

THE CHRONOLOGY OF MOUNTAIN SETTLEMENTS ON TUTUILA, AMERICAN SAMOA

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Shortly after Christian missionaries arrived, the population of Samoa was overwhelmingly concentrated along the coast. Synthesising information from a variety of previously published sources, Watters (1958) estimated that 96 percent of the population lived within a mile of the sea; the remaining 4 percent lived in isolated inland settlements or in one of just a few known inland villages. Before 1840, however, there were numerous mountain ridgetop settlements, which on the basis of oral traditions were thought to be refuge sites (Davidson 1969, Smith 1899).

These sites are often attributed by Samoans to a legendary period of warfare with the Tongans that is said to date between about the 10th and 13th centuries A.D. (Henry 1980, Smith 1899, Stuebel 1896). Archaeologists have since investigated fortified inland and mountain ridgetop sites, and they too have suggested that they possibly fall within this period in time (Best 1992, 1993, Buist 1967, Frost 1978), some even while simultaneously challenging the use of oral tradition to explain the sites (Best 1992). Both Clark (1996) and Green (2002a, 2002b) have noted that the timing of the appearance of Samoan fortifications is uncertain and that their relationship to unfortified aspects of Samoan settlement patterns remains unknown. No independent data has come forth to test the basic hypothesis that mountain residential sites were occupied by Samoans because of internecine warfare, or especially, Tongan occupation of coastal sites. A first step in evaluating these claims would be to establish an authoritative chronology of the mountain settlements, thus confirming whether or not the sites were occupied during the proposed time period. If they were not, then alternative explanations must be considered.

The term *mountain settlement* is used here to refer to extensive sites on ridges with a large number of foundations that are generally interpreted as indicating past residential activities (i.e., cook houses, guest houses and dwelling houses). Such interpretations are made by archaeologists when surveying, using descriptions of residential areas by ethnographers (e.g., Hiroa 1930) or information from local informants as guidelines. The term "residential" implies a function for the sites that has not been fully verified archaeologically. However, the diversity of foundation types and substantial size of these sites suggests that some sort of residential activity took place.

Furthermore, local informants routinely associate mountain sites with the “old villages” (Frost 1978, Kikuchi 1963, Smith 1899). Frost investigated two mountain residential sites (AS-21-002 and AS-25-001), leading her to conclude that they served both residential and defensive purposes (Frost 1978:241-48). It is not the purpose of this article to fully operationalise the term “mountain residential site”; further research is needed to adequately characterise it. However, it is important to distinguish these sites from other, more specialised, upland sites, such as quarries, work terraces, trails, cairns and *tia seu lupe* ‘star mounds’ that are not the subject of this investigation.

According to Clark and Herdrich (1993), who conducted a comprehensive survey in eastern Tutuila and wrote extensively on changes in settlement patterns over time, only in the last thousand years has there been regular use of true upland ridges for anything other than specialised sites. Indeed, they note that “upland settlement throughout the island was probably relatively late and uncommon” (Clark and Herdrich 1993:173). At the time of their research, only two radiocarbon dates had been obtained from mountain residential sites, placing them squarely in the last millennium.

The best known of the upland ridge settlements in American Samoa is Lefutu (AS-21-002), which was tested by Frost in 1972 (1976, 1978) and visited again by Clark and Herdrich (1988, 1993) as part of an intensive survey of eastern Tutuila. The lone date from this site of 810 ± 210 (GaK-4285), uncalibrated or corrected for Carbon-13 fractionation, is too imprecise to determine the timing of Samoan movements into mountain settings.

Frost also reported dates from Mt Alava (AS-25-001), another mountain residential site, of 380 ± 80 (Gak-4287) and 90 ± 80 (GaK-4286). Again, these dates are questionable because they are uncorrected for Carbon-13 variations, uncalibrated, and from the Gakushuin 4000 series that appears to have problems (see Spriggs 1989, Spriggs and Anderson 1993 for a discussion of dates from the Gakushuin lab during this era).

In 2004, archaeologists from Texas A&M University, led by the author, undertook a single-season exploration of the mountain settlements in American Samoa in order to resolve the question of their chronology. Determining the date of their initial construction was the primary objective. Because some are known to have been occupied until the historic period (Krämer 1902, Watters 1958), establishing the radiocarbon chronology for their abandonment was not a priority. It was also hoped that the excavations would reveal whether the sites were stratified, possibly indicating multiple occupations.

Three large, earlier identified mountain residential sites were selected for inclusion in the study (Figure 1). These sites were chosen because they were the largest known and most well-preserved mountain residential sites. The scope of the project was limited to establishing their chronology.

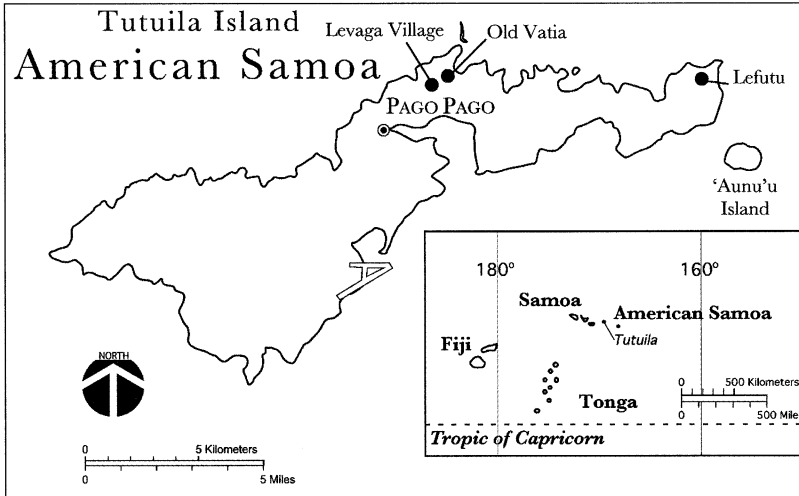


Figure 1: Map of Tutuila Island showing study sites and other important geographic locations mentioned in the text. Regional inset.

THE SITES

Lefutu (AS-21-002)

Lefutu is located at approximately $170^{\circ}34'22''$ West Longitude by $14^{\circ}20'34''$ South Latitude, on a ridge between the modern coastal villages of Tula and Onenoa (Figure 1). This site was first reported by Kikuchi (1963) and later investigated by Frost (1976, 1978), and Clark and Herdrich (Clark and Herdrich 1989, 1993). The site is mentioned by name in several ethnohistoric accounts of ancestral villages, including Krämer (1902), Fraser (1897) and Pritchard (1866). Watters, based on an extensive survey of previously published literature, shows the village as having under 100 inhabitants in 1840 (1958:6, Fig.4). The Eastern Tutuila Archaeological Project team estimated the residential remains extended over an area 65m wide and 35m long (Clark and Herdrich 1989:39). They recorded 32 surface features including pits, house foundations, ditches, stone alignments, graves and terraces.

Frost's excavations led her to conclude that the occupation belonged to a single phase, beginning in about the 12th century A.D., and that the site served principally as a defensive outpost. These conclusions were disputed by Clark and Herdrich (1989), who noted that the site is not very isolated, has little in the way of fortifications, and that the residential aspects of the site are extensive.

Lefutu has a link with the Tongan wars through oral histories. According to one account (Fraser 1897), Tuisamata and Fua'au of Pago Pago are brothers, descendants of Tele and Malae (To and Ali'i) in Manu'a. One of the brothers, Fua'au, is associated with driving the Tongans off of Tutuila. The other brother, Tuisamata, is said to have married at Lefutu.

Old Vatia (AS-24-002)

Old Vatia is situated on Faiga Ridge, southwest of the modern coastal village of Vatia, at approximately 170°41'00" West Longitude by 14°15'40" South Latitude. The site was first reported by Kikuchi (1963), but he did not visit the site. The site was formally recorded by the Eastern Tutuila Archaeology Project, who noted that it is probably the largest ridgetop site in American Samoa (Clark and Herdrich 1988). They recorded 26 features, mostly consisting of excavated terraces with foundations, but did not claim to have described the site in its entirety. Unlike Lefutu which sits on a broad terrace, the ridge on which Old Vatia is situated is rarely more than 20m wide. The site, therefore, is a linear residential complex, at least 300m long.

Levaga Village (AS-25-027)

Levaga Village is situated on Levaga Ridge, which extends down the north face of Mt. Alava, at approximately 170°41'45" West Longitude by 14°15'60" South Latitude. It consists of at least ten terraces, most with large stone foundations. Nearby are 14 large pits (possible *masi* storage pits) and two star mounds. Like Old Vatia, Levaga Village is a long, linear site, as the ridges on which it is built are rarely more than 20m wide. The site has a commanding view of the north shore, and the site of Old Vatia is clearly visible about 1.5km to the northeast, at a slightly lower elevation.

METHODS

In order to minimise the possibility of mistaking noncultural for cultural datable materials, excavation units were placed at each site in locations believed to have high potential to yield cultural charcoal, that is, in house floors or obvious cooking areas. Because our research goals did not include a comprehensive evaluation of each site, we tried to have a minimal impact on the overall archaeological context. We avoided impacting upon standing architectural ruins, including rock alignments, walls and grave sites.

Units were excavated in 10cm arbitrary levels, or by natural stratigraphy when changes occurred more frequently. We attempted to record cultural materials in place, but all sediments were screened through 1/4" mesh (or finer) as well. A one litre bulk sample from each stratigraphic layer was saved

Table 1: Radiocarbon results.

Laboratory number	MS	Depth (cm)	$\delta^{13}\text{C}$ Value(‰)	Conventional ^{14}C Age	Charcoal Identification	Calibrated Results (1σ) (Calendar year AD)
<i>Lefutu (AS-21-02)</i>						
Beta-194325	es	0-30	-26.2	570 \pm 40	unspecified wood	A.D. 1300-1360, A.D. 1380-1420
Beta-194326	es	1	-26.1	640 \pm 40	hardwood stem	A.D. 1295-1325, A.D. 1350-1390
Beta-193194	o	1	-27.0	690 \pm 40	unspecified vine	A.D. 1270-1310, A.D. 1350-1390
<i>Old Vatia (AS-24-002)</i>						
Beta-194807	es	4-46	-27.8	350 \pm 40	unspecified wood	A.D. 1480-1530, A.D. 1560-1640
Beta-193196	es	4-55	-27.4	670 \pm 40	hardwood stem	A.D. 1280-1320, A.D. 1350-1390
<i>Levaga Village (AS-25-009)</i>						
Beta-194323	o	8-38	26.9	310 \pm 70	unspecified wood	A.D. 1490-1650
Beta-193195	es	8-49	25.2	720 \pm 40	unspecified twig	A.D. 1260-1310, A.D. 1370-1380

for flotation recovery and processed at a temporary laboratory established in American Samoa. Plan views were photographed or drawn for each level, and each completed unit was profiled and photographed as well. Sketch maps were made of the features investigated, and GPS coordinates were recorded so that each unit might be relocated. Stratigraphy was characterised using the methods and terminology outlined in *Keys to Soil Taxonomy* (Soil Survey Staff 2003). All cultural artefacts and archaeological data were collected, and are undergoing analysis and curation at the Texas A&M University at Galveston Archaeology Laboratory.

During excavation, special attention was paid to charcoal and other organic material suitable for radiocarbon dating. Frost's (1978) descriptions of the sediments she encountered at the mountaintop sites in the 1970s indicate that the discovery of charcoal would not be a problem.

For a study such as this, it is essential that the range of each age determination be as tight as possible, that the calibration be as accurate as possible, and that the radiocarbon data refer to a particular, identifiable event. Accordingly, samples were selected for dating after careful evaluation in the laboratory. Our preference was to obtain AMS dates on single twigs or singular masses of charcoal from short-lived species. No fragment that was believed

to have come from a long-lived plant or driftwood would be used. Samples were examined under a reflected-light microscope and selected accordingly. Wood identifications were made at the Center for Wood Anatomy Research, part of the USDA Forest Products Laboratory in Madison, Wisconsin.

All samples were submitted to Beta Analytic, which performed the pre-treatments, and radiometric or AMS analyses. Each sample was corrected for isotopic variations by the radiocarbon lab. The resulting conventional radiocarbon ages are reported in Table 1, and discussed in the following section. For interpretive purposes, the conventional radiocarbon age was calibrated with the OxCal 3.9 radiocarbon calibration software (Bronk Ramsey 2001, 2003), using the INTCAL98 atmospheric carbon curve for calibration (Stuiver, *et al.* 1998).

RESULTS

Lefutu (AS-21-002)

Charcoal was recovered from a single 2 x 1m excavation unit that was placed near the interior edge of a large stone-lined foundation. The roughly circular foundation was approximately 10.7m in length and 6.8m in width, with the shortest axis running roughly north-south. The stone-lined foundation was originally built level by creating a wedge-shaped earthen base, 45cm high on the downslope (north) side, and pinching out on the upslope (south) side. The foundation outline is demarcated by ovate boulders, each 30-50cm long and 20-30cm wide, placed end to end forming a loose ring on the north half of the foundation, where they serve to form a downslope erosion barrier. The boulders are absent from the southern foundation boundary, which instead is marked by the extent of cobbles (*'ili 'ili*) that form a thin veneer over the entire surface of the foundation.

The 2 x 1 excavation unit encountered the foundation platform fill with very weak soil development over a buried *Fagasa* family soil (described in Nakamura 1984). The boundary between platform fill and terrace tread was clearly marked by a 2-5cm thick band of burned mixed vegetation. Artefacts, notably basalt stone tools and flaking debris, were encountered down to the burned layer, which followed the 10-15° slope of the hillside. The soil sequence is 1A-1Bw-2Bw, with the burned layer between the 1Bw and 2Bw soil horizons.

Three charcoal samples were selected from this unit. A sample of burned-wood charcoal from the distinctive burned layer gave a conventional radiocarbon age of 690±40 B.P. (Beta-193194). An AMS conventional radiocarbon age of 640±40 B.P. (Beta-194326) was obtained on the charred

remains of a single hardwood stem (less than 3cm in diameter) from the same location. Both samples were collected from the top of the burned layer, 41cm below the surface. Another AMS conventional radiocarbon age of 570 ± 40 B.P. (Beta-194325) was obtained on the woody charred remains of an unspecified vine recovered through flotation of a sediment sample taken from the lowest cultural bearing horizons, above the burned layer. The upper and lower dates effectively bracket the period of initial construction of this foundation.

Old Vatia (AS-24-002)

Charcoal samples used to date this site were obtained from beneath two different foundations located on separate terraces, each tested by a single 1 x 1m test unit. There was little differentiation between the units in terms of the soil sequence, which was a simple A-Bw-C progression and typical for the Fagasa family soils. Both test units contained basalt tools and debitage at the same levels as the charcoal.

The first unit was placed to bisect an apparent circular cooking feature (an *umu*). The feature, visible at the surface, formed a stone-lined depression, now filled with soil, up to 44cm below surface. Charcoal scraped from beneath these fire-cracked rocks at 44 cm below surface was submitted for AMS analysis, yielding a conventional radiocarbon age of 350 ± 40 B.P. (Beta-194807).

The second unit was placed near the centre of a large stone-lined foundation. The roughly circular foundation was approximately 10.7m in length and 6.8m in width, with the shortest axis running roughly north-south. Charcoal was collected through flotation of a soil sample taken from the lowest cultural bearing layers (44-45cm). An AMS conventional radiocarbon age of 670 ± 40 B.P. (Beta-193196) was obtained on the charred remains of a single hardwood stem (less than 3cm diameter).

Levaga Village (AS-25-027)

Charcoal was recovered from a single 1 x 1m excavation unit that was placed near the edge of a large stone-lined foundation. The roughly circular foundation was approximately 10.2m in length and 9.5m in width, with the shortest axis running roughly east-west, transverse to the direction of the terrace upon which it is situated. The soil was a simple A-Bw1-Bw2-C progression, within the range of expectation for the Fagasa family soils. Artefacts, notably basalt stone tools and flaking debris, were encountered down to about 40cm. There was a layer of abundant charcoal between 15-25cm, and scattered charcoal beneath, diminishing along with the stone artefacts. Among the stone tools encountered was a beautifully finished type I adze, encountered at 33cm (typology of Green and Davidson 1969).

Two radiocarbon samples were sent for analysis. A sample of burned-wood charcoal from the 28-38cm below surface gave a conventional radiocarbon age of 310 ± 70 B.P. (Beta-194323). An AMS conventional radiocarbon age of 720 ± 40 B.P. (Beta-193195) was obtained on the charred remains of a single twig (less than 0.5cm diameter) from an unspecified shrub, recovered through flotation of a soil sample taken from the lowest cultural bearing layers, 38-49cm below the surface.

RADIOCARBON DISCUSSION

Atmospheric radiocarbon fluctuations between A.D. 1325 and 1375 make calibration of dates in the 14th century problematic. Conventional radiocarbon ages between about 500 and 700 B.P., with standard deviations less than about 50 have a bimodal probability distribution when calibrated. This presents a slight, albeit surmountable, interpretive problem.

As with all radiocarbon dates, 68.2 percent of the variance is accounted for within the first standard deviation (sd.). However, it has become more common in archaeology to report two sd. results. While this is counter to Stuiver and Polach (1977), it represents a more conservative approach. The main advantage of using two sd. ranges for archaeological interpretation is that the probability of the true age of the sample lying outside the reported range is reduced (Type II error, in statistical terms). However, it has the distinct disadvantage of overstating the probability that the true age of the sample lay in the tails of the probability distribution. To minimise this form of error, when possible I will emphasise the one sd. results, because this confidence interval has the highest probability of containing the true age of the sample (following Stuiver and Polach 1977). I concede that it is possible that I may have committed a Type II error, but stipulate that this is not probable.

Figure 2 shows the full calibrated probability distributions for the seven radiocarbon ages in Table 1. Due to the strong bimodality of some of the calibrations, these results are difficult to refine. One solution to the problem is to use the 2-sigma confidence interval, which incorporates 95.4 percent of the variation, thus giving a calibrated age range incorporating both modes of the distribution. However, this solution masks the bimodal nature of the probability distribution, overemphasising the probability that the mean sample age is correct. Smoothing the calibration curve, or using a mathematical model that incorporates some smoothing, such as Talma and Vogel (1993), may also solve some of the issues, but not in a very satisfactory way. For example, using the aforementioned mathematical model smooths the one sigma results for Beta-193194 to A.D. 1280-1300, and Beta-193195 to A.D. 1270-1290, while leaving the other two results with some degree of bimodality. These

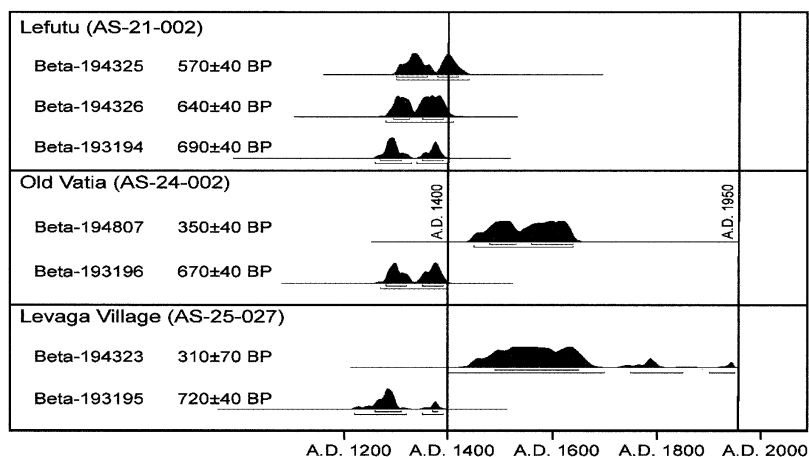


Figure 2: Probability distributions for radiocarbon determinations reported in the text. Results obtained from OxCal 3.9 (Bronk Ramsey 2001, 2003).

results, however, suggest that the earlier mode of each distribution may be the most likely candidate to reflect the true age of the sample.

Indeed, four of the dates ostensibly mark the period of initial construction of the foundations and, by extension, the occupation of the mountain settlements (Beta-194326, 193194, 193195, and 193196). A chi-square confidence interval ($df=3$; $T=2.1$; $\chi^2(.05)=7.8$). The pooled mean conventional age (calculated with OxCal 3.9) is 680 ± 20 B.P. I interpret these results to mean that the three sites were first established at roughly the same time: certainly within 100 years of each other and most probably within 50. If the pooled mean conventional age is calibrated, 56.7 percent of the variance at two sd. is captured within the period A.D. 1270-1310. I suggest that this is the most likely age during which the sites were initially built. This interpretation, which corroborates the curve smoothing results cited previously, is further enhanced if the curve intercept data are consulted. Though now considered less reliable than the probability method, the intercept method in Calib 3.3 (Stuiver and Reimer 1993) corroborates these results: A.D. 1300 (Beta-194326), A.D. 1300 (Beta-193196), A.D. 1290 (Beta-193194), and A.D. 1280 (Beta-193195). It is important to bear in mind that the calibration itself is an interpretation and subject to change as calibration curves are refined.

The project team opted not to date charcoal that was found at or near the surface. However, it is interesting to note that the only cooking feature we sampled, which was visible at the surface, could have been used by the most recent occupants of the site. Though oral traditions suggest that abandonment of mountain residential sites occurred recently, charcoal from that cooking feature at Old Vatia turned out to date between A.D. 1480 and 1640 (Beta-194807, Table 1). In any case, that date, as well as the upper date from Levaga Village (Beta-194323), indicate that these sites were at least in use over a period of several centuries, if not into the historic period.

MAIN ASSUMPTIONS AND PROBLEMS

Taken at face value, these dates indicate that mountain residential sites began to be occupied between about A.D. 1270 to 1310. This conclusion, however, requires several important assumptions. While this study is definitive in that it represents the most complete set of data on the chronology of mountain settlements, until these assumptions are further investigated the conclusions must be regarded carefully. The principal assumptions are:

1. that these sites are representative of other mountain residential sites on Tutuila;
2. that each site was constructed during a single major episode, or alternatively, that the excavation sampled the earliest phase of construction activity at the site;
3. that each radiocarbon sample is culturally associated with the initial construction of the feature from which it was excavated; and
4. that each sample does not have significant in-built age.

The last problem was mitigated through the sample selection procedure as outlined in the Methods section above. The first three issues, however, require some elaboration.

Representativeness of the Sites Assumption

The three sites tested in this study were arbitrarily selected for inclusion in the sample set. Consequently, from a statistical standpoint they may not be said to be representative of the population set of all known, and as yet undiscovered, mountain residential sites. However, because they are the three largest known mountain residential sites, they represent a thorough study of all known large mountain residential sites. Whether or not they are indicative of smaller mountain residential complexes is unknown, as is their representativeness of the population of unknown large mountain residential

sites (though there is no good reason to think that they do not represent them, at least on Tutuila). These sites certainly do not represent Samoa as a whole. It is an open question as to whether the chronology of mountain settlement on Tutuila correlates to that of other islands in the chain.

Construction Sequence

If the mountain residential sites underwent periodic development or expansion, then it is unclear if testing of any one area of a large site will truly be indicative of its first settlement. This study did not attempt a thorough excavation of any one site. This issue can only be resolved by a further, more intensive investigation of one or more large mountain settlements.

Sample Association Problem

In any project such as this it is important to take every precaution that the radiocarbon samples are associated with the proper event—in this case, the period of initial construction for each site—and to minimise the possibility of contamination. One possibility is that a charcoal sample might be the result of natural fire. A second possibility is that a cultural sample might represent activities other than the initial construction of the foundation under which they were recovered.

In any archaeological site, unless charcoal is recovered directly from a hearth, it is difficult to distinguish between charcoal caused by natural as opposed to cultural processes. While this is a persistent uncertainty with radiocarbon dating in general, it need not forestall efforts to date sites with the radiocarbon method. Rather, it means that dates must be assessed critically. In order to minimise the possibility of choosing charcoal that might predate human activity on the ridge, samples were only selected from layers that also contained clear evidence of human activity. In this case, each was associated with lithics or came directly from a cultural feature.

A larger problem is the possibility that the samples may be culturally contaminated. If they were introduced by occupants of the sites after the sites were built and occupied, then the dates represent a *terminus post quem* for their initial construction. However, if they were introduced culturally and before construction of the site, such as may have occurred if the area was used for swidden agriculture before its development as a settlement, then this would pose a greater problem.

The latter, however, may be ruled out at Lefutu as the charcoal comes from a burn layer worked into the base of the platform, suggesting that the charcoal was present on the surface at the time of construction. A layer this distinct would not have remained intact at the surface for more than a year, and probably resulted from clearing activity directly related to construction of

the foundation. Furthermore, the bracketing provided by the stratigraphically distinct upper and lower samples from Lefutu considerably narrows the range of possible dates for the feature's construction.

At Old Vatia and Levaga Village, the samples were recovered beneath a foundation and were associated with stone tools or flaking debris. While it is plausible that the charcoal might be related to older cultural activity, there is no other corroborating evidence to suggest this scenario. Taking a cautious approach, the charcoal is most likely associated with the foundation beneath which it was recovered. However, alternative scenarios must be borne in mind as new results become available.

DISCUSSION

The dates presented in this paper strongly suggest that mountain ridgetop settlements were built throughout Tutuila beginning about A.D. 1270-1310. This represents a major shift in settlement patterns beginning in the late 13th century. The lack of stratification at these sites suggests that they were, more or less, continuously occupied until their abandonment at the beginning of the historic era, c.1840 (Davidson 1969). One popular explanation has been that increased and sustained warfare activity may have caused the shift in settlement patterns, specifically, the construction of fortified mountain outposts (Best 1992, 1993, Frost 1978).

Ethnohistoric accounts of Tongan warfare in the last millennia have fueled speculation that the "Tongan wars" may have caused the initial flurry of construction. Based on genealogical accounts, the 19th century German ethnographer Stuebel (1896) placed the "Tongan Wars" at about 25 generations ago, or about 1250 A.D (p.100-1). This seems to be the standard accounting, as it is often repeated by other turn-of-the-century scholars (Ella 1899, Krämer 1902, 1903, Smith 1899). For example:

The following account is supposed to describe the final expulsion of the Tongans from Samoa, which occurred twenty-five generations ago, or about the year 1250 (Ella 1899:231).

From a mean of five generation tables given by Messrs. Bulow and Stuebel (varying from twenty-three to twenty-eight) we may take the period of this Male-toa as twenty-four generations ago, or about the year 1250 (Smith 1899:6).

... the ruins of stone foundations of their house, roads, enclosures, etc. in the interior of Upolu are remains of their ancient habitations during the time the Tongan-Fijians occupied the coasts (Smith 1899:6).

In the reign of Momo, the tenth Tui Tonga who lived at the end of the twelfth century, the invasion of Samoa was commenced by the Tongans. The occupation of Samoa continued until the reign of Talakaifaiki, the fifteenth Tui Tonga, when the Samoan chiefs Tuna and Fata defeated the Tongan forces (Hiroa 1938:294).

If the genealogical accounts of Stuebel are taken at face-value, the three sites in this paper date to just after the Tongans are allegedly defeated. However, it is not really possible to accept the genealogical accounts with certainty. If the period of the “Male-toa” (cf. Smith 1899) is 23 to 28 generations, and if a generation is not exactly 25 years, then the date for the end of the Tongan occupation can not be said to be so easily pegged at A.D. 1250. For example, it could be as late as A.D. 1350 if a figure of 23 generations is accepted, and the average generation length has been but 24 years. Consequently, there is not enough data to falsify the claim that the sites were initially built during a Tongan occupation. However, it is reasonable to assert that they were not initially constructed at the beginning of the Tongan occupation, which is said to have been about A.D. 950 (Henry 1980, Stuebel 1896—again, notwithstanding the inherent problems of determining an age based on genealogical accounts).

There are a number of other plausible working hypotheses that could also account for the contagious establishment of upland villages at the end of the 13th century A.D., including a simple population growth model and subsequent intra-island land disputes. While I agree with Clark and Herdrich’s assessment that there is little evidence that residential sites such as Lefutu were defensive in nature, there is no doubt that they are situated strategically, and patterns of conflict may have played a role in their initial settlement. It is axiomatic that land boundaries in modern Samoa are frequently disputed. Lehman and Herdrich (2002) make a strong case that the Samoan concepts of boundaries are fluid and temporary. Even today, the building of fences and registering of land is a highly contentious issue in Samoa. Following a “point-field” model of Samoan spatial concepts, it is possible to see the establishment of mountain residential sites in Tutuila as an internal attempt to solidify socio-political power during a period that probably saw the rise of complex chiefdoms throughout Polynesia. Sites such as Lefutu might, in fact, be satellite outposts related to a nearby coastal settlement. Though these sites may seem remote, few are more than a 30-minute walk to another population centre, and all afford strategic access to agricultural areas. This does not rule out secondary use of the sites as refuges (Green 2002a, 2002b). Indeed, permanent maintenance of nearby mountain settlements during an extended era of conflict might be highly desirable to the inhabitants of related coastal and lowland villages.

Mountain residential sites are often in close proximity to star mounds (*tia seu lupe*), which are often located nearby, if not on site (e.g., Levaga Village). Hiroa (1930:539, 544) takes note of *malologa* ‘rest’ camps near the star mounds, places where visitors of distinction were entertained by feasting and dancing. However, while only few star mounds have been dated, they are always recent and do not appear chronologically associated with the initial settlement of those sites (e.g., Holmer 1976, Jennings and Holmer 1980:7-10, Leach and Witter 1990:56). Indeed, the spatial association of star mounds with mountain residential sites makes it likely that they were used conjunctively in the late prehistoric period, possibly serving as *malologa* camps at that time. However, since little is known of them, one might also posit that *malolonga* camps were smaller sites in the forest. Turner (1861:214), a 19th century missionary, complains that the Samoans were “scattered” for “many weeks at a time” while engaged in pigeon catching, the ostensible use of star mounds (cited in Herdrich 1991:422).

The 14th century also saw climate and sea level changes that might have been partly responsible for infrastructural and social changes that occurred in Samoa at that time. In a recent paper (Pearl 2004, also 2003), I presented data that showed high localised rates of deposition at A‘asu, a valley on the northwestern coast of Tutuila. Substantial landscape erosion occurred between 650 and 350 years ago, which corresponds with the transition to the Little Ice Age from the preceding Little Climatic Optimum. Thirty-five years ago (Wilson *et al.* 1979), a study of oxygen-isotope ratios from a spellothem in New Zealand demonstrated that a rapid temperature drop occurred in southern Polynesia in the 14th century. Wilson *et al.* proposed that such a temperature drop would have had a catastrophic effect on agriculture and steepened latitudinal temperature variants, resulting in a more violent climate. They noted that a more violent climate would make long distance voyaging inherently more dangerous. Bridgeman (1983) developed the hypothesis further, proposing specifically that optimal voyaging conditions for Polynesian migrations would have ceased after A.D. 1250. These hypotheses have received renewed discussion in the last few years (Nunn 2000). The initial settlement and more widespread use of upland ridgetops seems timed to this period and might be an example of flexible settlement systems in place after the 13th century A.D.

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The purpose of these investigations was to determine the chronology of mountain residential sites on Tutuila, American Samoa. The data presented here indicate that mountain residential sites began to appear on Tutuila, with some variance, around 1300 A.D.

Large-scale changes were taking shape in Samoa by the beginning of 14th century. In addition to the establishment of mountain villages, we see the continuation of industrial quarrying activity and the final acts of exporting Tutuilan basalt around the Pacific (Best *et al.* 1992, Clark 1993, 1996, Clark *et al.* 1997, Leach and Witter 1987, 1990). If early ethnographic accounts are accurate, this was a time of great social transformation as well, as the period of Tongan domination was either ending, or peaking, at this time. Subsequently, there was a profusion of monumental architecture, including star mounds, fortifications, great walls and the like, associated with increasing socio-political complexity, between A.D. 1300 and 1830 (Green 2002b, Meleiseā 1995). This is the Samoan culture that was in full bloom when European explorers were first encountered, and may rightfully be termed "Classic Samoan." Archaeological investigation of this period is vital to an improved understanding of Samoan prehistory and its place in Polynesian cultural development.

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