from the Pulemelei mound site to construct a detailed chronology for the Letolo Plantation.

Site Location

Radiocarbon assays have been obtained for archaeological sites on Upolu, Savai'i, and Manono. The excavated sites are listed (see Martinsson-Wallin this publication, Table 2). Many additional sites are known, but have yet to receive archaeological excavation (e.g. Green and Davidson 1969, 1974a). The intention of archaeological programs in the 1960s and 1970s was to investigate a range of coastal and inland sites (Green 1969a:3-11). The investigation of inland sites include prehistoric deposits and structures from the Falefa Valley on Upolu, and the Letolo area on Savai'i, in addition to prehistoric and historic settlements at Mt Olo and Luatuanu'u on Upolu. Coastal sites have been investigated at Vailele, Faleasi'u and Lotufaga on Upolu, and on Manono and Apolima (Green and Davidson 1969, 1974a; Jennings *et al.* 1976, 1980).

Methodology

All charcoal samples reported here have been calibrated using CALIB (Version 5.0.1, 1986-2005 based on Stuiver and Reimer 1993), with the Southern hemisphere correction

Table 1. Samoan Radiocarbon dates

Site	Lab. No.	Age B.P.	Age (1 SIGMA)	Age (2 SIGMA)	Find Context	Material
SU-Fo-2	GaK-1197	180±70	AD 1672-1713, 1717-1745, 1830-1891, 1921-1951	AD 1654-1952	Oven in corner of square house on terrace	Charcoal
SU-Le-12	NZ-1430	184±75	AD 1670-1712, 1718-1749, 1751-1782, 1835-1950	AD 1644-1953	Posthole 2, perimeter house 1, sq G-5	Charcoal
SU-Le-12	NZ-1432	188±54	AD 1670-1710, 1720-1783, 1854-1880, 1924-1950	AD 1658-1819, 1823-1900, 1904-1951	Posthole 2, perimeter house 1, sq D-6	Charcoal
SU-Vg-1	GaK-499	200±100	AD 1654-1713, 1718-1814, 1835-1951	AD 1509-1580, 1620-1954	Inside umuti, age uncertainty estimated to ±100	Charcoal
SS-01-B-16	GaK-1201	210±100	AD 1648-1712, 1718-1814, 1835-1891, 1922-1951	AD 1507-1586, 1618-1954	Oven 2, house site 1, sq B-5	Charcoal
SU-Fo-1	GaK-1436	210±70	AD 1651-1708, 1721-1810, 1837-1950	AD 1626-1953	Rectangular pit on platform	Charcoal
SU-Va-1	GaK-501	220±70	AD 1646-1701, 1721-1810, 1837-1950	AD 1513-1545, 1623-1952	Firepit on platform lyer 1b	Charcoal
SU-Lu-21	GaK-498	230±70	AD 1640-1706, 1721-1810, 1837-1950	AD 1511-1572, 1622-1952	Oven off terrace	Charcoal
SU-Se-1	NZ-360	240±50	AD 1640-1690, 1727-1805	AD 1513-1544, 1623-1817, 1827-1893, 1916-1951	Charcoal from fire lens on platform	Charcoal
SuMu-165	RL-460	270±110	AD 1502-1593, 1613-1699, 1723-1809, 1838-1950	AD 1477-1819, 1823-1900, 1903-1951	Within stone fill of Cog mound	Charcoal
SU-128	UGa-1988	285±55	AD 1511-1549, 1622-1674, 174-1797	AD 1478-1699, 1722-1809	Ma'a Ti, earliest of 4 ovens at site	Charcoal
SU-Le-12	NZ-1434	286±91	AD 1499-1598, 1610-1685, 1729-1803	AD 1459-1815, 1829-1892, 1920-1951	Large post, layer 3 sq F-6	Charcoal
SuMu-48	RL-458	290±70	AD 1507-1586, 1618-1674, 1739-1798	AD 1460-1709, 1720-1811, 1837-1951	From bottom of earth oven, Janet's Oven	Charcoal
SS-Le-1	ANU-11890	310±90	AD 1495-1672, 1743-1797	AD 1449-1712, 1718-1813, 1836-1884, 1888-1951	Pulemelei mound, top platform	Charcoal
SU-Lam-1	GaK-1437	350±100	AD 1457-1655	AD 1421-1709, 1720-1811, 1837-1879, 1924-1951	Layer 1, pit or posthole sq B, Subsq H-5	Charcoal
SU17-484	UGa-1992	365±70	AD 1494-1633	AD 1441-1671, 1746-1796	Apulu HHU. From posthole in platform 4	Charcoal
SuMu-188	RL-462	370±110	AD 1450-1652	AD 1404-1710, 1720-1811, 1854-1880, 1924-1951	Earth oven fill, 60 cm from surface, Green Ti	Charcoal
SS-Le-1	Wk-13866	372±43	AD 1496-1521, 1536-1626	AD 1462-1637	Pulemelei, Umu Ti	Charcoal
SU-Le-12	NZ-1428	401±104	AD 1452-1629	AD 1391-1697, 1724-1808	Posthole in west baulk layer 3 sq F-6	Charcoal
SuMu-128	UGa-1987	440±60	AD 1438-1509, 1580-1620	AD 1425-1630	Ma'a Ti, latest of 4 earth oven at site	Charcoal
SuMu-165	RL-461	440±100	AD 1431-1515, 1540-1625	AD 1321-1348, 1387-1672	Within stone rubble fill of Cog mound	Charcoal (palm)
SS-Le-1	Wk-13867	454±46	AD 1437-1500, 1597-1611	AD 1418-1514, 1542-1624	Pulemelei	Charcoal
SU-Fo-1	GaK-1434	470±180	AD 1315-1356, 1381-1656	AD 1270-1817, 1827-1894, 1910-1951	Posthole 87, house II, house site 1, sq D-5	Charcoal
ss13-91	UGa-1672	485±125	AD 1395-1519, 1537-1625	AD 1285-1673, 1743-1797	Earth oven from Sapapali'i	Charcoal
ss13127	UGa-1673	510±60	AD 1402-1476	AD 1321-1348, 1387-1511, 1573-1621	Earth oven from Sapapali'i	Charcoal
SU17-193	Uga-1487	565±60	AD 1329-1336, 1391-1447	AD 1300-1368, 1373-1463	Earth oven, Cog Mound complex	Charcoal
SS-Le-1	Wk-15503	657±34	AD 1313-1358, 1380-1395	AD 1298-1401	Pulemelei, Under N-Mound	Charcoal
SS-Le-1	Beta-177607	680±80	AD 1294-1392	AD 1229-1250, 1260-1434	Pulemelei, Scattered in TP	Charcoal
SU-Va-1	GaK-500	680±80	AD 1294-1392	AD 1229-1250, 1260-1434	Oven, base layer Ivb step 1 (north)	Charcoal
SU-Lo-1	GaK-497	735±85	AD 1235-1328, 1338-1390	AD 1184-1415	Oven, layer V sq B-2, excavation B	Charcoal
SU-Fo-2	GaK-1196	740±100	AD 1229-1251, 1260-1328, 1338-1390	AD 1152-1435	Umu Ti at rear of terrace	Charcoal
SM17-2	UGa-2209	805±65	AD 1501-1633	AD 1453-1680	Falemoa, Stratum IV, below platform comp Uga-2211	Charcoal
SS-Sp-15	GaK-1202	750±80	AD 1229-1251, 1260-1320, 1350-1386	AD 1182-1405	Umu Ti in association with house platform	Charcoal
SS-Le-1	Wk-13865	754±59	AD 1233-1245, 1264-1316, 1355-1382	AD 1219-1391	Pulemelei, Charcoal cons. N-side	Charcoal
SU-Vam-3	GaK-1195	760±100	AD 1219-1323, 1346-1388	AD 1051-1077, 1147-1423	Oven associated with house site	Charcoal

Site	Lab. No.	Age B.P.	Age (1 SIGMA)	Age (2 SIGMA)	Find Context	Material
SS-Le-1	ANU-11891	780±120	AD 1184-1324, 1344-1389	AD 1042-1092, 1099-1419	Pulemelei, Umu at E-side	Charcoal
SU-Va-2	GaK-502	850±70	AD 1164-1280	AD 1044-1089, 1104-1304	Lens on surface of layer 2, sq B-6	Charcoal
SS-Le-1	Beta-172927	850±50	AD 1190-1273	AD 1053-1072, 1149-1291	Pulemelei, Charcoal conc.SW side	Charcoal
SU-Va-3	GaK-503	865±70	AD 1160-1274	AD 1042-1093, 1098-1294	Firepit at base of layer 5a, Sq C-5	Charcoal
SU-Le-12	NZ-1429	881±120	AD 1046-1086, 1109-1282	AD 988-1326, 1341-1390	Charcoal on interface layer 4 and natural sq C-3	Charcoal
SU-Le-12	GaK-1442	890±80	AD 1052-1076, 1148-1270	AD 1028-1288	Layer 1, sq F-5	Charcoal
SS-01-C-1	GaK-1200	890±70	AD 1053-1072, 1149-1269	AD 1040-1281	Firepit in houseplatform	Charcoal
SS-Le-1	Wk-13864	900±43	AD 1054-1060, 1150-1228	AD 1046-1085, 1110-1272	Pulemelei, Charcoal scatter on original surface S-side	Charcoal
SU-Va-4	NZ-855	927±241	AD 899-1316, 1355-1382	AD 656-1462	Fire hearth sealed under clay band on top of layer F-1a	Charcoal
SU17-483	UGa-1986	945±60	AD 1046-1086, 1109-1208	AD 1023-1230, 1249-1261	Apulu, from fill of shallow basin beneath stone piles	Charcoal
SS-Le-1	Wk-16642	955±44	AD 1045-1086, 1108-1121, 1128-1182	AD 1033-1211	Pulemelei, umu at S-side	Charcoal
SS-Le-PT	Wk-15504	992±34	AD 1036-1052, 1076-1148	AD 1023-1162, 1170-1175	Pa Tonga, Letolo plantation Original surface	Charcoal
SU-Lam-1	GaK-1438	1050±80	AD 983-1054, 1061-1150	AD 890-1209	Layer II, level 3 sq C subsq G-3	Charcoal
SU17-130	UGa-1985	1115±75	AD 887-1040	AD 779-793, 802-1053, 1062-1149	Tulaga Fale, from fire basin under platform?	Charcoal
SS-Le-1	Wk-15502	1134±37	AD 898-921, 944-994, 1009-1011	AD 891-1021	Pulemelei, scattered at original surface W-entrance	Charcoal
SS-Le-1	Wk-16640	1135±34	AD 898-920, 945-994	AD 894-1018	Pulemelei, Umu under Pulemelei mound	Charcoal
SuMu-165	RL-459	1150±110	AD 780-793, 803-1029	AD 688-1152	Bottom of fire basin beside Cog mound	Charcoal
SS-Le-1	Wk-13869	1157±44	AD 895-927, 934-987	AD 783-788, 814-843, 860-1022	Pulemelei, Umu, W-side	Charcoal
SU17-483	UGa-1990	1205±70	AD 782-848, 853-975	AD 694-748, 765-1017	From bottom of storage pit, Apulu platform	Charcoal
SS-Le-1	Beta-172928	1250±100	AD 709-747, 766-900, 918-961	AD 659-1016	Pulemelei, Umu at S-side	Charcoal
SU-Fo-1	GaK-1435	1410±100	AD 569-780, 793-803	AD 434-523, 526-898, 921-943	Brown layer under terrace sq D-11, house site 2	Charcoal
SU-Le-12	GaK-1443	1410±80	AD 608-725, 738-771	AD 549-875	Surface of layer 7, sq F-6	Charcoal
SU-Lu-41	GaK-799	1500±80	AD 537-666	AD 424-711, 746-766	Layer, cutting VIII	Charcoal
SM17-2	UGa-2210	1565±60	AD 816-972	AD 737-1026	Falemoa, Stratum II (probably too young)	Shell
SU-Va-38	GaK-1439	1550±80	AD 441-485, 532-644	AD 397-671	Firepit under mound layer 14	Charcoal
SU-Va-4	GaK-1693	1600±350	AD 88-829, 837-865	BC 356-286, BC 253-1179 AD	Oven toward base layer E, sq A-1	Charcoal
SU17-552	UGa-1991	1620±65	AD 424-560	AD 349-368, 379-637	From base of star mound	Charcoal
SU-Lu-53	GaK-1340	1660±80	AD 358-365, 381-556	AD 255-610	Agricultural activity layer 2, rectangle A-2	Charcoal
SU-Va-4	GaK-1198	1660±80	AD 358-365, 381-556	AD 255-610	Lens at base of layer F-1	Charcoal
SU-Va-4	GaK-1199	1680±80	AD 345-372, 376-539	AD 243-600	Cooking pit, Hearth Horizon	Charcoal
SM17-1	NZ-4342B/ UGa-1485	1752±37	AD 655-740	AD 613-792	Potusa, Stratum II, Pooled sample with UGa-1485	Shell
SU-Sa-3	GaK-1341	1800±80	AD 179-188, 213-404	AD 81-437, 488-512, 516-529	Layer 4, level 2, sq F-6	Charcoal
SU-Sa-3	GaK-1441	1840±100	AD 128-352, 367-380	AD 5-13, 16-439, 486-531	Layer 5, sq I-6	Charcoal
SU-Va-1	NZ-362	1850±50	AD 134-259, 297-320	AD 87-105, 121-360, 363-381	Bottom part of layer V	Charcoal
SU-Va-1	NZ-361	1880±60	AD 89-101, 123-255, 305-313	AD 58-349, 368-378	Top part of layer V	Charcoal
SU-Va-1	NZ-363	1950±120	BC 39-7, BC 5-251 AD	BC 175-406 AD	Pit sealed by layer V	Charcoal
SM17-2	UGa-2208	2020±55	AD 360-521	AD 272-578	Falemoa, Stratum III	Shell
SM17-2	UGa-2211	2030±60	AD 341-515	AD 259-580	Falemoa, Stratum IV, surface of platform	Shell
SS-Le-1	Wk-13868	1993±55	AD 1-129	BC 51-227 AD	Pulemelei, Umu at plain ware site	Charcoal
SS-Le-1	Wk-15501	2058±38	BC 45-32 AD, AD 36-52	BC 156-138, BC 113-82 AD	Pulemelei, Umu at plain ware site	Charcoal

Site	Lab. No.	Age B.P.	Age (1 SIGMA)	Age (2 SIGMA)	Find Context	Material
SU18-1	RL-478	2130±130	AD 138-477	AD 4-608	Janes Camp, Stratum III, Test 1	Shell
SU-Va-4	GaK-1194	2150±100	BC 349-314, BC 208-17 AD	BC 385-80 AD	Hearth Horizon sq N-2	Charcoal
SU18-1	RL-481	2220±120	AD 58-351	BC 108-492 AD	Janes Camp, Stratum IV, Test 2	Shell
SU18-1	RL-464	2220±110	AD 69-340	BC 84-463 AD	Janes Camp, Stratum II, probably too young	Tridacna shell
SU-Lu-53	GaK-1339	2170±100	BC 353-293, 230-218, 214-37, 28-2	BC 387-64 AD	Firepit on surface layer 1, under terrace	Charcoal
SM17-2	UGa-1484	2260±65	AD 72-240	BC 20-332 AD	Falemoa, Stratum II, Same as NZ-4343	Tridacna shell
SU-Le-12	GaK-1444	2210±100	BC 358-277, 258-242, 238-90, 71-59	BC 398-28 AD, AD 39-49	Pit, layer 5b, sq F-7	Charcoal
SU-Mf	NZ-1959	2475±63	BC 192-11	BC 314-60 AD	Lapita site Mulifanua, Latest phase	Marine
SU18-1	RL-477	2510±120	BC 324-21	BC 440-152 AD	Janes Camp, Stratum IV, “unacceptable old”	Shell
SM17-2	NZ-4343B	2540±40	BC 285-277, 270-116	BC 339-60	Falemoa, Stratum II, same sample as UGa-1484	Tridacna shell
SU18-1	NZ-2726/ 7/8B	2561±28	BC 298-167	BC 343-112	Janes Camp, Stratum II, Interpolated, 3 from same shell	Tridacna shell
SU-Mf	NZA-4780	2788±67	BC 597-383	BC 727-351	Lapita site Mulifanua	Marine turtle
SU-Mf	NZA-5800	3062±66	BC 901-764	BC 1018-699, 677-665	Lapita site Mulifanua	Shell
SU-Mf	NZ-1958	3251±155	BC 1252-870	BC 1448-730	Lapita site Mulifanua, Base of coquina layer sealing deposit	Shell/ coral

data set (SHCal04, McCormac *et al.* 2004). Marine shell determinations were calibrated with the marine correction data of Hughen *et al.* (2004). The local marine reservoir value (Delta R) was set at 57 ± 23 years. This value was calculated on a marine shell collected from Upolu (Phelan 1999), and was also used by Petchey (2001) when calibrating marine shell dates from the Mulifanua Lapita site. A recent examination of selected Samoan marine shell samples by Smith (2002:93-125) employed a slightly lower Delta R value of 45 ± 30 years. Although neither Delta R value makes much difference to the calibrated results, there are also a few inconsistencies in the conventional radiocarbon ages (CRA) values from Samoa reported by Smith (2002:110), which affect the interpretation and discussion of radiocarbon results from the Jane’s Camp site (see below). All calibrated dates are reported at two standard deviations.

Determinations on marine shell samples (NZ-4342B/ UGa-1485 and NZ-2726/7/8B) have been pooled when dating of the same marine shell gave similar CRAs. Some radiocarbon ages which do not appear to convincingly date prehistoric cultural activity have been excluded from Table 1, as have dates with modern calibrated ages. From the determinations reported by Jennings and Holmer (1980: 7-10), we reject UGa-1671 (14920 ± 175 BP), which is too old considering the generally accepted chronology of human entry to West Polynesia at 900 BC (Burley and Dickinson 2001), and RL-479 (3220 ± 130 BP), as it is not convincingly associated with prehistoric cultural activity, along with a modern result UGa-1486 (35 ± 70 BP). Among the dates reported by Green and Davidson (1974b) the following modern results (no CRAs reported) were excluded: GaK-1342, which was a contaminated charcoal sample, while NZ-1427 and NZ-1431 were on post wood from a recent house. NZ-854 has a reported CRA of 352 BP, but no standard errors were given and it was excluded from our analysis.

A problem with some of the Samoan radiocarbon samples are that 31 samples were carried out by the Gakushuin Laboratory in Tokyo. It has been argued that dates up to c. GaK-4500 may be erroneous (Spriggs and Anderson 1993:207). However, these dates are included here, since they seem to give similar dates to other laboratories concerning what they are expected to date.

Radiocarbon dating of settlements and stone/earth structures

Prehistoric settlements consisting of structures built in earth and stone can be difficult to date accurately with radiocarbon, and ^{14}C samples were evaluated according to whether or not they had a clearly identified archaeological context.

In situ fireplaces and earth ovens are prehistoric features that should provide relatively reliable radiocarbon determinations on wood charcoal. In both cases the burned wood derives from a localized feature that was constructed by prehistoric people, which links the sample to a specific action taking place over a short timeframe. The reuse of ovens and burning of old wood can result in CRA ages that are too early, but the multiple use of fireplaces and ovens can often be detected during excavation, as can the burning of old wood from charcoal identification, as well as the submission of several ^{14}C samples from different parts of the same fire place/earth oven.

In Samoa, earth ovens (*umu*) and fireplaces provide charcoal and radiocarbon results that should accurately date prehistoric activity. Archaeological excavations, though, often recover ^{14}C samples from scattered charcoal or thin charcoal lenses. Radiocarbon dates on scattered charcoal and charcoal obtained from fill material should always be viewed with scepticism, which makes the dating of structures made from earth and stone fill particularly difficult.

Food remains, such as bone and marine shell, found within sealed contexts can provide accurate radiocarbon ages, when the remains were recovered from a clearly defined cultural layer. However, old marine shells, that would supply earlier dates than the cultural activity they were associated with, may be introduced from the selection of old shells for tool manufacture, or the incorporation of old shell in beach fill used for structure construction. Introduction of modern and ancient gastropod shell to Pacific archaeological sites from hermit crab (genus *Coenobita*) activity can be identified from characteristic aperture damage, so that crab-transported marine shell is not selected as a dating sample (e.g. Carucci 1992).

When dating stone structures the context of the sample is of central importance, and it is necessary to evaluate whether a sample relates to one of four temporally distinct phases of activity during the life-history of a structure. A radiocarbon dating sample associated with a prehistoric structure may have been deposited:

1. prior to structure construction;
2. during building of a structure;
3. from structure use;
4. after a structure ceased to be used for its original purpose.

Phase 1 samples might be a cultural layer or feature sealed found beneath a built structure, and could include evidence for prehistoric activity that predated structure construction, such as low-density scatters of material culture and dispersed charcoal from vegetation burning prior to building. Phase 2 samples could result from ritual activity such as fires and sacrifices made during construction, which have been preserved within the matrix of a structure (Martinsson-Wallin *et al.* 1998:6). Phase 3 samples, depending on structure function, could be residential or ritual debris including, ovens, middens, caches and fireplaces that were deposited after structure completion, or from subsequent episodes of structure rebuilding/ refurbishing/elaboration. In West Polynesia the majority of archaeological structures are building foundations, and the insertion of posts and other structural elements into a foundation (Phase 2) could introduce materials that could be difficult to identify from Phase 3 remains. Phase 4 samples could consist of dateable materials found in surface and near surface contexts, including modern graves, fireplaces and remains introduced by visitors and from recent ceremonies, archaeological restoration and other heritage/scientific work (Wallin and Solsvik 2006).

The Samoan radiocarbon samples were identified to a particular context, with 26 dates from earth ovens (*umu* and *umu tī*), seven dates from fireplaces/fire pits, nine dates from charcoal lenses/concentrations, six dates on dateable material found in postholes, and five dates from samples found in several types of pit (Table 1). There were 36 determinations on samples of dispersed charcoal, or on marine shell, coralline crust and bone recovered from a defined cultural layer. By material type, 74 radiocarbon dates were on charcoal, 13 results on marine shell, with one determination each on turtle bone and on coralline crust. None of the charcoal samples has been identified to species, and some samples may carry inbuilt age from the burning of wood from long-lived tree species.

Initial Lapita settlement – the Mulifanua site

The Samoan landscape has been radically transformed since initial human arrival and the changes have had a significant impact on the visibility and survival of the oldest archaeological sites. In 1973 the first, and so far only, Lapita site was found underwater during dredging at the Mulifanua Ferry Berth at the northwest point of Upolu. Characteristic Lapita dentate-stamped pottery was found underneath a cemented coralline crust about 2.2 m below current mean sea level. The depth below sea level of the Lapita remains suggests that the earliest coastal sites have now been submerged as a result of island subsidence (Dickinson and Green 1998). Another factor affecting the visibility of the earliest human activity was the relatively continuous volcanic activity during the late Holocene that in some areas had covered large areas of terrain with lava. Not only have lava flows destroyed prehistoric sites or placed them beyond the reach of conventional archaeological techniques, but Green (2002:132) also notes that widespread volcanism has probably affected the coastal and inland settlement pattern on Savai'i.

The fortuitous discovery of dentate pottery at Mulifanua showed that Lapita groups had managed to cross the 850 km sea gap separating Fiji from the island groups of the West Pacific, and also settled Tonga and Samoa, but not islands further east. As the Mulifanua site was underwater and radiocarbon samples came from marine material collected by the dredge, the cultural association of the samples and their ^{14}C ages has been queried (Green 1974; Green and Richards 1975; Poulsen 1987; Kirch and Hunt 1988; Leach and Green 1989; Petchey 1995; Clark 1996; Dickinson and Green 1998; Petchey 2001).

Four marine samples from Mulifanua have been dated, with one date on coralline crust, two dates on marine shell, and one date on turtle bone. The sample of the coralline crust gave a CRA of 2475 ± 63 BP (NZ-1959 BP) and it has a calibrated age of 314BC–60AD. The age of the underlying Lapita deposit must be earlier than the crust. Two determinations on marine shell are both thought to be from a midden deposit beneath the coralline crust, but they do not overlap at two standard deviations. The oldest determination

(NZ-1958) has a CRA of 3251 ± 155 BP, and a calibrated age of 1448-730BC, while NZA-4780 has a CRA of 2788 ± 67 BP and a calibrated age of 727-351BC (Petchey 2001). The fourth sample NZA-5800 (3062 ± 66 BP) on turtle bone has an age of 1018-665BC, which fits well with the Lapita radiocarbon chronology for Tonga (Steadman *et al.* 2002), and with the estimated age of the site from the stylistic affinities of the Mulifanua Lapita pottery (Petchey 1995; Summerhayes 2001). However, dates on turtle bone protein might incorporate an unknown marine contribution and the accuracy of NZA-5800 is uncertain. The precise age of the Mulifanua site and the antiquity of Lapita occupation in Samoa have yet to be definitively established.

Plainware Deposits: Coastal and Inland

Plainware pottery sites represent the success of Lapita settlers in colonizing Samoa, and in all probability the rapid growth of the human population. The decorated and shaped pots of the Lapita era quickly gave way to undecorated (plainware) ceramics with a simple vessel shape, indicating a move toward the manufacture of utilitarian containers (Holmer 1980; Smith 1976a). Currently, sites containing plainware pottery appear to date to 300-400BC, implying that Lapita vessels could have been made for about 400 years in Samoa, if colonization of the archipelago took place at 850BC (Petchey 2001). Since there are few sites dating to the first millennium BC the decline of the Lapita pottery tradition cannot be reliably dated, but it is possible that the transition from classic Lapita pottery to characteristic Samoan plainware ceramics was underway, and possibly almost complete, by 600-500BC.

There are 14 dates from coastal sites on Upolu containing undecorated ceramics that suggest a Plainware phase dating from 350BC–500AD. At several sites the age determinations cover a relatively wide interval considering site stratigraphy. At Jane's Camp RL-477 on marine shell (unidentified to species) is dated to 324-21BC (2510 ± 120 BP), while RL-464, also on marine shell (*Tridacna* sp.) has a calibrated age of 84BC-463AD (2220 ± 110 BP). The age difference may be due to post-depositional movement of midden shell between layers. A marine shell date (RL-479, 3220 ± 130 BP) from Stratum I/II returned a calibrated age of 3689-3005 BP, which is too early, and might indicate the incorporation of sub-fossil shell into the cultural deposit. The determination has been excluded from our analysis.

Two stratigraphic units can be distinguished in the Jane's Camp site from the available ^{14}C dates and layer descriptions given in Smith (1976b:62-64). Stratum I/II is dated to about 300BC-0AD, and Stratum III/IV has an approximate age of 0-500AD. Smith (2002) also distinguished the same two stratigraphic units, but her analysis of the radiocarbon dates gave calibrated ages that are several hundred years older than those suggested here. The reason for this appears to be that Smith (2002:110) included the early date (RL-479), in her analysis of ^{14}C dates, but excluded RL-464. Unfortunately, there is also some confusion between sample details given in her text, for example, the details for RL-478 and RL-477.

The Falemoa site on Manono (Lohse 1980, Jennings 1980) has a similar age distribution to Jane's Camp, with an early unit (Stratum I/II), dated to 200BC-200AD, and a late unit (Stratum III/IV) dated to 200-AD600. These two sites reveal a continuous occupation or possibly a series of repeated occupations interspersed by short periods of site abandonment. At the coastal sites of the Vailele area, SU-Va 1 (Golson 1969b) and SU-Va 4 (Terrell 1969) only one premound phase of occupation was present. At SU-Va-1 the premound occupation is dated to 50BC-350AD, and at SU-Va-4 the premound phase containing ceramics is dated to 250BC-50AD. These sites are quite close to one another in age, and they could indicate an early settlement in the area at 250BC-350AD, which covers the time when the two stratigraphic units identified at Jane's Camp and Falemoa were deposited.

Inland plainware sites or locations containing plain pottery have been recorded on Upolu and on Savai'i. The earliest inland site with pottery on Savai'i was found at Pulemelei, which dates to c. 100BC-AD200 (see below). On Upolu the earliest inland site is SU-Le-12 dated to 400BC-30AD, and another Upolu site (SU-Sa-3) is dated by two ^{14}C samples to 80-440AD. This might indicate that most inland sites represent a relatively limited phase of occupation when populations initially expanded and moved inland. However, the stratigraphic evidence from SU-Sa-3 on Upolu persuaded Green (1974:111-115) that there were probably four successive prehistoric occupations of plainware age.

Overall, radiocarbon ages indicate that plainware sites from coastal and inland areas were used for a period of 800-900 years from 350BC-500AD (Figure 1).

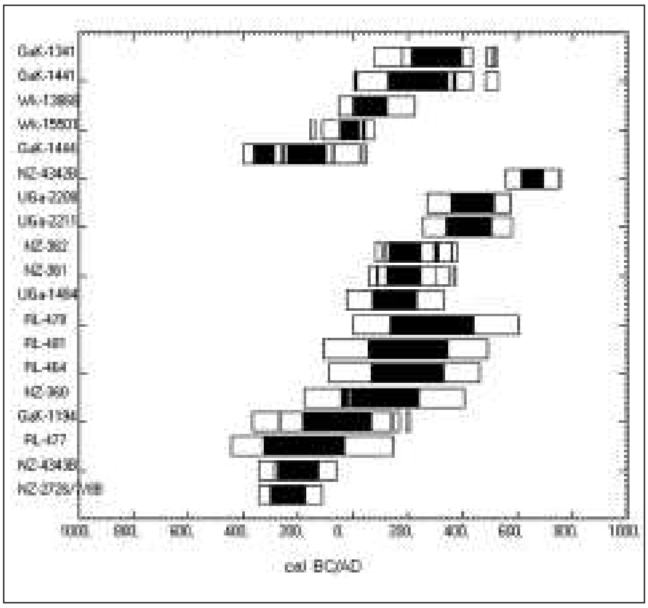

Figure 1. Dated samples from Plainware sites coastal and inland representations.

The "Dark Age" of Samoan Prehistory

The period 400-1000AD has been called the "Dark Age" of Samoan prehistory, from the limited archaeological evidence for prehistoric activity (Davidson 1979:94; Green 2002:140). It is an important period because it covers the span during which a distinctive Polynesian culture developed in Samoa. Near the beginning of the "Dark Age" pottery manufacture was abandoned in Samoa, and toward the end of the "Dark Age" West Polynesians began to move eastward into the uninhabited islands of East Polynesia. Furthermore, around 1000AD monumental architecture, comprising of raised platforms of stone and earth as well as walls, pavements and raised walkways, appear in West Polynesia representing the emergence of complex societies in the region.

With the end of pottery making and the absence of structures built in permanent materials that developed later, archaeological sites from the "Dark Age" are difficult to identify except from the results of radiocarbon dating. The ^{14}C dates for this period suggest it was far from being an archaeological "Dark Age", since there are 19 assays (Figure 2). By scrutinizing the archaeological remains found in association with the ^{14}C determinations we can extend our understanding of the prehistory of the "Dark Age".

Of the 19 radiocarbon determinations, seven were on samples derived from earth ovens and fireplaces, which we consider to be relatively reliable dating samples (GaK-1199, GaK-1439, Beta-172928, Wk-13869, RL-459, Wk-16640 and UGa-1985). One sample (UGa-1990) was from a storage pit, and seven samples (GaK-1198, GaK-1340, UGa-1991, GaK-799, GaK-1443, GaK-1435 and Wk-15502) are from more uncertain activities or possible clearing or agriculture etc.

We argue that the provenance of these samples is typical of the features and activities recorded from aceramic Polynesian sites in both West and East Polynesia. For example, dated samples from similar contexts have been recorded in East Polynesian settlements and agricultural features, and they also occur under *marae* structures (Wallin and Solsvik 2005). In these excavations prehistoric remains largely consist of earth ovens, 'storage pits', and scattered charcoal/lenses that are likely to originate from garden clearing, oven rake-out, and the burning of household debris (Wallin *et al.* 2004). In fact the context of dating samples reveals that the Samoan "Dark Age" may represent a typical Polynesian life style tied to domestic and horticultural activities.

Burley (1998:365) considers the term "Dark Age" to be misleading for Tonga, and has instead characterised the "Dark Age" as a formative stage prior to the emergence of the classical Tongan chiefdom. We believe the same also holds true on Samoa where the absence of pottery and the continued use of earth ovens and storage features signifies continuity in settlement, rather than social decline, as might be inferred from the term "Dark Age". The loss of pottery in Samoa and other parts of the Pacific has been extensively discussed, but there is little reason to assume that a decline in the manufacture of a utilitarian container represents a radical technological event that correlates with substantial change to the prehistoric economy or transformation of social relations. An alternative explanation is that the labour expended on domestic pottery manufacture was gradually transferred to the production of commodities, like mats and *tapa* cloth, used in economic and ceremonial exchange (see also Crown and Wills 1995).

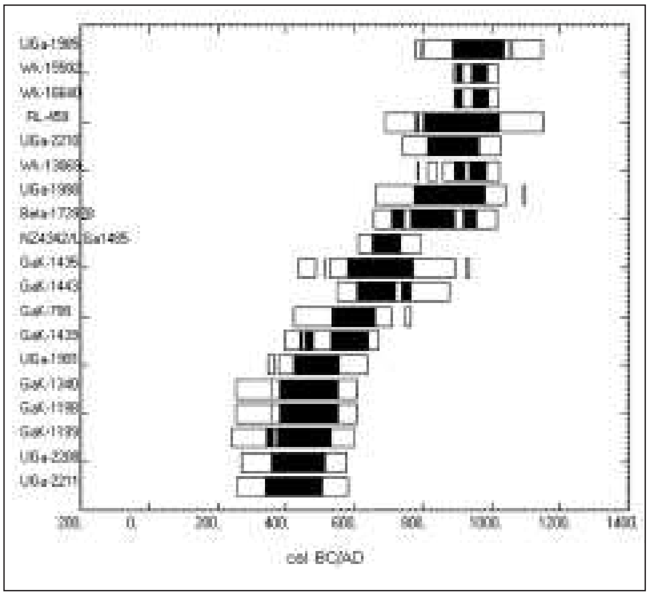

Figure 2. Dated samples from the Samoan "Dark Ages".

Late Prehistoric Settlement

There are 32 ^{14}C determinations associated with the remains of built structures such as terraces, pavements and mounds. The dating samples were recovered from beneath a structure, on the ground surface over which a structure was built, and inside the matrix of a structure, as well as from the surface of built features (Figure 3).

One result with an early CRA of 2170 ± 100 BP (GaK-1339 BP) has a calibrated age of 387BC–AD64. However, the sample was from a fire pit found under a terrace and clearly predates terrace construction. Ten samples have calibrated ages that fall within the span AD350-1050 (UGa-1991, GaK-1439, GaK-1435, Beta-172928, UGa-1990, Wk-13869, RL-459, Wk-16640, Wk-15502, UGa-1985) and belong to the "Dark Age", and are described in that section. The context of these samples is from beneath platforms/mounds, which shows that the structures must have been constructed after the feature was used, but the important question about the amount of time separating the two construction events cannot be answered.

Eleven samples are linked to monuments/monumental architecture. These samples were collected from the palaeoground surface close to stone foundations, and in one case from a fire pit under a mound. The samples have calibrated ages ranging from AD1025-1400 (Wk-15504, Wk-16642, Wk-13864, GaK-1200, Beta-172927, ANU-

11891, UGa-2209, Wk-13865, Beta-177607, Wk-15503, UGa-1487). It is probable that monumental structures in Samoa were first constructed within this temporal range as Davidson (1979:94) has previously suggested. Ten additional samples appear to date the construction, use and reuse of prehistoric structures, and were collected from within the stone fill, from postholes in platforms/mounds, and from fire pits and ovens dug into, or found on the surface of platforms/mounds (Wk-13867, RL-461, UGa-1992, ANU-11890, RL-460, NZ-360, GaK-498, GaK-501, GaK-1436, GaK-1197). The ^{14}C dates indicate ongoing use and reuse of structures from 1400-1800AD, which is also when star mounds appear to have been built (Herdrich and Clark 1993).

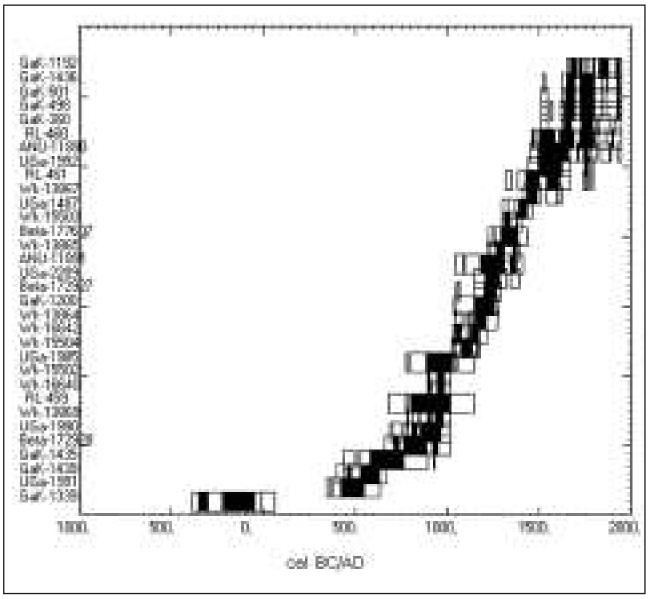

Figure 3. Dated samples from the Late prehistoric settlement and dates associated to stone structures.

Umu tī

Large raised-rim ovens with a diameter between 3 m and 15 m have been recorded in several prehistoric settlements in Samoa. The ovens are usually interpreted by local informants as *umu tī*, and according to tradition, were used for cooking the root of the *tī* plant (*Cordyline fruticosa*). Cooked at a high temperature, the root transforms from something inedible to edible and through this metamorphosis it may have contributed to ritual ceremonies (Carson 2002:347, Buck 1930:136 and Ehrlich 2000:371-400).

Seven structures interpreted as *umu tī* have been excavated in Samoa, and they have been dated with ten radiocarbon determinations (Figure 4). An *umu tī* from Mt Olo (*called Ma'a ti*) showed several phases of use (Jackmond 1980:51). A sample from the earliest phase produced a CRA of 285 ± 55 BP (UGa-1988) and a sample from the most recent phase had a CRA of 440 ± 100 BP (UGa-1987). The inversion of the dates may indicate that UGa-1987 was on old wood, or perhaps that prior to dating the sample/provenance information for the two samples was switched by accident in the field or laboratory. If old wood is responsible for the inversion then the age of the *umu tī* is likely to be closer to the calibrated UGa-1988 determination of 1478-1699AD.

Two determinations have a relatively early age indicating construction of *umu tī* in the period 1200-1400AD (GaK-1196, BP 740 ± 100 and GaK-1202, 750 ± 80 BP), while remaining ages for *umu tī* are later around 1400-1800AD (Figure 4).

Umu tī are clearly associated with late prehistoric settlement in Samoa. The location of *umu tī* indicates an association with platform features, such as large-to-medium sized mounds, walls and walkways, as seen for example in the Letolo plantation, and sometimes occur within household units (Jackmond 1977-78; Jennings *et al.* 1982).

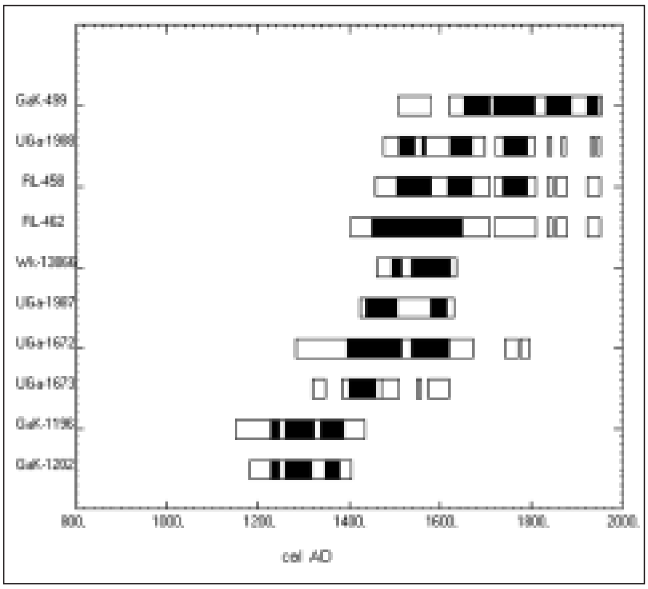

Figure 4. Dated samples from *Umu tī* ovens.

Defence structures

There are only two ^{14}C dates on samples found in possible association with defensive structures. One sample came from charcoal found under a wall at the inland fortification of Luatuanu'u on Upolu. The result has a calibrated age of 550-750AD (GaK-799, 1500 ± 80 BP), and may derive from earlier activity that was not associated with the fortification. The other sample is from scattered charcoal found 90 cm below the current ground surface at the base of the stone wall known as the "Pa Tonga" in the Letolo Plantation, north of the Pulemelei mound (Brødholt and Vuijsters 2004). The sample, Wk-15504 (992 ± 39 BP) gave a calibrated age of 1025-1175AD. The stone wall is aligned east-west and extends between two river streams. The wall was 2.44 m high in the 1960s and may have been for defence (Scott 1969:77), but could be a boundary marker dividing coastal from inland districts (Green 2002). The ^{14}C sample collected from the base of the wall might derive from vegetation burning during clearing of the area prior to settlement. If so, the wall could have been built soon after 1023-1175AD.

Although the association of both radiocarbon results with a defensive structure is problematic, as is the identification of a structure as serving a defensive function, the construction of fortifications and the “Pa Tonga” wall indicate that changes to Samoan society were taking place that required the creation of new types of built structure. Further dating of these “defensive” structures is required to establish if defensive/boundary structures were made soon after the “Dark Age” or were a more recent phenomenon.

Pulemelei Radiocarbon Chronology

A fundamental aim of our archaeological investigations at the Pulemelei mound site was to obtain radiocarbon dates for an absolute chronology for the emergence of monumental architecture in Samoa, as none of the largest mounds on Upolu and Savai’i had ever been ^{14}C dated. A total of 17 ^{14}C determinations on charcoal samples have been obtained for the Pulemelei site. Individual age results have been mentioned, when relevant, in the chronological outline of the Samoan sequence presented above, but here we use the dates to construct a local sequence for prehistoric human activity in the Letolo Plantation that begins around 2000 years ago, and ends with the final event associated with the construction of the Pulemelei mound in the 17th century AD (Figure 5).

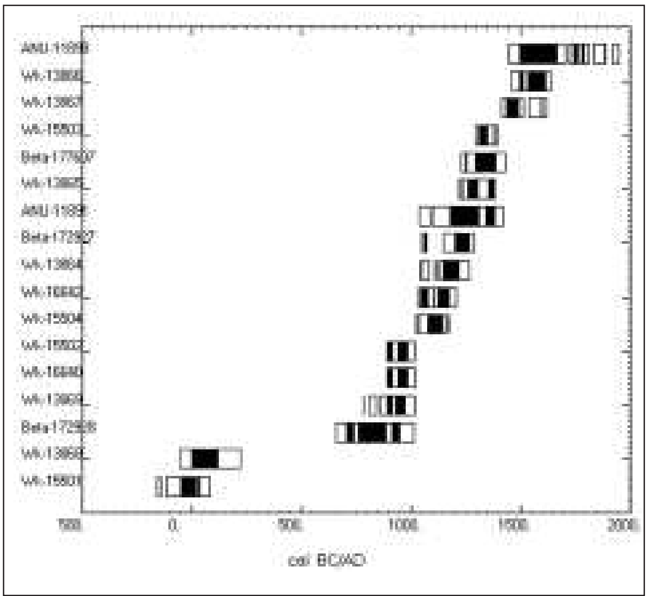

Figure 5. Multiplot of the radiocarbon assays from the Pulemelei site.

Initial settlement and abandonment

The two earliest dates of 1993 ± 55 BP (Wk-13868) and 2058 ± 38 BP (Wk-15501) are from the earliest settlement/horticulture activity in the area that involved the use of plainware pottery. The dates are not associated with the construction of mounds, platforms, or pavements. Both samples derive from the base of a large earth oven that also contained pottery and non-pottery artefacts (Clark and Martinsson-Wallin this publication). The oven was located on the south side of the Pulemelei mound on a natural terrace formed by the accumulation of clayey soil lying against and over a low volcanic outcrop. The two calibrated dates indicate inland settlement in the period 150BC-200AD. A few small plainware sherds were also found in test pits and trenches with ovens/scattered charcoal dated to c. 1150AD, but we believe the pottery from these contexts to be intrusive.

No ^{14}C determinations are from the 500-year period 200-700AD, despite numerous investigations in the vicinity of the mound. The absence of dates suggests there may have been limited use or abandonment of the inland Letolo area during this time. Large-scale archaeological investigations and more ^{14}C dates are required to determine whether the absence of human settlement at Letolo in the “Dark Age” is genuine. Another way to find out more about this would be with a palaeoenvironmental study. For example, palaeoecological investigation has shown that human impact on the vegetation continued through the Tongan “Dark Ages” (Fall 2005), despite the relative absence of archaeological sites dating to the first millennium AD (Burley and Clark 2003:246).

The apparent temporal cessation in human activity of the Pulemelei area from 200-700AD is similar to that noted at Vailele on Upolu, where pottery and other occupation debris predated the construction of several earth mounds by several centuries (Green 1969b). Elsewhere in Samoa there are only two ^{14}C dates from Vailele that might connect premound settlement with mound construction (Table 1, and see also Terrell 1969:165, Figure 69), but the dates have large standard errors (NZ-855, 927 ± 241 BP and Gak 1693, 1600 ± 350 BP), and they do not constitute secure evidence for continuity between premound occupation and the late prehistoric settlements constructed with durable materials. As yet there is no archaeological site in Samoa which has a continuous prehistoric sequence illustrating the development of the “traditional” Samoan settlement pattern from a cultural precursor.

Renewed activity

During the second half of the Samoan “Dark Age” (700-1000AD) there is stronger evidence for human activity in the Pulemelei area. Three ^{14}C charcoal determinations (Beta-172928, 1250 ± 100 BP, Wk-13869, 1157 ± 44 BP, and Wk-16640, 1135 ± 34 BP) were from earth ovens containing abundant charcoal and fire-damaged fist-sized stones. A fourth result (Wk-15502, 1134 ± 37 BP) was collected from a scatter of charcoal found on the west side of the mound at the same level as the earth oven dated by Wk-13869, which has a similar CRA of 1157 ± 44 BP.

The sample dated by Wk-16640 has a calibrated age of 894-1021AD and was from an earth oven found under the

Pulemelei mound. The earth oven had been dug into the ground surface prior to construction of the base platform. The major platform components of the Pulemelei mound cannot have been built, therefore, earlier than about 1000AD, although the small mound identified in the geophysical survey might be older, if it is anthropic and not a natural feature (see Chapter 4).

Initial mound building

There are six determinations from the Pulemelei mound and nearby structures and features that are interpreted as dating phases of construction/use. The dates fall within the period 1030-1440AD, and demonstrate activity on all four sides of the mound. Two of the charcoal samples were from earth ovens (ANU-11891, 780 ± 120 BP and Wk-16642, 955 ± 44 BP), and two were on charcoal concentrations found close to the base of the large upright foundation stones that form the perimeter of the base platform (Wk-13865, 754 ± 59 BP and Wk-13864, 900 ± 43 BP). The fifth determination was on a charcoal concentration recorded at 40 cm depth below ground surface (Beta-172927, 850 ± 50 BP).

The sixth date was on scattered charcoal from only 10-20 cm depth, which gave a more recent CRA of 660 ± 80 BP (Beta-177607). However, the calibrated age range for the determination is 1230-1440AD, which falls within the upper age distribution of the five ^{14}C results that have relatively secure contexts. So, by this time (1230-1440AD) the Pulemelei mound, at least the base platform, had probably already been built. However, since the dating samples that falls in the time frame 1030-1440AD were carried out on unidentified charcoal they might include an inbuilt age component. To account for that possibility we suggest that initial building of the Pulemelei mound could be dated to c. 1100-1300AD.

Another indication that stone structures, including the monumental Pulemelei mound, began to be constructed in the Letolo area around 1100AD is a radiocarbon date from the "Pa Tonga" wall located 1.3 km to the north of the Pulemelei mound as referred to above (Brødholt and Vuijsters 2004). However, since the dated sample was on scattered charcoal the result provides only tentative support for the construction of large stone structures at 1100AD.

Rebuilding and elaboration

Four ^{14}C dates from the Pulemelei site indicate ongoing use of the area after initial mound construction. A charcoal lens from under the foundation fill of the North mound had a CRA of 657 ± 54 BP (Wk-15503), similar to Beta-177607 on scattered charcoal from 10-20 cm depth from near the northwest corner of the Pulemelei mound. The charcoal lens was not disturbed, which suggests the North mound was built around 1230-1440AD. It was observed in 2002 that vegetation cleared from around the Pulemelei mound was often mounded down slope on a suitable rock outcrop or small promontory and burned when dry. The thick charcoal lens under the North mound might result from similar activity prior to construction of the foundation.

Three other radiocarbon results indicate further developments. The first date Wk-13867 (454 ± 46 BP) on a charcoal concentration found below a pavement/house platform on the south side of the Pulemelei mound had a calibrated age of AD1418-1514. If the determination dates a structural timber from a house, then the result may predate house construction by a small interval. An alternative is that the charcoal concentration came from a burning event prior to placement of a stone pavement on the south side of the mound, in which case the pavement may post-date c. 1500AD. The second date was on a sample from inside the large *umu tī* located just west of the North, and returned a CRA of 372 ± 43 BP (Wk-13866), which has a calibrated age of 1462-1637AD. The third sample was on charcoal found during the removal of tree stumps on the top platform of the Pulemelei mound at a depth of 60-70 cm. The sample gave an age of 1449-1712AD (ANU-11890, 310 ± 90 BP).

The presence of buried charcoal below the top platform in association with a thin lens of clay and pebbles recorded in the tree-stump hole suggests that the top platform was built in several stages rather than as a single addition to the base platform. Reinforcing this view is the stratigraphy from Trench 13 where there was also a thin lens of small-rounded river stones, like those used to pave the top platform. Whether the clay and pebble lens correlates with the top of the base platform or represents a distinct building event associated with the construction of the top platform is currently unclear. Ground penetrating radar identified a reflector layer at 2.0 m depth below the top platform, which is inferred to be closer to the top of the base platform than the clay and pebble lens found at 70 cm depth.

In any case the addition of the top platform is likely to be contemporary with the construction of the *umu tī* and the pavement/house on the south side of the Pulemelei mound. During this period 1450-1700AD the sunken entrance ways were also likely to have been built/rebuilt.

Conclusion

Most radiocarbon results from Samoa are on charcoal reflecting the loss of early coastal deposits holding abundant shellfish remains as a result of Holocene subsidence (Dickinson and Green 1998), and the poor preservation of cultural remains interred in young volcanic soils, other than charcoal, pottery and stone. Archaeological charcoal from earth ovens and fireplaces can provide reliable age determinations, but scattered and relatively small concentrations of charcoal are commonly encountered in excavations, particularly in association with the remains of built structures, where they frequently constitute the only dateable materials. A radiocarbon chronology for Samoa that includes the development of late prehistoric settlements marked by a variety of permanent structures must take into account the significant difficulty of obtaining accurate ^{14}C dates for mounds, walls, pavements, roads and walkways made in earth and stone.

Our approach focused, like other reviews of radiocarbon dates from the Pacific (e.g. Anderson 1991; Liston 2005), on the archaeological context of a sample, with determinations associated with prehistoric structures identified to a particular phase of construction/use. When applied to the Samoa sequence the ^{14}C results are similar to those of previous studies regarding the timing of colonization, production and decline of plainware, and the emergence of "traditional" Samoan society (Green and Davidson 1974a; Clark 1996; Green 2002).

Radiocarbon determinations from the Pulemelei mound site indicate, however, that the development of monumental architecture, and of the Letolo settlement pattern, could have begun as early as 1100-1300AD rather than in the 17th century as suggested by Jennings *et al.* (1982). There were probably several additions to the Pulemelei mound before the top platform reached its current size and height, and new structures such as the North mound, *umu tī* and a pavement/house platform were constructed, possibly in response to rebuilding/elaboration of the Pulemelei mound. Thus, the Letolo settlement pattern recorded by Jackmond (Jennings *et al.* 1982) is a palimpsest in which older features and structures can only be distinguished from those of more recent origin by radiocarbon dating and archaeological investigation. The Pulemelei dates suggest that settlement pattern studies, which frequently lack chronological control, are capable of conflating archaeological remains from, in the case of Letolo, some 500 years of prehistoric occupation. While it is unrealistic to radiocarbon date every prehistoric structure, our investigations at the Pulemelei mound site suggest that it is feasible to obtain a localized ^{14}C chronology for a range of structures, which more accurately portrays architectonic changes in the late-prehistoric settlement pattern.

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Settlement patterns – Social and ritual space in prehistoric Samoa

PAUL WALLIN and HELENE MARTINSSON-WALLIN

Abstract

This paper explores the extensive prehistoric settlement pattern at the Letolo plantation. Using the results of earlier research we use a correspondence analysis to investigate variation in the settlement pattern, particularly differences between coastal and inland locations.

Investigation of archaeological sites in Samoa in the 1960s and 1970s resulted in several suggestions about the prehistoric settlement pattern (Davidson 1969, Davidson 1974:242; Jennings *et al.* 1982). The first archaeological excavations investigated a variety of sites, and an important conclusion of this research was that prehistoric settlement was established at both coastal and inland locales in early prehistory (at least by c. 2000 BP). It was also found that house pavements were an early component of the settlement sequence, but raised stone and earth platforms/mounds for occupation or ritual space are, to current knowledge, confined to the last millennium (Wallin, Martinsson-Wallin and Clark, this publication). A temporal shift in material culture in Samoa is thereby evident. Roads and stone walls were frequently associated with large platforms/mounds. The roads were often clearly defined by stone walls and connected house hold units.

Settlement pattern studies

Jennings *et al.* (1982) based their discussion of Samoan prehistoric settlement patterns on data from ethnohistorical records, extensive archaeological survey data and excavations, which they compared with the layout of the contemporary village of Fa'a'ala on Savai'i. The results of the Letolo archaeological survey were employed to interpret the prehistoric settlement pattern, but other settlements at Mt Olo on Upolu, and the Sapapali'i settlements on Savai'i were also brought into the discussion. Using the ethnohistoric settlement data as a backdrop, Jennings *et al.* (1982) concluded that prehistoric settlements consisted of a household unit (HHU) made up of a few individual house platforms, with a cooking area separated from the other units by walls or walkways (more than 75% were enclosed by walls), and a possible garden area within the enclosure (Jennings *et al.* 1982:82). Several HHU grouped around a chief's dwelling unit, which was identified by a larger platform. Collectively these chiefly clusters constituted a unit called *pito nu'u* (residential wards). Several *pito nu'u* clusters constituted a larger unit called *nu'u* (village) with a *mala'e* (village green) and a *fale tele* (community house). Larger platforms were identified as a chief's dwelling or a community meeting house, and through the use of statistical methods the Letolo settlement pattern was divided in to five village wards (*pito nu'u*) by Jennings *et al.* (1982:84) (Figure 1).

Roger Green subsequently put forward a sequence in which the settlement pattern has various phases, but there is strong cultural continuity evident throughout the prehistoric sequence (Green 2002:135-146):

1. Settlement patterns during the period of the decorated Lapita ceramics (c. 2900-2700 BP)
2. Settlement patterns during the period of Polynesian plainware (c.2700-2000/1500? BP)
3. An interval for which settlement pattern evidence is extremely limited (c. 1500-1000 BP)
4. Settlement patterns between 1000 and 200 years ago (c. 1000-200 BP).

The earliest archaeological evidence for the settlement pattern came from a house site with Polynesian plainware at Sasoa'a which was dated to c. 1800 BP (Green 2002:138-139). The house comprised a principal dwelling (PPN **fale*) with its posts (PPN **pou*, *tulu*), and other features including an earth oven (PPN **umu*), stone pavement (PPN **paepae*), storage pit (PPN **lua*) and boundary fence (PPN **lotuqaa*). The house layout and features were seen by Green as similar to those of the later household units (HHU), suggesting that there was continuity in the social formations expressed in the Samoan settlement pattern. Green also suggests that Ancestral Polynesian societies were house societies and HHU were tied to a social group (PPN **kainga*) *'aiga* probably lead by a family elder (PPN **fatu*).

Excavations at Pulemelei mound during 2002-2004 have shown how the area has been utilised over time and identified developments in the construction of monumental architecture. Our investigations showed that the valley was utilised for human occupation about 2000 years ago by people using Polynesian plainware, long before the Pulemelei mound was built. Excavation and geophysical data also showed that the Pulemelei mound was built in several stages, and was not the product of a single construction event. This new information implies a long history of settlement at Letolo, which shows substantial variability in the settlement pattern. This knowledge, paired with preliminary results from excavations carried out on the

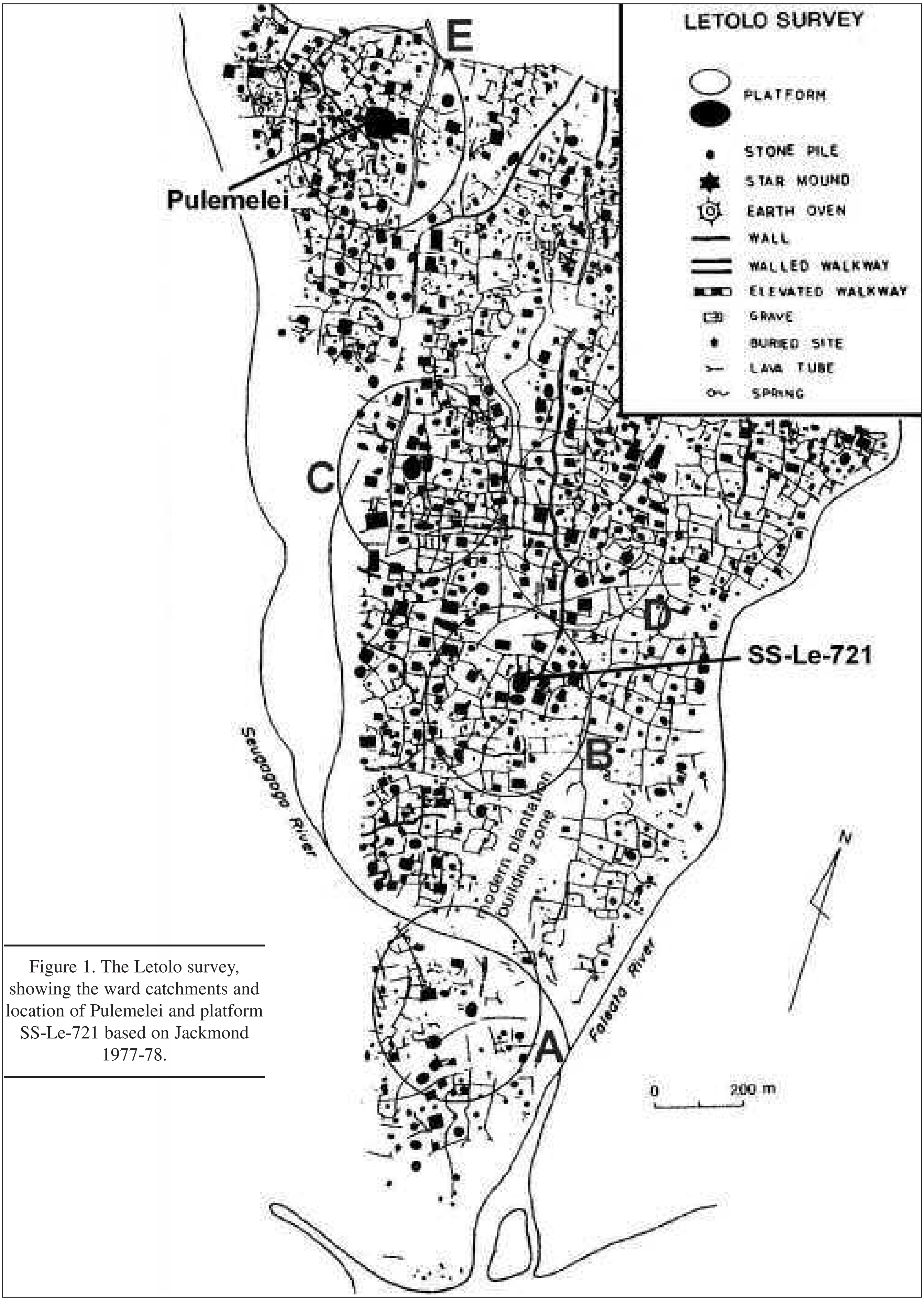

Figure 1. The Letolo survey, showing the ward catchments and location of Pulemelei and platform SS-Le-721 based on Jackmond 1977-78.

house platform SS-Le-721 (Figure 1), where a domestic structure was placed in an area previously used as a garden, suggests changes in the spatial distribution of the settlement. This highlights the probability that the remains of structures recorded in a settlement pattern survey have been constructed at different times (Martinsson-Wallin *et al.* 2006).

In late prehistory the majority of inland settlements were abandoned in favour of the coast. The change in the settlement pattern was probably caused by a population decline from introduced diseases, and the impact of Christianity (Green 2002:148). Thus, although the 19th century saw a major change in the location of the settlement pattern, previous researchers have suggested that there is little evidence for a major change in Samoan social organisation (Jennings *et al.* 1982:100; Davidson 1979:102).

Correspondence analysis

The Letolo prehistoric settlement is extensive, varied and complex and to analyse such data we have selected a multivariate statistical method, correspondence analysis. The use of such relational statistics has, for example, previously been applied when investigating complex and varied archaeological data tied to the ceremonial architecture on Rapa Nui and the Society Islands (Wallin 1993; Wallin and Solsvik 2002; Martinsson-Wallin 1994).

Correspondence analysis is a relational statistical technique that was developed in the 1960-70s based on absence/presence data (Benzecri 1992). It was initially used by the French scientific community among sociologists (Bourdieu and Wacquant 1992; Broady 1991). The technique is not commonly used within the Anglo-American research tradition or among archaeologists in general until more recently (Baxter 2003:142). The aim of a correspondence analysis is "to reveal the structure of a complex data matrix without losing essential information", by displaying the results visually (Clausen 1998:1). The method analyses relations among 'individuals' and their variables. The 'individual' is treated in relation to the variables they are attached to, while the variables are also analysed in relation to each other. The method has been used extensively by the French sociologist Bourdieu who proposed the concept of 'fields'. The 'fields' consist of a set of relations made up from the positions of the 'individuals' and 'variables' used in the analysis. The method can be used as an analytic 'tool' to study both the general and specific relations in a data set. Similarities are expressed through closeness among individuals/variables, and differences are expressed by distance among the positions of individuals/variables in the graph output (Broady 1991).

Among stone platforms and walkways

When carrying out archaeological survey at Mt Olo in the 70's Jennings and his team detected 120 household units (HHU) (Jennings *et al.* 1982:84). An important criterion in distinguishing an HHU was that it is delimited (at least 75%) by walls and walkways. According to ethnohistorical records this unit is related to the concept of the domestic family unit *fuaiala* translated to 'measurement along a path'. The HHUs that contained three or more stone platforms of large size (250-400 m^2) were regarded as chief's households and these were often associated with large *umu tī* ovens (Jennings *et al.* 1982:84). Furthermore, the study at Mt Olo suggested that several smaller HHU clustered around a larger chiefly HHU. These clusters were called residential 'wards' or *pito nu'u*, which means a lineage who reside together in a grouped domiciliary area. The ward concept has recently been evaluated and suggested to be defined as a *nu'u* rather than a *pito nu'u* unit (Asaua 2005:24). The walkways bound the units together.

Jennings *et al.* (1982) indicate that a similar settlement pattern to that of Mt Olo was found at Letolo, but with a higher frequency of platforms and *umu tī* and fewer star mounds. A total of 1059 platforms were recorded at Letolo and they varied considerably in size, but the general observation was for platforms to have a higher density and larger size in comparison to Mt Olo. Two parallel walkway systems traversed the length of the upper half of the Letolo survey area and represented the principal access routes through the village 'wards'. Remote residential units were reached by secondary walkways. Using a statistical analysis of the surveyed structures, 300 HHU were suggested of which 50 were clearly defined (ibid 1982:89). Based on the settlement pattern found at Mt Olo with large platforms representing chief's dwellings or community houses, five village 'wards' or *pito nu'u/nu'u*, were suggested by Jennings *et al.* for the Letolo settlement.

In his recent discussion of the Samoan settlement pattern Green (2002:142) concludes that "determining status and rank in HHUs and their dwellings certainly needs a great deal more data and further refinement". He points out that even though the raised platforms and dwellings seem to be status sensitive, archaeological evidence for large guest or community houses is still lacking. These substantial structures with large centre posts have been described in the ethnohistorical literature, and should be identifiable in archaeological survey and excavation (*ibid:*142). Green also states that the internal arrangement of HHUs should be given more attention, as well as the HHUs in relation to environmental resources (*ibid:*142).

A general trend toward the clustering of settlement structures over time is indicated. Archaeological excavations have shown that various structures close to the Pulemelei mound were built at various times, and the large mound itself were constructed over several centuries.

Structure attributes

The inventory used here is based on the survey of the Letolo plantation carried out by G. Jackmond, a volunteer of the United States Peace Corps, May 5, 1977 to November 8, 1978 (Jackmond 1977-78). The surveyed area covered was 198.8 hectares stretching from the coast to about 2.5 km inland, lying between the two rivers of Faleata and Seungagogo. The prehistoric settlement continues beyond the northern margins of the plantation further inland, and a fortification wall called the Pa Tonga is located about 5 km inland and spans the area between the Faleata and Seungagogo rivers. The wall was surveyed and test-excavated in 2004 (Brødholt and Vuijsters 2004).

Stone structures included in this analysis are mainly different kind of stone platforms, stone piles, ovens, walls and walkways. The platforms are interpreted, for the most part, as house foundations or spaces for assemblages/god houses. In our study we do not distinguish between platforms and mounds as has previously been done (Davidson 1974:225; Asaua 2005:71-72), and use the term 'platform'. At Letolo platforms were constructed of volcanic stones of varying size, and in many cases small rounded river stones (*'ili'ili*) were placed on the top surface. We suggest a division between two types of platform based on shape: a) round-to-oval and b) square-to-rectangular. The diameter of the base varies between ca. 2 m and 65 m. Since the size variation is significant we have made the following division of platforms based on area: 1) Small, platforms less than 700 m^2, 2) Medium, platforms between 700-1300 m^2, 3) Large, platforms greater than 1300 m^2. These values are based on mean area values, and the Medium group includes 50% of all platforms. The lower quartile (25%) includes small structures and the upper quartile (25%) represents large structures. Platform height also varies significantly and platforms were grouped as: 1) Platforms 0.1-0.6 m high and 2) Platforms higher than 0.6 m. In these calculations we have used mean values since the height of a platform located on sloping ground varies depending on where the structure height was recorded. The general observation is that there are few structures with a mean height exceeding 1.5 m, with the prominent exception of the Pulemelei mound, which has a top platform 8-12 m above ground level. The estimation of structure volume is another index that can be used to assess platform variation.

Circular stone ovens with raised rims and a depression in the centre have been interpreted as *umu tī*, ovens for cooking the roots of the *tī*, plant (*Cordyline fruticosa*). The*tī* plant is associated with ceremonial and chiefly activity (Carson 2002). The *tī* root contains a sugar that is caramelised when exposed to very high temperatures for a long period of time, and it was considered a high status food. To produce this delicacy large ovens were needed. Oven diameters were divided into two groups: 1) 3-11 m and 2) larger than 11 m.

Stone walkways were of great importance in connecting the different HHU, *fuaiala*, *pito nu'u* and *nu'u*. Walkways have been included in this study if they were found in close association with stone platforms. They are mainly of two different types; walled or raised walkways. The walled walkways are paved and can be up to 3-4 m wide, with walls of c. 0.5-0.7 m high on each side. The raised walkways are c. 1-2 m wide with a level surface.

Other walls appear to have functioned as land boundaries and these along with stone piles of uncertain function have not been included in the analysis.

Correspondence analysis of the Letolo settlement

The pioneering study of Jennings *et al.* (1982) indicated that Letolo comprised five central areas or village 'wards' identified by large platforms and clusters of HHUs. One of these 'wards' included the Pulemelei site, although the mound was not included in the statistical analyses. Ward groups have been maintained in our analysis in a modified sense by employing the concept of a 'ward catchment'. A 'ward catchment' was constructed by drawing a circle of 200 m radius using the principal structures in each ward as the centre (Figure 2). This was an arbitrary distance, which nonetheless was thought might realistically encompass structures linked to large platforms, and was a way to obtain comparable study areas.

All platforms within the 'ward catchment' area are defined as individuals in the analysis. Each individual is attached to different variables such as platform shape, size and height. Furthermore each individual is attached to variables such as ovens and walkways.

The structures within each 'ward catchment' were used in the correspondence analysis to study the composition and nature of internal relations within and among the wards catchments. The ward catchments are called A, B, C, D, and E (Figures 1 and 2), with wards A and B located on or close to the coastal plain, and wards C, D and E located 2-3 km inland.

After exploratory analysis we made a decision to combine wards A and B and form a coastal group that could be compared to an inland sample made up of wards C and E. Within each coastal and inland group all platforms, ovens, and walkways were included.

The central places of wards have a relatively even distribution throughout the landscape with about 400-800 meters between the central structures in each ward. Each central area also has one or more stone platforms of larger than average size. The correspondence analysis graph shows that the coast/lowland set (ward A and B) was positioned on the left, and the inland set (ward C and E) to the right (Figure 3). Associated with the coast/lowland set were the variables round/oval, small and low platform (all found in the small left circle in the graph, Figure 3), along with *umu tī* with smaller dimensions. Associated with the inland set (ward C and E) were the platform variables square/rectangular, large, and high. *Umu tī* with large dimensions and a close association with walkways were also placed in the ward C and E group (indicated within the right small circle in the graph, Figure 3).

The location of the individual platforms is indicated by numbered dots in the graph (Figure 3). The numbered dots in the upper part of the graph, lying above the X-axis, generally represents small structures, and the dots below the X-axis generally indicate structures that increase in size further down the Y-axis. The large oval in the lower part of the graph indicates the largest stone platforms independent of whether their shape is round/oval (represented mainly in the left part of the oval) or squared/rectangular (mainly in the right part of the oval). Because of their large size the dots within this oval could represent high-status platforms such as chiefly houses or community ceremonial-religious places.

Social and religious/ceremonial spaces

The patterns reflected in the correspondence analysis suggest the possibility that the coastal/lowland settlement pattern represents, in the main, a residential landscape, and inland settlement was associated with high-status individuals and possibly ceremonial-religious behaviour. The division between coastal and inland structural remains

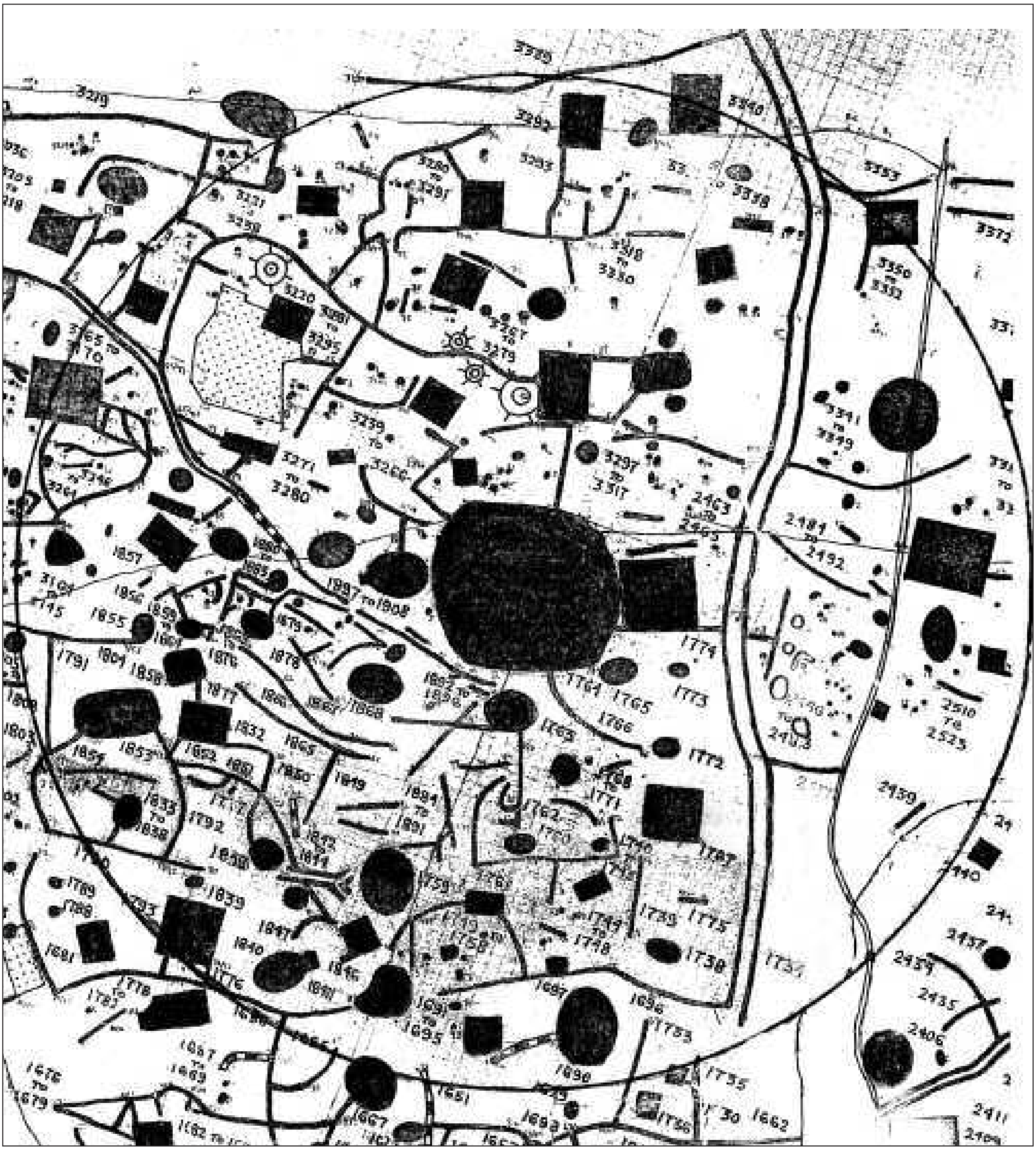

Figure 2. Detail of the Letolo survey map showing location of Pulemelei and ward catchment E.

might reflect, therefore, a dual leadership system, inviting a comparison with Tonga where ceremonial tasks were reserved for the Tui Tonga, and matters of practical government were the domain of collateral lines.

Alternatively, the division might simply mark a division of the landscape into chiefly and commoner zones. The difference between coastal/lowland structures (wards A and B) and inland/higher structures in ward C and E suggests the two areas be interpreted and partly understood as a series of binary oppositions between coast:inland, front:back, low:high, secular:religious, human:god. A general Polynesian view of symbolic social space has the coastal area representing *ao* (the light region) and the inland area *po* (the dark region, spirit realm) (Kirch 1996:257-274; Sahlins 1976:40; Shore 1989:161). Such thinking suggests that structures in the inland/high zone associated with *po* may derive potency as locations to conduct ceremony and ritual, and the construction of large, high platforms may represent the importance of ritual in the inland areas. If so, the coast/lowland was more important for social events, symbolized architectonically by domestic houses, community houses (*fale tele*) and open areas known as the *mala'e* or meeting ground.

As suggested above, stone platforms could represent house foundations or structures for meetings/rituals. Ethnohistorical records and archaeological evidence suggest that houses built on platforms were generally elliptical or rounded. Sleeping houses (*fale o'o*, *faleto'a*, *falefofa*) and guest houses (*faletele*) were rounded or elliptical and used by guests and could be used by the *aualuma* (the girls and chief's daughter). They were also used as the gathering places for important chiefly meetings (Holmes 1958:4). The missionary John Williams in 1832 (Moyle 1984: 76, 251) described Samoan houses and public structures seen near the coast as round-to-oval in plan and built on raised pavements. Kirch and Green (2001:193) suggest there are linguistic indications of change over time from the rectangular, stilt or pole-house dwellings (POC **Rumaq*) of Lapita groups to the open sided round ended Polynesian dwelling (PPN **fale*).

As a working hypothesis supported by the correspondence analysis, we suggest that squared/rectangular stone platforms as observed at Letolo, are commonly associated with the ceremonial/specialist/religious arena, and the oval/rounded platforms are domestic-community structures.

Concluding remarks

A new way to investigate the settlement patterns expressed in the rich material at the Letolo plantation (and elsewhere)

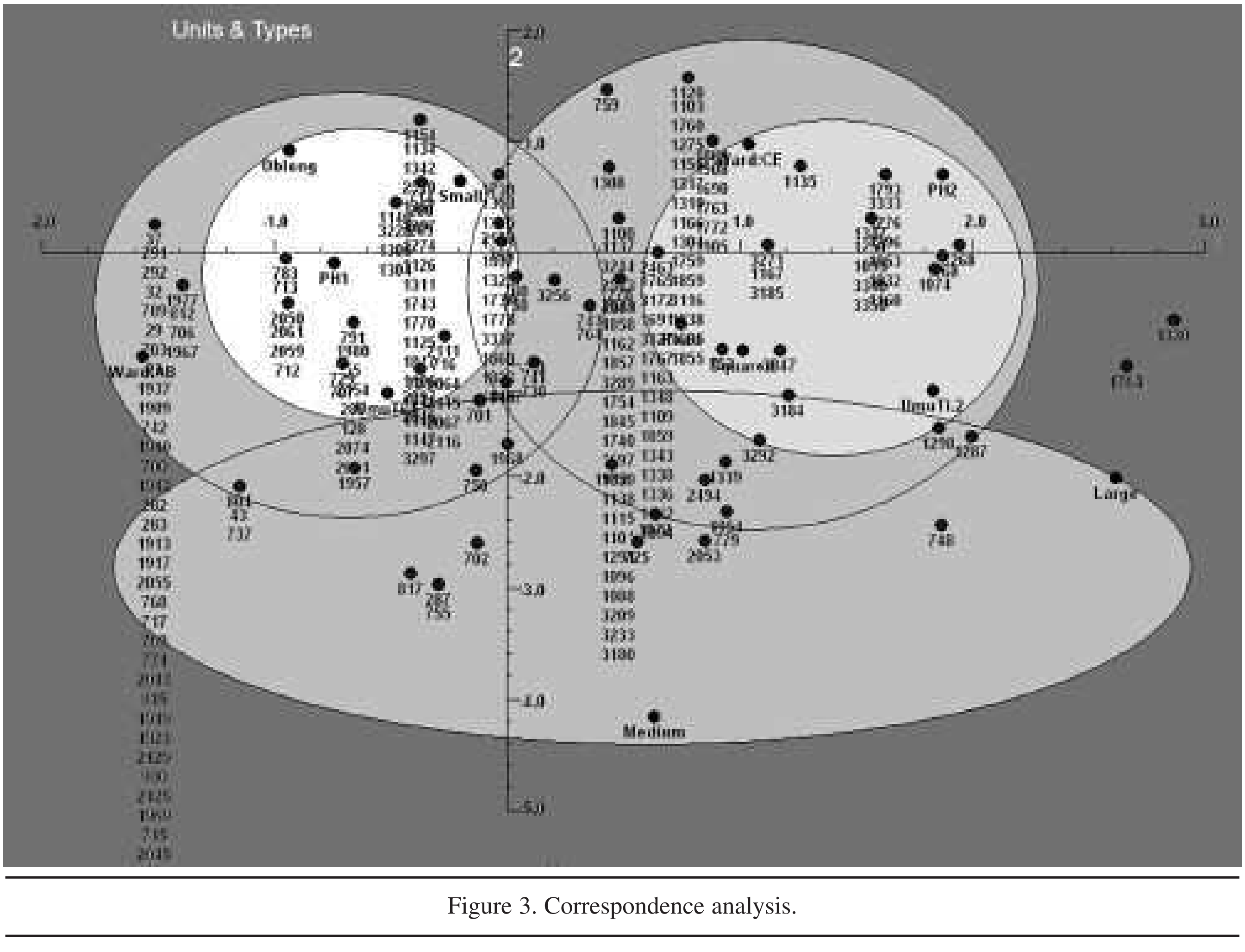

Figure 3. Correspondence analysis.

is through multivariate statistical analyses. The correspondence analysis carried out in this paper is an attempt towards this. It has shown the importance of relational analysis of structures in different contexts, and indicates how new ideas on the dynamics between the coastal area and the inland can be explored. It may also give indications concerning social structures not witnessed in historical records and indeed that might have vanished once the new religion took over from the old. In our opinion it might be better to highlight an archaeological understanding of prehistoric remains rather than building exclusively on linguistic data and ethnohistorical records.

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