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INVESTIGATION OF A LAVA TUBE REFUGE CAVE AT TUFUTĀFO'E

WESTERN SAMOA

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This note describes an investigation of a lava refuge cave situated near the village of Tufutāfo'e on the north coast of the island of Savai'i in Western Samoa. Discussion is made of the occupational evidence and the probable time of use; brief comparison is made with other sites of this type described from elsewhere on Savai'i and from Upolu, the other main island of Western Samoa.

The cave was initially visited by Moyle in June 1967 while engaged in ethnomusicological fieldwork. At this time, the late Mr Amosa, the man on whose land it is located, stated that he himself had never entered it and that nobody else had been inside the tube within living memory. (Its precise geographical location is not given here, in accordance with the wishes of the owner of the land). Revisits were made during further fieldwork in 1968 and 1969 and on each occasion evidence of damage from rockfalls, widening cracks in the walls and disturbance to stone platforms was clear. Despite Moyle's fluency in the Samoan language, no local knowledge of the cave nor any legends concerning the area as a whole were obtained. These factors suggest that any use of the cave was of considerable antiquity. This hypothesis is evaluated in terms of the character of the material collected from the cave.

Exploration

The lava tube is a natural phenomenon, apparently a result of early volcanic activity and is probably not unique in this area. Descriptions of the formation and development of similar lava tubes have been provided by Kear and Wood (1959). From behind the village, approximately 5 km inland, it runs seaward to the south.

The interior of the lava tube was mapped by gaslight using a tape, dimensions being recorded at intervals of approximately 6 m. Roof height varied between 12 m just after the entrance (Plate 1) to little more than one metre at its furthest negotiable extremity; the tube width varied correspondingly between approximately 15 m to less than two. It was possible to penetrate the cave for about 550 m on first exploration (the distance being limited only by fuel for the light). Near this point, on 20 June 1967 (the day following its initial exploration), the tube was blocked by a rockfall which occurred during an earthquake. The tube had

been further negotiable in the past, despite a slightly lessening roof height at this point. The form of the cave is represented in Figure 1.

The lava tube appeared to have originated from a cave located approximately 500 m inland from the first rockfall. While it was possible, although difficult, to enter through the first large rockfall, the exploring party effected entrance to the cave through a second collapse (Figure 1) which also exposed the tube. It is not clear which of the two entries was used in the past. Close to the first fall, on the eastern side of the tube, was a small natural side-cave approximately 1.5 m high and partially sealed by a rock wall a little more than .5 m in height. This wall had been broken down in the centre and rocks, many of which weighed in excess of 10 kg, lay in the main cave area. Near the second rockfall were several apparently natural depressions in the floor, most of which contained water at the time of the visits.

At several places along the length of the tube, there were signs of previous human visitation and perhaps more permanent occupancy. These took the form of various abandoned artefacts, stone platforms, pathways and cooking hearths. Several portable artefacts were collected and are now housed in Auckland. Their original locations are noted in Figure 1. No stratified deposits were noted in the cave, its floor generally comprising the natural substrate excepting where rockfalls had occurred and where lava from the tube walls and other stone brought into the cave had been used to form various structures. The position and form of these and other artefacts are described in the following sections.

Localities of various cultural features and other artefacts

Near the second rockfall, to the right of the pools (at 'a' in Fig. 1), were found three adzes lying together. These are discussed below.

About 30 m further into the cave, and immediately below a small opening in the roof, were four stone platforms (Fig. 1, 1 to 4). The first was almost circular, with a circumference of approximately 1.5 m. Immediately adjacent, on the eastern wall, was a second, elongated platform, raised some 150 mm and stretching for 15 m into the interior of the cave. The third and fourth platforms were situated against the opposite side of the tube; each measured approximately 2 x .75 m and stood .5 m high.

A second side-tunnel was situated on the western side about 20 m beyond the end of the second platform (Fig. 1). Its roof height was a little more than one metre. It contained two circles of small rocks; each apparently functioned as a hearth, because they both contained ashes.

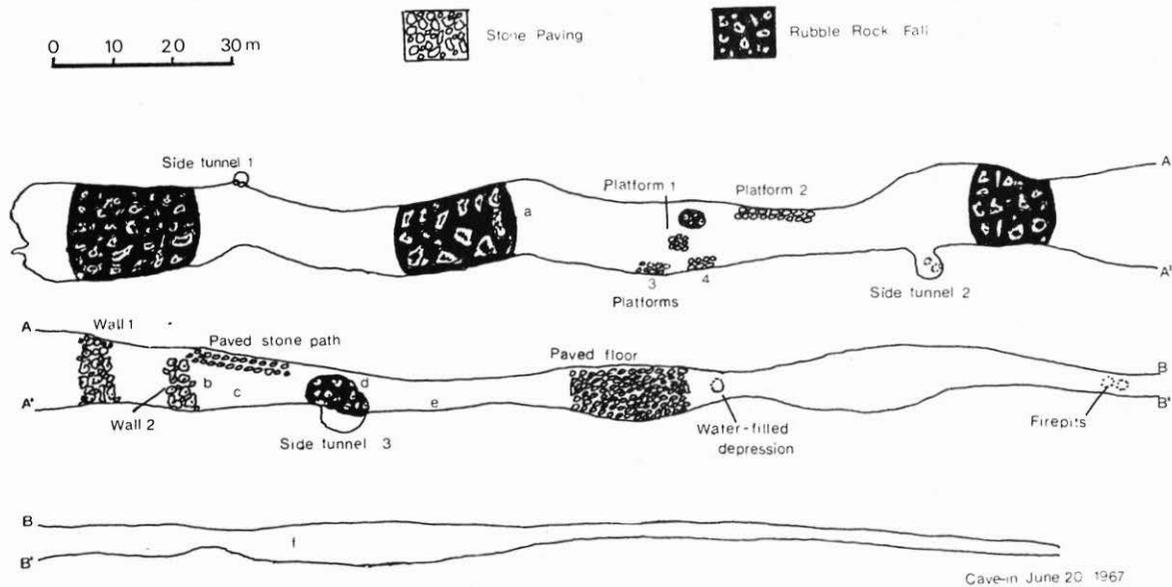


FIGURE 1. Lava tube refuge cave at Tufutafo'e, Western Samoa.

Beyond a rockfall near the second side-tunnel, two low walls were encountered. The first extended the full width of the cave, reaching to nearly 1.5 m in height and providing 1.25 m of clearance at the top, although the sloping sides of the tube severely restricted passage beyond this point to one section which was only 1 m in width. The second wall, on the other hand, stretched from roof to floor, except for a narrow path on the eastern side (Plate 2). The rock used in the construction of these walls appeared to have been obtained by dislodging large pieces of lava from the walls of the cave. A paved stone path, comprised of small stones of volcanic origin, led from the second wall to the next rockfall to be encountered.

Approximately 250 m from the tube entrance (Fig. 1, area 'b'), another adze was found. This area was littered with animal bone and the shells of marine molluscs. The animal bone was probably of pig, since a tusk was also found here; the molluscs included faisau (Tridacna sp.), pulepule (?Ovulum sp.) and alili (Turbo sp.). Near this area, a fifth large adze was collected (Fig. 1, 'c').

The lava tube reached its most constricted part at the next rockfall and passage was possible only by crawling on the stomach for several metres. A third side-tunnel (Fig. 1, '3'), which was almost concealed behind the rockfall at this point, contained an arrangement of large rocks forming a wall almost to the roof; this all but barricaded the tunnel off from the main passage and entry could be gained only by skirting the rockfall for several metres. On a shelf formed by a large boulder at the top of the fall rested a sixth adze.

Beyond the rockfall, the floor of the tube sloped sharply downwards. Here (Fig. 1, area 'd'), a stone mortar and pestle were found. Ten metres further on (at 'e'), was a large stone pounder, together with quantities of mollusc remains, a wooden spearhead and a human cranium.

Beyond this point, the largest paved area found in the cave started, continuing for almost 30 m for the entire width of the passage. The paving was formed from small volcanic stones, most of which were no larger than 25 mm in diameter. In the area of the paving were found firepits and further scatters of shell and bone. A depression in the floor at the far end of the paving contained about 50 litres of water. Much of the depression was obscured, however, by guano deposited by a colony of pe'ape'a birds (Collocalia sp.) and its overall size and depth were not clear. A further 60 m along the tube two further hearths were encountered, and another 50 m beyond this the seventh adze was recovered (Fig. 1, 'f').

From here to the place where the final, impassable, rockfall of June 1967 occurred, further marine shells were scattered on the floor. Beyond this point, on the occasion of the earliest visit, no further features had been noticed, other than a continual narrowing of the tube and a steeper angle of descent.

Adzes and other artefacts

A total of seven complete stone adze blades was recovered from the cave, along with numerous adze fragments. One of the three forming the initial adze cache was, strictly speaking, a chisel in Buck's terms (Buck, 1930); this is illustrated in Figure 2. The remaining six adzes were typically Samoan; according to the classification of Green and Davidson (1969), they are of three types:

Type I: three examples (areas 'b', 'c' and near 'd')

Type II: one example (area 'a')

Type III: two examples (areas 'a' and 'f').

Types I and II are flaked adzes with ground cutting edges and with flat, quadrangular cross-sections, Type II being slightly less regular. Type I is the most common of Samoan adze forms. Type III is similar to Type I, differing in exhibiting a fully ground finish (Green and Davidson, 1969:22-24). Types I and II are described as being, "probably the standard tool of the late prehistoric adze kit of the Samoans", although smaller varieties of both had been found to occur in early pottery-bearing contexts; Type III, while being a common surface find, is described as of identical form in both early and late contexts (Green and Davidson, 1969:32). In sum, then, while none of the adze types is seen as temporarily diagnostic, the assemblage is more likely to derive from a late rather than early context.

Other stone artefacts included a large stone pounder (Fig. 1, area 'e') and a pestle and mortar (area 'd'). The pounder was of considerable size, weighing more than 6 kg. The pestle appeared to be identical to those commonly employed in the village today for grinding cocoa beans, while the mortar comprised a flat stone of approximately 300 x 100 x 150 mm showing a marked depression in its upper surface.

The wooden, barbless spearhead was of a form similar to that described in early ethnographic contexts as a hunting weapon (for example, Buck, 1930:606). Its presence in relatively good condition indicates that the occupation - or the last use - of the cave was of no great antiquity.

Among the marine mollusc shells was one which was clearly an artefact; it resembled a miniature ma'ata'ife'e, the rat-shaped octopus-

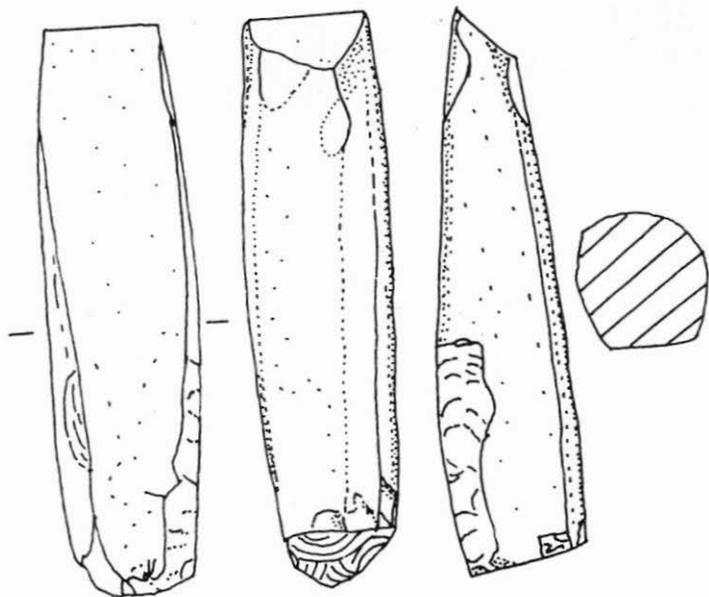


Fig. 2. Stone chisel

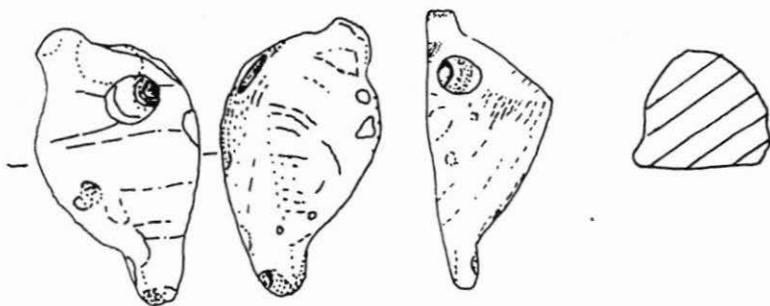
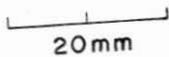


Fig. 3. Shell "ornament"

FIGURES 2 and 3.

lure which is still commonly used in fishing (Fig. 3). The raw material for this item appears to have been Trochus ?niloticus.

Several pieces of 'ēlei, the brown ochre used for decorating Samoan barkcloth, were found together in one section of the tube. The only source known today of this ochre is near the village of Uafato, about 60 km away from Tufutāfo'e on the island of Upolu.

Previous investigations of lava refuge caves in Samoa

The investigation of lava tubes in Samoa for occupational evidence have been made on both Upolu and Savai'i by Freeman (1943, 1944) and by Green and others (1969), and in American Samoa (by Kikuchi, 1963), as well as elsewhere in Polynesia. More recently, Jennings and others (1976: Fig. 3, Sites 190 and 191) noted the presence of lava tubes during their surveys of the Mt Olo tract of western Upolu, but did not explore them in any detail.

In 1943 and 1944, Freeman reported exploration and excavations of caves at Seuao and Falemauga noting evidence of intensive occupation. Seuao cave was described by Freeman (1943:101) as being the most famous of Samoan lava tunnels because of its role as a refuge during one particular important conflict. The cave, on the southern coast of Upolu, lies approximately 2 km inland of the coast with its entrance at about 40 m above sea level, rising to 90 m at its furthest end. Freeman made several visits to the cave in mid-1942, "making a survey and searching for artefacts" (Freeman, 1943:101). He described the cave as being almost circular in cross-section but with a flat bottom of cooled lava - a characteristic also common in others. He found the cave to contain "abundant evidence of human occupation" including "an elaborate series of terraces or platforms" and a stone footpath. The terraces were topped with "lava rubble the size of small pebbles, and almost exactly resemble the floor of an ordinary Samoan fale" (1943:103). Here he excavated ash deposits, recovering pig bones, teeth and shell remains and five stone adzes from within the shallow surface rubble.

Freeman cited a legend which indicated that the cave had been used as a refuge in time of conflict and speculated that the structures observed within the cave were preparations made in advance of the use of the cave as a place of refuge. He estimated, from the number of terraces, that the cave could have accommodated up to one thousand people and that the traditional refugees lived in the cave for "considerable time", utilizing a water supply adjacent to the cave and obtaining food from the reef flats and nearby gardens (Freeman, 1943:108). The traditional account suggested that the occupation had occurred in the middle of the 15th century A.D. (1943:109).

Similar structural features and deposits were typical of the Falemauga cave complex, situated on the northern side of Upolu at a height of 500 m, including 152 stone platforms but it also contained human skeletal material, specifically a cranium (Freeman, 1944:87). The platforms differed from those in the Seua cave by being built up above the floor level by approximately .5m (1944:88-89). Freeman excavated eight platforms and several mounds of lava rubble within the Falemauga caves to a depth of more than .5 m; no evidence of their having been used for the purpose of burial was revealed (1944:93). Traditional accounts placed the time of occupation in the 13th century A.D. Freeman noted the likelihood of both cave entrances providing strong defensive positions.

These cave complexes were later surveyed by Golson who was unable to confirm Freeman's observations of evidence of prolonged or intensive occupation. Golson submitted for radiocarbon analysis charcoal from the Seua cave and obtained an estimate of the time of occupation placing it about the beginning of the 18th century A.D. (Golson 1969:19).

On Savai'i, other archaeologists conducting field surveys have recorded the presence of lava caves. Buist explored three caves on Savai'i; only one had signs of occupation and this was thought to be recent. He concluded that lava tubes were not used for prolonged occupation (Buist, 1969:41-42). Scott, however, found no habitation remains in the lava tube surveyed at Palauli (Scott, 1969:79). Green, in his summary observations, noted that one cave inspected by Buist had associated with it a tradition which pointed to its role as a religious sanctuary and suggested that the same might apply for the example described by Scott (Green, 1969:268).

Green (1969:267-270) has provided a useful discussion of the available evidence, noting that lava tubes - the only form of cave known to exist in Samoa - can be divided into three types: waterholes, temporary refuge habitations and religious sanctuaries. Many of the first type were in contemporary use as water supplies. Refuge caves were not in use at that time - as their name implies. Features characterizing a refuge cave included: the presence of small platforms along the walls of the cave, a central paved pathway, hearths and food remains including edible shellfish, pig bone and teeth, along with pigments and stone adzes. Some such caves were described in traditional accounts as places of refuge. None of this range of occupation evidence was present in caves of the third type which provided sanctuaries for mythological beings (Green, 1969:267). Green went on to describe occupational evidence defining a lava refuge cave at Faia'ai at the western end of Upolu which is, in some respects, similar to that at Tufutāfo'e on Savai'i, as well as that described for elsewhere on Upolu by Freeman.

There is a conflict implied in the evidence for the extent and longevity of the habitation of lava refuge caves as seen by Freeman on one hand and by Golson on the other; further, the evidence resulting from the surveys by Green at Faia'ai on Upolu and by other members of his team on Savai'i is not sufficiently strong to decide which interpretation is correct. The evidence from Tufutāfo'e can assist in an evaluation of the situation.

Discussion of the Tufutāfo'e cave

Occupational evidence from Tufutāfo'e cave is of three main types: substantial structures, food preparation and artefact manufacture or maintenance.

The substantial structures recorded include walls, platforms and pathways. Two large walls of stone taken from the tube sides had been built within 20 m of each other to block one section of the tube. The first covered the entire width of the tube but did not reach to the roof level; the second was built to the roof but not completely to one wall. While it is not possible to be sure that at least the former had not been more complete in the past, this combination could have provided a strong defensive position within the cave.

The platforms found at Tufutāfo'e vary considerably in size, between 1.5 and 15 m in length and raised to between 150 and 500 mm above the tube floor. The use made of these platforms is not clear from the present context. They could have been used to provide a dry living area above the floor of the tube which must have acted as a water conduit in wet conditions (see Kear and Wood, 1959), or they might have served, more specifically, as sleeping platforms. The latter is suggested by the presence of paved areas elsewhere which are more akin to house floors. Like Freeman, Green (1969:268) noted that the presence of an even paving of small stones in the interior of a platform made a surface comparable to that found in the interior of house structures. He also noted that there appeared a consistency in the heights above the ground of the platform surfaces; two groups were defined, the first was raised by only a thickness of paving while the second was raised to approximately .5 m as in the case of the Falemauga cave described by Freeman. These appear to equate the two heights - 150 and 500 mm - recorded at Tufutāfo'e and possibly point to two separate functions.

The two paved floors in the Tufutāfo'e lava tube were constructed from volcanic pebbles. The first pathway extended for 20 m, the second for closer to 30 m; the first was only about 3 m wide but the second extended the whole width of the tube - approximately 10 m at this point. By comparison, the paved path in the Faia'ai cave was narrow and situated

in an area of rough floor while those in Freeman's Upolu caves extended almost the whole length of the cave floor. Presumably, they functioned to provide a sure, dry passage or working area for the occupants.

Evidence of food preparation and consumption can be found in the presence of fire pits and food remains. Pairs of hearths occurred in the second of the three side-tunnels and at the furthest negotiated extremity of the cave. Each was approximately 400 to 500 mm in width, outlined by small slabs of volcanic stone and contained a concentration of fine, partly consolidated ash. As such, they were not unlike hearths to be found within typical Samoan house structures.

While no food remains were recognized from the hearths or from their immediate vicinity, scatters of marine mollusc shell and pig bone occurred over a wide area of the cave, especially in the area of the paved pathway area, the interior cross-walls and the second paved floor. The shells representing Tridacna and Turbo spp. are of types commonly eaten throughout Oceania and could have been obtained from the nearby reef flat. The possible Ovulum shell could have been part of an ornament. Pig, of course, was one of the few domesticated animals and a frequent contributor to the Polynesian diet. Neither fishbone nor the remains of vegetable foods were noticed in the Tufutafo'e cave. Freeman noted the presence of edible shellfish, pig bone and teeth along with fire-places in both Seua and Falemauga caves on Upolu, as well as plant remains in the latter; however, none of these items was found in the Faia'ai cave.

Evidence of artefact manufacture or maintenance derives from two sources: presence of red ochre, and of flaking debris. A brown-red ochre, of the type used for decorating bark cloth probably indicates that this or similar activity was carried out in the cave; such work is done by women at the present time. On the other hand, stone tool manufacture was likely to have been the provenience of men. Many stone fragments were observed on the cave floor, along with numerous adze fragments. While it was not clear to the observer whether these adzes were broken as a result of the manufacturing process or through misuse, the former appears to be more likely in view of the large quantity of flake debris in the cave. On the other hand, no indication was found of the presence of abraders or grindstone used to polish flaked stone surfaces.

Some details of the adzes have been provided in a previous section. Broken adzes were not collected from the Tufutafo'e cave and no analysis of flaking debris was attempted. Apart from the frequency of occurrence of flakes, the evidence available is insufficient to indicate whether adzes and other tools were being made in the cave or merely sharpened or otherwise maintained.

As Green (1969:267) emphasized, the most striking evidence of prehistoric occupation of the two Upolu caves described by Freeman was the presence of stone adzes. Eleven examples of Type I and one each of Types II and III were found there but none occurred in the Faia'ai cave. Flaking debris was not mentioned by Freeman as existing in the Upolu caves, although adze fragments were recovered from Falemauga. They were described as being "buried in the shallow surface rubble on the platform" or "in kitchen middens in association with shell and pig-bones" (Freeman, 1943:91).

Conclusion

Evidence for the prehistoric occupation of the lava tube at Tufutāfo'e can be evinced from three major sources. The observation of the extensive artificial structures in the form of walls, pathways and platforms with fine pebble floors. The presence of hearths and food remains also tends to confirm that occupation of the cave was more than transitory. Finally, a variety of portable artefacts including, most significantly, stone adzes and flake materials, indicates that possibly both men and women were active during their sojourn in the cave. The presence of stone materials foreign to the lava tube suggests also that the necessity for its occupation as a place of refuge was premeditated. It is unlikely, however, that this occurred on the scale envisaged in the accounts by Freeman.

Lack of knowledge of the cave by present day inhabitants suggests that the habitational evidence was of some antiquity. While there is little evidence on which to come to a strong conclusion, certain indications support the view that occupation occurred relatively late in Samoan prehistory. The presence of a wooden spearhead in good condition is one; another is the trend of the evidence resulting from the classification of the stone adzes according to the scheme of Green and Davidson which suggests that they are of predominantly late types. It seems likely then, that at least the last occupation dates to within the last 500 years; it was possibly prompted by internecine conflicts or the presence of invading forces from nearby Tonga.

Comparison with the descriptions available from investigations of other lava tubes on the island of Savai'i shows that, of the two exhibiting cultural evidence, the Tufutāfo'e cave provides the more extensive information of prehistoric habitation of refuge caves.

There was more opportunity for comparison with the larger caves at Seuao, Falemauga and Faia'ai on Upolu. Occupational evidence tended to be generally comparable, including the heights and surface treatment of platforms and the range of adze types recovered, especially at Seuao.

In general terms, the results of the analysis of the occupational evidence from the Tufutafo'e cave on Savai'i tend to support the interpretation of the use of such lava tube caves as places of refuge, although not necessarily endorsing the extent of their use as concluded from some earlier accounts of cave occupancy on Upolu.

Acknowledgements

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SAMOAN REFUGEE CAVE Plate 1. Cross-section near entrance.



SAMOAN REFUGEE CAVE Plate 2. Wall 2 reaching to tube ceiling.