EXCAVATIONS ON UPOLU, WESTERN SAMOA

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Jesse D. Jennings
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ABSTRACT

The findings of the University of Utah Samoan Archaeological Program on the northwest coast of the island of Upolu, Western Samoa, in the Mulifanua District during a survey and testing program in 1974 are presented. There were four test excavations: one was at Vaiusu, one at Faleasi'u, and two in the vicinity of Mt. Olo. The tests include a sample excavation of a fishing camp (Jane's Camp), two earth ovens (Green Ti and Janet's Oven), and a star mound (Cog Mound). The excavation reports, an analysis of the fish camp midden, an exhaustive ceramic analysis, and a settlement pattern study of some 194 structures comprise the bulk of the topical studies; they present analytic, descriptive, and comparative treatments. The sites tested range in age from A.D. 1510 to 2550 ± 50 B.P., according to radiocarbon assays. A brief assessment of the general contribution of the research to Polynesian prehistoric study appears in the summary.

SECTION 1

INTRODUCTION

JESSE D. JENNINGS

The purpose of this report is to record research done by a group of University of Utah graduate students under the guidance of Jesse D. Jennings during the 1974 field session of the University of Utah Samoan Archaeological Program on the island of Upolu, Western Samoa (Fig. 1). A previous short-term project in 1973, which confirmed the presence of a Lapitan village on the northwest coast of Upolu at Mulifanua Ferry facility (see Jennings 1974a), led to the initiation of the more extensive study of the Mulifanua District with which this report is concerned.

Designed as a survey and testing program, with locating of additional Lapitan sites also being an important objective, the research yielded both less and more than was hoped. No location showing evidence of Lapitan occupancy with characteristic decorated pottery was discovered, but two sites yielding ceramics were found and sampled. A portion of an extensive zone of settlement, noted in 1973, on the flanks of Mt. Olo, was mapped in great detail. Within the Mt. Olo settlement, two raised-rim ovens (SUMu-48, Green Ti; and SUMu-188, Janet's Oven), and a cluster of four structures including a star mound (Cog Mound, SUMu-165) were excavated. At Faleasi'u, a fishing camp (?) midden (Jane's Camp, SUFl-1) yielded considerable dietary data, along with ceramics of different types in firm stratigraphic context. Test trenches at Vaiusu (Paradise Site, SUVs-1) recovered pottery from a context far from clear.

Site designations used herein follow common practice. The island chain provides the first letter, the island itself the second letter, the locality the second pair of letters, with the numeral representing merely the sequence of site discovery in that locality. (For example, Jane's Camp is also SUFl-1: Samoa=S, Upolu=U, Faleasi'u=Fl, and the site, the first one noted there, is 1; thus, SUFl-1.)

The Samoan group consists of four major islands, Manua, Tutuila, Upolu, and Savai'i, and many islets. The western pair, Upolu and Savai'i, comprise Western Samoa, with the eastern ones, Manua and Tutuila (under United States governance), called American Samoa. Western Samoa, as an independent nation, maintains close relationships, both economic and otherwise, with New Zealand. The islands of Western Samoa lie at approximately 172°W, 14°S, with the center of Upolu falling about 171°45'W and 13°55'S. Known to the world since the early 19th century as fertile, well-watered, and inhabited by a Polynesian people of beauty and charm, the Samoan islands have long been the object of scholarly attention, and consequently an extensive and well-known literature has been generated.

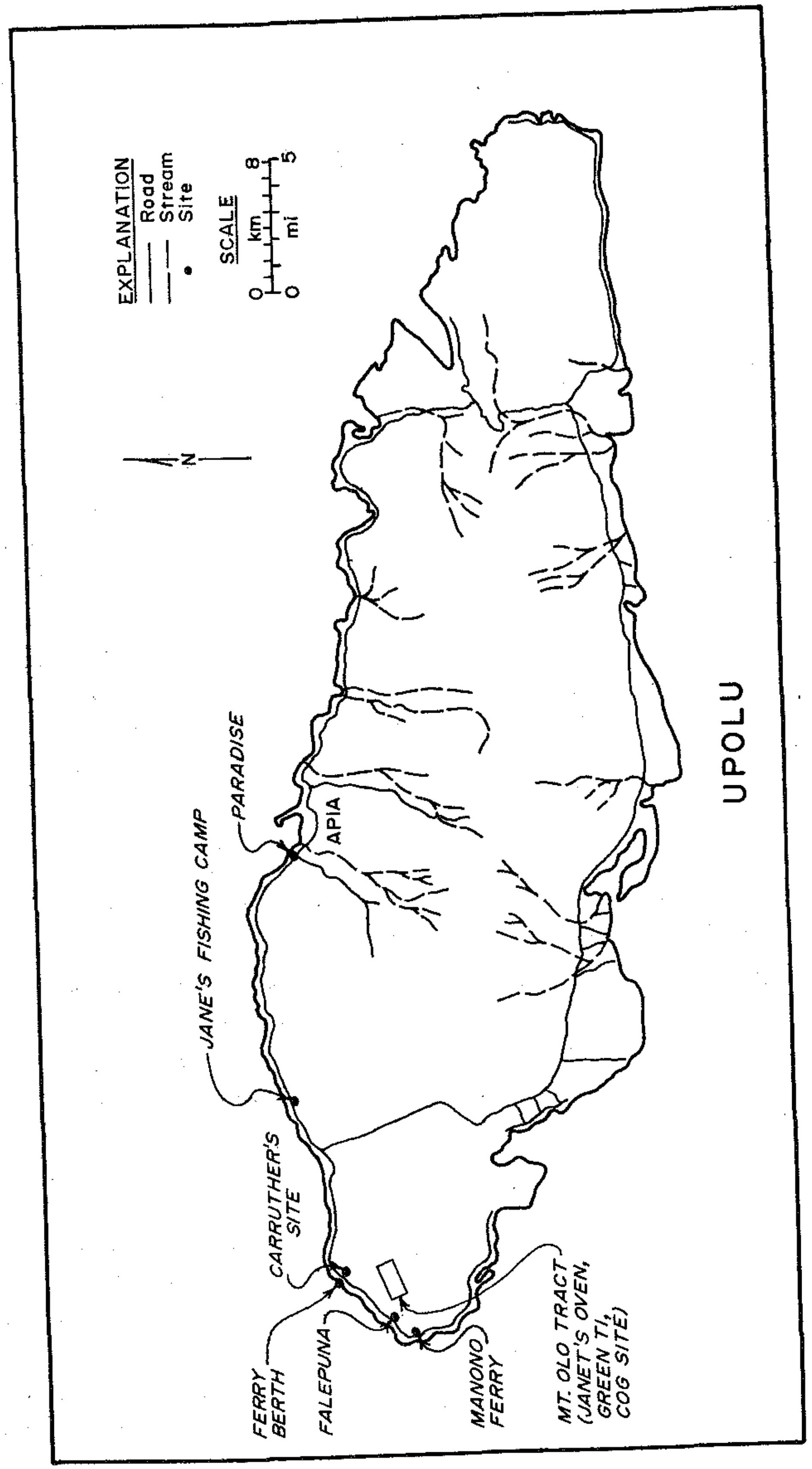


Fig. 1. THE ISLAND OF UPOLU, SHOWING TEST EXCAVATION LOCATIONS.

However, scholarly interest in Samoan archaeology is not reflected in any printed sources prior to the 1960s. Most of the data available have been recorded by a team of New Zealand students, led by Roger Green, in a series of studies following an assessment of archaeological potential in 1957 by Jack Golson, who was then also stationed in New Zealand. The institutional research program, established at the University of Auckland as a part of the Pacific Culture History project of Bernice P. Bishop Museum, Honolulu, resulted in the recovery of much data. Today most of the archaeological literature bearing directly on Western Samoa available to the profession is in two volumes edited by Green and Davidson, Eds. (1969; 1974). These volumes contain 40 descriptive and synthesized papers of varying quality reporting field research from 1957 to 1967 and conclusions derived from study of the data generated during that decade of field work.

The accomplishments of the New Zealand team toward the realization of objectives enumerated by Green (1969a:3-11) are remarkable, considering the conditions that existed. Major contributions were the discovery of prehistoric manufacture of pottery before the Christian era by the Samoans and the establishment of a firm chronology of about 2,000 years duration documented with several suites of radiocarbon dates (Green and Davidson 1974a:214-215). These two achievements, coupled with the discovery at about the same time of Lapitan and plain pottery of even greater age on Tonga, inevitably lead one to speculate that Tonga and Samoa should credibly be regarded as having contributed equally or simultaneously to the elements which were blended into the cultural kit with which Polynesians began their conquest of the Pacific. The kit, of course, was derived in large measure from the Melanesian island-hopping traders who made the diagnostic Lapitan pottery; the complex constitutes a horizon marker for the first millennium B.C. across that vast area of the Pacific extending east to west from the Solomon Islands to Tonga. (Lapitan pottery dating to about 3000 B.P. is now known from Western Samoa as well.) Green (1974d:253-259; see also Specht 1974:447-451) has listed the elements of the Lapitan culture in some detail. He has also described (Green, various) the basic proto-Polynesian kit that he believes evolved in Samoa, one of his choices as the staging area for the Polynesian dispersal over the Pacific (for example, Green 1974e).

In view of the divergent positions taken by Groube (1971) and Green (various) on the roles played by Lapitans themselves and by the Tonga and Samoa island groups in the crystallizing of early Polynesian culture, a Lapitan bias is introduced into any studies of Samoan prehistory until the several issues are more convincingly resolved. Since such a bias could obscure some insights on other matters, it must be noted, if not extensively dealt with, here.

Most would agree, I think, that the time is past when reports of Lapitan pottery from Melanesian or Western Polynesian locations generate great scholarly excitement. Decorated Lapitan pottery in small percentages in dominantly plain collections has been reported from perhaps 20 locations ranging from the New Hebrides to Samoa. So far the radiocarbon age ascriptions would identify the Fijian occurrences as being the oldest, where the dates for Sigatoka, Yanuka, and Natunuku hover at 3000 B.P. As Golson (1971) has made clear, the very low percentage of decorated wares in most of these early ceramic assemblages makes it necessary to develop some standards or criteria for determining whether the plain sherds in any

Lapitan collection are really Lapitan or whether there is a related, but undecorated, ware which can be distinguished on other grounds from the decorated pieces. Or are the sherds identical in all physical attributes save that of the distinctive decoration so that one can safely ascribe an entire collection, where decorated sherds are present, to Lapitan age and origin? As Golson points out, scholars (save possibly for Green and Specht) have been so taken with the highly distinctive decorative motifs and techniques that they have dismissed the rest of any Lapitan collection with the simple statement that the sherds are "plain" without particularly careful study of their intrinsic attributes as compared with the decorated pieces. As one but recently concerned with Polynesian plain pottery, it seems to me that Golson's attempts to transfer the problem of Lapitan "from a distinctive style of ceramic decoration to a culture complex" may be more important than additional quick releases about finds of Lapitan pottery in the core area.

One of the best ways to forward the study of Lapitan ceramics would be the comparison of sample collections on the basis of all quantifiable physical and cultural attributes by some of the statistical procedures now available in computer assisted statistics. Smith (Section 9, this volume) has made a strong beginning along this line. He shows, among several other things, that Samoan Lapitan sherds, both plain and decorated, share a single set of physical attributes and are, aside from decoration, a single ware or type. It is believed that a major contribution of his article will lie in the direction of clarifying the larger issue of Polynesian ceramic tradition.

Samoa is involved in the Polynesian ceramic discussion because in Western Samoa, in the eastern district of Falefa on Upolu, what was regarded as a progression of plain, locally made Polynesian pottery lacking decoration is found. On the basis of both stratigraphy and radiocarbon dates, the earliest type (Samoan thin ware) is established as comparatively well-made, fine-textured, hard, frequently red-filmed, red-brown pottery. The only vessel shapes are the shallow or hemispherical bowl. There follows in time a ware which has been called Samoan thick, which can be more than 20 mm in thickness. It is marked by very coarse, granular temper inclusions and represents the final stage of pottery production in Samoa. No pottery was made thereafter in Western Samoa.

In 1973 (Jennings 1974; Ms.) a submerged, apparently "pure," Lapitan site was reported; some 5,000+ sherds were recovered. The purity of the site is ascribed because the decoration is distinctively and unmistakably early Lapitan in execution. Here, too, Smith has shown that the distinctiveness of the Lapitan wares (color, temper, form), as contrasted to later wares, is much less real than has been generally believed or assumed. A radiocarbon date of 2980 ± 80 B.P. (NZ 1958 B) has been ascribed to shell cemented in coral over the Lapitan site which today lies submerged about 2.8 meters below the mean tide level at the Ferry Berth site at Mulifanua District on Upolu.

It is necessary to speak briefly of Western Samoa as a set of climatic and geologic factors that establish a special archaeological "environment" affecting the course of archaeologic field endeavor. Drawing on the material in Kear and Wood (1959), Fox and Cumberland (1962), Mohr and Van Baren (1954), Schofield (Ms.), and Bloom (Ms.), the following brief sketch of the environment is presented.

The Samoan group is, of course, volcanic in origin. Major flows have been recorded as recently as the 20th century on Upolu and Savai'i. The oldest of the flows are the Fagaloa and Salani. Their ages are uncertain, but the Fagaloa volcanics may be of Pliocene origin; the Salani are credited to the late Pleistocene. The Mulifanua is presumed to be 10,000 to 40,000 years old, Lefaga is just post-Pleistocene with the Puapua placed at mid-Holocene (5000 B.P. ?), and the Aopo flows are modern, being of historic record. Except for small areas near Apia and in the Falefa District, there are no alluvial deposits recorded on Upolu. Thus, most of the Samoan soils are derived *in situ* from parent volcanic material. The soils vary in depth and fertility, depending to some degree on the age of the parent material. Only the Mulifanua formation is of immediate interest here because all the data reported herein (except the Paradise Site) come from the Mulifanua volcanic area. Except for a strip west of the Falefa River, Mulifanua exposure is confined to the northwest coast, extending east to west all the way from the east edge of the Apia District to the western tip of Upolu. The north-to-south distribution is from the coast to the line of volcanic peaks that form the east-to-west highland ridge which constitutes the backbone of the island (Kear and Wood 1959:Fig. 40). Mulifanua volcanics display attributes of youthfulness in the surface occurrence of blocky, angular basalt fragments and the shallow soils, from 30 to 50 cm deep, resting upon decomposing basalt blocks or surfaces of sheets of unfragmented lava not significantly modified by soil-forming agencies. There are two sands, Tafagamanu at 1.52 meters elevation above mean sea level and Nu'utele at 4.57 meters, recognized intermittently around the island. They are dated, insecurely, as late Holocene. They have been interpreted as resulting from recent higher-than-present sea stands.

Another part of the environment, of course, is climate, which not only has aided in developing the physical surroundings but establishes yet other constraints on human day-to-day and long-term adaptations. Upolu has the tropical high island climate characterized by high and relatively stable year-round temperatures and heavy, somewhat seasonal, rainfall. Rainfall, as on other high islands, varies greatly with elevation and location with respect to the highlands and the prevailing winds.

According to S. C. S. Wright (1963), that part of the Mulifanua District of greatest concern here can be described as lying in the leeward semiarid zone where a marked dry season of three months (July, August, and September) affects vegetation noticeably, although the precipitation during the remainder of the year averages 225 cm. Heavier annual moisture characterizes all the other districts of Upolu; up to 500 cm fall in the highlands. Even the lowlands of the southeast coast receive 250 to 320 cm where only one dry month is noted per year. Mean annual temperature for the lowlands is 78° F. High average is 80° F; the low 71° F.

Given the volcanic parent material, the available moisture, the small annual temperature range, the intense biochemical podogenetic process under tropical vegetational and moisture conditions, a soil of moderate fertility quickly exhausted by horticulture is to be expected. S. C. S. Wright (1963) confirms this expectation by classifying the lowland (below 305 meters elevation) as being humic latosols; the older term, lateritic soils, is also applicable. He specifically assigns the soils of the Olo District to the Magia latosol series, it being one of many in the soils grouped together as being derived from the Mulifanua flows. The Magia is described as being friable, brown to red-brown clay loam, stony with many boulders locally. Because of the porous nature of the Mulifanua volcanics, there are no perennial streams in the area. However, strong springs abound along the coast. The same characteristic porosity, as well as the extreme youth of the soils, probably explains the lack in Magia soils of the impervious lateritic zone which is found with older latosols.

The general set of ecological resources comprising the full Mulifanua area can now be stated succinctly thus: seasonally well watered, but with a distinct dry season sometimes deleterious to vegetation, no permanent surface water, young stony latosols, with many scattered angular basalt boulders on the surface, and a mean Fahrenheit temperature in the high 70's. Biotic resources include indigenous and introduced species varying by locality.

The natural environment outlined above creates an archaeological environment which imposes some specific constraints, quite apart from any modification of the landscape referable to aboriginal usage of the resources. Certain of these have been touched on by Green (1969a), who describes the enervating effect of the continuously high temperatures on unacclimatized persons, the difficulties for archaeological survey imposed by the rapid growth and density of vegetation, and social factors such as the failure by modern Samoans to grasp the objectives of, or reasons for, archaeological research. While recognizing from experience the factors cited by Green, another cluster of both natural and cultural factors establish certain hazards for field work that require mention.

A major difficulty that one encounters is to determine the extent and nature of subsurface disturbance of the soil by prehistoric users of the land. As described later (Section 2, this volume), the interpretation or even the recognition of subsurface rupture of the soil (for example, a pit) is hampered by the dynamic and continuous nature of the podogenesis of tropical soils. Evidently the process obscures or "heals" evidence of rupture or disturbance very rapidly, so that any prehistoric episode of movement of earth cannot be detected today in the soil zone between the surface and a depth of 30± cm unless the phenomenon was covered or protected by some subsequent event, such as the construction of a stone house platform, or some other episode occurred that inhibited or prevented the continual effect of leaching or root action above the initial disturbance. Two or three such instances where the excavator could not discover the level of origin of aboriginal pits that were almost certainly dug from near the modern surface, are described in later sections (Sections 2 and 4). Green and Davidson (1974a:218) have made similar comments.

Another factor, in this case both cultural and natural, was the difficulty sometimes encountered in correctly identifying patterned, purposeful arrangements of stone as opposed to random distribution of stones in the boulder-strewn Mt. Olo District. The surveyors were aware that ancient house platforms, walls, and pathways were there and could be identified. Equally characteristic, however, were what appeared to be no more than formless rubble heaps. The rubble heaps could be the stones collected during land-clearing for gardens, or the disturbance of ancient human constructions by roots of large trees after abandonment, or merely hillocks or ridges of lava breaking up in their original position, or possibly even burial cairns. The only solution is to accept, with all possible grace, the fact that one cannot distinguish these several phenomena with full certainty. In fact, certainty can be achieved, if then, only by excavation. But by establishing a series of criteria (Jennings Ms.) for identifying ancient structures, the Mt. Olo surveyors succeeded in identifying paths, house mounds, and other patterned construction. Some reasonable inferences about certain clustered rubble heaps have been made, but are tenuous at best.

At a different level, one more natural circumstance should be briefly cited. This has to do with the overall geology of the Samoan group as geological history affects archaeological understanding. Green (various) and Groube (1971) have engaged in debate as to whether the Samoan prehistoric sequence was as long and deep chronologically as could be inferred from Tongan data. One aspect of the argument was the lack of Lapitan ceramics in Samoa. With the report of the Ferry Berth site, a Lapitan village (Green 1974c; Jennings 1974), this problem was dissolved. However, the present location of the village some 3 meters below sea level just offshore, sealed by cemented shell and coral rock, requires explanation. That a local tectonic subsidence movement was responsible for the submergence was the easy and obvious explanation, but it was based on no local evidence. A major shift in sea level would also serve to explain the matter. However, there appears to be no convincing evidence of a 3-meter worldwide rise in sea level as recently as 1000 B.C. According to Green and Richards (Ms.) both sea level shifts and local tectonics are invoked by scholars in explanation of raised beaches on various Pacific islands. The generalized explanations offered tend, understandably, to rest on data collected in the area most familiar to the scholars offering the explanations. Of course, it is easy to accept either explanation, based on local evidence, for any local situation. Depending on the chronology, sea level changes may account for raised beaches in one archipelago, with tectonic action responsible elsewhere for either raised or lowered beaches. But, it seems reasonable to suppose that in volcanic situations, tectonics is the more likely and logical explanation. The matter is of urgent interest for Samoan prehistorians because the likelihood of determining the full cultural kit of the pioneer Lapitans, presumed to have been the Samoan founder population, is more remote than ever if all the Lapitan beach settlements are now submerged.

On the sea level-tectonic problem there is now new evidence. It appears that consensus is developing among scholars engaged in current Pacific studies that the island of Upolu, at least, has been submerged through tectonic movement from 2 meters to 3 meters in the past 3,000 years (Bloom Ms.). From their research, Hawkins and Natland (1975) have concluded that Upolu is subsiding at the rate of 1.5 mm per annum, a figure interestingly congruent with Bloom's estimates, and equally compatible with the 3 meters submergence of the Ferry Berth site since 3000 B.P. Earlier, Schofield (Ms.) expressed the similar opinion with respect to charcoal recovered (with no associated cultural material) during coring operations in the harbor of Asau on Savai'i.

One can conclude, therefore, that little Lapitan data will be generated in Samoa until, with good fortune, pioneer villages or fishing camps on low, seaside escarpments originally higher than 3 meters (perhaps under more recent village structural remains) can be discovered. This particular hazard provides, at the same time, a specific objective for future research, as well as a pessimistic outlook for full data on the earliest phases of Samoan prehistory. In passing, one can remark that the Nu'utele (4.5 meters) and Tafagamanu (1.5 meters) beaches lose any significance they might have had as archaeological time markers. That they were and are sometimes favorable locations for villages is true; there is no assurance, however, that they were prime locations for villages of the earliest Lapitan population.

As further introduction to the later sections, brief comment on the chronology of Samoan sites is appropriate here. For the Samoan sequence itself, abundant controls exist. Green and Davidson (1974a:214) have tabulated a ladder of 45 radiocarbon dates ranging from 2276±100 B.P. (310±100 B.C.) to A.D. 1840. The lower/earlier dates in the series are consistent, but ascribe an earlier time of occurrence for the two distinctive ceramic complexes of eastern Upolu at several sites than previously noted. However, Green's work shows that his "Samoan thin fine ware" is evidently earlier than A.D. 1 (A.D. 1 actually probably falls toward the end of its popularity) and that the "thick coarse" pottery in a similar tradition co-occurs with the thin ware. The coarse ware eventually becomes dominant and finally disappears, probab by A.D. 200-250. What needs to be briefly stated is that part of the series of 10 radiocarbon of phenomena recorded by the University of Utah Samoan Archaeological Program work appears to b fully compatible with the New Zealand sequence, as well as with previous archaeological finding

The earliest 1974 date is 2980±80 B.P. (NZ1958 B) ascribed to the shells imbedded in the cemented shell and coral stratum above the submerged Ferry Berth site (SUMu-1). This date applies to the decorated Lapitan ceramics. The youngest date of 290 B.P. is presumed to date the last use of SUMu-48, Green Ti earth oven.

Table 1, which is self-explanatory, demonstrates the manner in which the University of Utah Samoan Archaeological Program radiocarbon dates integrate with the earlier Samoan chronology, in that both the dates and associated archaeological material are generally compatible with the previous findings at Vailele and Falefa Valley. However, the New Zealand dates give a firm date for the Samoan fine ware some 550 years earlier than that yielded by Green's specimens.

Two of the shell dates, however, should be disregarded. These are RL-477 and RL-479, both derived from shell scrap. They are incompatible with the 45 radiocarbon dates derived earlier from the New Zealand research as well as with the cultural (ceramic) sequence established by that same New Zealand work. They are also incompatible with the University of Utah Samoan Archaeological Program cultural data in being too early, and in that both dates reverse the stratigraphy. For complete correlation with the other University of Utah Samoan Archaeological Program dates, RL-477 and 479 should have assayed about 2100 to 1800 B.P

The foregoing pages are intended to serve as a general introduction for the detailed sections which follow.

Table 1. RADIOCARBON DATES

University of Utah Samoan Archaeological Program						Comparable data from Green and Davidson (1974a)		
Sample No.*	Site No.	Context	Material	Date	Corrected tree-ring Christian calendar dates	Sample No.	Context	Date
RI-458	SUMu-48 Fs13	Bottom of earth oven, 60 cm from surface	Charcoal	290 B.P.	Younger than A.D. 1510			
RL-460	SUMu-165 Fs8	Stone rubble fill of Cog Mound	Charcoal	270 B.P.	A.D. 1600±150			
RL-462	SUMu-188 Fs12	Earth oven fill, 60 cm from surface	Charcoal	370±110 B.P.	A.D. 1520±110			
RL-461	SUMu-165 Fs9	Stone rubble fill of Cog Mound	Charcoal (palm)	440±100 B.P.	A.D. 1450±70	GAK-1434	SUFo-1	470±180 B.P.
RL-459	SUMu-165 Fs1	Bottom of fire basin	Charcoal	1150±110 B.P.	A.D. 820±130	GAK-1438	SULam-1	1050±80 B.P.
RL-477	SUFI-1 Fs117	Stratum IV (Test II)	Shell	2510±120 B.P.†	660±180 B.C.			
RL-481	SUFI-1 Fs119	Stratum IV (Test II)	Shell	2220±120 B.P.	290±150 B.C.			
RL-478	SUFI-1 Fs69	Stratum III (Test I)	Shell	2130± 30 B.P.	200±210 B.C.			
RL-479	SUFI-1 Fs80	Stratum II (Test I)	Shell	3220±130 B.P.†	1550±150 B.C.			
RL-464	SUFI-1 Fs45	Stratum I	Tridacna shell	2220±110 B.P.	310±130 B.C.	GAK-1194 GAK-1339 GAK-1444	SUVa-4 SULu-53 FULe-12	2150±100 B.P. 2170±100 B.P. 2210±100 B.P.
NZ2726**	SUFI-1	Stratum I	Outer 1/3 of Tridacna shell, companion to RL-464	2510± 60 B.P.				
NZ2727**	SUFI-1	Stratum I	Intermediate 1/3 of same Tridacna shell	2550± 50 B.P.				
NZ2728**	SUFI-1	Stratum I	Inner 1/3 of same Tridacna shell	2590± 40 B.P.				
NZ1958B	SUMu-1	Base of coquina layer sealing submerged Lapitan deposit	Shell	2980± 80 B.P.				

*RL - Indicates Radiocarbon, Ltd. lab dates based on half-life of 5570; NZ - Indicates New Zealand lab.
**Results calculated by new T 1/2 (5730±40 years).
†Unacceptable dates.

SECTION 2

THE MT. OLO TRACT SURVEY

RICHARD N. HOLMER

INTRODUCTION

The Mulifanua District of Upolu, Western Samoa, has received limited interest as a focus for settlement pattern studies (Davidson 1974d:195-200). The area, however, appears to have potential for the identification of probable behavioral patterns of social and political activity. Several characteristics of the Mulifanua area give it its potential. One is that ethnohistorical data (Stair 1897:57) supported by the recent C-14 dates (Section 1, this report) show that the inland zone surrounding Mt. Olo supported an 18th-century and earlier settlement that was probably in the process of abandonment when the first missionaries arrived. The significance of this is that the Mt. Olo area is a "protohistoric" settlement where archaeology, ethnohistory, and tradition potentially overlap. Green (1967:126) has emphasized that the data resulting from such an overlap is essential in establishing a "base line" against which archaeological evidence from earlier periods can be tested.

Another advantage of the Mt. Olo area is that, once abandoned in the early 1700s, it was not again extensively settled. The core of the Mulifanua plantations was established in 1865 by German immigrants (Lewthwaite 1962:142), and a gradual expansion of plantation lands into areas of secondary "bush" growth has taken place ever since (Davidson 1974d:197). The area has remained unaltered by historic settlements except for the clustered residences of plantation workers. Any site disturbance, therefore, did not result from repeated historic occupancy of a single location as is common in other parts of Upolu, but is primarily the effect of plantation road and fence construction. Site destruction caused by roads is easily noted, but disturbance resulting from fence construction is often subtle and may go undetected in that an earlier structure may have been robbed of stones thus altering its shape and size.

Tree growth has also left its mark on many structures. The plantation coconut palms have caused limited disturbance, but the secondary forest growth that followed the suspected 17th-century abandonment appears to have caused considerable site damage. In some cases the disturbance is readily visible as depressions and dislocated boulders; but other times it can only be detected by excavation.

Further disturbance, though minor in nature, has resulted from cattle that graze throughout the plantation lands. Cattle paths are visible on most structures and have probably accelerated the collapsing and erosion of structure side walls. The presence of cattle, however, offers a distinct advantage for the surveyor in that they keep the undergrowth closely cropped,

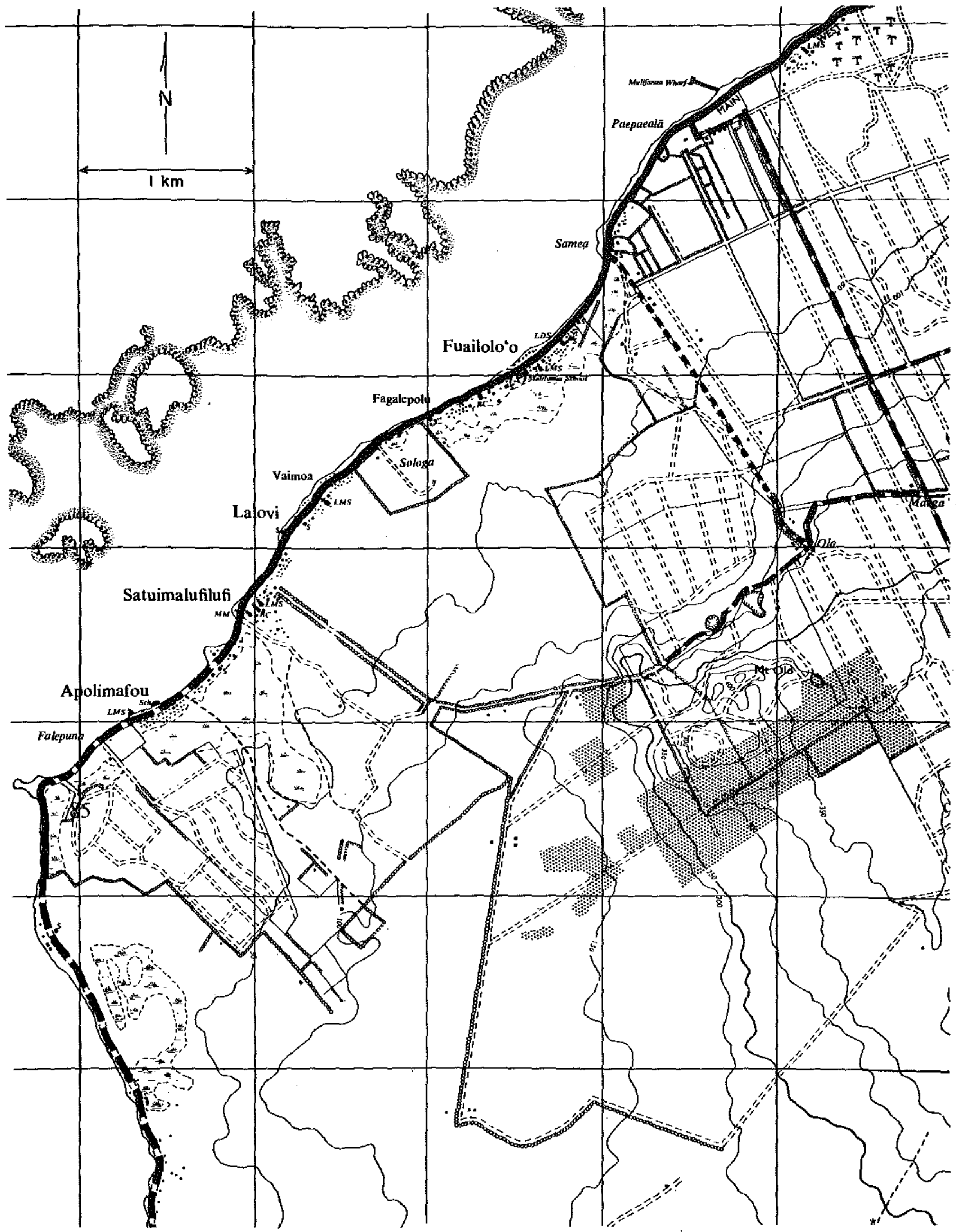


Fig. 2. MAP OF THE MT. OLO DISTRICT. The shaded area is that covered by the Mt. Olo Tract mapping activity.

a circumstance which aids in site recognition and often eliminates the necessity for site clearing.

The organization and planning of the Olo survey and resultant settlement pattern study (Section 5, this report) follows the suggestions outlined by Green (1967:125). He concludes that the most effective survey type in present-day Polynesia is an intensive survey of a local area with selected excavations. Also stressed is the importance of integrating the survey study with ethnohistorical, traditional, and ecological evidence. The objectives of the following reports on the Mt. Olo survey area, therefore, are a detailed description of the Mt. Olo Settlement (this section), a description of the test excavations that followed (Sections 3 and 4), and an interpretation of these data within an ethnohistorical, traditional, and ecological framework (Section 5).

Survey activities began on September 10, 1974, with the detailed mapping, using plane table and telescopic alidade, of a portion of an extensive settlement that extends from the northern and western coasts of Upolu inland for well over 5 km (Fig. 2). Selected elevations were recorded during mapping to note general trends in the topography. The generalized topographic data, which only included the survey area itself, were then joined with larger scale topography (N.Z.M.S. 174, sheet 17) to form the topographic data recorded in Figure 3 (foldout at end of volume). A base line for the survey was established along a secondary plantation road that joins with, but runs perpendicular to, the area surveyed by Davidson (1974d:195-200). It was intended that a transect of roughly 400 meters in width be surveyed centered on the base line, although the width was considered to be completely flexible if interesting areas were located outside the transect width. By the completion date of October 9, 1974, an area of roughly 1 sq km had been intensively surveyed revealing 192 architectural phenomena. Individual structures were given consecutive numbers as they were identified and recorded using the prefix SUMu (S=Samoa, U=Upolu, Mu=Mulifanua) continuing the recording system described by Green (1969a:10). Information concerning dimensions, construction materials, and unusual characteristics was recorded for each site. A total of five of these sites were then excavated during the period October 15 to November 8, 1974.

SETTING

The Mt. Olo Tract area is located approximately 3 to 5 km inland from the westernmost tip of Upolu, Western Samoa. It lies within the Olo and Tausagi sections of the Mulifanua Coconut Plantations of the Western Samoa Trust Estates Corporation (WSTEC). Access to the area is via the Olo Plantation road that turns inland off the main coastal highway at Samea. Views of portions of the survey area are shown in Figure 4.

Mt. Olo itself rises to an altitude of 130 meters above sea level and is the northwestern-most mountain in the central ridge that divides Upolu along its east-to-west axis. It is, in fact, a low volcanic cone on what is otherwise a gentle slope, and is rather inconspicuous when viewed from a distance. Its upper slopes are steep (slope of 1:3; see Fig. 3) but shortly become gentle (1:30) for the remaining distance to the sea. Mt. Olo, as well as

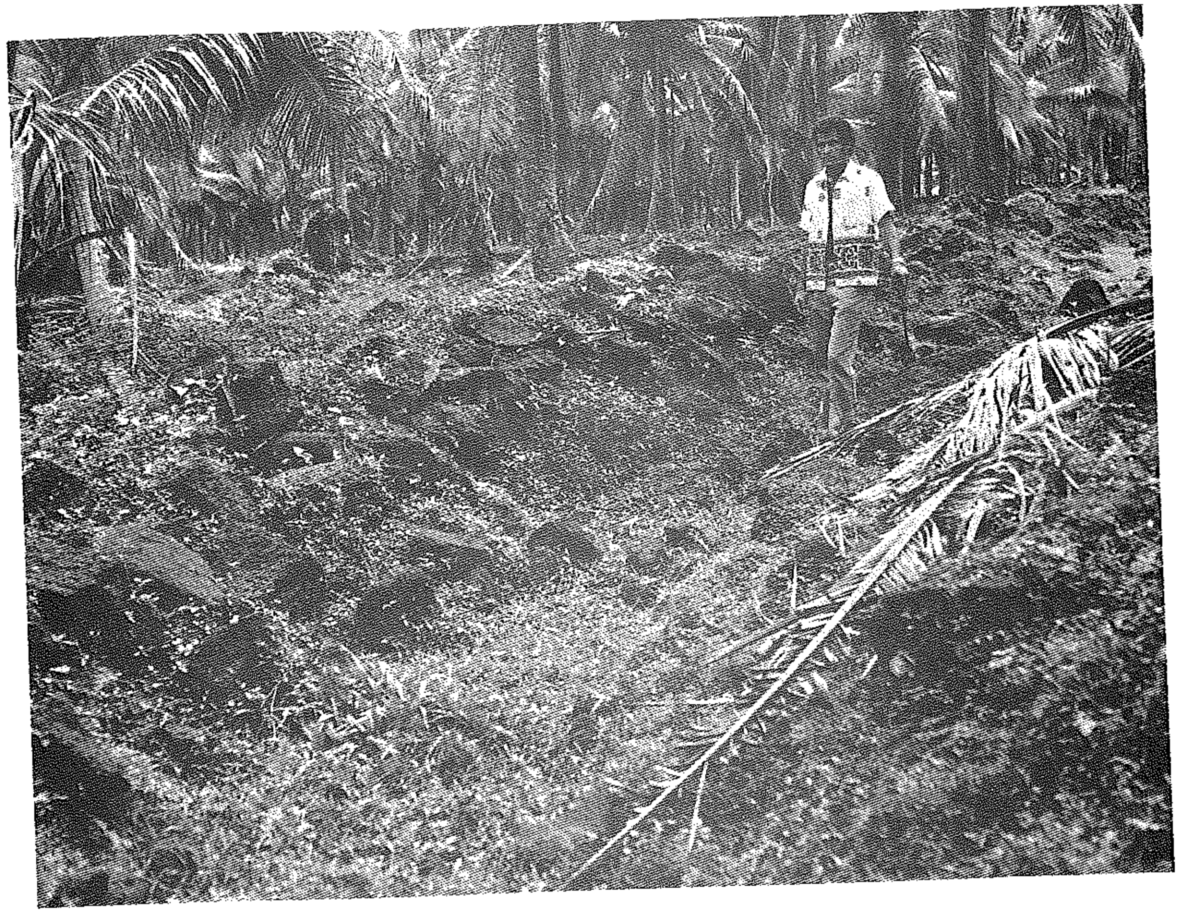


Fig. 4. VIEWS OF OLO TRACT SURVEY AREA. Top, a walled path. Bottom, ferns impeded search parties.

Fig. 4 (cont'd). Top, general view of south end of tract road that served as midline for mapping. Bottom, rubble in foreground, house mound beyond.

other cones in the area, dates to the Mulifanua volcanic series of 10,000 to 40,000 years ago.

The survey tract has been divided into three areas as the result of archaeological and topographical data (see Fig. 3). Area B has a higher density of scattered stones and boulders and is generally steeper and more rugged than Areas A and C which are best described as gently rolling. The boundary between Areas A and B is the low pass or saddle that connects Mt. Olo with the other mountains in the range. The B/C boundary is where the more steeply sloping zone of Area B levels off and blends into the gentle slope of Area C.

The soils in the Mt. Olo area are well suited for all subsistence crops and retain their fertility if a bush fallow of 3 to 5 years is maintained (A. C. S. Wright 1962:97). The lack of surface water, which results from the porosity of the volcanic rock, doesn't restrict the use of the land for agricultural purposes. Soil-moisture retention and annual rainfall are the primary factors when considering the agricultural potential of an area such as Mt. Olo (Curry 1962:55). Monthly rainfall amounts vary greatly from year to year but are generally adequate to prevent a soil-moisture deficit during the dry season (Curry 1962:58). The soil and climate characteristics provide favorable conditions for subsistence agriculture.

For culinary water, rainfall collection was probably a necessity although small seeps with questionable productivity were found in two lava tubes (SUMu-190 and 191) within the limits of the survey.

ARCHITECTURAL REMAINS

The architectural remains recorded in the Mt. Olo Tract consist of four general categories: mounds, pathways, fences, and ovens (see Fig. 4). Construction material for all structures is primarily stone, although there is some limited use of soil. Several possible structures were not recorded because they were too highly disturbed to be identified with relative certainty. Other structures that are moundlike but lack the symmetry and top surface levelness characteristic of platforms were not recorded, although areas of concentration were noted. There is little doubt that these amorphous "heaps" were intentionally constructed, but they possibly result, as suggested by Davidson (1969c:239), from agricultural clearance. Some heaps have been excavated and demonstrate deliberate sorting of stone by size, which suggests stockpiling (Buist 1969:43-44).

MOUNDS

Two general classes of mounds occur in the Mt. Olo Tract: platforms and star mounds. In this discussion no attempt to break them into size categories is made, although this aspect is discussed in detail later in Section 5.

Platforms

Platforms make up approximately 70% of the 192 architectural structures recorded. Shapes range from elliptical to rectangular, and there is a tendency for a continuum from small and round to large and square. The tendency may not reflect a cultural preference in that corners

naturally show the results of wear or erosion more than sides; thus, the closer the corners are together the more rounded the structure becomes when exposed to continuous erosional processes.

The sides generally are uniformly sloping at 30° to 45° off horizontal although a few vertical examples were recorded. The consistency of the slope may again not reflect a cultural preference but may simply be the "angle of repose" for the collapsing stone masonry. Structures of other types demonstrate the same tendency. Fences, which can be assumed to have been vertical at one time, have collapsed into rounded linear heaps that have sides sloping at a similar range of angles. Occasionally platforms were recorded that have short sections of vertical side walls which blend directly into obviously collapsed portions. Other platforms have sloping sides that appear not to be collapsed remnants of previously vertical walls. Uncollapsed but sloping side walls are often detectable by the existence of curb stones that separate the small top stones from the larger side stones. For platforms with collapsed side walls the segregation of stone sizes by curb stones is not maintained, resulting in a mixing and possible superposition of the smaller top stones on the larger side stones. These data suggest that the side walls originally ranged from gently sloping to vertical, but erosion over time has generated sides with a similar range of slopes for most platforms. Davidson (1974d:197) confirms that even recently abandoned stone platforms soon lose their shape and become somewhat amorphous.

Platform sizes (see Table 2) range from 0.2 meter high and 3 by 3 meters basal dimensions to 1.6 meters high and 35 by 35 meters basal dimensions. The majority fall within the range of 0.2 to 1.2 meters high and 5 by 5 meters to 25 by 25 meters basal dimensions.

Construction material for the platforms is quite uniform. Stones averaging 26 cm in diameter are incorporated in all but three of the structures. Thirty-one platforms have definite size differences between the top surface stones (diameter 14±6 cm) and the sloping side stones (diameter 38±5 cm). Often there is a curbing of large stones that separates the smaller top surface stones from the larger side stones. No house outline curbings were evident, except for one example of a very small oval outline (2 by 4 meters) on a low but extensive mound (SUMu-177). There are three platforms constructed of soil, and three others of a combination of soil and stone. Six platforms have a clearly definable step that divides the top surface area approximately in half, one portion averaging 35 cm higher than the other.

Only one site (SUMu-41) can be definitely classed as a terrace. It is identical to the surrounding platforms except it is built into a steep slope. It is the only example encountered of a structure on such a slope, and its mere location probably necessitated a terrace construction technique.

Ramps on platforms are also rare. SUMu-184 is the only example discovered during the survey, but subsequent excavation revealed that SUMu-164 (see Section 3) probably had one, though small by comparison. Thus there is a possibility that others have ramps but erosion and vegetation have made their identification difficult.

Star Mounds

Three mounds (SUMu-95, 157, and 165) that differ in form from the previously discussed platforms were recorded. Their characteristics agree with the description given by Davidson (1974f:227) for "star mounds." Two of the three (SUMu-157, 165) are large, measuring approximately 2.5 meters high and 20 meters in diameter. The other (SUMu-95) is similar in size to the smaller platforms, measuring 75 cm high and 16 meters in diameter. All three are constructe of stone although the larger two have earthen caps. The dry masonry side walls are almost vertical and form the regular protrusions that are characteristic of star-shaped mounds. The two larger ones both appear to have nine, 3 meter wide protrusions extending outward for approximately 2 meters. A few of the protrusions have collapsed, thus partially obscuring their original shapes and sizes. One of the larger star mounds (Cog Mound, SUMu-165) and two associated structures were later excavated. The findings are discussed in Section 3 of this report.

The smaller star mound (SUMu-95) has four protrusions that are approximately 3 meters wide and extend outward for approximately 5 meters. The structure is quite symmetrical and resembles a four-pointed star, whereas the larger two resemble gears or cog wheels. The smaller one has a central depression (1.2 meters in diameter) that is surrounded by a low wall. The wall may be modern in that it resembles the tree wells that are constructed to protect young trees from foraging cattle. There are many tree wells in the area, and several, as is this one, are located on top of architectural features. Some, also, no longer have trees growing within them.

The small star mound is located directly on the rim of the Mt. Olo crater near the bounda of Areas A and B. It has an impressive view of the crater and surrounding area. The larger two are located in prominent, although not commanding, positions on the gentler terrain of Area C.

WALKWAYS

There are two types of walkways prevalent in the Mt. Olo Tract: raised walkways and walled walkways. A third type, a trenched way, is present but is represented by only one example. The total length of all walkways recorded in the 1 square km area surveyed is approximately 4.5 km.

Raised Walkways

Raised walkways are low, linear, flat-topped earth and stone structures that are trapezoi shaped in cross section. The type has in the past been called a causeway (Scott 1969:72), but this terminology is not used here because of an implied association with water or marshland. The sides slope inward at about 45°, and the height varies from 20 cm to 1 meter with the average just under 60 cm. The width varies from 2 to 11 meters, with an average of about 4.5 meters. A total of 2.5 kilometers of raised ways are present in the survey area, making i the most prevalent type of walkway.

Walled Walkways

Walled walkways are ground-level paths bordered by two parallel fences. They have alternatively been called sunken ways (Davidson 1974f:239), but in the examples here recorded, the title would be deceptive primarily because they are ground level. The parallel fences have collapsed into rounded linear masses of stone so it is difficult to determine path width. In their collapsed condition the widths (measured between the outside edges of the two fences) vary from 4 to 7 meters with the average height of about 60 cm. The total length of walled ways within the survey area is 1.2 km.

Trenched Walkways

The one example of a trenched way is SUMu-96. It is troughlike in that the 2 meter wide path is about 50 cm below the surrounding surface. Its length is 65 meters and it directly connects with raised pathways on both ends. The connecting of different types of pathways is common for all types. Several walled ways transform abruptly into raised ways, the best examples being SUMu-64 and 179.

FENCES

A total of 2.4 km of linear rock arrangements recorded have been interpreted as fences, though in some instances the classification is tentative (those marked by a ? in Table 2). They are questionable in that the possibility exists that they may be highly disturbed raised walkways. If the site in question is clearly trapezoidal in cross section, it is classed as a raised way; if vaguely trapezoidal, it is tentatively a raised way; if the top surface is rounded but in some places shows a tendency toward flatness, it is tentatively classed as a fence; and if completely rounded it is classed as a fence.

There are two obvious groups of fences, based on size comparison (discussed in detail in Section 5). The smaller group averages 50 cm high and 3 meters wide. The larger group averages 1.9 meters high and 5.8 meters wide. Three of the four large examples (SUMu-172, 173, and 178) make up what is known locally as the Pa Tonga (Green, personal communication, 1974). The other example (SUMu-176) forms a large fortlike, irregularly shaped enclosure that measures 85 meters long by 60 meters wide. The northern ends of the walls become low with the sizes averaging within the range of the smaller fences described above. Within the confines of the wall is a small (3.2 by 4 meters) roomlike enclosure formed of walls about 1 meter high.

Several other interesting configurations of fences are present. There are at least seven examples of penlike rectangular enclosures (SUMu-80, 129, 144, 156, 167, 170, and 175), the largest one measuring 35 by 40 meters (SUMu-144). Another example (SUMu-171) is composed of several parallel stalls that average 4 meters wide and 20 meters long giving it a stockyard appearance.

OVENS

A total of six earth ovens were recorded. They are composed of a raised crater or circular ring of earth that averages 60 cm high and 8 meters in diameter. The central depression often has rock showing toward the bottom. All but one are directly adjacent to a platform structure. There is evidence, though, to suggest that the isolated one (SUMu-188) also has an adjacent platform, which is highly disturbed by plantation road construction and was not recorded. Two ovens (SUMu-48 and 188) were later excavated and a further discussion is contained in the excavation reports (Section 4).

SECTION 3

THE COG SITE (SUMu-165)

RICHARD N. HOLMER

INTRODUCTION

The Cog Site is located 3.3 km inland from the westernmost tip (Fatuosofia Cape) of the island of Upolu, Western Samoa. It lies within the Tausagi Coconut Plantation of the Western Samoa Trust Estates Corporation (WSTEC) on the gentle western slopes flanking the extinct volcanic cone of Mt. Olo. Access to the site is via the Olo Plantation road which turns inland off the main coastal highway at Samea.

EXCAVATION AND STRATIGRAPHY

The Cog Site was initially reported and surveyed during the Mt. Olo Tract survey. A plane table map was made of the neighborhood (Fig. 5), which includes the Cog Mound, four low mounds, two earth ovens, and a raised walkway. Several vertical slabs near the raised walkway are shown on Figure 6. Excavation activities began October 15, 1974, with a crew of four Samoan workers and a foreman/interpreter/driver. Training proceeded rapidly, enabling a total of more than 40 cubic meters of earth and stone to be removed and then replaced by the completion date of November 8, 1974.

Work began with the removal of the vegetation from the Cog Mound, a portion of the raised walkway, and the low mound directly to the north of the Cog Mound. The soil from approximately one-fourth of the top surface of the Cog Mound was carefully stripped in hopes of shedding some light on the use of the structure. At the same time a trench was begun on the northwestern edge of the Cog Mound. Purposes for this trench were to establish stratigraphic control, and to answer specific questions concerning the construction of the Cog Mound. Other exploratory trenches were dug into the walkway and the low mound. Four additional sondages were dispersed down the slope looking for agricultural remains, although none were found. All trenches were extended downward into sterile subsoil to insure stratigraphic control.

The stratigraphy of the site is simple and uniform. Stratum I is a homogeneous, dark, yellowish-brown, clayey, sterile subsoil. It contains fist-sized and larger vesicular basalt stones that are in the process of weathering into soil. The lower portions grade directly into decaying bedrock, the parent material for the soil. Stratum II is a dark-brown topsoil with a well-defined coarse-crumb structure. When comparing it with Stratum I, it is less compact, less clayey, and contains much more organic material. These strata are

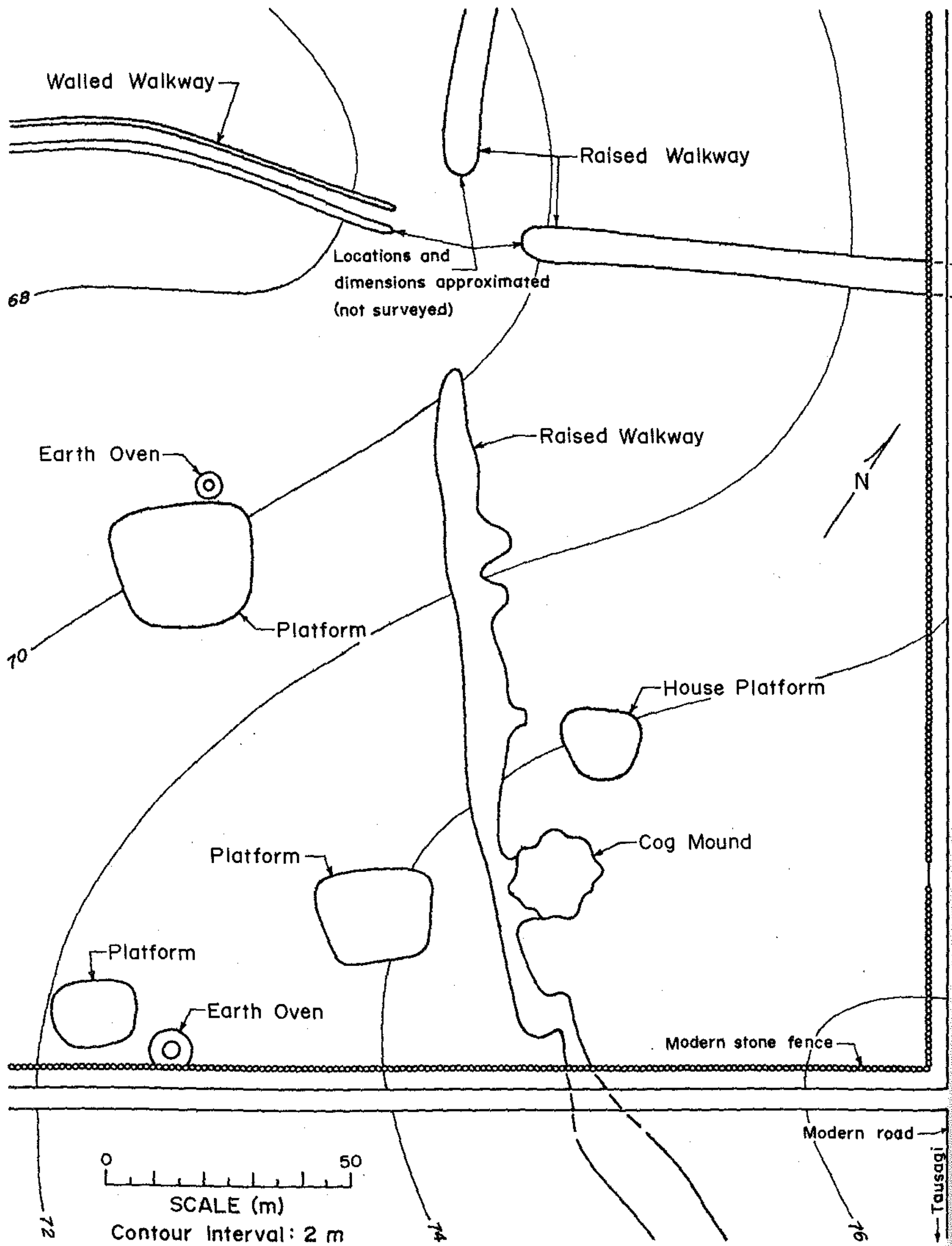


Fig. 5. PLAN MAP OF THE COG SITE (SUMu-165) AND SURROUNDING AREA.

undoubtedly the result of *in situ* pedogenesis, and do not represent two distinct time horizons as they might if they were aeolian or alluvial. The pedogenic processes are not restricted to the prehabitation period of the site. During habitation, the ground surface must have been greatly modified. Once the vegetation had been cleared, soil was probably collected for construction purposes and the newly exposed ground surface was susceptible to foot traffic and water erosion, greatly reducing the thickness of the topsoil. When occupancy ended and "bush" growth returned, soil development resumed with the re-establishment of topsoil of a thickness compatible with tropical forest vegetation. This process involves the conversion into topsoil of upper portions of the directly underlying subsoil by primarily organic mechanisms. It had the general effect of lowering the interface between Strata I and II by 20 to 30 cm in those areas where topsoil displacement had presumably taken place (that is, in the areas cleared of vegetation and not protected by overlying earth or rock structures). This is particularly noticeable in the profiles of the house mound and the raised walkway (see Fig. 8) where the Stratum I/II interface parallels the profile of the surface structures. Coinciding with this is the obscurity of use surfaces, if there are any, and surfaces of origin for intrusions. The obscurity seems to result from the tremendous amount of organic activity that takes place, not only during the conversion of subsoil to topsoil, but in already established topsoils.

The surface of origin for the three structures excavated appears to be the modern surface, although some structures demonstrate this better than others. Portions of the raised walkway are clearly superimposed on the modern surface. The stone "core" of the Cog Mound also rests on the modern surface, although the perimeter wall foundation stones penetrate 5 to 10 cm below it. A footing trench is a possible explanation, but there is no supporting evidence visible in the cross sections. The extension of the wall beneath the apparent surface level may have resulted from the settling of the weighted stones, although it would be expected that the stone "core" would settle an equal amount. The house mound is the most difficult to interpret in that there is no clear stratigraphy visible that might differentiate the redeposited topsoil (for the construction of the mound) from the presumably underlying prehabitation topsoil; thus no precise surface of origin is defined. The excavator's lack of experience in tropical volcanic soils may explain some of the inconclusiveness of these interpretations.

STRUCTURES

COG MOUND

The Cog Mound is located on a prominent, naturally flat area on what is otherwise a gentle slope. It is the largest and most conspicuous structure in the immediate area. In plan view (Fig. 6) it looks much like a cog wheel or gear; hence the name, Cog Mound. A total of 36 similarly shaped mounds have been reported in areas of Upolu, Manono, and Savai'i (Davidson 1974f:227) under the general classification of "star mounds."

The Cog Mound has nine protrusions that vary somewhat in size and shape. The northern half of the mound has several collapsed portions obscuring three of the protrusions. The

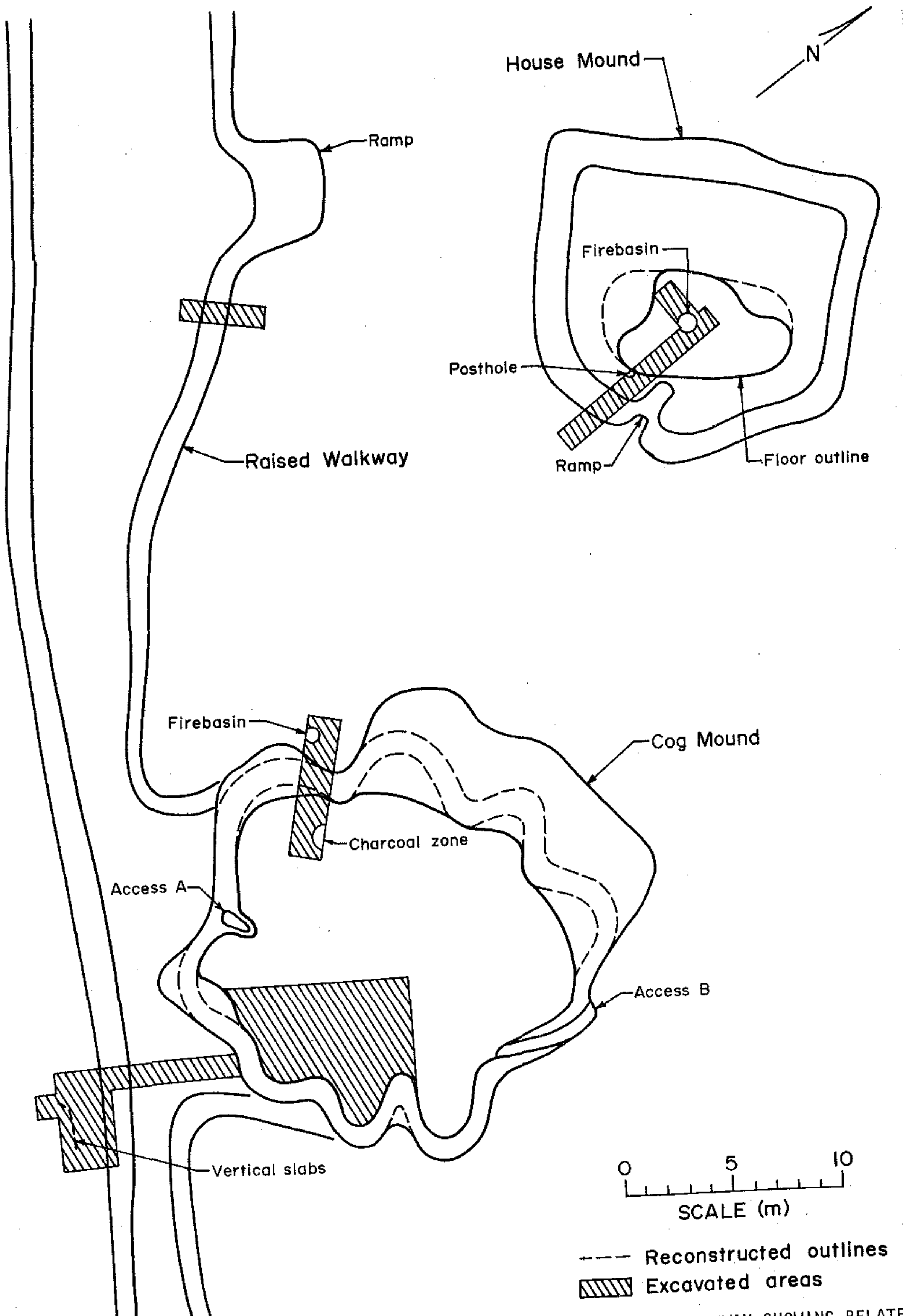


Fig. 6. PLAN MAP OF THE COG MOUND, HOUSE PLATFORM, AND RAISED WALKWAY SHOWING RELATED FEATURES AND AREAS OF EXCAVATION.

southern half is in mostly good condition. Careful examination of the perimeter and interpolation between uncollapsed portions gives a good idea of its original shape (Fig. 6). The height of the mound varies from 2.5 meters on the north side to 1.8 meters on the south. The 70-cm difference is due to the gentle northerly slope of the ground rather than a slope in the mound's top surface. The maximum diameter of the top surface is 17 meters (from the tip of one protrusion to the one opposite it), the minimum 13 meters. The mound is capped with soil forming a slight dome with the center being approximately 25 cm higher than the perimeter wall.

The perimeter wall is made of vesicular lava blocks (average dimensions 15 by 32 cm) stacked one course thick (Fig. 7). There is no evidence to suggest that mortar was used or that any of the stones were worked to provide a better fit. The wall slants inward at an average angle of 24° with the exception of the portions that have collapsed. The interior fill is entirely unfitted stone rubble (average diameter 19 cm), which hindered the excavation because of its general instability and tendency to slide (Fig. 7).

A heavy zone of charcoal was uncovered approximately 3 meters into the stone rubble fill (Fig. 8). Pieces of charcoal were scattered throughout the stones in a zone 1.5 meters long by 0.5 meter high (width remains undetermined). The lowest pieces rested on the surface of Stratum II, but there was no reddened earth to suggest that it had burned *in situ*. Scattered in the zone were a few fire-reddened stones, but they suggested no pattern or possible surface. Several large pieces of charcoal were removed as C-14 samples (RL-460-461) which provided dates of A.D. 1600±150 and A.D. 1450±70 (tree-ring corrected). The largest piece (10 cm in diameter) was immediately identified by the local workers, and later verified, as a palm. Also associated were a piece of branch coral, a bivalve shell, a piece of worked, fine-grained basalt, and several pieces of broken coconut shell.

The stone rubble core of the Cog Mound is the same height as the perimeter wall. Directly on top of it is the earthen, dome-shaped cap which consists of a Stratum II type of soil. Thickness of the cap grades from 25 cm at the center, feathering out on or near the perimeter wall. Approximately one-fourth of the earthen cap was carefully removed down to the rubble fill and then passed through a ½-inch screen. Absolutely nothing was found in the soil or on the summit surface; no post holes, firepits, or artifacts of any kind. It seems possible that post holes might have existed and have long since been obliterated by the organic activity mentioned earlier, but the conspicuous absence of all artifacts suggests that the top surface of the mound was not a living surface. It should be mentioned that the earthen cap was apparently an integral part of the construction of the mound rather than being a naturally transported or *in situ* pedogenic soil.

Two possible ramps exist for access to the top surface. Access A is on the western side directly adjacent to the walkway. It might best be described as a "giant step," consisting of a lower 1-meter vertical wall with a toe hold, and a ramp (90 cm wide) ascending to the final 30-cm step to the top surface level (total horizontal distance covered is 1.8 meters). Wear was undetectable on the toe hold and steps, possibly implying limited use.

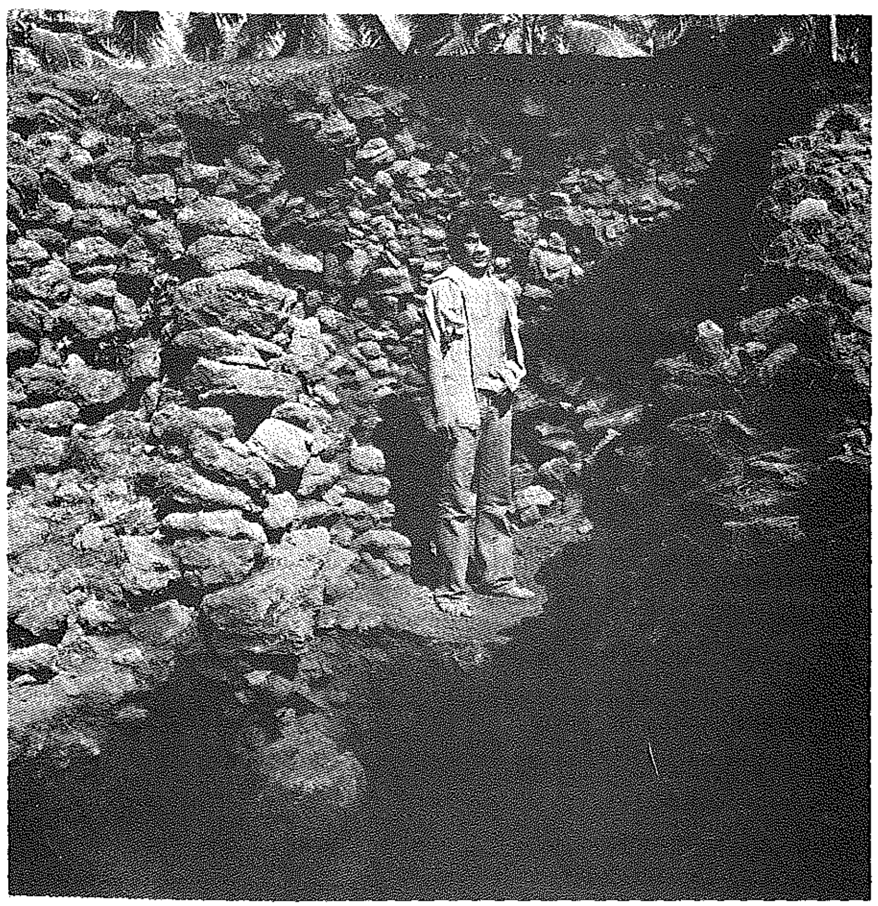


Fig. 7. THE COG MOUND SITE. Top, with ferns removed. Bottom, showing the amorphous nature of the interior fill as opposed to the coursed facing masonry.

Fig. 7 (cont'd). Top, slump where test cut was made. Bottom, as restored.

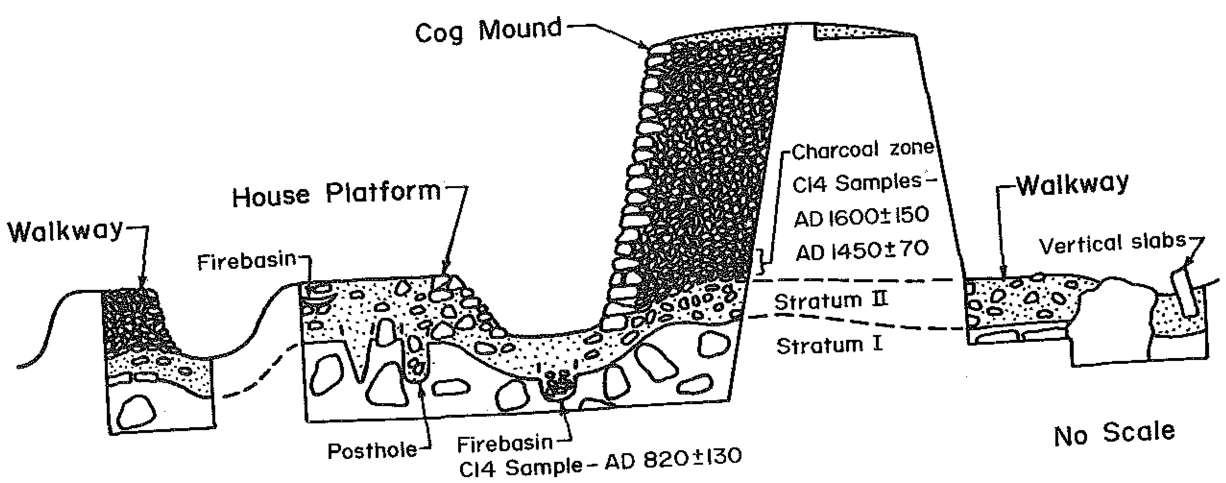


Fig. 8. SCHEMATIC CROSS SECTION OF THE COG MOUND AND THE ASSOCIATED STRUCTURES SAMPLED.

Access B is on the eastern side of the mound, directly across from A. It is a curved staircaselike ramp, 80 cm wide, and ascends the 2.2 meter high perimeter wall at a 45° angle. It consists of blocks unevenly placed in stairlike fashion, except for the bottom 80 cm which has either been disturbed or was purposely made difficult to negotiate.

The Cog Mound was apparently constructed in one phase in that there is no earlier structure within or beneath it. The construction technique probably involved building the perimeter wall up a few stones at a time then bringing the stone rubble fill up to that level, the pattern being repeated until the desired height was reached. The same technique was used in refilling of the trench and the reconstruction of an adjacent collapsed portion, and it proved to be efficient. Extrapolating from the time required for restoration gives an approximation of 600 man-hours invested in the construction of the entire Cog Mound, assuming that all the required construction materials were at hand.

HOUSE MOUND

This is a low, flat-topped mound 12 meters north and slightly downhill from the Cog Mound. It measures 15 by 15 meters and averages 65 cm in height. In both size and shape, it greatly resembles present-day Samoan house platforms. The sides slope at an angle of 23° (off of horizontal) and consist primarily of rock, although some soil is present. On the southern edge an indentation forms a possible ramp that ascends at approximately the same rate as the sloping sides. The top surface has intermixed areas of stone and soil. The largest homogeneous soil area measures 4.5 by 7.5 meters, and proved to be either a use area or a portion thereof. Excavation revealed two intrusions both about 70 cm deep. One appears to be a post hole, although it was not fully explored. The other is V-shaped and suggests no particular function. A firebasin was uncovered 15 cm under the modern surface near the center

of the suspected use surface. It measures 75 cm in diameter and 12 cm deep. The reddened earth is 12 cm thick near the center and thins out completely near the edges.

Considerable effort was invested in identifying a use surface associated with the firebasin and suspected post hole. A surface of origin was not definable, however, apparently because of the organic disturbance of the topsoil. Even with the absence of a definable living surface and the uncertainty concerning the post hole it can be concluded that this probably is a house platform.

The construction of the platform in relation to the Cog Mound cannot be fixed in time although it seems likely that they are contemporary. The platform is constructed of local soil that has been piled into the desired shape. The larger stones were segregated and used primarily in the sloping sides leaving the soil for the central use area.

A total of 30 pieces of basalt of a much finer grain than is locally available were found in or on top of Stratum II within the confines of the house platform. Eleven pieces show definite signs of use ranging from obvious striations to polishing.

RAISED PATHWAY

This structure runs in a northwest-southeast direction for a distance of approximately 300 meters, and is only a short portion of a rather extensive system of pathways. One hundred and twenty meters to the northwest of the Cog Mound, there is an intersection with another raised pathway which connects to a second mound of almost identical size and shape. To the southeast there is an intersection with a walkway that extends into unmapped settlements of the Mt. Olo area.

The raised walkway is flat-topped with sides that slope at a 45° angle. The average basal width is 8 meters and the height is 80 cm. Two gently sloping ramps are present: one at the intersection with the other walkways at the northwestern end; the second is adjacent to the westernmost corner of the house mound. The raised walkway is primarily constructed of unfitted stone rubble, the only earthen portion being the 20 meters directly adjacent to the Cog Mound where it blends into the flat area that the Cog Mound is constructed on. It is possible that this section may have been modified to accent the southwestern edge of the walkway, or possibly just to provide additional drainage. This is suggested by the relative thinness of soil overlying the suspected bedrock.

FIREPIT

This feature is located 1.5 meters northwest of the Cog Mound. It is basin shaped and is 70 cm in diameter and 50 cm deep. The upper 10 to 15 cm is obscured in the same way as the intrusions within the house mound. The basin is filled with stones (diameter about 10 cm) that are heavily fire-reddened. A 10 cm thick layer of charcoal coated the bottom providing a C-14 sample (RL-459) that resulted in a date of A.D. 820±150 (tree-ring corrected).

VERTICAL SLABS

Five vertical slabs form a semicircle and are located 8 meters to the southwest of the Cog Mound and 1 meter from the edge of the walkway. Excavation revealed no additional slabs, associated artifacts, or features, but did show that all five slabs are portions of one large fractured stone. Several other stones in the immediate area have been broken or dislodged around what appears to have been the base of a large tree. It is therefore felt that these slabs are not culturally significant.

PORTABLE ARTIFACTS

Of a total of 40 artifacts recovered during excavation, 35 are stones or stone chips of a much finer-grained basalt than the local vesicular type. Ten chips are too small to be certain whether the smooth portions are natural or are the result of working. All of the small chips were found either on the top surface, in the upper stratum, or in the suspected post hole of the house mound. None show any signs of being retouched.

Sixteen obviously worked stones were recovered. Thirteen have well-defined linear striations and came from either the top surface or within the upper stratum of the house mound. They range in size from 0.5 by 1.5 cm to 5 by 8 cm. The general smoothness of all surfaces suggests use in their present state rather than being the broken pieces of larger grinding stones.

Three other ground stones, although lacking distinct striations, were found in the upper stratum of the house mound, in the upper stratum of the raised walkway, and on the ground surface under the stone rubble fill of the Cog Mound. They range in size from 4 by 4.5 cm to 5.5 by 9 cm. Their rounded surfaces suggest a rocking motion during use rather than the planar motion implied by the more flattened use surfaces of the striated samples.

Nine additional pieces of nonindigenous stone without any apparent wear were found. Six came from the top surface or upper stratum of the house mound and two from within Stratum I, just outside the house mound.

Two pieces of shell, one identified as a Lucinidae (*Codakia tigerina* ?) and the other too small to identify, and a 1.5 by 3.5 cm piece of branch coral were found mixed in with the charcoal within the Cog Mound. Also present, although just outside the charcoal area, were several pieces of coconut shell, which, when pieced together, compose approximately one-quarter of a complete shell. The pieces were near or actually on the original ground surface. Wedged between the stones of the perimeter wall of the Cog Mound was a bird bone. Since it was extractable without the removal of any stone it is probably recent.

INTERPRETATION

The excavation of the Cog Site has provided a sample from one of many neighborhoods that make up what appears to be a continuous settlement that extends inland from the northern and western coasts of Upolu for over 5 km.

The C-14 dates suggest that this particular neighborhood was utilized, although possibly intermittently, over a period of 1,000 years beginning about A.D. 700. The isolated firebasin is the only archaeological feature that can be associated with the early end of the time span, although there is a possibility that the house platform could also be that early. The Cog Mound and the raised walkway are probably contemporary, as is suggested by their being connected as well as their surface of origin being both clearly defined and near the modern surface. Dates for the Cog Mound rely on two samples of charcoal that were apparently placed in the stone rubble fill shortly after the beginning of construction. The uncorrected C-14 dates overlap from A.D. 1570 to 1610; the tree-ring corrected dates overlap from A.D. 1450 to 1520. It seems reasonable to attach a construction date of approximately A.D. 1500 to the Cog Mound and surrounding structures realizing that some may be earlier. Ethnohistorical sources (Stair 1897:57) indicate that the inland area to the east of Mt. Olo had one remaining settlement as late as 1829. The dates of the Cog Mound, which are generally supported by ethnohistorical records, agree with the impressions of earlier excavators that star mounds are relatively late in the history of Samoa (Davidson 1974f:243).

Little can be added to the meager amount known concerning the function of the apparently specialized mounds. The only other star mound that has been excavated (Peters 1969) showed no evidence of any structure having existed on its surface and offered no evidence as to its function. Tradition offers an explanation, although it needs to be viewed with extreme caution. Informants stated that star mounds were used for the royal sport of pigeon catching in order to divine the future or settle disputes. A bait of berries is said to have been used to entice the pigeons to land within snaring distance of the persons concealed within the notches of the mound, the gods revealing their will through the success or failure of the individuals.

The two access routes to the top of the Cog Mound may be functionally important. The lower 1 meter of each appears to have been constructed purposely to restrict access by short-legged creatures, such as pigs. Another possibly relevant fact is that the thickness of soil spread on top of the mound is considerably more than is necessary to make a smooth, flat, nonrocky surface. The possibility that the surface was used for agricultural purposes seems far-fetched, but should not be discounted.

The neighboring house platform fits well within the range of previously recorded sizes and shapes, although two characteristic elements are missing: the gravel pavement living surface and the curb stones. The living surface was apparently soil and a rough interpolation from the extant soil area gives a possible oval floor shape of approximately 5 by 8 meters resulting in a total floor area of c. 31 square meters. This compares nicely to the 32 square meter average that Davidson (1974f:234) reports for prehistoric house sites in eastern Upolu.

From the limited data, it appears that the Cog Site house was constructed with large support posts around the roof's perimeter. It is common for houses also to have large central supporting posts. This may indicate that the V-shaped intrusion exposed near the center is in fact a large post hole. It is also common for one or two firebasins to occur near the central supporting posts. They are not believed to have been used for cooking but solely as sources of light. Cooking fires were located outside the house in their own small shelters. It is probable that the isolated firepit near the Cog Mound is a cooking oven, although any association with the house mound cannot be demonstrated. Evidence that the pit is a cooking oven is derived from the fire-reddened stone fill that is characteristic of Samoan ovens.

Since the artifact recovery was so limited, specimens do not give much information about the site. The only significant implication results from the association of the stone scraps, many of which are worked, and the house mound. Since no other house mounds in the area have been excavated, it isn't known what is typical in the way of worked stone quantities, but in comparison with the smaller quantities reported for sites excavated in other areas of Upolu, the amounts here seem significant. More than 90% of the 35 pieces of stone came from the upper stratum of the house mound. The deep striations on many of them imply that they were used to work other stone, which suggests that a stone-working specialist resided or at least worked upon the platform.

SECTION 4

GREEN TI (SUMu-48) AND JANET'S OVEN (SUMu-188)

JOEL C. JANETSKI

GREEN TI (SUMu-48)

SETTING

Green Ti (SUMu-48) is located on the southeast flank of Mt. Olo within the Mt. Olo Tract, which is in turn located c. 3.5 km due east of Fatuosofia Cape at the extreme west end of the island of Upolu, Western Samoa. The exact coordinates of SUMu-48 on the Universal Transverse Grid System are 2LLK89056781.

SUMu-48 was a structure type identified by Davidson (1974f:236-237) and by Green (personal communication, 1974) as an *umu ti*, or a large earth oven for baking the roots of the *ti* plant (*Cordyline fruticosa* L.). Buck's description (1930:136) of the *umu ti* supports Green's and Davidson's identifications of this type of structure.

On the surface, SUMu-48 consisted of a circular, raised-rim, earthen structure lined with basalt boulders (see Fig. 10). Outside dimensions for the structure were 7.5 meters in diameter along the east-west axis, 7.3 meters along the north-south axis, and about 45 cm above the surrounding ground level. The slightly ovoid central depression measured 3.1 meters north to south, 2.8 meters east to west, and, at its deepest point, the center was about 45 cm below the rim of the oven. The north side was a bit higher than the south.

EXCAVATION

Excavation of the oven was designed to accomplish two primary objectives: (1) to reveal structural features; and (2) to obtain charcoal samples for dating purposes. Secondarily, it was desirable to determine the temporal relationship between SUMu-48 and SUMu-49, a raised rock structure referred to as a living platform which lay immediately to the north of and tangential to SUMu-48.

After clearing SUMu-48 of all vegetation, excavation was begun 1.5 meters within SUMu-49, and a trench 1.5 meters wide was extended south into SUMu-48. A similar trench was initiated 1.5 meters to the west of SUMu-48 and extended east into the oven until within 35 cm of intersecting the north-south trench. Both trenches were deepened until basaltic bedrock was reached at about 50 cm below the current surface. No dirt was sifted for artifacts.

STRATIGRAPHY

Stratigraphy revealed by these trenches was not sharply marked, although three strata were eventually identified. Stratum I was a slick, yellow-brown, rather claylike sterile soil found immediately above bedrock or intermingling with crumbly, decaying basalt. Overlying Stratum I was Stratum II, a slightly darker, red-brown soil varying in texture from friable to rather claylike. This textural irregularity plus the occurrence of scattered charcoal specks and the charcoal lenses within the stratum led the excavator to believe that it was spoil dirt generated by the original builders of the oven and/or utilized in some way during the baking process. Stratum III was a more crumbly, darker, gray-brown forest soil overlying all.

DISCUSSION

The first problem involved the temporal relationship between SUMu-48 and SUMu-49. Although stratigraphy was certainly not clear cut, SUMu-49 appeared to overlie the northernmost edge of the oven rim which would imply an earlier date for SUMu-48.

At the intersection of the north-south trench with the fill of the earthen rim, several boulders in a possible linear arrangement were encountered that were suspected of being a constructional element of the oven. However, when no such boulders in the east-west trench were encountered, this theory was eventually discounted.

Completion of the north-south trench, to the extent shown in Figure 9, revealed a concentration of lava boulders 2.8 meters in length and about 45 cm deep. This concentration corresponded to the outline of the central depression of the oven. Underlying the rocks were several dense pockets of charcoal and accompanying layers of reddened, pebbly soil. This red, rock-soil layer, measuring 5 to 8 cm in thickness, was most evident along the upward edges of the rock concentration and generally occurred above the charcoal deposits. The pebbly quality of this reddened soil was judged to be a result of the fractioning of the basaltic stone from the intense heat of the oven. The charcoal pockets ranged from 5 cm to 12 cm in thickness including an intact piece 18 cm long by 7 cm in diameter. Underlying all, and immediately above the lava bedrock, was a thin (2 to 5 cm) layer of a dark, red-brown soil.

This concentration of lava boulders and accompanying fire-reddened soil and charcoal apparently denotes the main oven whose edges were shown by the red, grainy soil and whose bottom lay on the basaltic bedrock. The intense heat reached in the oven during use was attested by the occurrence of a few partially melted stones resembling scoria, or "slag."

Within Stratum II in the fill of the earthen rim in both the north-south and east-west trenches, charcoal lenses were found. The lens in the north profile of the east-west trench stretched for 1.4 meters and seemed to follow the same general shape as the earthen rim. Its depth from the surface of the oven rim varied from 5 cm to 20 cm and measured from a trace to 9 cm thick. It contained, in addition to the charcoal, one of the slag stones mentioned earlier. The lens revealed in the west profile of the north-south trench extended horizontally 55 cm and occurred 40 cm from the rim surface, which seemed to give it a deeper

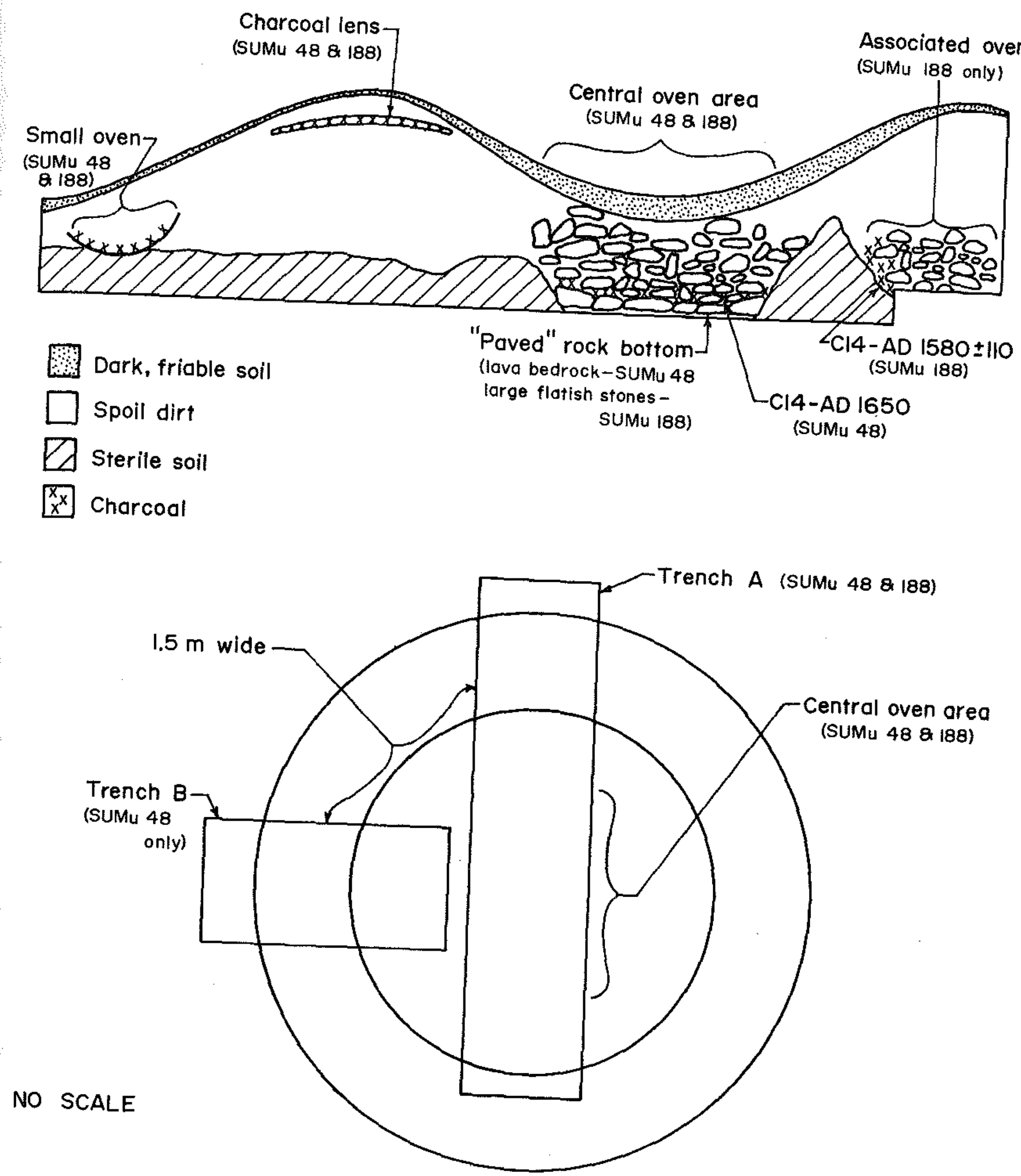


Fig. 9. PLAN VIEW OF EXCAVATION PROCEDURES AT SUMu-48 AND SUMu-188. The structural features of SUMu-48 and SUMu-188 were so nearly identical that a single idealized cross section has been prepared. The shared details as well as the features unique to one or the other site are appropriately labeled. Radiocarbon dates and the point of origin of the dated charcoal samples are also indicated.

placement than the lens within the east-west trench. These lenses could have resulted from cleaning the main oven prior to reuse, as described by Buck (1930:136).

Another feature encountered in the east-west trench was a rock-filled pit lined with a charcoal and reddened-earth layer. Each layer measured 1 to 2 cm in thickness. Overall width of the pit was 1.17 meters and the depth was 25 cm. Point of origin on the south profile from this pit was c. 28 cm deep at the west end and 50 cm at the east end. This structure was interpreted as a small pit oven associated with the main oven, and it certainly predated the most recent use(s) of the large oven.

ARTIFACTS

The only portable artifact found at SUMu-48 was an adz 83 mm long by 38 mm wide and corresponding to Type I of Green and Davidson's Samoan adz typology. This was found at the south end of the north-south trench outside the oven, but with uncertain provenance other than within the fill of Stratum II.

JANET'S OVEN (SUMu-188)

SETTING

Janet's Oven (SUMu-188) is located about 1 km south of the Mt. Olo Tract, which is in turn approximately 3 km east of Fatusofia Cape at the western tip of Upolu. The exact coordinates of SUMu-188 on the Universal Transverse Grid System are 2LLK87986713.

Like Green Ti, Janet's Oven was also presumed from its surface features to be an *umu ti*. These features of the structure are described as circular, earthen crater or raised-rim, with a central depression. Outside diameter dimensions were 10.9 meters on the north-south axis and 9.6 meters on the east-west axis. The central depression measured about 5.5 meters in diameter and 70 cm deep from the top of the earthen rim (Fig. 10). The total height of the structure from ground level was about 1 meter.

EXCAVATION

The reasons for excavating SUMu-188 were to obtain charcoal samples for dating, as well as to reveal construction features of the oven. The structure was first cleared of all vegetation on the eastern half then was bisected north to south with an exploratory trench. Clearing the oven revealed a homogeneous earthen surface with the only variation occurring along the north flank where an area of ash and charcoal specks was encountered. Only three stones were found on the surface within the central depression. After this clearing, the north-south trench was laid out and initiated 1.5 meters outside the south edge of the structure. The trench was deepened until a sterile layer of rotting basaltic rock was reached. It was then extended in 1.5 meters increments to the north through the structure and into the opposite earthen rim. No dirt was sifted for artifacts.

STRATIGRAPHY

Although the stratigraphy was rather difficult to read, three strata were identified that were quite similar to those found at SUMu-48. Stratum I was a slick, almost yellow-brown, claylike sterile soil in which occurred the decomposing basaltic rock. Stratum II overlaid Stratum I and was a rather crumbly, reddish-brown soil layer which made up the bulk of the fill of the oven rims. Within it were found charcoal specks, the charcoal lens, and the point of origin for another smaller, associated earth oven. Because of these facts, Stratum II is thought to be spoil dirt from the original excavation of the central oven and/or dirt utilized in the baking process. Overlying Stratum II was Stratum III, a coarser, crumblier, dark-brown soil which became almost black within the central depression and along the southern edge of the structure. It varied in thickness from 12 cm along the southern edge to 2 cm along the flanks of the earthen rim.

DISCUSSION

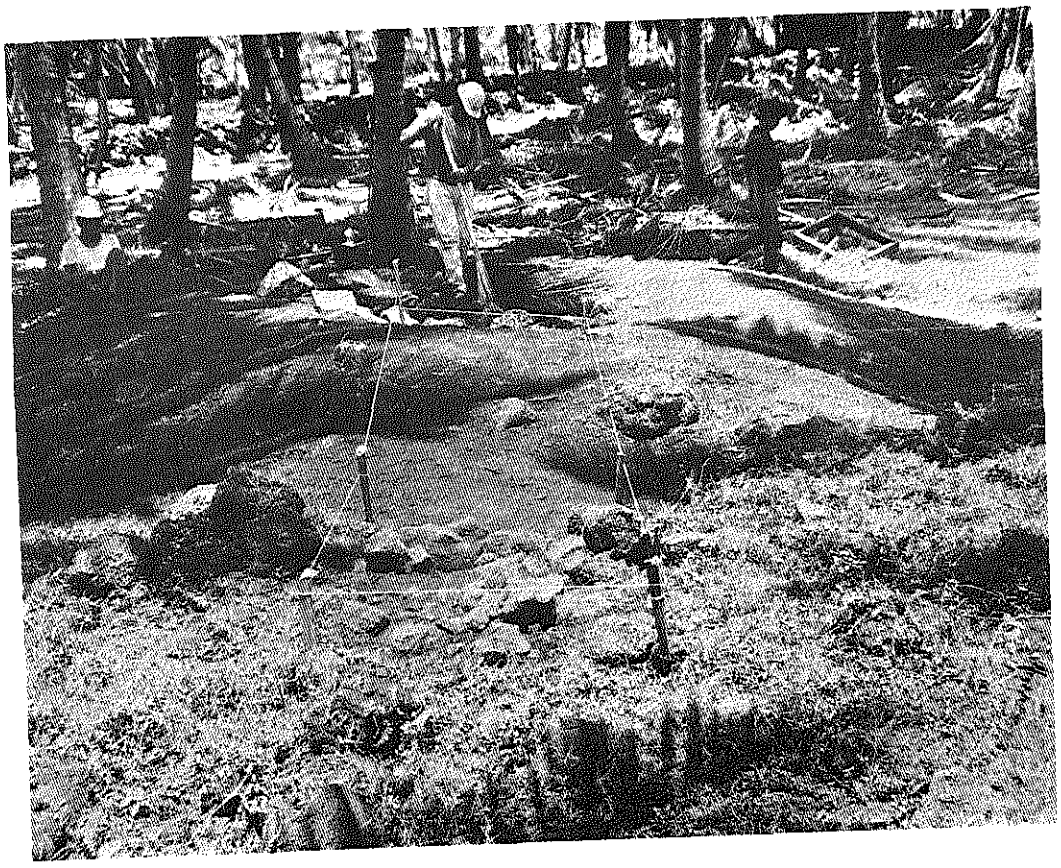
A heavy concentration of angular boulders was encountered under the center pit area. This concentration measured about 90 cm in depth and 2.9 meters across. Toward the bottom of the concentration dense pockets of charcoal were uncovered. Around the edges of the rock core was a reddened layer of pebbly soil extending diagonally downward into the oven pit. The pebbly quality of this reddened earth was most likely a product of the fractioning of the soft basaltic stone caused by the intense heat of the fire.

At the bottom of the rock concentration was an identifiable layer of larger, flatter rocks including one fine-grained stone whose surface had apparently been used for grinding. Below this rock bottom was sterile soil. It is hypothesized that, in the absence of bedrock, the builders of the oven had paved the oven bottom to maximize the heating potential of the oven; that is, a rock bottom would probably hold heat longer than would a soil bottom.

Upon extending the trench to the north beyond the central depression and into the earthen rim, another rock concentration, another reddened layer of earth, and additional charcoal were discovered. The charcoal was less abundant than in the central oven. This apparently was another oven of some size, but there was not time to excavate it fully. Regarding the temporal relationship between the central oven and the partially observed pit, the pit is considered to be earlier. The earlier assignment is based on the 60 cm of fill above its point of origin, and the fact that the observable surface features were oriented to the main oven.

Another associated feature was discovered about 1.2 meters from the south end of the trench. This was a 1 meter wide, 25 cm deep basin lined with a thin (1 to 3 cm) layer of reddened earth and some charcoal. The point of origin for this basin within Stratum II was 30 cm from the surface of the south flank of the oven rim. It appears to predate the latest use(s) of the central oven since it is overlain with Stratum II soil.

The fill of the earthen rim contained one observed charcoal lens. It extended more or less horizontally for 1.04 meters along the west profile of the trench and 1.5 meters along the east profile. This lens occurred within Stratum II and varied from 4 to 30 cm from the surface of the rim and from specks to 5 cm in thickness. In the opinion of the excavator, this lens resulted from the cleaning of the central oven.



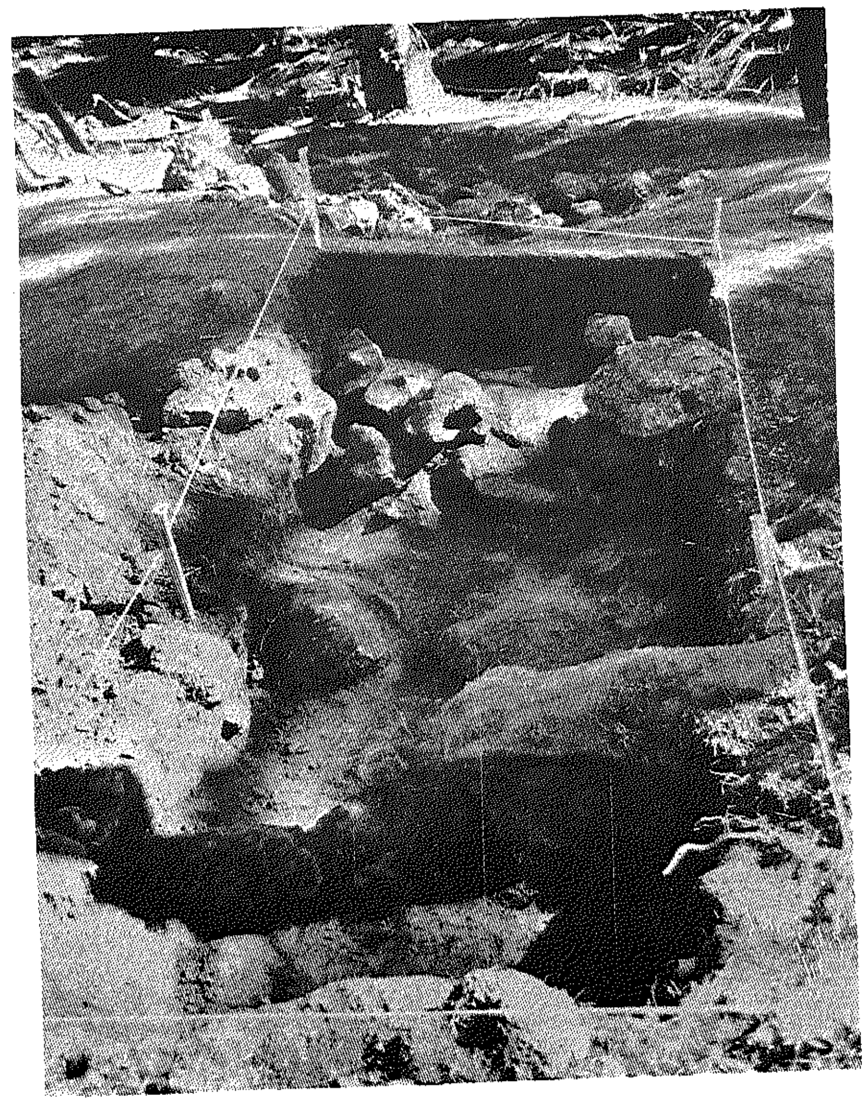


Fig. 10. RAISED-RIM OVENS.
Above: Green Ti before and after clearing.
Below: Janet's Oven cross section and central pit.

One completely unexplained phenomenon at this site was an intrusive pit that was observed on the east profile of the trench about 3.5 meters from the south end of the trench. It measured 1 meter across at its point of origin on the upper edge of Stratum II and 50 cm deep into Stratum III. Its point of origin was 90 cm from the surface of the oven rim.

With the exception of the abraded stone, no artifacts were found at SUMu-188.

SECTION 5

MT. OLO SETTLEMENT PATTERN INTERPRETATION

RICHARD N. HOLMER

INTRODUCTION

As the result of the previous Western Samoan settlement archaeology (Davidson 1974f) and the ethnohistorical settlement data (Davidson 1969e), it is apparent that a logical starting point for the interpretation of the Mt. Olo communities is an analysis of mound shape and size. This course of action is suggested by the repeated implications in the sources that mound morphology is somehow related to function. If culturally significant mound types are determinable by shape and size comparisons, then an understanding of the spatial distribution of the types with relation to other architectural remains should provide certain variables that are of primary interest to settlement archaeology. For example, focal points of political and religious activities as well as centers of local or supra-local authority might be determinable if chief's residences, religious shrines, community houses, and community meeting grounds can be distinguished in the field. There is good evidence to suggest that these structures are definable; however, further excavation of specific mounds will be necessary before the apparent correspondences can be adequately demonstrated to be correct. The objectives of the following report, therefore, are to outline the evidence for the existence of culturally significant mound types as determined by size and shape, and demonstrate that the distribution of mound types and other architectural phenomena is consistent with ethnohistorical descriptions, thus providing the foundation for the formation of Green's protohistoric base line (see Section 2, this report).

ARCHAEOLOGICAL REMAINS

MOUNDS

Consolidating Davidson's (1969e) conclusions from the ethnohistorical literature, five functional categories of mounds and their relative size differences are suggested:

1. Community house (*fale tele*) foundations. No dimensions are given except for a height of 30 cm, but they should be recognizable by the large top surface area. The house supported by the platform is described as being the largest within a community, measuring about 11 by 15 meters.

2. Chief's house foundations. There is conflicting evidence, but it appears that generally chief's houses are the same size as other dwellings within a community although the

supporting platforms may be relatively massive (about 1 meter high and 20 meters square), the size reflecting the rank of the chief.

3. God house (*fale aitu*) foundations. Sizes range from very small (to support a structure the size of a dog house) to large (about 1 meter high and 20 meters square), depending on the influence of the associated god.

4. Normal residential house foundations. Sizes range from 10 to 15 meters in breadth to 20 to 60 cm high.

5. Star mounds. Descriptions are very limited, although one height of 3 meters is recorded. It appears that these mounds did not support house structures.

In the description and interpretation of previous archaeological survey data in Western Samoa, there has been a reliance on the grouping of mounds into size categories (Buist 1969:39; Scott 1969:71; Davidson 1974d:197). The category definitions, however, utilize arbitrary dimensions with no functional connotations. The Mt. Olo data indicate that size categories are statistically definable and that they generally correspond to the above categories derived from the ethnohistorical data.

In order to group the mounds into size categories, scattergrams were constructed for all measured variables. No apparent group segregation was evident until locational data was included. The survey area was divided into zones based on mound clusters. Scattergrams were again constructed and a pattern emerged utilizing the relationship between height and basal area. Diagrams demonstrating similar size distributions were combined with regard to location and three areas established themselves. The resultant scattergrams (Fig. 11) indicated that volume is the key factor in the segregation of size categories. The points generally fall along lines representing an exponential relationship between the two variables, which, if the platform sides were vertical, would represent the mean volume. Since the sides are usually not vertical but slope inward, the volumes recorded on Table 2 are adjusted accordingly. Calculating the mean and standard deviation for the types with respect to location and then making a comparison between areas demonstrates that Area A and Area C are probably two samples from the same population (a Fisher's t test utilizing the respective size categories for Area A and C produced a 0.90 chance that they are samples of the same population). Combining Areas A and C and comparing the respective size categories with Area B using a Fisher's t test demonstrates a probability of less than 0.01 chance that any size pair represent a single population.

Three categories of platforms are therefore readily definable from the histograms (Fig. 11), but are significant only in their respective areas. The mean volumes and standard deviations (in cubic meters) are as follows. The types are divided into two general classes, small and large, with large having two subclasses:

Platform Type	Area A	Area B	Area C	Area A and C
small (I)	107±80	54±34	102±63	104±77
large (II)	473±80	296± 6	414±56	426±46
large (III)	611±28	402	598±21	604±22

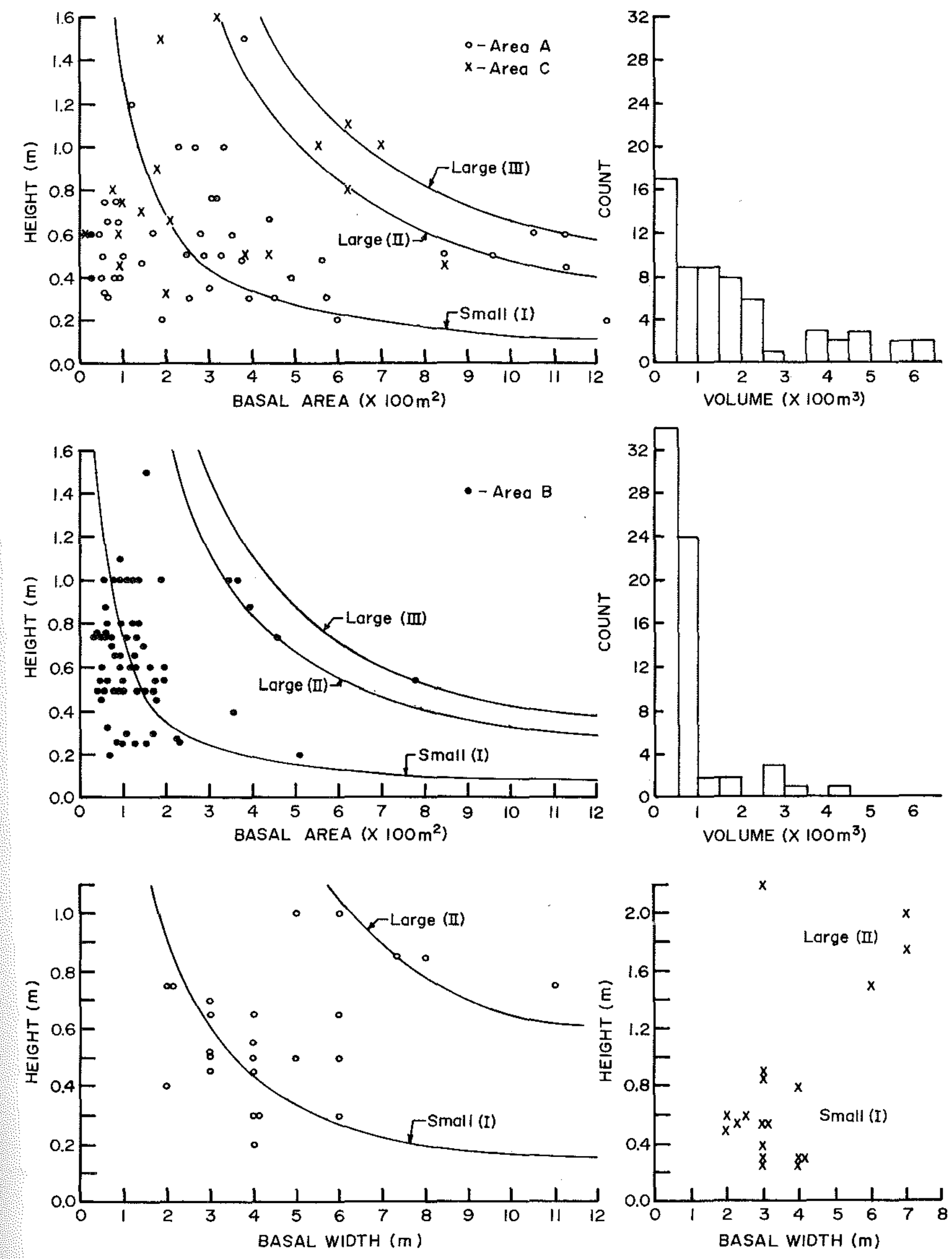


Fig. 11. SCATTERGRAMS AND FREQUENCY DISTRIBUTIONS OF THE MT. OLO STRUCTURAL REMAINS. Top, Platforms in Areas A and C. Middle, Platforms in Area B. Bottom (left), Fences; (right), Raised Walkways.

Table 2. LIST OF MT. OLO STRUCTURAL REMAINS

A. MOUNDS

Site Number SUMu-	Type	Measurements (m)			Area (m^2)		Volume (m^3)	Location (Area)	Comments
		Height	Width	Length	Basal	Top Surface			
PLATFORMS									
3	I	.30	19	30	570	522	164	A	Highly disturbed
4	I	.20	11	18	198	179	38	A	Disturbed
5	I	.65	8	10	80	45	40	A	Well-defined
6	I	.45	11	17	147	115	59	A	
9	II	.50	29	33	957	845	452	A	
12	I	.40	7.5	12	71	51	24	A	
13	I	.35	20	30	300	271	100	A	Kava pounding bowl present
14	I	1.00	17	20	267	177	220	A	Disturbed
16	I	.60	14	20	280	216	148	A	
17	I	.45	18	21	378	322	157	A	
19	I	.35	7.5	9	53	38	16	A	Well-defined
23	I	.60	13	13	169	121	87	A	
24	I	.20	20	30	600	565	116	A	
25	I	.45	22	28	560	543	248	A	
26	I	.30	15	17	255	224	72	A	
27	I	.65	9	9	64	36	32	A	
28	I	.60	7.5	7.5	44	23	20	A	Well-defined
30	I	.75	8	14	88	49	51	A	
31	II	1.50	13	37	378	198	424	A	Disturbed, possible tier?
33	I	.75	11	35	302	215	192	A	Central raised portion, tier?
34	I	.60	17	21	357	285	192	A	
35	III	.60	30	35	1050	924	591	A	
36	I	.40	25	25	490	439	185	A	
37	I	.50	8	9	57	36	23	A	
38	I	.75	16	19	304	253	208	A	Constructed of soil
41	I	.30	9	9	64	50	17	A	Constructed of soil
42	I	1.00	14	21	231	147	187	A	Constructed of soil and rock
43	III	.60	32	35	1120	990	631	A	35 cm central tier
44	I	.40	5.5	6.5	28	17	9	A	
45	I	.60	5	5.5	22	8	9	A	Constructed of soil and rock
46	I	1.20	10	15	118	51	99	A	
47	I	.75	10	19	51	96	54	A	
49	I	.20	35	35	1225	1175	240	A	
51	I	1.00	16	21	336	222	277	A	
53	I	.30	17	23	391	352	111	A	Disturbed
54	I	.30	17	17	289	256	82	A	
55	I	.40	10	11	86	65	30	A	
56	I	.50	16	19	249	194	110	A	
57	I	.40	9	9	41	29	14	A	
58	I	.50	10	10	100	69	42	A	
59	I	.65	17	26	442	276	231	A	20 cm central tier
60	I	.30	18	25	450	408	128	A	
62	II	.45	25	45	1125	1022	482	A	
63	I	.50	16	20	320	262	145	A	
65	I	.60	16	10	126	87	63	B	
66	I	.55	9	9	64	40	28	B	
67	I	.80	9	17	120	70	75	B	Well-defined
68	I	.85	8	10	63	29	38	B	
69	I	.30	11	17	147	125	41	B	
70	I	.25	12	19	228	201	54	B	
72	I	.35	7	10	50	26	13	B	Well-defined
73	I	.25	10	12	94	80	22	B	
74	I	.75	7	7	38	16	20	B	
75	I	.30	10	13	102	84	28	B	
76	I	.25	10	12	94	80	22	B	
77	I	.25	12	13	122	106	28	B	
78	I	.20	9	9.5	67	58	12	B	Central depression
79	I	.20	25	26	510	484	99	B	
82	I	1.00	7.5	10	59	21	38	B	
83	I	1.00	8	12	75	31	51	B	
86	I	.25	13	15	153	135	36	B	
87	I	.25	14	16	224	200	53	B	
88	I	.75	6.5	7	36	14	18	B	
89	I	.75	7	10	70	34	38	B	
90	II	.85	18	22	396	290	290	B	Well-defined, central depression?
91	II	.75	19	24	456	355	303	B	25 cm central tier
92	I	.50	9	9.5	67	45	28	B	
93	I	.35	11	15	82	68	26	B	Disturbed
94	I	.40	16	20	360	272	126	B	
98	II	.50	28	30	840	744	395	A	
100	I	.75	8	13	52	28	30	B	
101	I	.75	9	12	108	62	63	B	
102	I	.65	15	17	128	95	72	B	

Table 2. (cont'd.)

Site Number SUMu-	Type	Measurements (m)			Area (m^2)		Volume (m^3)	Location (Area)	Comments
		Height	Width	Length	Basal	Top Surface			
PLATFORMS (cont'd.)									
103	I	.60	7	9	49	27	22	B	
104	I	.65	9	13	92	58	48	B	Well-defined
105	I	.80	13	13	133	83	86	B	
106	I	1.00	10	14	110	55	80	B	
107	I	.50	9	12	54	38	23	B	
108	I	.50	8	11	88	59	36	B	
109	I	.75	8	9	57	27	31	B	
110	I	.35	8.5	9.5	63	48	19	B	
111	I	.80	8	8	64	28	36	B	
113	II	1.00	20	22	345	242	292	B	
114	I	.30	12	14	168	132	45	B	
115	I	.45	15	18	188	174	81	B	Disturbed
117	II	1.00	18	20	360	242	299	B	
118	I	.55	10	10	100	66	45	B	
120	I	.65	8	9	72	39	36	B	
121	I	.75	8	12	75	40	42	B	
122	I	.55	9	12	54	36	25	B	
123	I	.55	9	19	171	127	82	B	Very disturbed
124	I	.60	12	17	160	117	83	B	
125	I	1.00	11	15	82	44	62	B	
126	I	.80	11	11	95	54	59	B	
127	I	.75	6	12	72	33	38	B	
130	III	.55	27	29	783	680	402	B	
132	I	1.10	9	13	92	38	69	B	
133	I	1.00	13	17	221	140	179	B	
134	I	1.00	11	12	132	65	96	B	Well-defined
135	I	1.00	10	11	110	50	78	B	
136	I	.75	11	12	132	80	79	B	Well-defined
137	I	.30	11	15	165	140	46	B	
139	I	.30	16	16	200	166	60	?	
142	I	.30	8	8	40	24	10	B	
143	I	.60	13	15	195	143	101	B	
145	I	.55	13	15	195	145	93	B	
146	I	1.50	13	15	153	61	155	B	Disturbed
148	I	.60	11	14	121	84	61	B	
150	I	.60	11	11	95	63	47	B	Fire-reddened area
151	I	.50	10	10	100	69	42	B	
153	I	.50	10	17	133	100	58	B	
154	I	.70	13	13	137	89	78	C	
155	I	.90	9	19	171	96	118	C	
158	I	.45	6.5	15	98	68	37	C	
159	II	.80	24	26	624	496	447	C	
162	I	.50	19	23	437	368	200	C	
163	III	1.00	25	28	700	531	613	C	
164	I	.65	14	15	210	151	117	C	
166	I	.70	13	14	143	97	83	B	
167	II	.75	10	12	94	55	55	C	Central depression
169	II	1.60	20	20	314	166	374	C	
175	III	1.10	20	31	620	445	583	C	
177	II	.45	29	29	841	756	359	C	Oval curb outline
180	I	.50	20	24	377	321	174	C	Disturbed
181	II	1.00	23	24	552	404	476	C	
182	I	.60	3	3	9	1	3	C	
183	I	.60	7	13	91	55	43	C	
184	I	1.50	14	17	188	83	198	C	Sloping ramp
185	I	?	7	8	44	?	?	C	Possible outcrop
186	I	.80	7	10	70	31	39	C	
187	I	.35	15	17	200	171	65	C	
192	I	.50	14	17	238	165	100	C	
STAR MOUNDS									
95	I	.75	16	16.5	68	65	51	B	Central depression
157	II	2.30	15	20	373	196	607	C	
165	II	2.70	20	20	253	191	597	C	

B. RAISED RIMMED OVENS

Site Number SUMu-	Height	Width	Length	Location (Area)
40	.30	3.00	4.5	A
48	.70	7.50	7.5	A
128	.56	8.70	8.7	B
188	.80	10.50	10.5	C
193	.70	8.00	8.0	C
194	.50	5.00	5.0	C

Table 2. (cont'd.)

C. WALKWAYS AND FENCES

Site Number SUMu-	Type: Raised Walkway	Type: Walled Walkway	Fence	Measurements (m): Height	Measurements (m): Width	Measurements (m): Length	Cross Sectional Area (m^2)	Recon-structed Height (m)	Path Width (m) (reconstructed or measured)	Location (Area)
7		I		.45	5.5	25	0.8	0.9	2.0	A
8		I		.45	5.5	60	0.8	0.9	2.0	A
10	I			.20	4	70	0.8		3.6	A
11			I	.55	3	22	1.1	1.1		A
15	?			.45	3	45	1.1		2.1	A
18	II			1.00	6	150	5.0		3.0	A
20			I	.25	3	45	0.5	0.8		A
21		I		.60	4	100	0.7	0.9	1.4	A
29			I	.85	3	180	1.7	1.4		A
32	II			.85	8	100	6.1		6.3	A
39	I			.50	6	370	2.8		5.0	A
50	I			.30	6	80	1.7		5.4	A
52			I	.50	2	50	0.7	0.9		A
61			I	.30	3	100	0.6	0.8		A
64	I			.65	4	60	2.2		2.7	A
		I		.65	4	50	0.8	0.9	1.3	A
71			I	.25	4	17	0.7	0.9		B
80			?	.30	4	38	0.8	1.0		B
81			?	.30	4	40	0.8	1.0		B
84	?			.25	4	40	0.9		3.5	B
85	I			.30	4	75	1.1		3.4	B
96	sunken way			.50	3	65			2.0	A
97	I			.70	3	80	2.4		1.6	A
99	I			.50	3	30	1.3		2.0	A
112	I			.50	4	13	1.8		3.0	B
116	?			.65	6	130	3.5		4.7	B
119	I			.50	3	50	1.3		2.0	B
129			I	.55	2.2	68	0.8	1.0		B
131		I		.60	5	580	0.9	1.0	1.8	B
138	I			.65	3	95	1.5		1.7	B
140	?			.45	4	65	1.6		3.1	B
141	?			1.00	5	8	4.0		3.0	B
144			I	.55	3	120	1.1	1.1		B
147			?	.60	2.5	30	1.0	1.1		B
149	I			.55	4	100	1.5		2.9	B
152	I			.40	2	45	0.6		1.2	B
156			I	.40	3	120	0.8	1.0		B
160	II			.85	7	50	5.3		5.3	C
		II		.85	7	450	1.8	1.4	2.3	C
161	II			.75	11	360	7.7		9.5	C
168	I			.75	2	80	0.9		0.8	B
170			I	.80	4	55	2.2	1.6		B
171			I	.90	3	300	1.8	1.4		B
172			II	1.75	7	65	8.2	3.1		B
173			II	1.50	6	70	6.0	2.6		C
174			I	.60	2	178	0.8	1.0		C
176			II	2.20	3	520	4.4	2.2		C
178			II	2.00	7	265	9.3	3.3		C
179	I			.50	5	100	2.3		4.0	C
		I		.50	5	190	0.8	0.9	1.8	C
189	I			.75	2	200	0.9		0.8	C

The comparison of the platform sizes with the categories derived from the ethnohistorical data is relatively straightforward. The small (I) correspond to the average residence platform and an occasional small god house or cook house foundation. The large (II and III) correspond to the platforms of the larger god houses, chief's houses, and community houses.

SMALL (I) PLATFORMS

The evidence for the correspondence between average residence houses and small (I) platforms results primarily from the size range. The ethnohistorical house platform descriptions demonstrate a range in volume from 15 to 135 cubic meters. The Mt. Olo examples average within this range, but have a variation that extends both above and below it. The platforms on the small end of the scale are probably not house platforms because the top surface area could not support even a small house.

Previously excavated houses demonstrate a range in floor area of 14 square meters (Davidson 1969b:200) to 68 square meters (McKinlay 1974:30). A small house curbing outline enclosing 10 square meters, which is similar in size to the only curb outline found at Mt. Olo, is interpreted as a bush refuge (Green 1974a:104) because of its small size and its location. In order for a platform to support a 14 square meter or larger oval house, the platform's top surface area would have to be a minimum of 18 square meters. However, houses do not utilize the maximum amount of top surface area. From the limited data available, it is suggested that only 5% to 25% of the platform's total basalar area is actually roofed (the data are not sufficient to make any correlations with top surface area). The excavated house mound at the Cog Site demonstrated a probable 17% of the basal area or 23% of the top surface area being roofed. It is suggested, therefore, that platforms that have a basalar area of less than c. 40 square meters may not have been residences but specialized structures of some type (for example, god houses or cook houses). All but one lay close to large (II and III) platforms, the best example being the small platform associated with SUMu-130. It measures about 4 by 5 meters and has nicely formed vertical side walls (60 cm high), with an ascending ramp at one side.

Approximately 5% of the small (I) platforms are believed to be too small for residence houses. The other 95% are adequate to support normally sized houses. Variation in size, however, is still substantial, particularly when comparing the volumes of those in Area B to Areas A and C where the platforms average about twice as large. One significance of the size differences between areas is that the platforms of Areas A and C probably represent twice as many man-hours invested in their construction. This aspect will be discussed more completely in the concluding segment of this section.

Two features that are characteristic of house platforms throughout Samoa are missing in the Mt. Olo examples: the pea-sized gravel living surface paving (*'ili'ili*); and the curb stones that outline that living surface. Their absence may result simply from the fact that no pea-sized river gravel exists in the area. The inhabitants apparently used the next best thing, that is, the smaller local stones; since the supply was not restricted, the entire top surface of the platform was covered. Twenty-three percent of all the platforms recorded during the Mt. Olo survey had a distinct size difference between the top surface stones (diameter 13.98±5.52 cm) and the side wall stones (38.48±4.80). In those examples, curb stones separated the larger side stones from the smaller top surface stones. As suggested in Section 2, stone side differences were not detectable for the majority of platforms probably because the sides had collapsed causing a blending of the two stone sizes.

The fist-sized stones covering the entire platform surface appear to be functionally equivalent to the pea-sized gravel paving and the house outline curbs. The larger stones allow adequate ventilation and drainage under the layers of floor mats thus reducing the potential for rot; a house outline curbing is not needed to contain the gravel (since the whole top surface is homogeneous); and the curbing is not needed to restrict rainwater drainage into the house because the top surface stones provide adequate drainage into the stone fill of the platform.

LARGE PLATFORMS (II AND III)

Equating the large group of platforms (II and III) with chief's houses, god houses, and community houses is supported by ethnohistorical descriptions; however, associating a subgroup (II or III) with an individual house type is much more tenuous. The implied division that is derived from the ethnohistorical literature is the grouping of god houses and chief's houses with the large (II), and the community houses with the large (III). This division is suggested primarily because community houses are recorded as being the largest house structures in a settlement, having low platforms which should be denoted by their expansive top surface areas (Davidson 1969e:70). The Mt. Olo large (III) are not low when compared with the small (I); however, they do average slightly lower than the large (II).

Davidson (1974f:234) concludes that a definable floor area of 90 square meters or more is necessary before a superstructure outline can be suspected of being a community house. J. Williams in 1832 (see Davidson 1969e:63) describes community houses as being oval in shape and having from 90 to 130 square meters of floor space. If the 90 square meters minimum is 25% or less of the total basal area (as suggested earlier) then the supporting platform would need to be 270 square meters or larger. All of the large (II and III) exceed this minimum size. One low, but extensive, platform (SUMu-49) exists in Area A that possibly should be included as a community house candidate even though it is classed as a small (I) because of its low elevation. It may, however, be an example of a platform that supported more than one house, which can be ethnohistorically associated with a chief's residence (Davidson 1969e:65).

Chief's residences are usually described as being on massive platforms even though the houses themselves are apparently no larger than normal. Three ethnohistorical records (Turner 1884:153; Stair 1897:111-112; and Charles Wilkes, in Davidson 1969e:65) confirm that chiefs of sufficient rank had house platforms that measure 1 to 1.5 meters high and 15 to 20 meters square. The size range agrees with the large (II) of Area B, but is a little small when compared to those in Areas A and C.

Another trait that appears to be associated with chief's houses (see Wilkes in Davidson 1969e:65) is a centrally located step or tier which results in a portion of the floor being slightly raised. Six stepped platforms are recorded in the Mt. Olo Survey area. One (SUMu-31) is disturbed and the step appears to have resulted from stones being "robbed." The others have a clearly defined step (average height is 35 cm) that traverses the platform's width dividing it into roughly equal portions. An interesting aspect of the tier is that five of the six tiered platforms are large (II and III) or are directly adjacent to a large platform. The sample size, however, is probably too small to accept the apparent correspondences as a generalization.

God house platforms, as described in the ethnohistorical literature (Stair 1897:111-112; Buzacott Ms., 1836-37, in Davidson 1969e:67), appear to range from the smaller examples of the small (I) through the large (II). Personal gods belonging to chiefs whose authority covers only one settlement or a portion thereof were believed to live in either natural phenomena, in very small houses, or in houses indistinguishable from average dwellings. God houses may often have been surrounded by wooden fences and have been located near the meeting ground (Davidson 1969e:68-69). Davidson (1969c:231) concludes that the size of the god house and supporting platform probably reflects the relative reverence with which the god was viewed, the largest houses being constructed for the regional war gods.

STAR MOUNDS

Relying entirely on the limited data provided by the ethnohistorical literature (Platt Ms., 1835-36, in Davidson 1969e:67), it appears that star mounds may functionally be related to god house mounds in that both probably had religious connotations. The two excavated star mounds (Section 3, this report; Peters 1969) shed little light as to possible use except through the negative evidence that no living surface or superstructure was detectable. The functional evidence that is suggested from tradition and is supported by ethnohistorical data is that chiefs divined their military aspirations by netting wild pigeons on them, and that they were used to lay the bodies of the dead upon(Platt Ms., 1835-36, in Davidson 1969e:67). There appears also to have been a separate competitive sport of pigeon catching although without the religious significance (Davidson 1969e:67). Bush clearings, often prepared on the edge of a steep slope, were apparently used for these purposes (Davidson 1974f:230). Several clearings interpreted possibly as the latter type by Davidson (1974a) are recorded for the upper Falefa Valley, but she provides no supporting evidence as to their alleged function. One of the three Mt. Olo star mounds may be of this type because it is located at the edge of the Mt. Olo crater precipice. It corresponds in size to the Falefa sites although its arms are much more pronounced. The primary differences are that SUMu-95 lies within or on the edge of a community whereas the Falefa examples are on high and relatively inaccessible ridges quite separate from the communities, and that SUMu-95 has a central, rock-lined pit. The locational differences may result from the fact that there are no ridges around Mt. Olo that are isolated from community structures. Concerning the central pit, the only other star mound reported in Western Samoa with a similar pit is on Savai'i

(Scott 1969:72), the significance being a possible correspondence with the centrally pitted pigeon mounds of Tonga.

The two larger star mounds are typical of the larger star mounds reported in Western Samoa. They are located within the communities and are directly associated with elaborate walkway systems that make them accessible from surrounding settlements.

A size comparison (by volume) of the star mounds and the platforms demonstrates a correlation between the larger star mounds and the large (III) platforms, and the small star mounds with the small (I) platforms. The size differences reflect a considerable difference in man-hour investments during construction and, in turn, probably denote a difference in function or prestige.

WALKWAYS

There is little mention of walkways in the ethnohistorical literature, and what does exist usually reflects the condition or difficulty of passage rather than size or locational information (Davidson 1974f:240). Because of the lack of early references it is difficult to interpret possible differences in function between the two principal types of walkways (raised and walled). Davidson (1974f:240) suggests that the path type might be related to status, in that a distinction between people walking on the path and those occupying adjacent mounds needs to be emphasized. This generally holds true for the Mt. Olo data, although there are some minor exceptions. Comparing the large (II and III) platforms with their adjacent walkways demonstrates the tendency for the platform to be higher (either topographically or structurally) than the adjacent walkway. SUMu-31 is a good example demonstrating a high walkway (85 cm) and a higher platform (150 cm). Following the same walkway westward, it lowers; and as it passes SUMu-35 it becomes the only example of a trenched way. Once past the platform it becomes a raised way again. Transitions between types of walkways occur adjacent to other large platforms as well. Both SUMu-95 and 175 have raised ways approaching from the northwest, then directly adjacent they become surfaced level walled ways.

The few exceptions to the above tendency are undramatic in that the differences are very small (10 cm or less), and the walkways in question are short and may be directly related to the structure rather than being "public" thoroughfares. All walkways that are of substantial length prove to be lower than adjacent large (II and III) platforms.

The present condition of both types of walkways appears to be related to their respective constructions. The raised walkways are broad and low with sloping sides resulting in a very stable structure. The walled walkways, conversely, lack stability because of the high, narrow, and vertical nature of the parallel walls. Attempting to reconstruct the original path width and wall height demonstrates that two size categories probably exist. (Derivation of the reconstructed heights and widths is discussed in the following section on fences.) SUMu-160, the walled way that runs adjacent to one of the large star mounds (SUMu-157), is considerably wider with higher walls than the other walled ways. Its path width is 2.3 meters and wall height is 1.45 meters compared to the others with path widths of 1.61±0.33 meters and wall heights of 0.95±0.04 meter.

The raised walkways demonstrate a similar grouping into small and large categories. Scattergrams utilizing base and height show this segregation in much the same manner as did the platform scattergrams. The two variables (base and height) appear to be related exponentially, suggesting that cross-sectional area is the important factor. Accounting for the sloping sides (average c. 45°) that are characteristic of raised ways, the small (I) have a 1.54±0.68 square meters cross-sectional area and the large (II) have a 6.00±1.23 square meters cross-sectional area.

Two of the four large (II) raised ways are directly associated with the two large star mounds of Area C supporting the relationship suggested by the large (II) walled way.

Davidson (1974f:240) suggests that large walkways and wide walled walkways are probably associated with high-status settlements. The walkway data presented here seems to support that conclusion if it is accepted that the large star mounds were viewed with reverence and had a certain amount of status associated with them.

FENCES

Fences also fall into two categories according to cross-sectional area: small--1.02±0.49 square meters and large--6.97±2.19 square meters. The cross-sectional areas are estimated by applying the formula for the area of a parabola [Area = 2.3 (width)(height)]. The parallel walls of the walled walkways are calculated in a similar fashion. In order to get an idea of the original dimensions of the fences before their collapse, measurements were taken of several modern Samoan fences in order to determine the relationship between their heights and cross-sectional areas. While heights and widths vary, two relationships remain constant: the height is consistently equal to the basal width, and the top width is equal to 75% of the height. Utilizing the equation for a trapezoid and solving for the height (incorporating the above relationships between the height and the widths) results in the equation: height = $\sqrt{1.15\ (\text{area})}$. A check on the equation's predictive accuracy was performed on a collapsed portion of an otherwise intact 1 meter high modern fence and yielded a height of within 5% of the measured height.

Applying the formula to the collapsed fences gives reconstructed heights of 1.07±0.22 meters for the small (I) and 2.80±0.49 meters for the large (II). In the case of the walled walkways discussed in the previous section, the wall heights were estimated in the same manner. The path widths were estimated by assuming that the walls probably collapsed uniformly and that the center of the remains is the center of the original wall. Knowing the distance between centers and the width (which is equal to the height) yields the path width.

Fences in the Mt. Olo Tract form many interesting configurations. The most prevalent are the rectangular fenced enclosures that are found in Areas B and C. The enclosed areas range in size from 6 square meters to 832 square meters and occur both alone or connected to platforms. Such enclosures are reported from all parts of Western Samoa where rock is available as a construction material, although most are larger than the Mt. Olo examples. Functional interpretation is difficult because little evidence exists as to whether they were used for agricultural or animal husbandry purposes. In either case the question is whether the fence was used to keep pigs in, away from the plantation lands, or keep them out, away from the enclosed garden. S. C. S. Wright (1963:92) suggests that it was probably the latter and that the enclosed area supported a special crop of some kind.

Interpretation is also difficult for the cellular configuration of SUMu-171. The fact that it is directly connected to a fenced enclosure possibly suggests a functional relationship; however, nothing further can be stated at this time.

In the immediate vicinity (lying between SUMu-171 and 129) are several level, square plots (averaging 30 by 30 meters) that are separated by amorphous piles of stone. The possibility that these are agricultural plots seems likely, although personal observations indicate that there is little reason to clear agricultural ground; taro and coconut seem to grow well no matter how rocky the soil.

The fenced (II) enclosure of SUMu-176 is unique within the survey area. The southern portion is composed of a 2.2 meters high wall with several portions retaining their original vertical construction. The walls on the northern one-half of the enclosure are lower with heights more characteristic of fences (I). Along the southern wall is a roomlike enclosure (3.2 meters by 4.0 meters by 1 meter high) that appears to have been added after the construction of the main wall. The southwestern corner of SUMu-176 forms another roomlike rectangle with one side opening into the large central area. The ground throughout the enclosed area is relatively free of stone and the three internal small platforms are well preserved.

An enclosure such as this with high walls suggests a possible defensive function although in this case it does not seem applicable because of the lower height of portions of the walls and the poor strategic position.

OVENS

The interpretation of the circular raised-rim, craterlike structures as earth ovens is supported by several excavations. All excavated examples (Davidson 1974f:237; Section 4, this report) demonstrate the same pattern of a lining of large stones and a thick deposit of charcoal which implies a high initial temperature and long heat retention. All previously recorded Samoan examples have been interpreted as specialized ovens (*umu ti*) for cooking the root of many varieties of the *Cordyline* (*ti*) plant (Davidson 1974f:237). Support for this interpretation is derived from ethnohistorical, traditional, and archaeological sources. Krämer (1903:155) describes the *umu ti* but states that they were always constructed in the bush, away from the settlement. Tradition confirms this (Davidson 1974f:236), although archaeological survey data do not. All recorded raised-rim ovens occur in relation to other archaeological remains. Davidson (1974f:237) suggests that the relationship may be fortuitous in that the favored varieties of *Cordyline* may have been found in old clearings (that is, abandoned fields or settlements). Another suggestion is that certain varieties were cultivated and then baked in ovens within the settlement. If the latter suggestion is true then it might offer an explanation for the function of the small fenced enclosures as being garden areas for *Cordyline*.

The interpretation of raised-rim ovens as specialized ovens used only for baking the *Cordyline* root seems somewhat tenuous even though Davidson (1974b:107) reports an excavated oven at Folasa yielding what appeared to be *Cordyline* root. The six Mt. Olo raised-rim ovens form an interesting pattern. All lie within 10 meters of platforms and all are located relatively close to large (II and III) platforms. If the ovens and platforms are contemporary (the excavation of SUMu-48 yielded no conclusive evidence concerning construction sequence), then it might be suggested that the ovens could have been used for the baking of a variety of foodstuffs. Ethnographically (Mead 1968:251), descriptions of the use of a ranked household oven state that the oven is "made" about twice a week. The chief (*matai*) does most of the important work, such as butchering and stuffing the pig. Numerous items are cooked at one time: pig, fish, coconut pudding, breadfruit, taro, and bananas. An oversupply of food is prepared so that gifts can be sent to relatives or visitors. An oven would have to be quite large to contain the items, probably of the size range of the raised-rim ovens. The correlation of large ovens to ranked households might correspond to the juxtaposition of ovens and large platforms in the Mt. Olo Tract.

THE DISTRIBUTION OF ARCHAEOLOGICAL REMAINS

Community descriptions derived from the ethnohistorical literature provide additional information to aid in the interpretation of the Mt. Olo data. Davidson (1969e) observed that the distribution of house platforms within a settlement appeared very haphazard to the early European observer, but followed patterns well known to Samoans. Adjoining settlements were considered discrete units even though no boundary markers were usually present. The haphazardly arranged houses were often clustered around a track, a meeting ground, the residence of a person of rank, or an important resource. Structures considered essential to the community were the meeting ground (*malae*), community house (*fale tele*), and god house (*fale aitu*).

Apparently all independent communities had a meeting ground of some kind. Directly associated with it was a community house. Most communities had only one, but if more than one chief were in residence then a like number of community houses would be present. Community god houses also occurred near the meeting ground. One was present in most villages, although some smaller villages used the community house for their religious activities. Both community god houses and chief's houses were often surrounded by a wooden stockade. Stair (1897:106) describes a principal chief's residence as being encircled at a distance of 8 to 10 meters by two high fences with a mazelike entrance.

The distribution of platforms and walkways within the Mt. Olo Tract generally agrees with the pattern described in the ethnohistorical literature. The primary discrepancy is the lack of positively identifiable community meeting grounds. Meeting grounds in Samoa are traditionally large, centrally located open spaces that are often intersected by foot tracks and, more recently, roads. The earliest ethnohistorical description of a Samoan village is that of LaPerouse who visited Tutuila in 1787 (Davidson 1969e:51). He describes the central meeting ground as being 300 meters in diameter with houses scattered around the perimeter. The grounds are similarly described by most later missionaries (Davidson 1969e:62).

If the Mt. Olo settlements had similar meeting grounds, which were somewhat level and relatively free of stone, they should be detectable because stone-free areas do not naturally occur in the area. There is one, or possibly two, candidates for interpretation as meeting grounds. The primary stone-free area is directly north and west of the Cog Mound. The area is large enough and is bisected by a raised walkway with a large (III) platform at the southern edge. Further surveying and test excavations in the area might provide the data necessary to make an interpretation with more certainty. The other possible meeting ground is the square cleared areas directly south of SUMu-130. Even though they individually measure only 30 by 30 meters, the several adjoining cells make a sufficiently large area with amorphous piles of stone scattered throughout. This area is also bisected by a walkway and is surrounded by platforms of all sizes. The SUMu-130 complex should be another target for future work. If the size distinctions are valid then it can be assumed that a community house exists, with possibly an associated god house at the edge of the meeting ground. An extensive walkway, probably a public thoroughfare, passes nearby; and a raised walkway connects the possible community house with two possible chief's houses (large II). Directly associated are four small (I) platforms, one of which has an adjacent raised-rimmed oven.

Davidson (1974f:234, 240) suggests that an idea of a settlement's status can be obtained from the relative sizes of the structural remains; the higher-status settlements containing larger platforms, and more and wider walkways.

If this is the case then differentiation of status can be seen within the Mt. Olo survey area. Areas A and C have a much higher percentage of large (II and III) platforms than does Area B (19% and 7%, respectively); and all platform types average considerably larger. A and C also have more walkways (2.6 km compared to 1.2 km). Putting these distances into perspective, Areas A and C have 41.8 meters of walkway for every platform whereas Area B has 17.6 linear meters of walkway for each platform. If Area C is actually a high-status area, as the presence of the two large star mounds might indicate, then further evidence to support Davidson's suggestion concerning the correlation of large walkways and high-status areas is that the one large (II) walled walkway and two of the four large (II) raised walkways are directly associated with the star mounds. The other two large (II) raised walkways are in Area A. An additional point that may relate to status is that Area B has a higher density of platforms (1.1 platform/100 square meters and 1.9 platforms/ 100 square meters, respectively) suggesting that more people lived in less space.

The size differences in the structural remains between Areas A and C and Area B are probably related to the terrain differences. The effect of terrain on a structure's size, however, is probably impossible to determine at this time. It is possible that the relative ruggedness of Area B restricted the construction of the larger sizes of platforms. This does not seem likely, however, because construction materials are available in abundance; and the slope isn't significantly steeper than Area A or C to suggest that it might be a limiting factor. Another possibility is that area B was considered less valuable than Areas A and C because of the increased amount of labor needed for cultivation owing to the higher density of surface rock scatter. In either case, the facts that fewer large (II and III) platforms occur and that all platform types are smaller indicate that the man-hour investment per platform is considerably less for Area B. Stair (1897:111-112) states that the platforms for chief's houses and god houses were constructed by the united labor of the inhabitants; the number of workers being relative to the influence of the chief or god. From this it is clear that chiefs of greater rank would have more man-hours at their disposal for the construction of their house platform than chiefs of lower rank. The same should be true for the construction of god house and community house platforms.

Data collected during the reconstruction of the excavated area in the Cog Mound demonstrate that approximately one cubic meter of stone and associated dry laid masonry "facing" can be constructed in one man-hour. The two large star mounds each represent approximately 600 man-hours. A similar man-hour investment is associated with the four large (III) platforms of Areas A and C. The large (III) platform of Area B, however, represents only 400 man-hours, possibly suggesting that the local chief had fewer resources from which to derive a work force. The relative sizes of all the other structures in Area B also represent fewer man-hours and, therefore, possibly a lower status (as compared to Areas A and C).

If there is a relative status difference between Area B and Areas A and C then the numbers of raised-rim earth ovens may also be an indication of a high-status community. Areas A and C contain five of the six examples; the one example in Area B is directly associated with three large (II and III) platforms.

POPULATION ESTIMATES

Population estimates for the Mt. Olo Tract are difficult to make. Davidson's (1974f: 235) attempt to make estimates for two settlements in the Falefa Valley suggests a range of from 3.5 to 4.1 people per dwelling, based on floor-space measurements. An ethnohistorical source, Charles Wilkes in 1845 (see Davidson 1974f:236) describes 75 people occupying 20 houses yielding an average of 3.75 people per dwelling. Davidson (1974f:236) concludes that the 3.75 figure is probably an accurate estimate, at least for the Falefa settlements. Applying this estimate to Mt. Olo suggests that approximately 450 people resided within the survey area, assuming that 10% of the platforms were, at any given time, not occupied. Comparing this to modern village statistics shows some interesting similarities. Of an average of ten villages on Upolu there is approximately 2,023 square meters of village living space per capita (Farrell 1962:187). If the constant of 3.75 persons/dwelling is used, then an average dwelling has approximately 7,586 square meters of space within the village. The density of sites at Mt. Olo (assuming that 90% were occupied) is 7,719 square meters per dwelling, which compares closely with the modern data. The distribution of space, however, is not very uniform; Area B is 1.6 times as dense as Areas A and C. Farrell (1962:187) also notes that plantation lands average 6,070 square kilometers per capita. Utilizing a population of 450 suggests that 2.7 square kilometers of plantation land would probably be necessary for the section of the Mt. Olo settlement that was surveyed.

The detail of data produced makes them valuable tools for the interpretation of all Polynesian settlement archaeology. The conclusions from the Mt. Olo survey parallel Green's conclusions in several ways. The ecologically more favorable areas exhibit greater internal differentiation in structure sizes and shapes, implying a higher level of social stratification; and the structure types are identifiable as to function, although the Mo'orean examples can, at this time, be classified with considerably more certainty. The detail and certainty of the Mo'orean work is probably obtainable for Mt. Olo; however, further survey, test excavations, and ethnohistorical research will be needed before that end can be achieved. When and if it is achieved, then in-depth comparative studies will be able to answer questions concerning the political and religious organization of the original populators of Polynesia.

SUMMARY AND CONCLUSIONS

The Mt. Olo settlements date to a time (A.D. 1500 to 1700) when the population of Western Samoa was probably substantially greater than when the missionaries first arrived. At that time a much higher percentage of settlements were inland, and some were probably quite extensive. Reasons for the population decline are not readily evident, although Pirie (1964:27-28; Davidson 1969e:75) argues that it was probably a result of the introduction of European diseases before the missionaries' arrival. Warfare is another possibility, but from ethnohistorical evidence (Davidson 1969e:76) it seems unlikely that it would cause such a dramatic reduction. Furthermore, suggestive structures, such as forts, are not present in the Mt. Olo area, even though its name, *Olo*, means "fortress" or "refuge" (Stair 1897:5,99; Fox 1962:114).

Comparing the Mt. Olo survey to settlement pattern data from other parts of Polynesia demonstrates that the structure types and distribution as interpreted here are hardly unique. The comparative data available for Western Polynesia, as well as for many parts of Eastern Polynesia, demonstrate the same basic pattern. The existence of identifiable community meeting grounds, meeting houses, god houses, chief's houses, and residences forms a common basis for Western Polynesian settlements.

Perhaps the study most readily comparable to the Mt. Olo survey is Green's survey and excavations on Mo'orea (Green and others, 1967; Green 1967:112-115).

SECTION 6

PARADISE SITE (SUVs-1)

JOEL C. JANETSKI

SETTING

The Paradise Site (SUVs-1) is located on the grounds of the Paradise Night Club on the edge of Vaiusu Bay about 2.8 kilometers west of downtown Apia, Western Samoa. The club building was built on reclaimed land along the shore of the bay, whereas the area to the south and west of the club had apparently been leveled. As a consequence, there were no surface features to provide orientation in the excavation.

EXCAVATION

The decision to excavate at Vaiusu was based on rumors that pottery was found during the construction of club facilities. Roger Green visited the premises and picked up several sherds which gave credibility to the reports.

Excavation procedure consisted of digging several 1.5 meter square test pits to the south and east of the club in an attempt to locate the source of pottery (see Fig. 12). The pits were dug in 15 cm levels, and all dirt was screened for artifacts. Squares 1 through 5 proved to be sterile, but Square 6 produced a few sherds of pottery at a 40 to 55 cm level. It was subsequently deepened to 1.1 meters and extended to the east. Since this effort uncovered little more than several additional sherds and a historic oven for manufacturing lime from coral, the pit was back-filled.

While work was carried on in Square 6, another test pit, Square 7, was dug in a garden to the northwest of the club building. Here pottery was found occasionally from 30 cm down to 70 cm, but no concentrations were encountered.

STRATIGRAPHY

Three faint, gradually merging strata were identified in the cross sections. Stratum I was a damp, red-brown layer which contained a large number of rotting basaltic rocks. Stratum II was a soil similar in tone to Stratum I but less claylike and containing fewer rotting stones. Stratum III was a loamy, friable soil containing many pebbles and high in organic content.

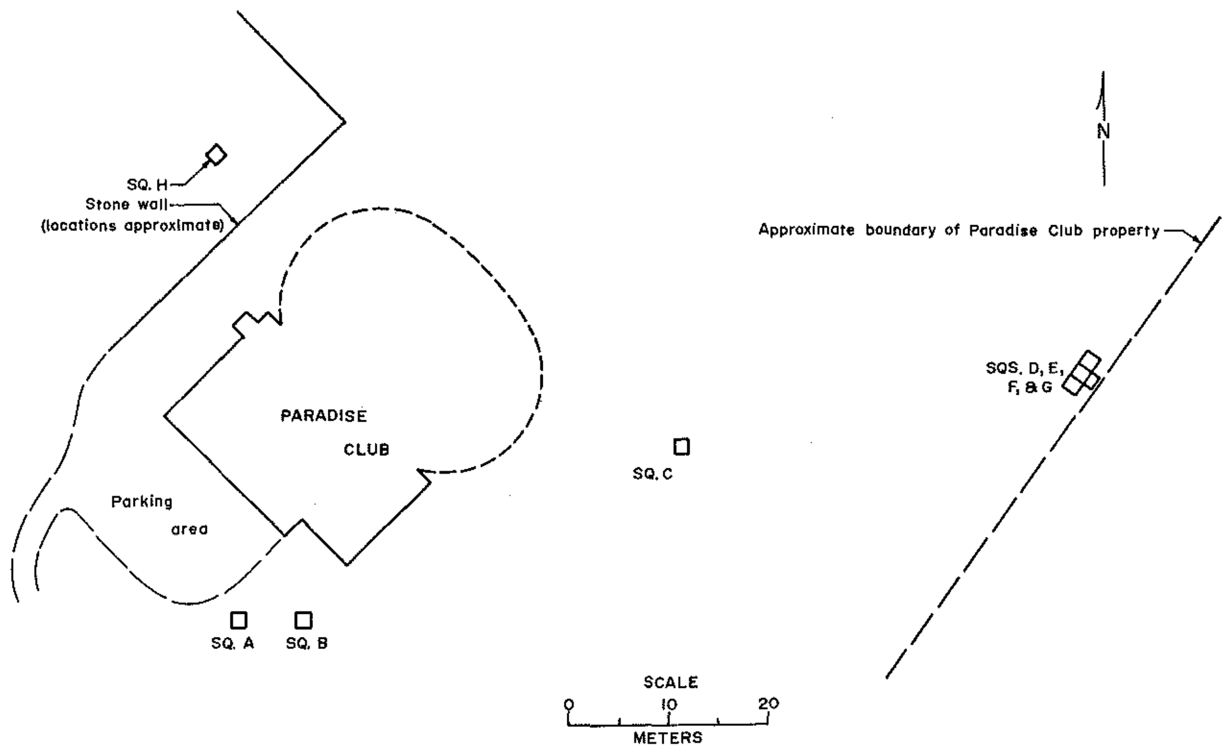


Fig. 12. MAP OF PARADISE SITE.

ARTIFACTS

The artifacts found at the Paradise Site included two complete adzes, a broken adz, various stone flakes, a "kava pounder," and pottery sherds. One complete adz, the broken adz, several stone flakes, and most of the pottery sherds were part of a surface collection gathered in the area with the help of some Samoan children who had followed the excavations with interest.

An adz fitting Green and Davidson's description of Type III was found at a depth of 30 to 45 cm in the test pit in the garden. It measures 5.15 cm long by 2.85 cm wide by 1.05 cm thick. The other complete adz was found on the surface and appears to be a Type VIII. It measures 7.1 cm long by 3.45 cm wide by 2.55 cm thick. The broken adz, also found on the surface, was apparently ground on all sides but is not complete enough for typing. It consists of the poll of the adz and measures 5.2 cm long by 3.5 cm wide by 1 cm thick.

The "kava pounder" stone, which was identified by our local interpreter and driver, was found in the same stratum as the Type III adz. It is a rounded, basaltic river rock measuring 12.3 cm long by 6.8 cm wide by 5.6 cm thick. The stone is not noticeably pecked or smoothed, which speaks against its validity as an artifact.

In all, 71 plainware pottery sherds of both the fine and coarse varieties, as described by Smith in Section 9 of this report, were found on the surface and in the test pits. The sherds from both pits were quite small and eroded. Because of the absence of structural

context, the presence of the sherds could not be explained. The eroded state of the sherds led the excavator to hypothesize that they were redeposited by colluvial action; however, the nature of the stratigraphy is not supportive. It is also possible that the sherds from Square 6 were related to a mound directly to the east of the pit, but we were unable to gain permission to extend a trench in that direction.

SECTION 7

JANE'S CAMP (SUFl-1)

HOWARD L. SMITH

SETTING

Jane's Camp (SUF1-1) is located on the north shore of Upolu, 16.4 air line km west of Apia. It lies within the Tauo'o section of the village of Faleasi'u.

Jane's Camp consists of a low mound, some 60 to 65 meters long and about 30 meters wide, which lies only 15 to 20 meters from the water's edge at high tide. On the west, deposits forming the mound appear to end abruptly at a vertical outcrop of rock, while the opposite side of the mound slopes gradually down to the level of a flat coastal strip that extends to the east. Inland of the site, the land slopes gradually upward, rising only about 15 meters in the first 1,700 meters from the sea. The reef in the immediate neighborhood is located from 1,600 to 2,200 meters offshore, providing an expanse of lagoon environment.

A portion of the site nearest the beach was destroyed by construction of the road from Apia to Faleolo airport. The excavation involved in this construction created a 1.25 to 1.5 meter deep road cut in which deposits containing large quantities of shell could be seen.

At least two buildings, a church and a traditional style dwelling, are presently located on top of the deposits at Jane's Camp. A driveway cuts through a portion of the deposits and runs between these two buildings (Figs. 13 and 14).

EXCAVATION AND STRATIGRAPHY

Five test excavations were conducted at the site. Test I was located in the northern corner of the lawn area in front of the dwelling and measured about 2.8 meters northeast to southwest by 2.5 meters southeast to northwest. Average depth of the deposits in Test I was 1.2 meters. Roughly 8.4 cubic meters of soil were removed in Test I. Test II, which measured 2.0 by 2.0 meters, was located in the road cut bank to the northeast of Test I, on the opposite side of the driveway. Tests III, IV, and V were excavated along the southwest edge of the church; each measured 1.0 square meter. A primary purpose of these soundings was to establish the extent of the deposits at Jane's Camp. Figure 14 shows the site layout and the location and extent of excavations.

The initial excavation procedure for Test I consisted of cleaning and straightening the existing banks on the northwest and southeast sides of the midden. A trench 90 cm wide was then dug to subsoil on the northeast side of the deposits, adjacent to the driveway.

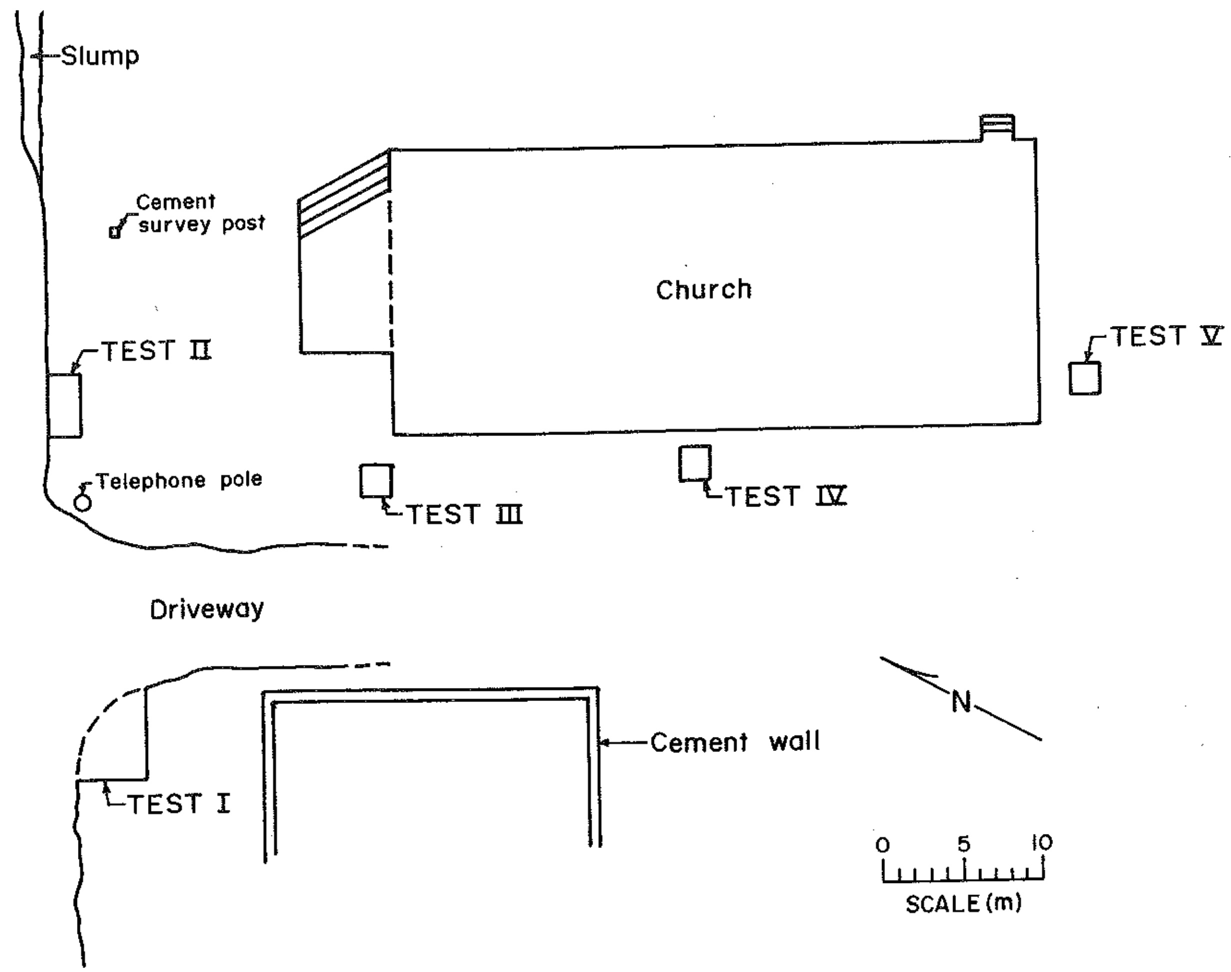


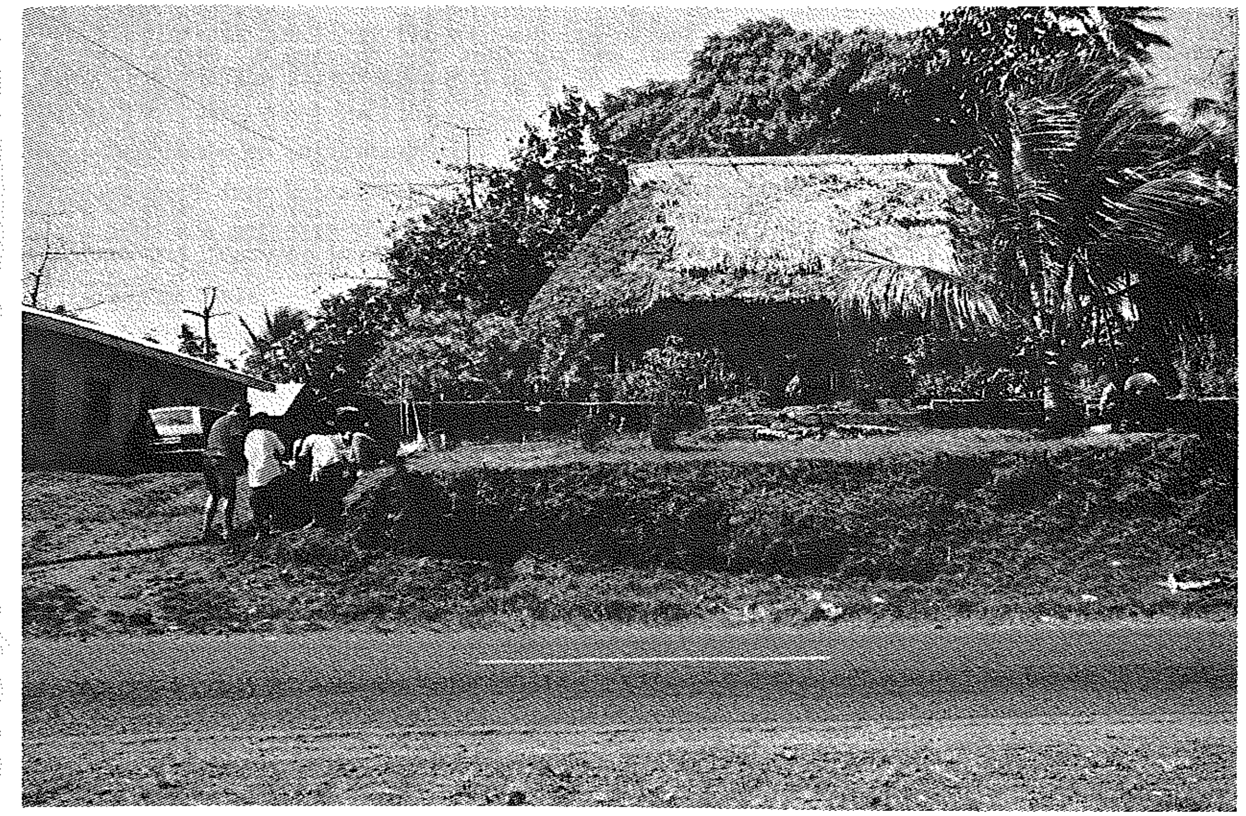
Fig. 13. MAP OF JANE'S CAMP.

Once this operation had exposed the stratigraphy, the excavation area was sectioned into 1.0 meter squares, which were removed stratum by stratum. All dirt was passed through either a 1/2- or 3/16-inch screen, and the resultant material was provenanced according to square and stratum.

Deposits at Test I consisted of five major strata that rested upon a brown subsoil containing a high proportion of rotted basalt stone. Small quantities of shell and coral were present in the subsoil, but no charcoal was visible, nor were any artifacts recovered from the portions of this stratum that were screened.

Stratum I is the basalar culture-bearing soil layer in Test I, and is composed of a greenish-brown silty sand containing scattered charcoal flecks. It measures from 10 to 25 cm in thickness and lies directly upon the subsoil. Tridacna shell from Stratum I yielded a radiocarbon date of 2220±110 B.P. (RL-469); another dated 2550±50 (R-4973).

Stratum II overlies Stratum I, and varies in thickness from 10 to 20 cm. It is similar in color to Stratum I and is distinguishable largely on the basis of textural differences,



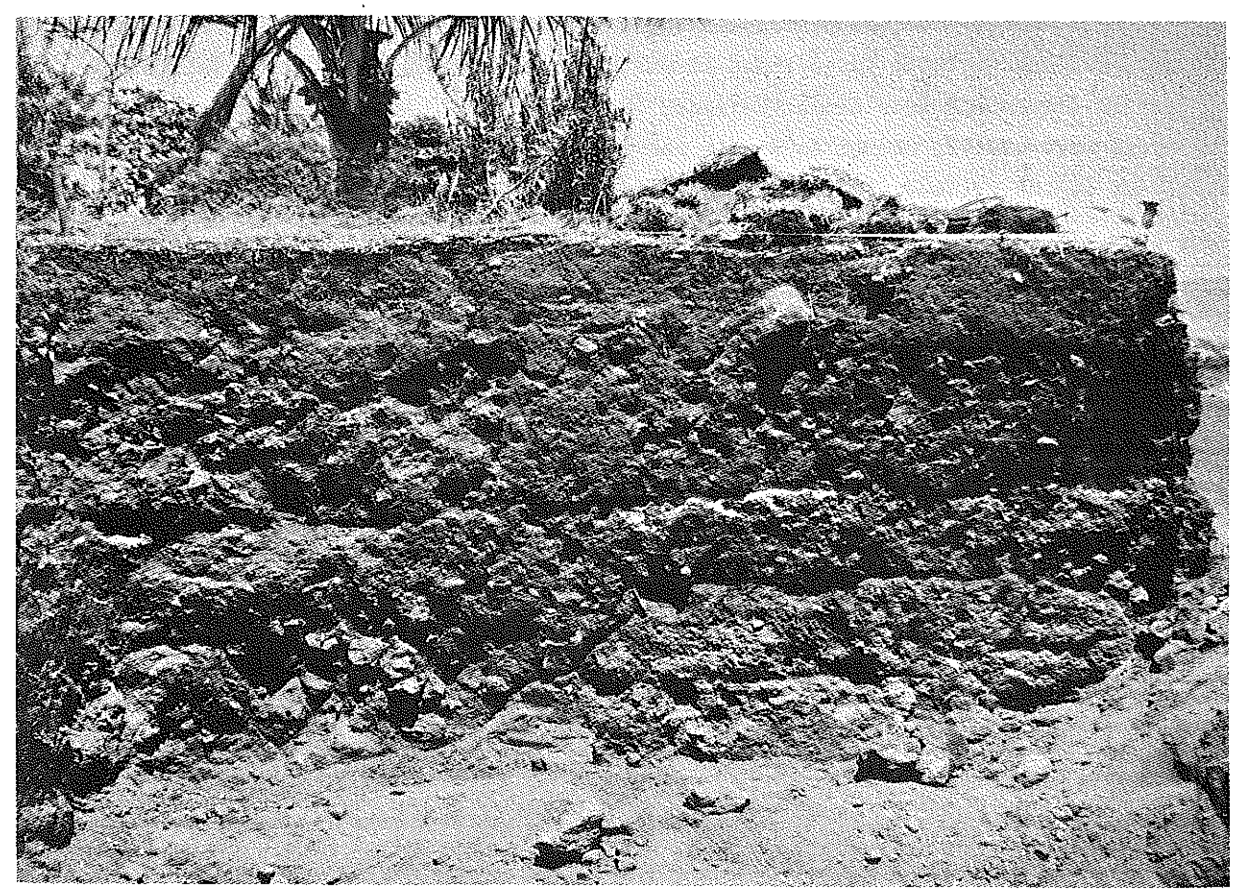


Fig. 14. JANE'S CAMP.

although it does contain somewhat less charcoal and ash than does Stratum I. Shell from Stratum II yielded the unacceptable date of 3220±130 B.P. (RL-479).

Stratum III is composed of dark gray sand containing high quantities of shell and charcoal. One burial and two pit features were discovered in association with Stratum III, which measures from 25 to 30 cm in thickness. A radiocarbon date of 2130±130 B.P. (RL-478) was provided from shell originating in Stratum III.

Stratum IV is indistinguishable from Stratum III, being composed of the same dark sand. The division between these two strata was made on the basis of discontinuous lenses of clean, white sand which occurred at approximately the same depth throughout the Test I deposits. Two fireplaces, two pit features, and possibly one burial were associated with Stratum IV, which ranged from 30 to 40 cm in thickness.

Strata III and IV were the richest and most concentrated midden deposits at the site, and produced most of the shell material recovered from the test.

Stratum V overlies Stratum IV, and is the topmost layer of soil present. It is composed of a slightly silty brown sand, and measures from 25 to 40 cm in thickness. Numerous European artifacts were recovered from Stratum V, including objects of glass, porcelain, and metal. Among the latter was a 1915 shilling.

Figure 15 contains a scale drawing of the stratigraphy in the Test I area.

Only three strata could be distinguished in the deposits in Tests II-VI Since a portion of the road cut bank between Tests I and II was destroyed by the driveway, absolute stratigraphic correspondences cannot be made. However, soil characteristics in the two tested areas were similar enough to permit the conclusion that Strata III, IV, and V are present east of the driveway, while Strata I and II are not.

Stratum III in Test II is somewhat thicker than in Test I, measuring between 45 and 50 cm in thickness. Portions of the stratum also appear to be slightly browner than in Test I, making it easier to distinguish Strata III and IV. Several patches of ash and burned earth were located on the top surface of Stratum III. This may indicate the presence of a use surface, and provides possible additional support for the division made between Strata III and IV in Test I.

Stratum IV is also slightly thicker in Test II than in Test I, averaging about 40 to 50 cm in thickness. In other respects it is identical to Stratum IV in Test I. A radiocarbon date of 2510±120 B.P. was obtained from shell from Stratum IV in Test II.

Stratum V in Test II is identical to Stratum V in Test I.

Tests II, III, and IV determined the northwest to southeast extent of the midden deposits. At a distance of 20.5 meters southeast of the road cut, only two strata (IV and V) are present; and at 33 meters, only Stratum V and the subsoil are visible. Thus it appears that the stratigraphically more recent soils are horizontally more extensive than the

underlying strata, and that the deepest and oldest deposits are in the area of Test I. Figure 15 shows the correspondences between Test I stratigraphy and that of Tests II through IV.

PITS

Four pit features were located in the deposits at Jane's Camp. An earth oven and a possible post hole originated from Stratum III, and one possible earth oven and a pit of uncertain function originated from Stratum IV.

Pit 1 was an earth oven or *umu* located along the southwestern edge of Test I. It originated at the top surface of Stratum II and extended through Stratum II and into Stratum I. It measured 90 cm in diameter, reached a maximum depth of 30 to 32 cm, and was bowl-shaped in cross section. The walls and floor of the earth oven were composed of smooth, hard Strata I and II soils which were burned to a reddish color in parts of the feature. Along portions of the northwest side of the pit, this reddening was as much as 2.0 cm thick. Fill of this feature was noticeably softer than the overlying soil and consisted of Stratum III soil containing concentrations of charcoal and numerous small (5 to 10 cm) basalt stones that had been burned to a reddish color. Figure 15 shows Firepit 1 in cross section.

Pit 2 was located in the eastern corner of Test II and originated at the surface of the subsoil layer. It was overlain by and filled with Stratum III soil. Pit 2 was oval-shaped, measuring 42 cm east to west by 33 cm north to south. It reached a maximum depth of 55 cm. The sides were composed of medium-sized (15 to 25 cm) rounded basalt stones, only a few of which appeared to have been burned. Several reddened stones were uncovered on the surface adjacent to Pit 2. Fill of this feature consisted of Stratum III soil which contained numerous pieces of charcoal.

The function of Pit 2 is not immediately apparent. The generally unburned nature of the walls and its relatively small size would seem to indicate that it was not an earth oven. It is possible that this feature is an isolated post hole of some structure that excavation was not extensive enough to reveal. The stones lining the sides of the hole could have served to stabilize a post, and the charcoal in the Pit 2 fill might have resulted from burning of the post. The few reddened stones from the feature might easily have been used as *umu* stones previous to their inclusion in Pit 2. However, no pavement or use surface which would indicate the presence of a structure was located in association with Pit 2.

Pit 3 was located on the northeastern edge of Test II, near the midpoint of the excavation, and originated from the base of Stratum IV. The northwestern portion of the pit was destroyed in the excavation of the road cut, and consequently the exact shape of the feature is uncertain. Nevertheless, enough of the feature remained to allow a reliable reconstruction of its original form. It measured 1.0 meter in diameter at the mouth, expanding to its widest point 30 cm below the top, and tapered to 10 cm near

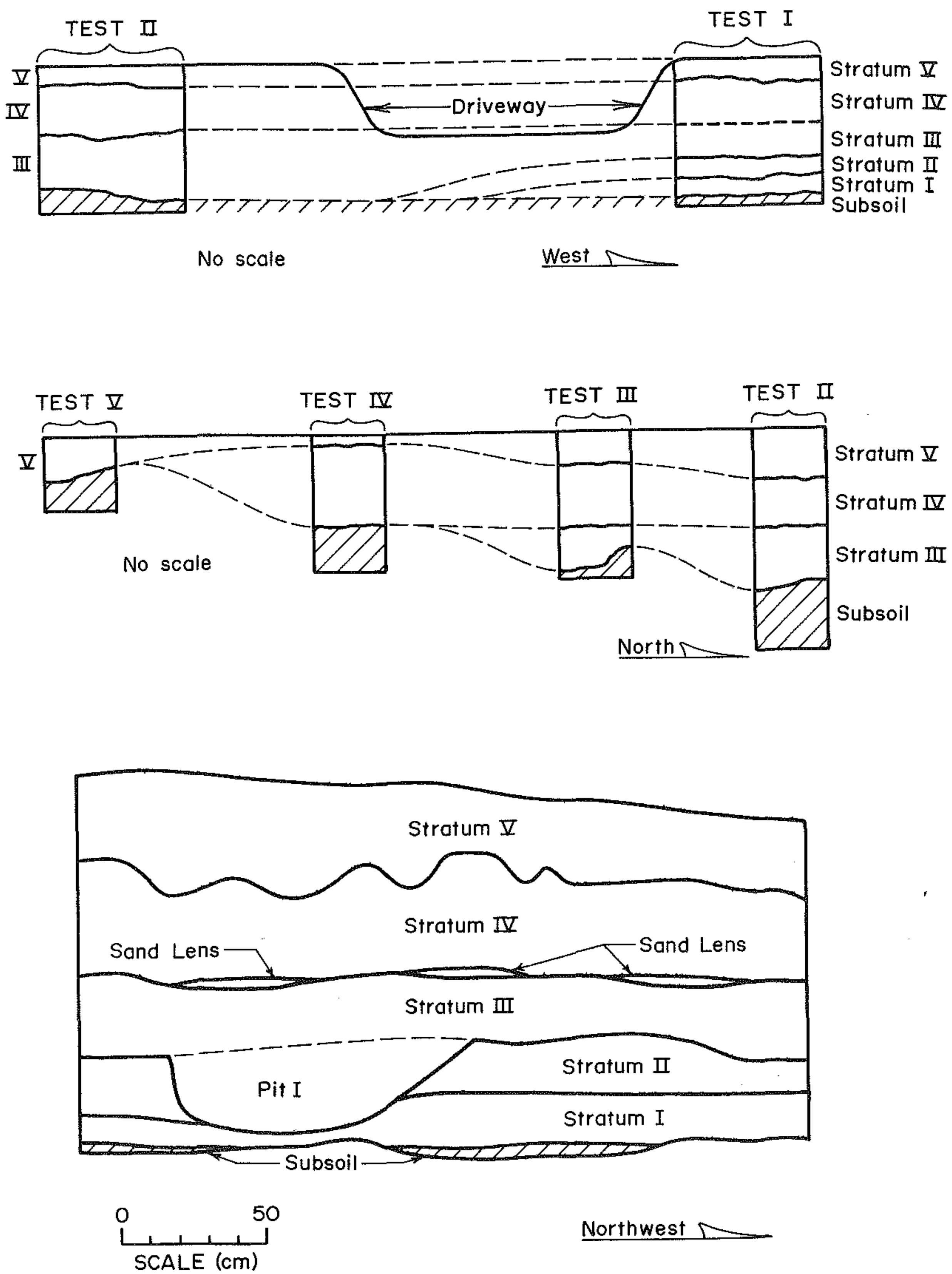


Fig. 15. CROSS-SECTION DRAWINGS OF STRATIGRAPHY AT JANE'S CAMP.

the bottom. Pit 3 reached a maximum depth of 90 cm, intruded the subsoil layer to a depth of 30 cm, and resembled a truncated oval in cross section.

The walls of the pit were composed of unpacked Stratum III soil, and did not exhibit any evidence of burning. Fill consisted of soft Stratum IV soil which contained reddened basalt stones, scattered flecks of charcoal, and pockets of white ash, bone, and large quantities of shell.

The presence of reddened stones, ash, and dietary remains in the Pit 3 fill may indicate that this feature served as an earth oven. The lack of reddening on the walls and the gêneral low concentration of charcoal in the fill would seem to preclude its having been used extensively, however.

Pit 4 was located in the northwest corner of Test IV and originated from the top surface of the subsoil. It was roughly circular, measured 50 cm in diameter, a maximum 30 cm in depth, and was bowl-shaped in cross section. The sides and bottom of Pit 4 were composed of subsoil material which was not reddened. Fill consisted of Stratum IV soil which was appreciably softer than the surrounding earth. No significant amounts of charcoal or ash were present in the fill, but numerous reddened stones did occur.

FIREPLACES

Two fireplaces of amorphous shape which did not occur in pits were located in Stratum IV.

Fireplace 1 was a poorly defined phenomenon which was located in the western quadrant of Test I and originated from within Stratum IV at a depth of 20 cm below the top of the stratum. In profile, Fireplace 1 consisted of a shallow, basin-shaped concentration of small, reddened, angular basalt stones averaging approximately 5.0 cm long. It measured about 45 cm in length and 25 cm in depth and overlay a 2 to 3 cm thick lens of charcoal. This charcoal lens was situated in the bottom of a shallow (5 cm deep) basin. Two bones were recovered from the top surface of Fireplace 1.

Fireplace 2 was located within Stratum IV in the eastern quadrant of Test I, and originated from a depth of about 27 cm below the top of the stratum. This feature consisted of a concentration of small (5 cm or less) rounded basalt stones which exhibited the reddish color characteristic of burning. These stones overlay a lens of charcoal 15 cm long. Fireplace 2 measured 70 cm in length and 25 cm in thickness, and a large quantity of shell and some bone were recovered from within the feature.

Fireplaces 1 and 2 resemble the virtually flat fireplace still in use in Samoa.

BURIALS

Two separate burials were located in the SUF1-1 deposits. In compliance with the wishes of the village's inhabitants, these remains were rapidly removed and reburied. Consequently, detailed analysis of this osteological material was not possible.

Burial 1 was located in the southeastern end of the initial 90 cm wide trench, at a depth of 70 to 75 cm below modern ground surface. Since the stratigraphy had not been defined at the time of its excavation, the precise stratigraphic position of Burial 1 is not clear. However, it probably lay within the basalar portion of Stratum IV, and was definitely not intrusive from above.

Burial 1 contained the remains of three individuals: an adolescent, a juvenile, and an infant. All bones, with the exception of the long bones of the adolescent, were in fragile condition. The adolescent long bones, which had been broken prior to excavation, were solid and heavy, and appeared to be at least partially mineralized. Bones of all individuals appeared to have been interred in a bundled or tightly flexed position, and pottery and sea urchin spines were found in association with the burial.

Burial 2 underlay Stratum III and was located on the southwest side of Test III, in a shallow (15 cm deep) pit dug into the subsoil layer. It contained the largely articulated skeleton of a single adult. Only the head, upper torso, and hands of the individual were present in Test III, with the remainder of the burial apparently lying to the southwest. From the position of the bones that were present, it appears that this individual was interred in a more extended position than was Burial 1. The bones of Burial 2 were in extremely fragile condition.

ARTIFACTS

STONE

Adzes

Twelve complete and partial adzes were collected during the course of excavations at Jane's Camp. Seven of these were surface finds or otherwise of uncertain provenance, while the remaining five were recovered from within the deposits. Four came from Stratum IV, and one from Stratum V.

The adzes from Jane's Camp fall into three to four of the types defined by Green and Davidson (1969a). Positive identification is not possible in all cases because most of the adzes are only fragmentary. For example, several of them completely lack a bevel and cutting edge, making identification difficult. Figure 16c, d, e, and f show this typical type of breakage.

Of the eight adzes and fragments that can be classified with confidence, five are Type V, two are Type III, and one is a Type IV. Three of the remaining four most probably consist of a Type III and two Type V adzes. One is so battered as to make classification impossible. Only four of the classifiable adzes were recovered from controlled contexts. Stratum III yielded one Type V adze, a Type III and a Type V were recovered from Stratum IV, and a single Type V from Stratum V.

Type V is by far the predominant form of adz at Jane's Camp. This supports Green's (1974d:258) identification of Type V as an early form in Samoa. Furthermore, although the

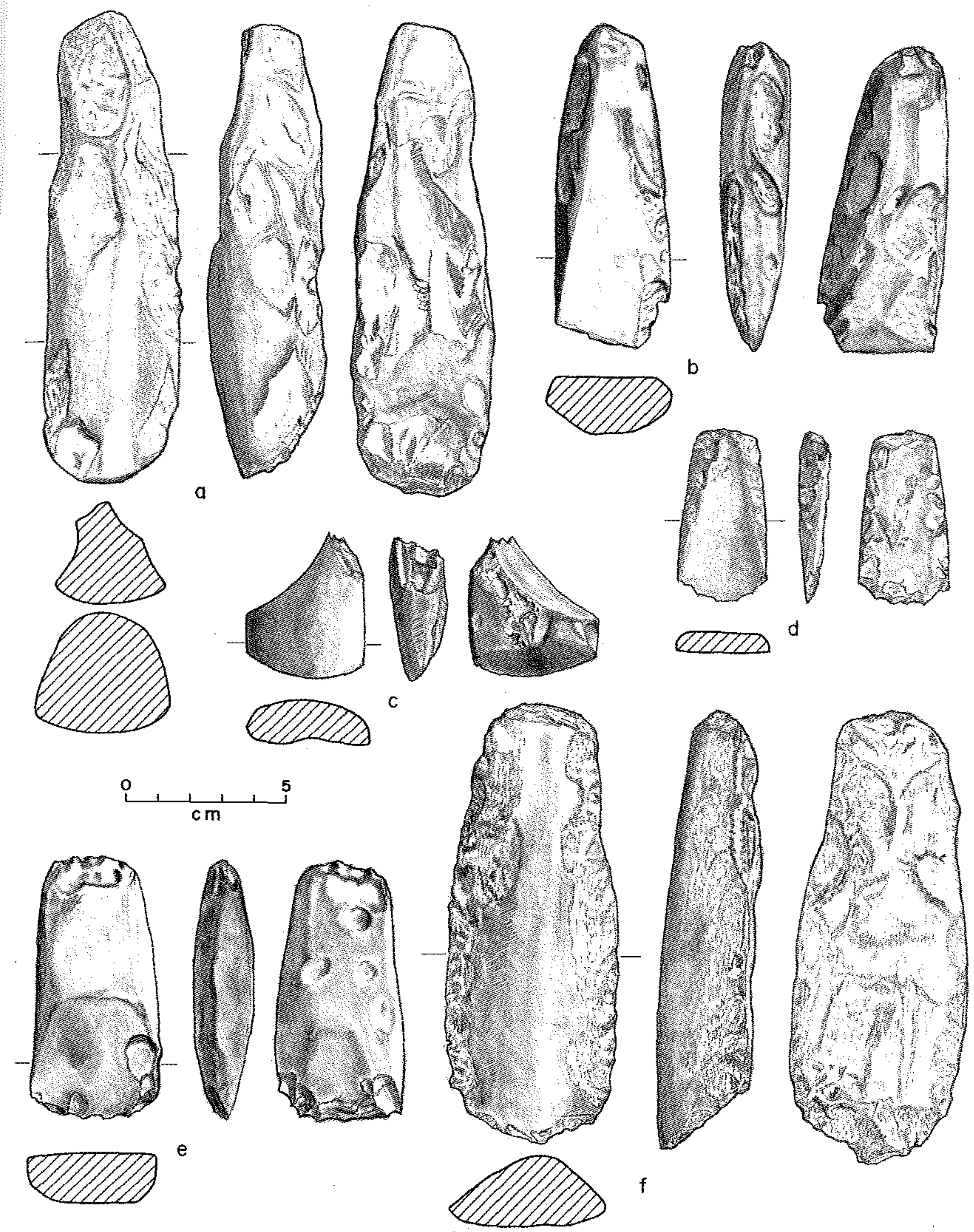


Fig. 16. ADZES FROM JANE'S CAMP. a, Type Vb, with incipient tang. b, Type IVb. c, Type V bevel and cutting edge. d, Type III. e, probably Type IV. f, Type Va (types as defined in Green and Davidson 1969a). Adzes b, c, d, and e are composed of fine-grained black basalt, f is composed of slightly coarser and lighter basalt, and a of a light gray porphyritic basalt.

total sample is so small as to make meaningful statistical inference unreliable, the frequency of Type V adzes at Jane's Camp may still be significant, as it far exceeds that found by Green in either Fine or Coarse Ware contexts (1974d:257). It is possible that this form of adz was utilized in an activity or range of activities more strongly associated with a coastal location than an inland one such as that from which Green's artifacts were recovered.

Five of the Jane's Camp adzes are composed of a fine-grained, black basalt which does not resemble any stone observed during the course of excavations in Upolu. Subsequent chemical analysis of the basalt used for the adzes revealed, however, that the basalt was definitely of local origin (James Natland, personal communication). This material is extremely smooth on the ground surfaces of the adzes, and often displays a lustrous, polished appearance (Fig. 16b, c, d, e). Five of the adzes and fragments are composed of a dark gray, fine-grained basalt which closely resembles the black material discussed above, although slightly coarser and lighter in color. It also presents a polished appearance (Fig. 16f). One adz (Fig. 16a) is composed of a porphyritic basalt consisting of a light gray, medium to fine-grained groundmass containing small (0.5 to 1.0 mm) ferromagnesian phenocrysts. This artifact is almost identical to one reported by Green (1974b:135, Fig. 62c) as having an incipient tang. The single remaining adz is made of a dark gray-green basalt which is extremely fine-grained, and which displays a polished appearance on the ground surfaces of the artifact.

Adz Blanks

Two uncompleted adzes were collected. The smaller of these, which came from Stratum II, weighs 189.4 gms and is diamond-shaped in cross section and rectangular in plan view. It is composed of a light gray porphyritic basalt and measures 8.7 cm long by 4.0 cm wide, and a maximum of 3.5 cm thick. It shows obvious signs of chipping, but none of the surfaces are ground. The larger blank, which is part of the surface collection, is oval-shaped in cross section and is composed of a light gray porphyritic basalt very similar to that of the smaller blank. The unbroken end shows what appears to be either a nascent bevel or tang. It measures 10 cm in length by 4.7 cm in width and 3.5 cm in thickness. It weighs 341.8 gms.

Miscellaneous Stone Artifacts

Two small basalt balls of unknown function were recovered. Both are composed of a medium to fine-grained gray basalt and have been ground until moderately smooth. Surfaces of the two artifacts are featureless. The smaller of the two artifacts is somewhat ovoid in shape, measures 2.8 by 2.8 by 3.3 cm, and weighs 40.3 gms. The larger is spherical, measures 3.0 cm in diameter, and weighs 41.2 gms. Figure 21m shows this artifact. It is possible that these two balls are smooth river pebbles which were transported to the site and used in their natural form.

A hammerstone was recovered from the fill of Pit 3. Apparently this artifact was originally a slightly flattened sphere, but about one-fifth of it is missing as a result

of breakage. It is composed of a coarse-grained gray basalt. The extant portion of the hammerstone measures 6.5 by 6.5 by 4.0 cm and weighs 359.8 gms. The lateral surfaces of the object show unmistakable evidence of percussion.

One piece of a bright red-orange, hard, fine-grained stone was recovered. This stone probably represents either a piece of the top of a lava flow or a piece of stone over which the lava ran, which was consequently baked to a red color. One surface of this stone bears obvious evidence of having been scraped. Informants state that this type of stone is currently sometimes crushed and used in medicinal preparations for the treatment of sores. It is further suggested that stone such as this may have been the source for the material used to color the orange ceramics found at Jane's Camp.

ARTIFACTS OF SHELL, BONE, CORAL, AND SEA URCHIN SPINES

Joel C. Janetski

Artifacts of shell, bone, and coral were scarce in the Faleasi'u midden as they were in the midden at Lotofaga (Davidson 1969c:251). However, some of the items which did occur are previously unreported for Samoa and are important in filling out the rather sparse artifactual picture. Artifacts were recognized by appearing shaped in a regular fashion and/or by seeming to have been eroded or worn by processes other than wave or soil (chemical) action.

SHELL

Shell artifacts are both ornamental and functional in nature. Functional items include two *Conus* shell scrapers, one *Cypraea tigris* shell scraper, one *Turbo* shell scraper (?), one whelk scraper (?), and at least one *C. tigris* top for an octopus lure.

Of the two *Conus* scrapers, the specimen from Stratum IV (Fig. 17-1) is complete and has been beveled along the outside of the curved cutting edge. The other *Conus* scraper, which is from Stratum V, is not beveled but, although broken, appears to be shaped to the same pattern as the first. The *C. tigris* scraper (Fig. 17n), also from Stratum V, has been heavily abraded along both lateral edges.

The *Turbo* and whelk scrapers are questionable artifacts. Both appear worn along the outer lip; but other recent breaks, possibly suffered during excavation, obscure the validity of these shells as cultural tools. The *Turbo* shell is from Stratum III while the whelk shell is unprovenanced.

The *C. tigris* cap (Fig. 17b) is the best example of several such specimens which could be interpreted as tops for octopus lures; however, no sinkers for the lures were identified at the site. Buck's (1930:435) drawings of ethnographic examples of octopus-lure caps show the shell cut squarely across the ends rather than rounded as is this cap. The general shape of this lure top is closer to that pictured by Poulsen (1968:88) from Tongatapu.

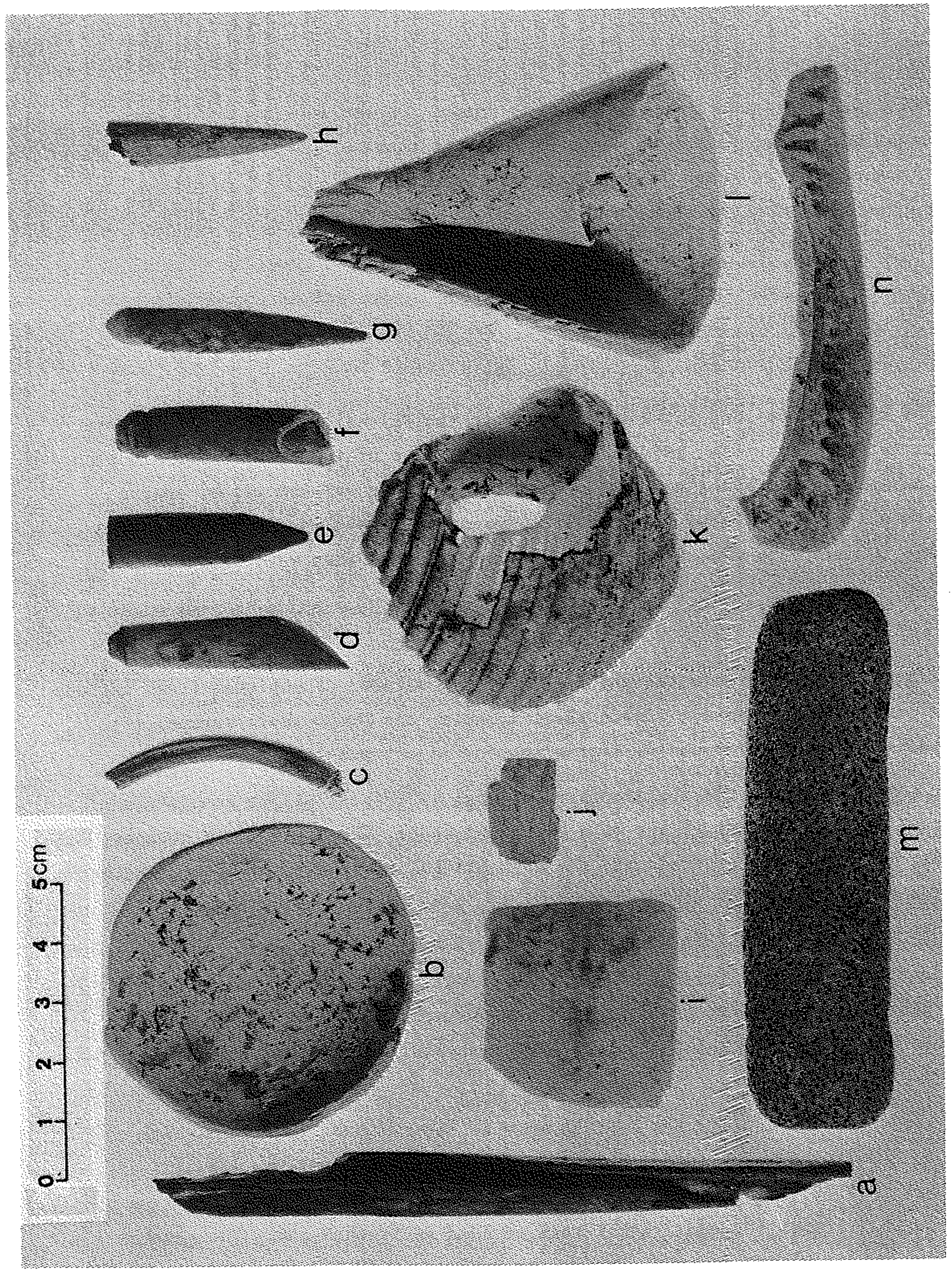


Fig. 17. EXAMPLES OF SHELL, BONE, AND CORAL ARTIFACTS FROM JANE'S CAMP. a, Striated and shaped mammal bone, Stratum IV. b, *Cypraea tigris* shell, cap for an octopus lure (?), Stratum III. c, Segment of shell ring, Stratum III. d, e, g, Slate pencil sea urchin files. f, Notched slate pencil sea urchin spine. h, Polished bone point, Stratum III. i, Shell (*Conus*?) square, Stratum III. j, Piece of shaped shell, subsoil. k, *Turbo* shell scraper (?), Stratum III. l, *Conus* shell scraper, Stratum IV. m, Branch coral file, Stratum IV. n, *Cypraea* shell scraper, Stratum V.

The Faleasi'u artifact is photographed in such a way as to reveal the smoothed nature of the broken edges. This smoothing of the shell-cap edges varied from those seen in Figure 17 to the unaltered raw edges on the other *C. tigris* shells broken to the same pattern.

Of considerable interest is a segment of a finely shaped and polished shell ring (Fig. 17c) from Stratum III. The inner face of the segment is quite flat and squared on the edges, whereas the outer surface is rounded. It measures 8 mm across the inner face by 4 mm thick by 3.5 cm in length. If the ring were complete it would measure about 7 cm in diameter. The species of the shell from which the artifact was manufactured has not been identified.

Other shell artifacts include three pieces of square-cut *Conus* (?) shell whose function is interpreted as potentially decorative, although none were perforated. The specimen seen in Figure 17j is finely shaped and smoothed and is lightly and identically scored on both sides in a gently curving arc.

BONE

Three pieces of worked bone were found in the midden--two from Stratum IV and one from Stratum III. The former appear to be from the same species of mammal (flying fox), and both seem to have been abraded with a rather rough scraping tool. The bone pictured in Figure 17a seems to have been shaped into a tapering form by this abrading process. The mammal bone not pictured is fragmentary, measures 9 cm long, and is burnt. The third piece (Fig. 17h) is a hollow bone, finely polished and nicely shaped.

CORAL

One branch coral file (Fig. 17m) was recovered in the midden. It measured about 8.5 cm long by 2.3 cm wide by 1.7 cm thick. The side shown in Figure 17 is noticeably smoothed and flattened because of abrasion.

SEA URCHIN SPINES

In all, 86 worked slate-pencil sea urchin spine files were found in the excavations at Faleasi'u. They occurred in all strata although Stratum III, with 34, produced by far the most. Figure 17d-g shows the various forms of these files, that is, a diagonal flattening (d), a long, tapered point (g), and a rather blunt point (e). Specimen f has been notched completely around the spine just above the proximal end.

CONCLUSIONS RESPECTING ARTIFACTS

As mentioned at the onset, bone, shell, and coral artifacts were scarce in the excavated deposits. Several, such as the *Turbo* and the cowrie scrapers and the sea urchin spine files, have been discussed before (Davidson 1969c:245-246) and will not be given much attention here. The artifacts of worked bone, the shell ring segment, the coral file, and the occurrence of sea urchin files in quantity are new to Samoa and require some comment.

The relative abundance of sea urchin files implies a possibility of work in shell but more likely in bone, as Sinoto (1968:113) and Davidson (1969c:245) suggest. Although Sinoto's comments are based on evidence from the Marquesas and apply specifically to bone fishhook production, his remarks are given support here by the occurrence of the three pieces of worked bone.

Coral files, on the other hand, are recognized as evidence of shell work (Emory, Bonk, and Sinoto 1968:19; Sinoto 1968:112) in other areas of Polynesia. The single file from Faleasi'u, therefore, does provide evidence for the manufacture of shell tools and ornaments in the general vicinity of Jane's Camp. Evidence for this shell work is supplied by the artifacts of cut and polished shell at the site.

Although both the coral and sea urchin files are associated with the manufacture of fishhooks of various types elsewhere in Polynesia, complete examples of piscatorial gear continue to elude archaeologists in Samoa. It is not possible to attribute the absence of fishhooks to "consumption" by acid soils at Faleasi'u since most of the organic debris there is recognizable; therefore, it must be because the early Samoans did not depend on baited hooks to catch fish. This absence of fishhooks, added to the relatively low occurrence of fish bones, suggests that fish did not play an important subsistence role.

The discovery of the segment of shell ring is an important addition to the Samoan artifact picture. Shell rings are recognized as an integral part of the Lapitan cultural assemblage (Green 1974e:254) and are shown by Poulsen (1968:88) in his collection from Tongatapu. It is impossible, without further excavation, to determine whether such shell rings were common to the culture being sampled and were manufactured locally, or whether they were a relatively rare import. Regardless, the occurrence in Jane's Camp midden of the ring segment, along with the branch coral files, worked bone, and *Conus* shell scrapers does give Samoa several early artifactual ties with Tonga which have heretofore been lacking (Green 1968:104).

SECTION 8

DIETARY REMAINS FROM JANE'S CAMP - A MIDDEN SITE

JOEL C. JANETSKI

INTRODUCTION

The tropical climate and acid soils of Upolu, Western Samoa, have been the source of some frustration for archaeologists inasmuch as these conditions apparently effectively accelerate the decomposition of bone, shell, and plant remains, which are, of course, the primary bases for dietary speculation and often provide much in the way of "fleshing-out" an understanding of the artifact assemblage of a site. Both Green (Terrell 1969:170) and Davidson (1974c:159) in their excavations at Vailele and in the Falefa Valley, respectively, comment on the deteriorating effects of the soil and the difficulties that the resulting paucity of artifactual and subsistence data impose in regard to cultural conclusions.

These frustrations are keenly felt in Samoa where evidence of prehistoric shell hooks and trolling lures have been much sought for but are thus far lacking. (An exception is the one-piece, *Turbo* shell fishhook found by Davidson [1969c:229] in "pre-European" midden deposits at Lotofaga; however, neither the photograph nor the drawing of Davidson's find are very convincing.) This apparent dearth of shell and bone fishing gear could be attributed to one or a combination of the following: (1) The artifacts are very scarce or do not exist; (2) They have been "consumed" by the soil; or (3) Artifacts are concentrated in specialized sites from which fishing was accomplished, and no such site has yet been uncovered in Samoa. In any case the results are identical: the Samoan archaeological record comes up lacking so far as revealing prehistoric fishing practices and other subsistence foci is concerned.

STRATIGRAPHY

Five strata were identified in Test I with Stratum I being the basal layer. Only Strata III, IV, and V were represented in Tests II, III, and IV. A complete description of the stratigraphy of the site can be found in Section 7 of this report.

DATING

A date of 2550 ± 50 B.P. has been derived from a *Tridacna maxima* shell from Stratum I. Stratum V was judged to be historical based on the occurrence of glass, metal, and a 1915 shilling.

PROCEDURE FOR DIETARY ANALYSIS

Once excavated, all artifacts and food scrap were washed and labeled; and after careful scrutiny, attempts were made at identification. Since none of the project members were malacologists, all identifications were derived from literature which pertained generally to the Pacific region inasmuch as no study on this subject specific to Samoa was available.

Although some shell fragments were of the "water-rolled" type mentioned by Davidson (1969c:242), the majority of the shell was judged to represent food scrap rather than wave-worn shells gathered with coral gravel to be used as flooring in the Samoan houses. This decision was based on the unworn condition of broken shell edges and the lack of any concentrations of coral gravel in the excavated portions of the site.

During the identification process it became apparent that some system of sorting the shells for minimum count needed to be devised. Five categories were subsequently labeled and defined as follows:

Whole. Whole shells were those that were not broken other than a crack or an insignificantly chipped edge.

Broken. The broken category presented the most difficulty in terms of definition as it was to provide an important percentage of the minimum count of the different species. Davidson's Table 25 (1969c:243) includes a minimum count, but she does not disclose how the count was derived. Andrews (1974:185), in an analysis of a shell midden on Isla Cancun on the Yucatan Peninsula, classifies shells as entire or as fragments. Entire specimens were those with more than one-half of the original shell present, whereas fragments represented less than one-half of the shell. However, the species which he examined were predominately large *Strombus costatus* and *S. gigas*. When these shells were shattered to extract the animal, the central whorl of the *S. costatus* or large lip of the *S. gigas* generally survived, giving a good basis for a minimum count. It was felt that the shattering of the shells of the smaller gastropods examined at Jane's Camp would seldom leave pieces that would represent more than one-fourth of the original shell. Therefore, it was decided that shell pieces judged as representing one-fourth or more of the shell would be classified as "broken" and included in the minimum count. Certainly the subjectivity involved in deciding whether or not a piece of shell represented one-fourth of the original, combined with lack of experience with shell, can have led to some overestimation of the numbers of animals utilized.

Broken to a pattern. This category emerged as the shells were examined and it was noted that certain shells were frequently broken in a similar way. This phenomenon was interpreted as resulting from a standardized breaking process in order to get at the flesh, a procedure which did not always shatter the shell. This was especially notable with the larger *Cypraea* species such as the *C. tigris*. Some examples of this are shown in Figure 18.

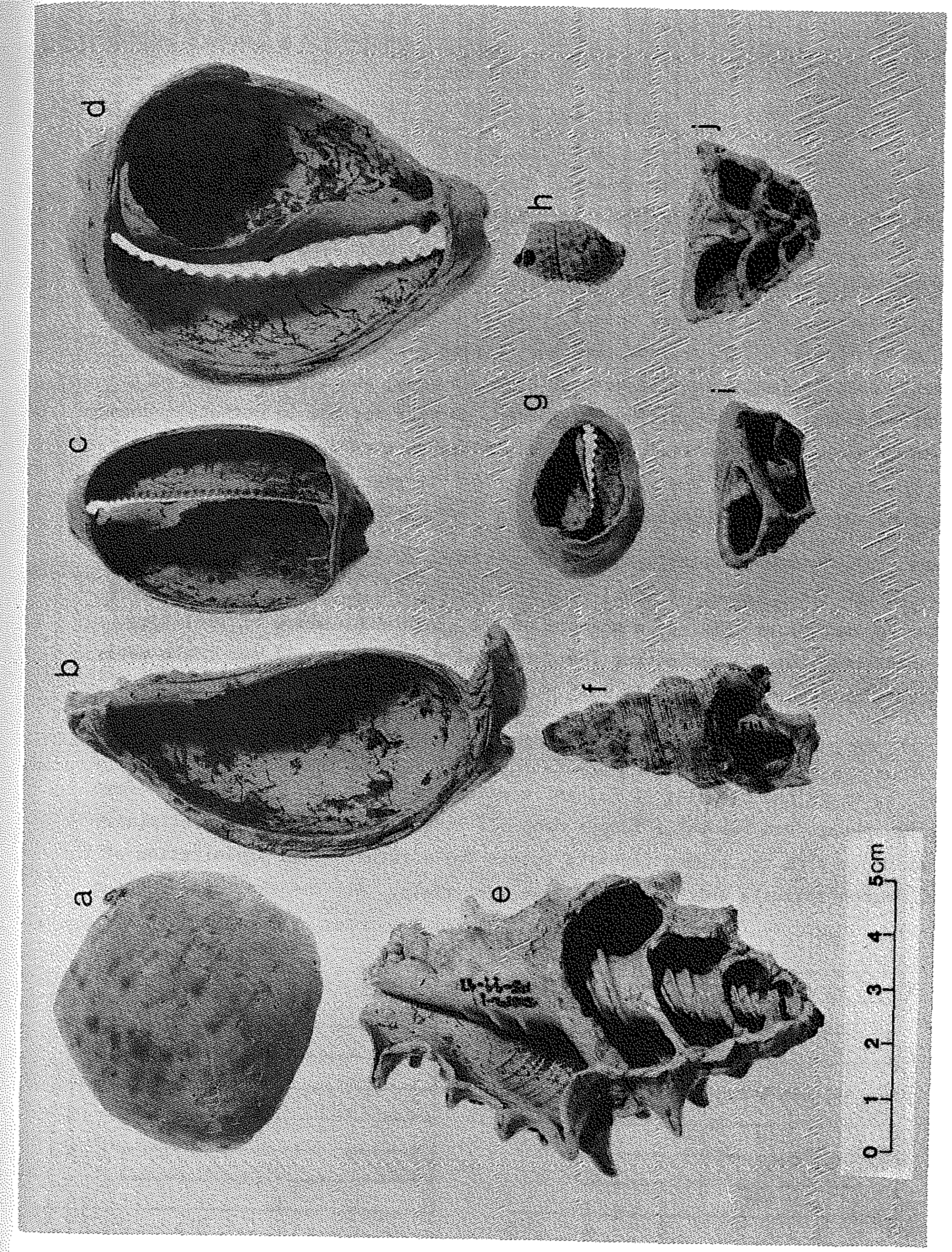


Fig. 18. SHELLS REPRESENTING THE "BROKEN TO A PATTERN" CATEGORY. a, *Cypraea tigris*, top. b, *C. tigris* split in half. c, *C. arabica* with top removed. d, *C. tigris* with top removed. e, Split Vasidae shell. f, *Cerithium nodulosum*. g, *C. caputserpentis* with top removed. h, *Cerithium* with top removed. i, *Trochus* shell, split. j, Split *Trochus* shell.

Worked. Shell, bone, or coral that appeared to have been shaped in a regular fashion and/or seemed to have been worn by activities other than wave or soil (chemical) were classified as "worked."

Fragments. Fragments were those pieces of shell smaller than one-fourth of the entire specimen.

The "broken," "broken to a pattern," and "fragments" categories were considered to be the most significant from a dietary standpoint. Certainly a whole shell would not be likely to represent an animal used for food whereas broken shells would be the expected result of the food-gathering process. An example supporting this assumption is provided by comparing the occurrence of *Cypraea annulus* with *C. tigris* and *C. arabica*. The *annulus*, a small cowry yielding little meat per animal, totaled 88 whole and 18 broken shells; the much larger *C. tigris* and *C. arabica* combined totaled 5 whole and 125 broken shells. It seems, then, that the larger cowries were gathered, broken, and the meat apparently consumed, while the small *annulus*, although gathered, perhaps for use in personal adornment, were not commonly broken for subsistence purposes. Although the "broken" and "broken to a pattern" groups were included in the minimum count, the "fragments," also an expected result of food gathering, were not represented.

Therefore, in addition to establishing minimum counts of individual species, it was decided to weigh the total amount of shell from the corresponding strata of Tests I and II. From these two approaches we obtained a measure of the grams and numbers of shell per cubic meter excavated. Graphs reflecting the grams and numbers of shell per cubic meter in the sample strata are shown in Figure 19.

DIETARY INTERPRETATIONS

The reef lagoon in the vicinity of Faleasi'u extends seaward for 1 to 1.2 km before the reef margin appears and the outer slopes drop off into the Pacific. The preliminary subsistence evidence from the midden deposits speaks for a rather broad exploitation of the protein-rich, lagoon mollusks which inhabit these reef flats. All the shellfish species

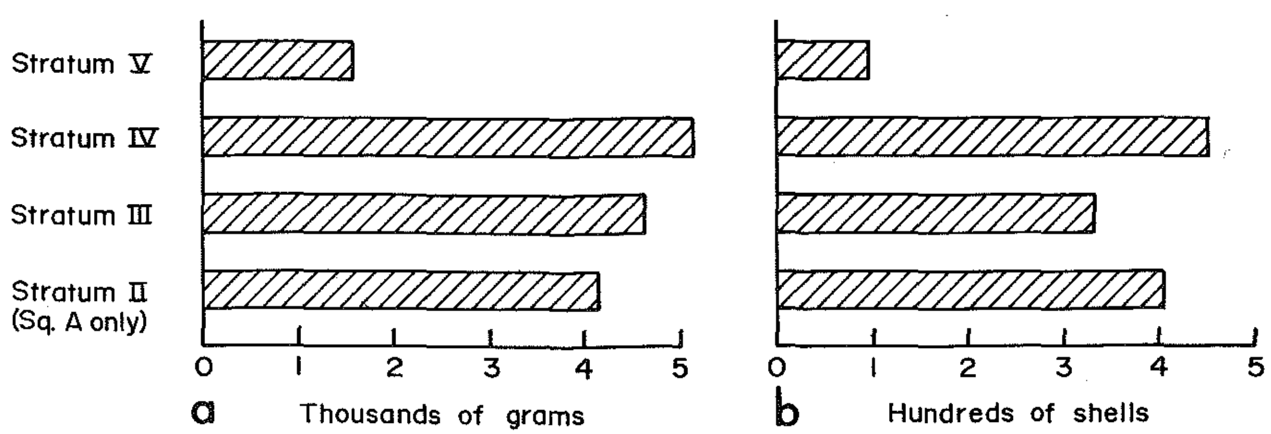


Fig. 19. a, Grams of shell per cubic meter in SUF1-1. b, Number of shells per cubic meter by stratum in SUF1-1 (combining Test I Sq. A; Test II Sq. E and F).

identified in the midden are available within the lagoon (Wiens 1962:256-262; Kay and Switzer 1974:278-282). The percentages show that the single preferred shellfish family, bivalve or gastropod, was the Cypraeidae with the *Cypraea arabica* and *C. tigris* the most popular species within the *Cypraea* group. Among the bivalves the *Gafrarium pectinatum* of the Veneridae family and the *Quidnipagus palatum* of the Tellinidae family were most commonly encountered. More than 50 shellfish families and/or species have thus far been identified (see Table 3).

Table 3. LIST OF SHELLFISH IDENTIFIED AT JANE'S CAMP MIDDEN

GASTROPODA

BUCCINIDAE

BULLIDAE

BURSIDAE

CASSIDIDAE

CERITHIDAE
Cerithium nodulosum

CONIDAE
Conus bandanus
C. eburneus
C. litteratus
C. marmoreus
C. puncticulus

CYPRAEIDAE
Cypraea annulus
C. arabica
C. caputserpentis
C. erosa
C. tigris

EPITONIDAE

FASCIOLARIIDAE

MURICIDAE
Murex ramosis
Thais amigera
Pupera tubrosa

NATICIDAE

OLIVIDAE

STROMBIDAE
Canarium microurceum
Lambus truncata

TEREBRIDAE
Maculata

TROCHIDAE
Tectus pyramis
Trochus niloticus

TURBINIDAE
Turbo argyrostomus

VASIDAE
Turbinellis

BIVALVIA

ARCIDAE
Arca antigerata

ASAPHIDAE

CARDIIDAE
Cardium flava
C. fragum (?)

LUCINIDAE
Cadokia tigerina

SPONDYLIDAE
Spondylus ducalis

TELLINIDAE
Quidnipagus palatum

TRIDACNIDAE
Tridacna gigas (?)
T. Maxima
T. Squamosa (?)

VENERIDAE
Gafrarium pectinatum

The presence of vegetable foods is indirectly evidenced by the occurrence of two scrapers of *Conus* shell, one of *Cypraea tigris* shell, and one of *Turbo* shell. Such tools are traditionally used for peeling taro and breadfruit and may represent a certain dependence on these crops. No coconut graters were identified.

A comparison of Faleasi'u with the Lotofaga midden (Davidson 1969c) reveals that, regarding food scrap, both could be considered what Davidson labels "non-concentrated" middens (Davidson 1969c:234). Faleasi'u appears to be considerably richer in shellfish remains than Lotofaga, although it cannot be classed with the "concentrated" middens of Tonga and New Zealand. Also, Faleasi'u did not, in the test excavations, have the concentrations of stone and coral such as those encountered at Lotofaga. *Cidarus* spines as well as many of the same species of shellfish occurred at both sites, although at Lotofaga *Turbo* shells predominated, whereas the *Cypraea* was the most common at Faleasi'u.

Another difference between the sites is the occurrence of pig bone. At Lotofaga, for instance, pig bone was found in nearly every stratum, but at Faleasi'u none was identified although some 51 bone fragments and 25 turtle carapace bones were found. This apparent lack of pig bone at Faleasi'u may be a function of the temporal difference between the two sites; Lotofaga dates no earlier than 820 B.P. (Davidson 1969c:232) while Faleasi'u, excluding Stratum V which is considered historic, has no dates later than 2000 B.P. It is possible that pigs had not yet been introduced to Samoa at the time the early midden deposits at Faleasi'u were laid down.

The answer to the question of when the pig made its appearance in Samoa is an important one since, as suggested by Groube (1971:311), its absence may imply less dependence on horticulture and more on intensive reef exploitation. Although much more data are needed before other than very general inferences can be made, present information from Lotofaga and Faleasi'u seems to support such a shift in subsistence habits, that is, a gradual movement from a greater to a lesser dependence on reef foraging and from a lesser to a greater dependence on horticulture and domesticated animals.

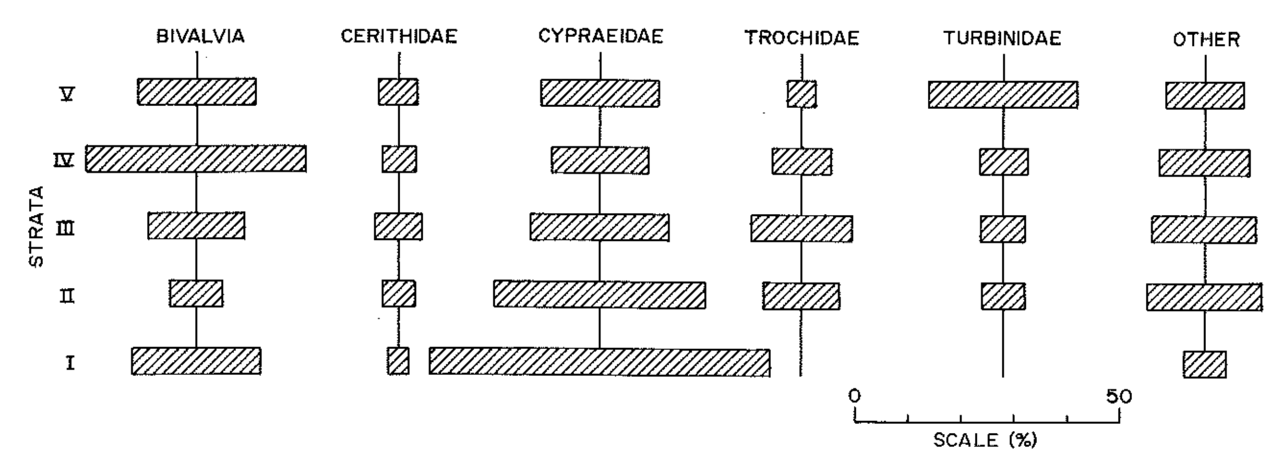


Fig. 20. RELATIVE FREQUENCY OF SHELL SPECIES BY STRATUM.

DIETARY CONCLUSIONS

The location and subsequent sampling of the Faleasi'u midden has provided students of Western Polynesia with some new data from Western Samoa. Basically, this is in the form of identifiable food scrap from which tentative conclusions about subsistence patterns can be made.

Evidence points to an early Christian era economy which practiced an extensive exploitation of lagoon fauna. According to the evidence from the sampled portion of the site, this reef exploitation pattern persists and expands through time climaxing in Strata III and IV and decreasing markedly in Stratum V. The most commonly occurring remains in the deposit were of shellfish followed by slate-pencil sea urchin spines, reef fish, turtles, and possibly some sea birds. The role of chickens, dogs, and pigs as additional protein sources is, at this point, viewed as minimal at best owing to the absence of bones from dogs and pigs and but scanty evidence for the chicken. Shell scrapers may be evidence of horticultural activity although this cannot be supported by pollen analysis since pollen was lacking in the Faleasi'u midden as it generally is in Samoan soils. On the other hand, the absence of pig remains may be circumstantial evidence against horticultural dependence if, as Groube (1971:311) suggests, the two are usually associated.

More general consequences deriving from the mere existence of an early shellfish midden in Samoa could include a re-evaluation of earlier subsistence conclusions based on the absence of such middens in Samoa (Groube 1971:312; Green and Davidson 1974b:279). Such re-evaluations may result in viewing early Tongan-Samoan cultures more as concomitant groups with influences flowing in both directions rather than as precedent-subsequent developments. Such a view is in accordance with opinions held by Green (1974e:254) and Jennings (1974 Ms.).

As is apparent from the above comments, there are still many gaps in the data from Faleasi'u regarding Samoan subsistence. Among them the lack of pig, the scanty chicken evidence, and the persistent absence of the fishing gear, which Suggs (1960:89) claims the early inhabitants of Western Polynesia brought with them, are some that clamor for an intensive excavation of the sampled deposits at Faleasi'u.

SECTION 9

A PRINCIPAL COMPONENTS ANALYSIS OF SAMOAN CERAMICS

HOWARD L. SMITH

The archaeological work done in Samoa between 1957 and 1969 by Green and Davidson and the recent discovery of Lapita ceramics from Upolu (Green 1974c; Jennings 1974) have resulted in a reasonably complete and controlled collection of Samoan ceramic material. This collection has been augmented by pottery from Jane's Camp, with the result that the known time span and spatial distribution of ceramics in Samoa have been extended. Consequently, it would appear that data are complete enough to support an attempt at classifying the Samoan ceramic material.

Typology of this material is at a rather rudimentary stage at present. Golson (1971:75) has proposed that the term "Lapitoid series" be used to designate the entire Samoan ceramic sequence, as well as the related, Lapita-derived pottery from other islands in the region. Green, however, takes issue with Golson's proposal, on the grounds that the use of a single term for the entire tradition obscures significant developments in the ceramic sequence (Green 1974d:249-250). As a result of his analysis of Samoan ceramics from the SUVa-1 and SUVa-4 mounds at Vailele (Green 1969c; Terrell 1969:170-175) and from the prehistoric occupation at Sasoa'a (Green 1974b), Green feels that he has established the major temporal trends in the Samoan ceramic tradition. These consist primarily of changes in rim form and vessel shape, temper material, surface decoration, and paste texture. Green concludes that a largely undecorated ware, for which he proposes the term "Samoan Plain Ware," developed out of the ancestral Lapita ceramics. This pottery is characterized by a more restricted range of rim and vessel shapes than Lapita pottery and is replaced toward the end of the sequence by a type or variety of pottery characterized as being thicker, coarser textured, and containing temper material not found in the earlier pottery (Green 1974d:249-252). Having established these trends, Green did not consider a wider range of technologically oriented variables, on the assumption that they will not be as sensitive to change through time as are stylistic characteristics (Green 1974d:251).

In the light of the current state of ceramic typology in Samoa, the purpose of this analysis can be viewed as threefold: (1) to provide an independent test of Green's conclusions utilizing material from a new location and different time period; (2) to make the first controlled and extensive comparison between Ferry Berth Lapita ceramics and the later Samoan pottery; and (3) to attempt a meaningful and useful classification of the present

Samoan ceramic material using a wide range of both stylistic and technological variables. It was believed that even if the present analysis entirely supported Green's conclusions, a more complete description of his types, involving more than the limited number of characteristics dealt with by him, was desirable.

The analysis was conducted with a sample of 705 sherds from a collection of 1,792 sherds recovered during the Utah Museum of Natural History's excavations on the island of Upolu, Western Samoa. Ceramic material was recovered from three separate sites along the northwestern shore of the island.

Most of the collection (1,642 sherds) was recovered from Jane's Camp, a stratified coastal shell midden located in the village of Faleasi'u. Pottery was found in quantity in four of the five major strata (Table 4), in association with concentrated deposits of shell, basalt adzes, coral and sea urchin spine files, and other dietary and artifactual remains (Section 7, Section 8). Shell from the basalar stratum yielded a radiocarbon date of 2550 ± 50 B.P. Pottery from this site apparently resembles that found at various other localities on Upolu. It ranges in color from dark red-brown to beige (2.5YR3/2 to 10YR6/3) on the Munsell color charts, and is tempered with material similar to that previously reported for Samoan pottery (Appendix, this volume). The predominant vessel form is the bowl with incurved rim (Fig. 21). Surface decoration is absent, with the exception of three or four sherds which show modeling or incision (Fig. 21b, c). Approximately 8% of the collection is colored with a bright orange (2.5YR5/8) fugitive wash, and one sherd has a light beige, lustrous slip on the exterior surface.

Seventy-three sherds were recovered from the Paradise Site (SUVs-1) in the village of Vaiusu. Pottery occurred in deposits adjacent to a low coastal mound and underlying

Table 4. PROVENANCE OF JANE'S CAMP CERAMICS*

	Strata	Test I	Tests II-IV	Total, Tests I-IV	Thick Ware 10 mm and over	Feldspathic Temper	Orange Ware
	V	14	1	15	2	4	0
	IV	22	308	330	18	17	1
	III	32	225	257	16	4	28
	II	112	-	112	4	1	1
	I	224	-	224	10	3	0
Total		404	534	938	50	28	30
Uncertain Provenance				704	43	25	18
Total				1,642	93	53	48

*Columns designated "Thick Ware," "Feldspathic Temper," and "Orange Ware" refer only to sherds in the sample used for analysis.

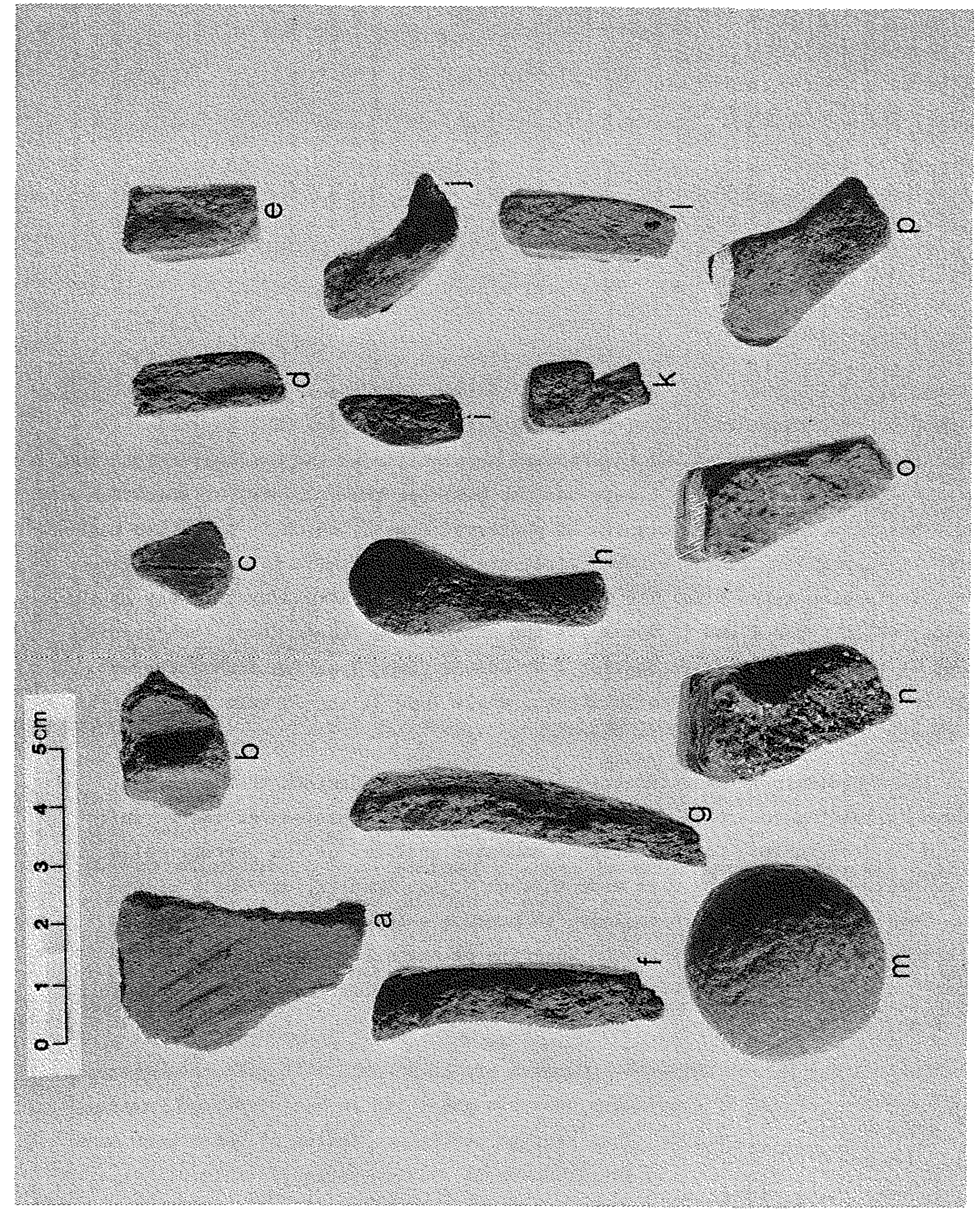


Fig. 21. CERAMICS FROM JANE'S CAMP. a, Irregular striations on sherd surface. b, Modelling. c, Incising. d and e, Possible coil construction. f, h, i, j, k, l, o, and p, Type II, variety A rims. g and n, Type II, variety B. rims. m, Stone ball.

a modern garden to the west. The condition of the pottery may indicate secondary deposition, as the sherds are badly eroded. Little or none of the original surface remains, but in other respects the Paradise ceramics appear to resemble those from Jane's Camp.

Materials were also collected from the Ferry Berth Site near the Mulifanua Wharf on the west end of Upolu. Seventy-seven sherds of Lapita ceramics were obtained from material originating in an offshore lens of cultural deposits discovered during dredging operations. This lens was overlain by a layer of cemented coral and shell, 1 meter thick, and lay in some 2 meters of water (Jennings 1974a:176). Pottery from this same source is described by Green (1974c).

Approximately one-half of the total collection, including all of the Ferry Berth and Paradise sherds, was examined in Samoa. This preliminary analysis involved the evaluation of every sherd for each of four different characteristics: wall thickness, surface friability, gross paste texture, and surface color. The collection was sorted into groups on the basis of one characteristic at a time, and the resulting classes were checked against stratigraphic position at Jane's Camp, the only site with significant stratigraphy. The variables of friability and color were discarded, as they showed no significant temporal variation, and the entire collection was sorted into classes on the basis of the variables of thickness and texture. This resulted in three classes of pottery: Type I, which is thick and coarse-textured; Type II, a thinner, finer-textured ware; and Type III, which is extremely fine-textured and variable with respect to size. Type III is composed almost exclusively of the Lapita ceramics, while Types I and II encompass the sherds from Jane's Camp, the Paradise Site, and some of the Lapita sherds. In Test I at Jane's Camp, Type I sherds occurred predominantly in the two upper prehistoric strata, while Type II sherds were found in the two basalar strata.

Although these preliminary results were suggestive, it was decided that a more rigorous procedure leading to a more detailed description and comparison of the ceramic materials would be profitable. Consequently, a computer analysis of the pottery collection was begun. Initially, arrangements were made through M. Ann Bennett, currently of the University of Utah Department of Anthropology, to procure a copy of the SELGEM program used at Eastern New Mexico University in the analysis of Anasazi ceramics. Coding was originally done on a form (shown in Figure 23) which is a modification of the coding format presented in Bennett (1974).

When the Eastern New Mexico University program proved incompatible with the University of Utah's computer, the principal components analysis presented in Wahlstedt and Davis (1968) was selected as an alternative. This program performs a series of operations on the original variables which results in the grouping of related variables into principal components. A principal component represents a new variable which is independent of other components and which may also represent a functionally related set of the original variables. In operation, the program selects the three principal components which account for the largest amount of variation in the sample and, using them as the axes of a graph, plots the position of each sherd with respect to each of the three possible pairs of components.

Much of the original data, which was coded for use with the SELGEM program, had to be recoded for the principal components analysis. In many cases this took the form of entering the original ordinal values as such. Other variables had been assigned values representing a range of actual measurements (for example, filler size was originally coded on a 5-point scale, representing the ranges 0-0.25 mm, 0.25-0.5 mm, 0.5-1.0 mm, 1.0-2.0 mm, and more than 2.0 mm). In cases of this type a median value for each range was assigned to the sherds falling within that range. In this manner, a total of 30 variables were coded for the entire sample. For a complete list of these variables, see Table 5.

The Wahlstedt and Davis program is designed to perform calculations on either a covariance matrix or a correlation matrix. The correlation matrix was selected as more appropriate to the ordinal type of data employed in this analysis. Further, it results in unweighted variables which are independent of their actual coded values (Wahlstedt and Davis 1968:1), and therefore eliminates the possibility of a single variable dominating the results by virtue of its larger measured values.

With coding problems resolved, data could be analyzed. Unfortunately, results of the initial computer run were unsatisfactory because the variables selected for principal components were largely of little cultural significance. For example, the first component,

Table 5. CERAMIC ANALYSIS VARIABLES

Variable	Type of Data	Variable	Type of Data
GENERAL		SURFACE CHARACTERISTICS	
1. Wall Thickness	Interval	16. Exterior evenness	Ordinal
2. Texture	Ordinal	17. Exterior texture	Ordinal
3. Compactness	Ordinal	18. Exterior luster	Ordinal
4. Exterior color-hue	Ordinal	19. Exterior temper protrusion	Ordinal
5. Exterior color-value/chroma	Ordinal	20. Interior evenness	Ordinal
6. Interior color-hue	Ordinal	21. Interior texture	Ordinal
7. Interior color-value/chroma	Ordinal	22. Interior luster	Ordinal
8. Paste color-hue	Ordinal	23. Interior temper protrusion	Ordinal
9. Paste color-value/chroma	Ordinal		
10. Core color	Ordinal	SURFACE FINISH	
11. Core positions	Ordinal	24. Impressing	Nominal
12. Core thickness	Ordinal	25. Scraping	Nominal
		26. Slurry	Nominal
SURFACE CONDITION		27. Slip	Nominal
13. Wear	Ordinal	28. Filler type	Nominal
14. Pitting	Ordinal	29. Filler density	Interval/Ordinal
15. Crazing	Ordinal	30. Filler size	Interval/Ordinal

which accounts for the largest amount of variability in the sample, was composed of the variables of surface wear, interior and exterior evenness, surface texture, and surface luster. This component is clearly a complex of variables dealing with surface condition, and serves to distinguish the Paradise and Ferry Berth sherds from the Jane's Camp pottery. While this could indicate differences in manufacturing technique or in clay composition, it seems more likely to be the result of postdepositional factors, particularly in light of the different conditions of preservation at the three sites. Evidence from the Paradise Site, although equivocal, may indicate redeposition of the ceramic material; and the Ferry Berth ceramics, because of their offshore origin and method of recovery by means of a dredge pipe, have been subject to considerable wear. In contrast, there is no evidence of large scale redeposition at Jane's Camp. Furthermore, the predominantly sandy soil which constitutes the midden deposits may have been much less damaging to cultural remains than clay soils elsewhere. Such a possibility is indicated by the fact that bone and shell from Jane's Camp were noticeably less decomposed than similar, probably younger, material from other excavations on Upolu. Whatever the cause, ceramics from this site are much less worn than those from either of the other two sites, and values for such variables as texture, evenness, and luster are therefore distinctive.

Among the other variables selected in the initial run were: core color, core position, core thickness, and temper protrusion. These characteristics seem unlikely to reflect culturally significant practices, but rather are more likely to be the result of more or less random factors.

As a result of the selection of variables on the initial computer run, the groupings in the initial plot were insignificant. Therefore, a total of nine variables, consisting of core color, core position, surface wear, interior and exterior texture, interior and exterior luster, and interior and exterior temper protrusion, were eliminated from the analysis, and a second run was made using only 21 variables. The results of this analysis are presented in Figure 22. The horizontal axis in this plot (Component I) represents a total of six of the original variables: ware texture, paste compactness, paste hue, paste value/chroma, filler size, and filler density. Each variable contributes to the component in roughly the following percentages: ware texture, 17.6%; paste compactness, 12%; paste hue, 20.1%; paste value/chroma, 21.4%; filler density, 10%; and filler size, 5.1%. Sherds located toward the right of Figure 22 are finer textured, with smaller and fewer temper particles, and more compact paste, which tends to be redder and/or darker than the paste of the other sherds. Component 1 can be easily interpreted as representing a complex of variables related to paste character, since four variables reflect paste texture and the other two paste color. For this reason, Component I, is designated as the "Paste Index" in Figure 22.

Component II forms the vertical axis in Figure 22 and is composed mainly of surface color variables in the following percentages: exterior hue, 27.88%; exterior value/chroma, 33.07%; interior hue, 7.4%; and interior value/chroma, 15.08%. Sherds located toward the bottom of the plot have redder or darker surface colors than those located toward the top

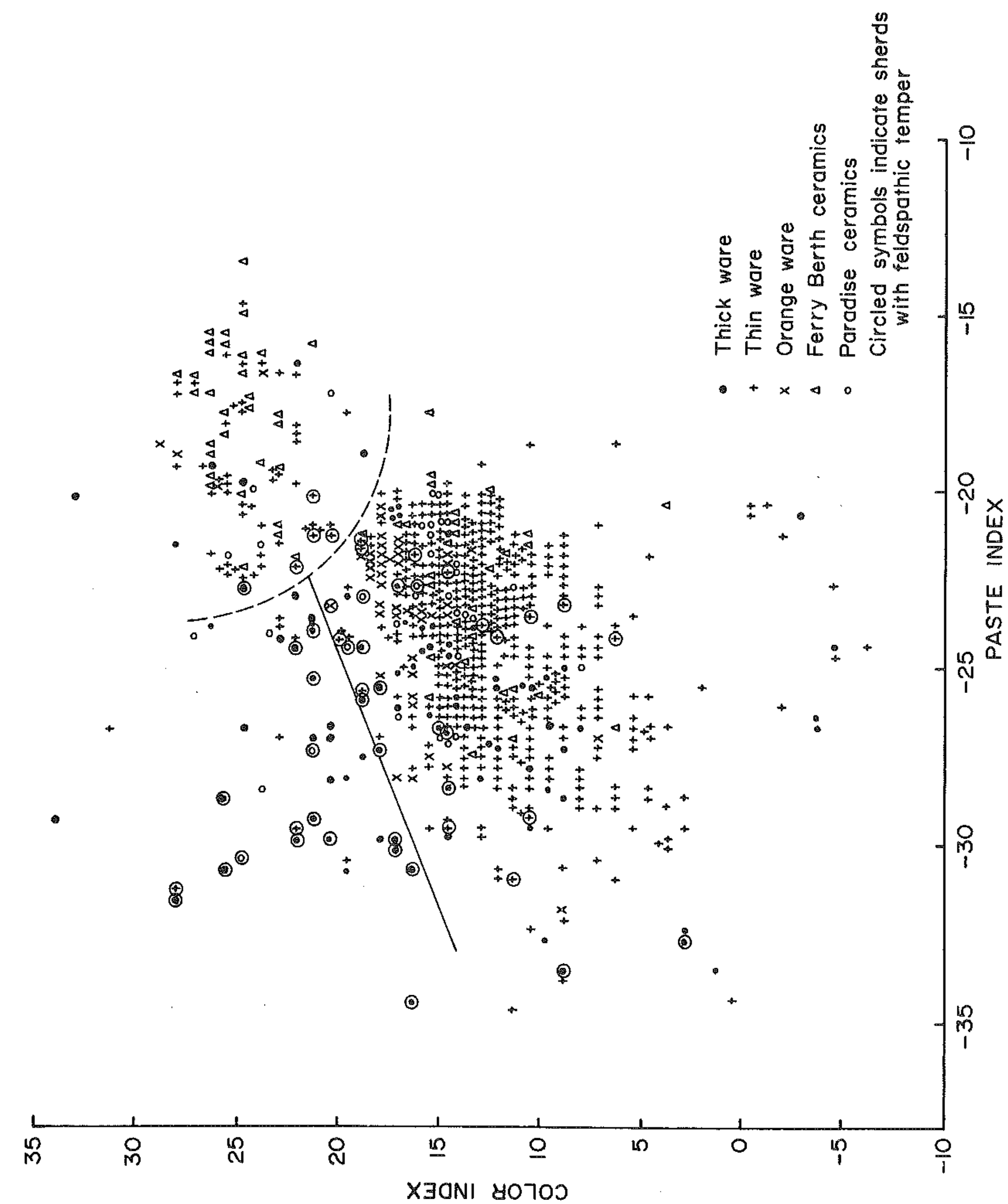


Fig. 22. SCATTERGRAM OF PASTE INDEX AND COLOR INDEX.

of the figure. That is, orange, brown, and yellow colored ceramics tend to fall in the upper portions of the plot and red and gray ones toward the bottom. Component II is referred to as the "Color Index" in Figure 22.

Component III, which is not shown, is composed of five major variables: wall thickness, 9.41%; exterior evenness, 19.33%; interior evenness, 18.38%; filler type, 13.36%; and filler size, 7.6%. It does not appear possible to interpret this combination of variables in any meaningful fashion.

Symbols used in Figure 22 correspond roughly to the tentative types assigned during the preliminary analysis, except that all Lapita ceramics are designated with a single symbol, as are all the Paradise sherds. Further, sherds containing temper material of the feldspathic type are designated by a symbol enclosed in a circle. An arbitrary thickness of 10 mm or more was used to define those sherds labeled as "Thick Ware" and any sherd with an orange wash was designated "Orange Ware." The remaining Jane's Camp ceramics are classed as "Thin Ware." These classes are not meant to be particularly significant, but are used only as convenient tags which should bear some relationship to chronology, since it is known that Lapita ceramics predate other Samoan pottery, and the preliminary analysis and Provenance Chart (Table 4) indicate that thick coarse sherds increase in frequency through time.

The initial impression given by Figure 22 is generally one of an absence of differentiation in the sample. An intense cluster of sherds is located in the neighborhood of coordinates (-29,15) with the remainder of the sample scattered at various distances from this point. There is no comparable second cluster of sherds. This emphasized the essentially homogeneous nature of the sample. However, some general tendencies with respect to differential location are apparent. A weaker and more diffuse group, which is delineated by a dotted line, is located in the region of coordinates (-22,24). This grouping represents a subset of the total population which differentiates itself on the basis of finer texture and more compact paste, fewer and smaller temper particles, paste colors tending toward gray and red, and surface colors in the orange, brown, and yellow ranges. It is obvious that there is no one-to-one relationship between these clusters and any meaningful division of the sample with respect to chronology or geography. However, there is a fairly marked tendency for the Lapita ceramics to fall in the area above and to the right of the dotted line. While Ferry Berth sherds comprise only 8.97% of the total sample, they constitute 33.3% of the sherds in the group above the dotted line; 50.8% of Lapita sherds fall in this area, compared with only 9.9% of the total Jane's Camp collection and 12.5% of the Paradise ceramics; 10.5% of the "Thin Ware," 8.3% of the "Orange Ware," and 7.4% of the "Thick Ware" sherds fall in this group. There is, then, a fairly strong tendency for the Lapita pottery to differentiate itself from the rest of the collection on the basis of those characteristics which define the cluster above the dotted line.

A second tendency is apparent in Figure 22 with respect to the location of the "Thick Ware" pottery. Although the tendency to cluster is markedly less than with the Lapita sherds,

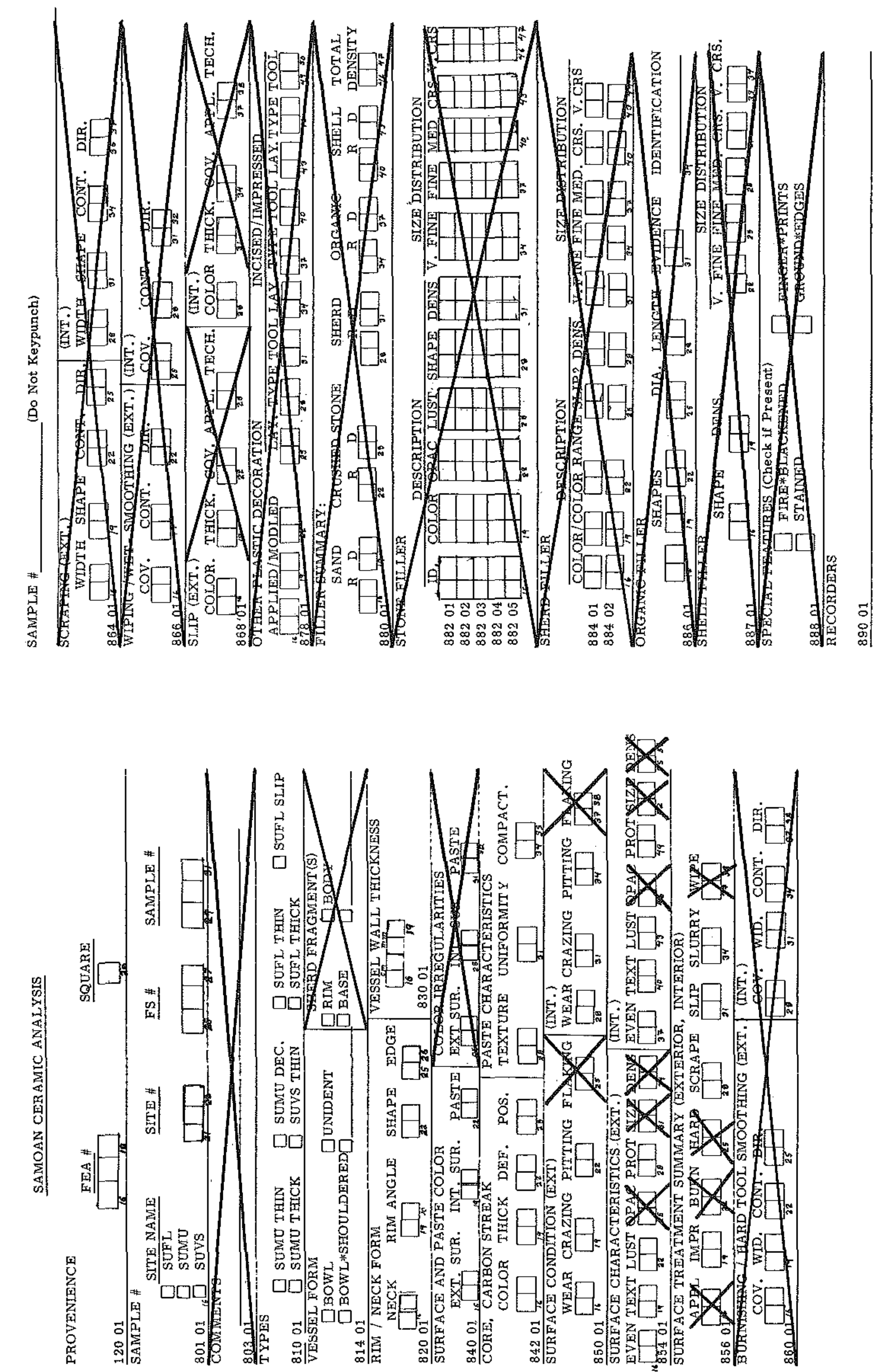


Fig. 23. CODING FORM DEVELOPED FOR SAMOAN CERAMIC MATERIAL FROM FORMAT PRESENTED IN BENNETT (1974), WHICH SHOULD BE CONSULTED BY INTERESTED PARTIES. Crossed-out areas proved to be insignificant variables, and were not used in the final analysis.

the thick pottery tends to fall in the upper left-hand portion of the figure. Of the sherds which are 10 mm or more in thickness, 30.1% fall above the solid line in Figure 22, as compared with no Lapita pottery, 15.6% of the Paradise, and 1.7% of the "Thin Ware" sherds. An additional 7.5% of the thick sherds are located below the solid line but toward the left-hand side of the figure, demonstrating a further correlation between coarse texture and thickness. There is, then, a slight tendency for "Thick Ware" sherds to sort into roughly the same surface color range as the Lapita ceramics, but at the opposite end of the paste index scale.

CONCLUSIONS

In general, results of this analysis are consistent with what has been previously published concerning the Samoan ceramic sequence. The homogeneous nature of the sample analyzed here reflects the common tradition which connects the Lapita ceramics of about 3000 B.P. and the later plain ware. This demonstrated similarity would clearly seem to support Golson's suggestion that the entire ceramic sequence might properly be referred to as a Lapitoid series. Such a nomenclature would indicate the common origin of the ceramics of Western Polynesia.

However, there are considerations which support subdivision of this term. Types constructed so as to represent the chronological sequence of changes in the Samoan ceramic tradition would be of obvious value in future excavations in the islands. Further, a more complete description of the technological trends involved in the decline of Samoan ceramics may provide data which will be of use in understanding this decline.

It is apparent from inspection of Figure 22 that the information contained in this plot, in conjunction with that given in the two plots not shown, is sufficient to propose a typology of Samoan ceramics. This would involve the definition of two types, one of which is composed of two varieties. Type I, defined on the basis of fine texture, compact paste, and other characteristics previously enumerated, would consist of that group which lies above the dotted line in Figure 22. The remainder of the collection would constitute the second type, and could be further divided into two varieties on the basis of those characteristics discussed with respect to the thick sherds. Unfortunately, the types so defined could be used only as descriptive categories, since there is little apparent connection between them and either chronology or spatial distribution. For example, only about one-half of the Lapita pottery from the Ferry Berth Site would fall into Type I, with the remaining half in the finer textured variety of Type II. In effect, this means that both types span the entire Samoan ceramic sequence. This division of the ceramic collection, which is after all inherent in the material, may indicate a continuing tradition of plain and fancy pottery. However, it seems more likely that it is the result of nothing more than the variation present in the sample.

It does appear that types of temporal significance can be constructed if the information contained in Figure 22 is combined with data on rim and vessel shape obtained from inspection of the present sample and from review of the relevant literature. In effect, this approach entails the correlation of the temporal sequence established by Green with respect to stylistic variables with the trends defined by the present study of largely technological variables. It should be emphasized that the types so defined represent more or less isolated points on a temporal continuum. Consequently, as the Samoan archaeological record becomes more complete, the discreteness of the types, which is not particularly marked to begin with, will probably disappear (compare Ford 1954:51-52). Nevertheless, the following types can be constructed within the Lapitoid series so as to represent the early and late extremes of the Samoan sequence as well as a midpoint between the two.

TYPE I--LAPITA PROPER

Lapita pottery is characterized by a relatively wide range of vessel shapes, including simple bowls, flat dishes, and jars. Distinctive rim forms include collared and everted forms which are rare or absent from the later ceramic collections. Of the 16 rims pictured and described by Green (1974c) only one or two are incurved, but none of the five rim sherds in the sample analyzed in this report can positively be described as incurved. The most common forms appear to be the everted rim with rounded edges and collared rims, such as those shown in Green (1974c:172).

Typical decoration of Lapita sherds includes dentate stamped designs, incision, and an occasional applique. In addition to the red slip reported by Green (1974c:171) there is also a steel gray lustrous slip present on eight sherds in this sample.

Paste texture of the Lapita sherds ranges from the sandy, friable, and somewhat rough texture, which represents the modal rank of the present sample, to a smooth, hard, and almost vitrified paste. The majority (85.5%) of the Lapita sherds are finer textured than the modal texture for the entire sample, and 35.5% present the almost vitrified appearance, which is all but absent from the rest of the collection. Paste compactness of the Lapita sherds varies from the mode for the entire collection, consisting of the presence of flat open-air pockets covering between about 5% and 10% of the surface area of a freshly broken cross section, to the most compact extreme in which air pockets are only hairline gaps in the paste and fill less than 5% of the surface. Of the Lapita ceramics, 74% are more compact than the mode, and 24% display the most compact condition, which does not occur in the rest of the sample.

All of the Lapita ceramics are tempered with ferromagnesian tempers, almost exclusively (93.7%) in the 0.0-0.5 mm size range.

Surface color ranges from a slightly yellowish brown (10YR4/2) to a dark reddish-brown (2.5YR3/2) with the majority of the sample (53%) in the gray-brown or brown range, (10YR4/2-5YR4/3). Paste color varies from a dark red-brown (2.5YR3/2) to gray-brown (10YR4/2). A portion of the sample, 71.7%, falls in the range from dark red-brown to orange-brown (5YR5/6).

TYPE II--SAMOAN PLAIN WARE

Variety A

This variety of Plain Ware is characterized by a more restricted range of vessel shapes. With only one apparent exception, Green (Terrell 1969:174, Pl. 17) reports only a simple bowl shape. Rim sherds from the collection analyzed here (Fig. 21j, k) confirm that the jar is present, and a few sherds may indicate a shouldered jar or bowl, but the overwhelming shape is clearly the open bowl. Rim forms are almost completely restricted to incurved rims with parallel or slightly expanded lips (Green 1974b:124-125; Fig. 21f, g, i). Tapered rims (Fig. 21i), everted rims (Fig. 21h), and collared forms (Fig. 21k) are rare.

Surface decoration is limited to incision of the rim area in a small percentage of Green's sample (1974b:128) and is virtually absent from the Jane's Camp sherds; 12.8% of the analyzed sherds have a bright orange fugitive wash.

More than 50% of the Variety A sherds fall in the modal rank for paste texture described above, with 30.7% in the next finer category. Almost 70% of these sherds occupy the modal position with respect to paste compactness, with 12.5% more compact and 18% in the least compact category, in which a cross section displays many open air pockets and a generally "chunky" appearance resulting from the many gaps in the paste.

Variety A sherds are tempered with ferromagnesian filler materials, 83.4% of which fall in the 0.0-0.5 mm size range.

Surface color of this variety shows the same range as the Lapita ceramics, but with a much stronger tendency to cluster in a narrow range of colors. Sixty per cent of the sample is dark brown (5YR3/2) to orange-brown (5YR5/6) in color. Paste color ranges from dark red-brown (2.5YR3/2) to a slightly yellowish brown (10YR3/3) with a similar distribution as for the Lapita ceramics.

Variety B

This variety represents the final stages in the production of Samoan pottery and is consequently characterized by the most limited range of vessel and rim forms. No shape other than the bowl is reported by Green, and no others are apparent in the sample studied here. Rim forms are restricted entirely to the incurved, flat-lipped type (Fig. 21g, n; Green 1974b:120).

Texture of the Variety B sherds varies from the modal rank to the coarse extreme, with 57.7% of the sherds coarser than the mode. Paste tends to be somewhat more compact than the Variety A pottery, with 70% more compact than the modal rank for Variety A.

Filler is of the feldspathic variety, with temper particles ranging from 0.25 to over 2.0 mm in size; 73.6% of the sample falls in the 1.0 mm or larger size range.

Surface color varies from dark red-brown (2.5YR3/2) to light brown (10YR6/3) with 57.7% of the sample in the dark-brown (5YR3/2) to orange-brown (5YR5/6) range. Paste color

varies from red (2.5YR4/4) to gray-brown (10YR4/2) with the majority of the sample (71.1%) in the range from dark red-brown to orange-brown.

It should be obvious from the above descriptions that there is a considerable amount of overlap in the proposed types. This serves to emphasize their relationship as arbitrary points along a continuum of declining quality and elaboration of ceramics in Samoa. Even in the realm of stylistic variables it can be seen that this is a gradual development and there do not appear to be discrete groups inherent in the material itself. For example, rim forms in the Jane's Camp collection are somewhat more elaborate than those reported by Green, which is perhaps to be expected since they are also slightly earlier in time. This analysis clearly indicates the gradual nature of the decline of the Samoan ceramic tradition. It is to be hoped that the descriptions given above illustrate relative position on the chronological continuum described.

SECTION 10

SUMMARY AND EVALUATION

JESSE D. JENNINGS

The report above contains descriptive, analytic, and comparative data. It represents a distillate of most of the useful information generated by the University of Utah Samoan Archaeology Program research. As has been mentioned, the program was conceived as both a survey and a sampling excavation activity. The findings exceeded expectations. What is intended here is a mere listing of the highlights of the study.

Of greatest interest to most readers is the discovery of the midden at Faleasi'u called Jane's Camp. Good evidence of an early fishing camp on Upolu or any of the other Samoan Islands has hitherto been completely lacking except for a very thin deposit near Lotofaga reported by Davidson (1969c). Therefore the fishing camp is, to date, unique by virtue of its depth, size, and richness. Although similar locations undoubtedly await discovery, it so far stands alone. The site was used, perhaps not continuously, for several hundred years and was clearly stratified. It yielded pottery of two varieties, remains from various reef-dwelling animals, and a few artifacts. Its contribution to knowledge of the beginnings of Samoan culture are therefore considerable. These contributions include the suggestion that 2,500 years ago the Samoan subsistence base was heavily reef oriented. There was no evidence of the pig or dog, although the chicken was present. There was found only one of the artifacts associated with agriculture; specifically, these were probable shell peelers. One or two pieces of shell may be fragments of fish lures, but one cannot be sure. Once again, then, on Jane's Camp evidence, intensive early exploitation of deep-sea fish resources at that time must be denied.

Of probably more than local interest is the demonstration that Samoan ceramics do not separate into discrete types, but that they constitute nodes on a continuum over a 1,000 to 1,500-year time span. Locally made, typical decorated Lapitan sherds and the associated plain ware are at one end of the continuum with the terminal coarse variety at the other. These findings can only strengthen the position held by some scholars that Pacific ceramics represent a remarkably stable tradition called Lapitoid. Whether the concept of a Lapitoid tradition provides a sharper interpretive tool is not a certainty, but, if it has value, the University of Utah Samoan Archaeological Program work supports the concept.

On another front the Mt. Olo tract, which appeared to be little more than a random scatter of ancient platforms and pathways, divided readily into three separate villages. The entire settlement was prehistoric but late in time. Two of the three villages were larger, and possibly held by relatively high-ranking chiefs, with the third much smaller. Of the three, Cog village was the oldest, the Cog tree ring corrected radiocarbon dates being A.D. 1450±70 and A.D. 1600±150, with Janet's Oven at A.D. 1520±110. There is a hint that Cog was the location of some earlier activity because the little earth oven beside Cog Mound dated at A.D. 820±130 tree ring corrected radiocarbon years. The youngest village was Village A, where the Green Ti oven dated at younger than A.D. 1510 radiocarbon years. However, it must be noted that the plus-minus range on the dates overlap, so the three villages, A, B, C, could well be contemporary. The villages were identified with the aid of several statistical procedures: the clustering of small platforms around central space; the presence of one or two large platforms; the presence of star mounds in each aggregation of structures; and, especially, the strategic locations of the paths are demonstrated as being statistically significant. It is possible, and to be hoped, that the settlement pattern study above can serve someone as a model for other, perhaps larger, analyses. Of further interest in connection with Mt. Olo settlement is the apparent time depth of almost 1,000 years represented by the test excavations on the tract.

The radiocarbon dates from all sites where samples were taken yielded two small suites of dates. They were internally consistent. Moreover, they were (except for two at Jane's Camp) entirely in agreement with the stratigraphic and artifactual data. They were similarly compatible with the radiocarbon, stratigraphic, and artifactual evidence reported by Green. Thus it seems reasonable to claim that our work has in general offered support or reinforcement to earlier research, even while extending its detail in important ways and extending the time depth of Samoan occupancy by some 300 radiocarbon years back to 2550±50 B.P.

It seems possible to claim that the contributions of the University of Utah Samoan Archaeological Program research, so tersely reviewed above, are toward both improved culture history and theory. Jane's Camp seems to add data useful in both areas.

APPENDIX

MINERALOGY AND PETROLOGY OF SAND TEMPERS IN SHERDS FROM THE FERRY BERTH SITE, PARADISE SITE, AND JANE'S CAMP

WILLIAM R. DICKINSON

Twelve sherd thin sections sent by J. D. Jennings were examined petrographically in the context of the preliminary descriptive work and temper-matrix classification of M. A. Bennett based upon study with the binocular microscope. The thin sections sent to me were intended to be representative of the sand-grain types present in different temper classes, but not necessarily of the typical relative proportions of the various types present in each class. Consequently, my emphasis here is on the specific character of the grain types present and on the genetic relationships of associated grain types, rather than on details of frequency percentages of grain types although the latter are included as well.

GRAIN TYPES

The compositions of these and other Samoan temper sands examined to date (Dickenson 1969, 1974) can be described as various combinations of certain of the following grain types, nearly all of which are either single mineral crystals or polycrystalline lithic fragments derived from volcanic rocks of the sorts exposed locally on Upolu and nearby islands:

(1) Feldspar grains (mostly plagioclase), which are clear transparent where fresh, but also whitish translucent or even opaque where weathered.

(2) Dark ferromagnesian mineral grains, which include some opaque black iron oxides as well as the two more common silicates:

- (a) augite, a clinopyroxene that is clear in thin section but is typically opaque black to dark green megascopically;
- (b) olivine, greenish translucent where fresh but commonly tinged with yellowish or reddish alteration product called iddingsite.

(3) Volcanic lithic fragments, a spectrum of varicolored multicrystalline grains that include three salient variants:

- (a) pale gray trachyte grains composed mainly of minute feldspar crystals;
- (b) dark gray basalt grains in which enough minute ferromagnesian crystals are imbedded with the feldspar to impart strong coloration;
- (c) black glassy basalt grains in which an intercrystalline matrix of opaque volcanic glass dominates the color.

(4) Noncrystalline fragments of volcanic glass (anhydrous sideromelane and hydrous palagonite), translucent brownish to reddish in thin section, but mostly shiny black in megascopic view.

(5) Calcareous grains of skeletal (shelly and reefal) organic debris.

TEMPER CLASSES

The main categories of temper or filler sands recognized by Bennett in the Ferry Berth Site, Paradise Site, and Jane's Camp collections can be grouped mineralogically into the following overall classes:

(1) Wholly calcareous tempers (not diagnostic of geologic provenance except for coastal setting and not treated further here).

(2) Crystalline sands composed mainly of ferromagnesian mineral grains (analogous to crystal-rich subtype of ferromagnesian basaltic temper as identified in Dickinson 1974).

(3) Multicrystalline sands composed mainly of lithic fragments of fine-grained volcanic rock of one of two kinds:

(a) pale-colored feldspathic rock (analogous to homogeneous style of feldspathic trachytic temper as identified in Dickinson 1969);
(b) dark-colored ferromagnesian rock (partly analogous to lithic subtype of ferromagnesian basaltic temper as identified in Dickinson 1974 but partly a homogeneous variant not observed previously).

(4) Mixtures of feldspar grains and dark-gray basaltic rock fragments or ash particles (analogous to feldspathic basaltic temper as identified in Dickinson 1969).

FERROMAGNESIAN BASALTIC TEMPERS

Five of the sherds examined contain various types of ferromagnesian basaltic temper composed of different mixtures of ferromagnesian mineral grains and basaltic rock fragments of diverse internal texture reflecting multiple source rocks. Two are similar to the crystal-rich subtype recognized previously at Mulifanua and Vailele (Dickinson 1974), and the other three are roughly analogous to the contrasting lithic subtype, although even richer in volcanic rock fragments than those observed previously. As noted before, the ferromagnesian grains are dominantly olivine, translucent green where fresh but tinged yellowish or reddish by iddingsite as alteration product. The clinopyroxene augite is also present in proportions that vary from 10%-15% of the ferromagnesian grains in the two crystal-rich tempers to about 20%-30% of the ferromagnesian grains in the three lithic tempers. All the lithic fragments are basaltic. Microcrystalline varieties are dominant, but basaltic glass fragments are also present. Their proportions vary from 5%-10% of the lithic fragments in the three lithic tempers to about 20%-30% of the lithic fragments in

the two crystal-rich tempers. Rare grains of opaque iron oxides and plagioclase feldspar also occur in the temper sands. The mineralogical composition of the ferromagnesian basaltic tempers is entirely suitable for derivation from bedrock somewhere in north-central or northwestern Upolu where olivine basalts of the Salani and Mulifanua volcanics are exposed extensively to the near exclusion of other lava units (Kear and Wood 1959). Specific notes on individual sections are provided in the following paragraphs.

Slides #1 and #9 (from either Stratum I or II at Jane's Camp and the Ferry Berth Site, respectively) contain crystal-rich sands that are well sorted and partly rounded beach (?) sands (#9 even contains scattered calcite grains). Ratios of ferromagnesian mineral grains to volcanic lithic fragments are about 55/44 in #1 and 65/35 in #9.

Slides #8 and #10 (both from Stratum I at Jane's Camp) contain lithic sands that are well sorted and partly rounded beach (?) sands. The varied textures of individual basalt rock fragments reflect their derivation from diverse exposures. About half the grains in #10 are calcite; the ratio of ferromagnesian grains to volcanic lithic fragments in #8 is about 35/65, closely comparable to that reported previously for the lithic subtype of ferromagnesian basaltic temper (Dickinson 1974). The temper in slide #5 (from Stratum III at Jane's Camp) is similar in rounding and sorting, and also contains some calcite grains, but is almost entirely lithic, with only a few ferromagnesian mineral grains.

BASALTIC TEMPERS

Slides #2 and #3 (from Stratum IV at Jane's Camp and the Paradise Site, respectively) also contain lithic basaltic sands, but these are less well sorted and contain lithic fragments that are essentially all of a kind, although different in the two cases. Lithic fragments in #2 are rather fine-grained intergranular basalt rich in olivine that is altered in large part to iddingsite. Slide #3 contains fragments of coarser-grained intergranular basalt with a rather low olivine content. Neither sand contains appreciable separate ferromagnesian mineral grains. Both sands were probably collected from small interior streambeds (?) or other small accumulations of sand from local sources. No homogeneous basaltic temper sands of similar character have been observed previously in any Samoan sherds examined in thin section.

TRACHYTIC TEMPERS

Slides #6 and #7 (both from Stratum IV at Jane's Camp) are similar to #5 and #8 in that homogeneous and distinctive populations of relatively unsorted lithic fragments are present in each. They are different in that the lithic fragments present are feldspar-rich trachytic rock with pronounced fluidal fabrics. Small proportions of separate mineral grains are also present. In #6, grain frequencies are roughly as follows: 85% microcrystalline trachyte fragments (some with feldspar microphenocrysts); 10%-15% feldspar grains; and traces each of clinopyroxene, olivine, hornblende, and opaque iron oxide grains. In #7, grain frequencies are roughly as follows: 65% microcrystalline trachyte fragments (some with feldspar or hornblende microphenocrysts); 20% feldspar grains;

and about 5% each of hornblende grains, opaque iron oxides, and volcanic glass particles. These tempers are similar to trachytic tempers reported previously (Dickinson 1969), and probably also reflect derivation from the Fagaloa Volcanics, perhaps in local pockets of sand among the exposures around Cape Mulitapuili west of Lefaga Bay (Kear and Wood 1959).

FELDSPATHIC BASALTIC TEMPERS

Slides #4, #11, and #12 (from Stratum IV, Stratum III, and Stratum IV, Jane's Camp) contain closely comparable tempers of rather poorly sorted sand composed of about 40%-50% plagioclase mineral grains and roughly 50%-60% basaltic rock fragments, in some of which plagioclase microphenocrysts occur. The lithic fragments are fine-grained intersertal basalt with ore-charged black glass or trachylite in the groundmass, as is the case for the lithic fragments in feldspathic basaltic temper described previously (Dickinson 1969). As before, a number of the lithic fragments have the cusped or scalloped outlines typical of basaltic ash. Derivation from fresh cindery debris seems most likely. Thus, although the Lefaga Volcanics exposed inland from Lefaga Bay to the drainage divide contain feldspar-phyric basalts as a possible source, the younger cone Tafua Upolu that rises about 600 meters on the spine of the western end of Upolu is perhaps a more likely source. This large cone was mapped by Kear and Wood (1959) as being the same age and composition as Fito Peak above Apia. Both these cones of feldspar-phyric Puapua Volcanics may have been in active eruption during times of prehistoric settlement (Kear and Wood 1959:45). If so, they could have supplied abundant fresh ash for temper. My suggestion of Tafua Upolu as the probable source for these feldspathic basaltic tempers in sherds from western Upolu thus parallels my previous suggestion of Fito Peak as the probable source for analogous feldspathic basaltic tempers in sherds from eastern Upolu (Dickinson 1969). Both suggestions could be tested if samples of ash could be acquired from subsoil excavations on the flanks of Fito Peak and Tafua Upolu.

SUMMARY

Temper sands in these dozen sherds fall within the general spectrum of temper types represented in the two dozen Samoan sherds examined previously (Dickinson 1969; 1974), although minor deviations have been noted above. Mineralogical compositions are entirely suitable for local derivation on Upolu, and apparently reflect the following kinds of collecting places: (a) coastal beaches where calcareous grains from fringing reefs are characteristically mingled with ferromagnesian mineral grains and volcanic rock fragments from multiple sources in widespread basaltic bedrock to form dominantly calcareous sands, crystalline sands, and lithic sands as proportions of the three sand components vary; (b) interior sites in valleys or on slopes where local accumulations of trachytic or basaltic lithic sand from restricted nearby sources could be found; and (c) cinder cones where fresh basaltic ash was available.

The spectrum of coastal sands available is probably similar for long reaches of shoreline. Detritus from widely separated sources is gathered into and transported within the marginal lagoon. Consequently, the identification of specific sources of coastal temper

is apt to be tedious, wholly empirical, and partly dependent upon luck. Interior (?) collecting sites for monolithological basaltic or trachytic sand could perhaps be sought with eventual success, but probably with only random aim at first. Only the suspected ash sources on Fito Peak and Tafua Upolu can be checked directly as the intended fruit of specific prediction.

The occurrence of most or all of the Samoan temper types in sherds recovered at each of the sites excavated raises two alternatives: either trade was general and effective in disseminating all wares widely; or each pottery center made use of the same wide variety of types of temper sources. If it could be shown that people actually trekked from the coast to Fito Peak and Tafua Upolu to get temper sand, then it would be clear that they were willing to carry sand for temper over surface routes that are long and arduous in the local context. Attempts to check the Fita and Tafua sources thus also seem important to shed light on this question.

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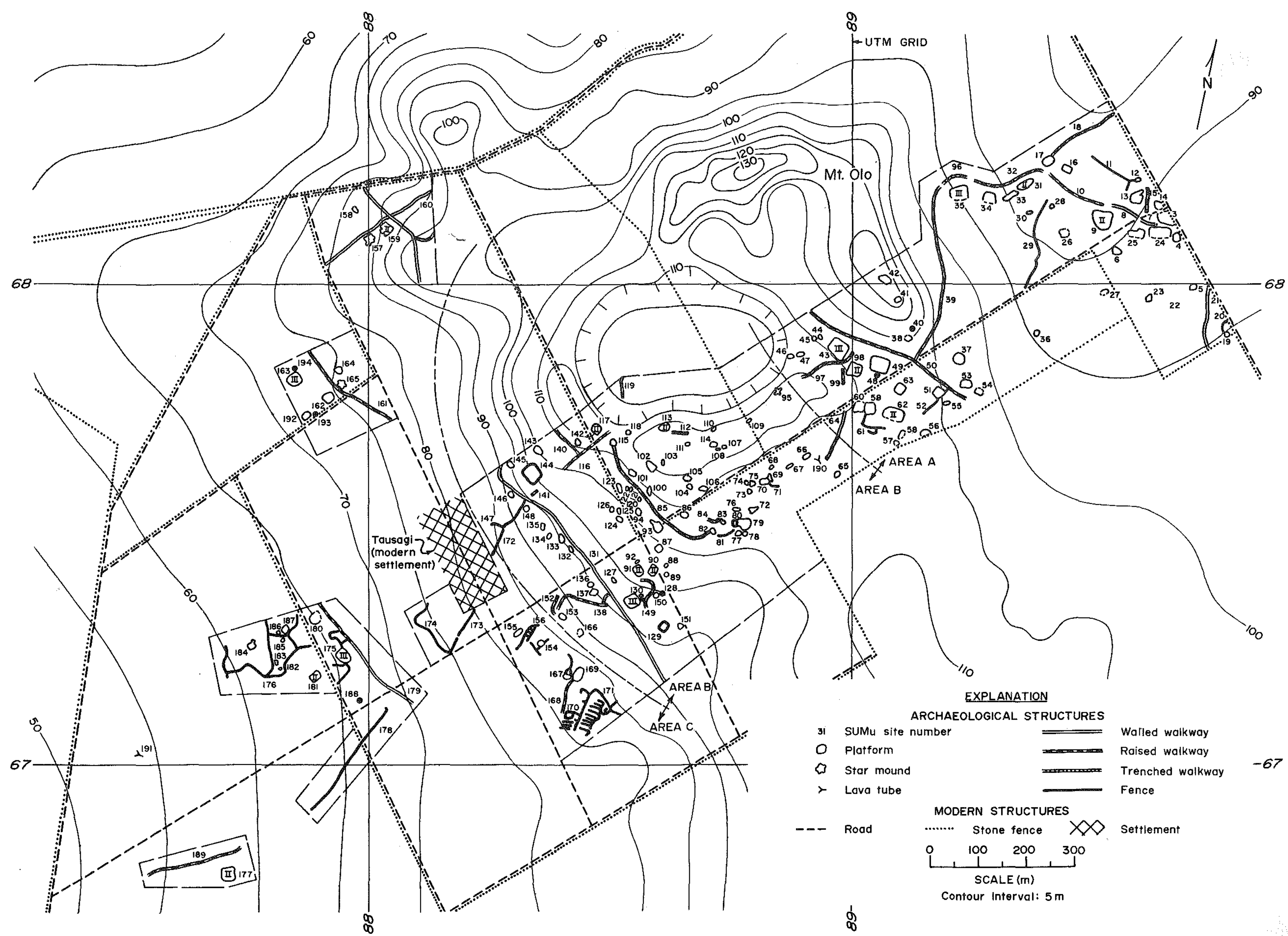

Fig. 3. SITE LOCATION AND TOPOGRAPHIC MAP, MT. OLO TRACT.