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Further Investigations at the Tataga-matau Site, American Samoa

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ABSTRACT

The second phase of field work conducted at the Tataga-matau site in 1988 revealed that the quarry originally visited by Buck in 1927 and mapped by the authors in 1985 was part of a much larger fort and quarry complex that included three major quarry areas, two large defensive ditches, four star mounds and numerous terraces. Excavations produced evidence of human presence over the last two millennia, with a major period of organised industrial activity and terrace building from the fourteenth to the sixteenth centuries A.D. Adzes were made at the site from the eleventh or twelfth century to the end of the prehistoric period.

Keywords: POLYNESIA, SAMOA, QUARRY, ADZE MANUFACTURING, REDUCTION SEQUENCES, FORTIFICATIONS, STAR MOUNDS.

BACKGROUND TO THE RESEARCH

The history of Te Rangi Hiroa's (Peter Buck's) visit to this traditionally well known quarry in 1927, and of subsequent publications concerning its whereabouts, has already been described in detail by the authors in an account of their 1985 survey and investigation (Leach and Witter n.d.; Leach and Witter 1987). In the 1987 paper it was concluded that the quarry complex mapped in 1985 was in fact the site to which Buck had been taken and which he had described in his 1930 monograph, *Samoan Material Culture*. The site which Clark had recorded as Tataga-matau in 1980, on the basis of finds of flakes and preforms in a large crater on Malaloto Ridge (Fig. 1), was regarded as a separate workshop area (Leach and Witter n.d.: 20).

Late in the 1985 survey, bush-covered terraces, including one masonry-edged platform, were found at the top of the ridge, above Buck's site. Lying 60 m above the main quarry slope and the pit-trench feature which was interpreted as providing defence for the quarry, these terraces were not included in the site plan because they lacked surface evidence of adze manufacture and because time was running short. However, the site report recommended that they should be included in any future study, along with the workshops discovered under dense forest cover upstream of the quarry ridge. It was also considered important to determine whether there was "another dyke or flow contributing adze-quality basalt to the streambed or quarried *in situ*" (Leach and Witter n.d.: 56–7).

At the conclusion of the 1985 survey, Tataga-matau was successfully nominated to the United States National Register (approved 19 November, 1987). To achieve further recognition of the site as a National Landmark, the Historic Preservation Officer of the American Samoa Government encouraged the authors to undertake further field work there.

This took place in July and August, 1988. The field team consisted of Dan and Alison Witter, Helen Leach, Simon Best and two local assistants, Henry Stowers and Palafu Moetai.

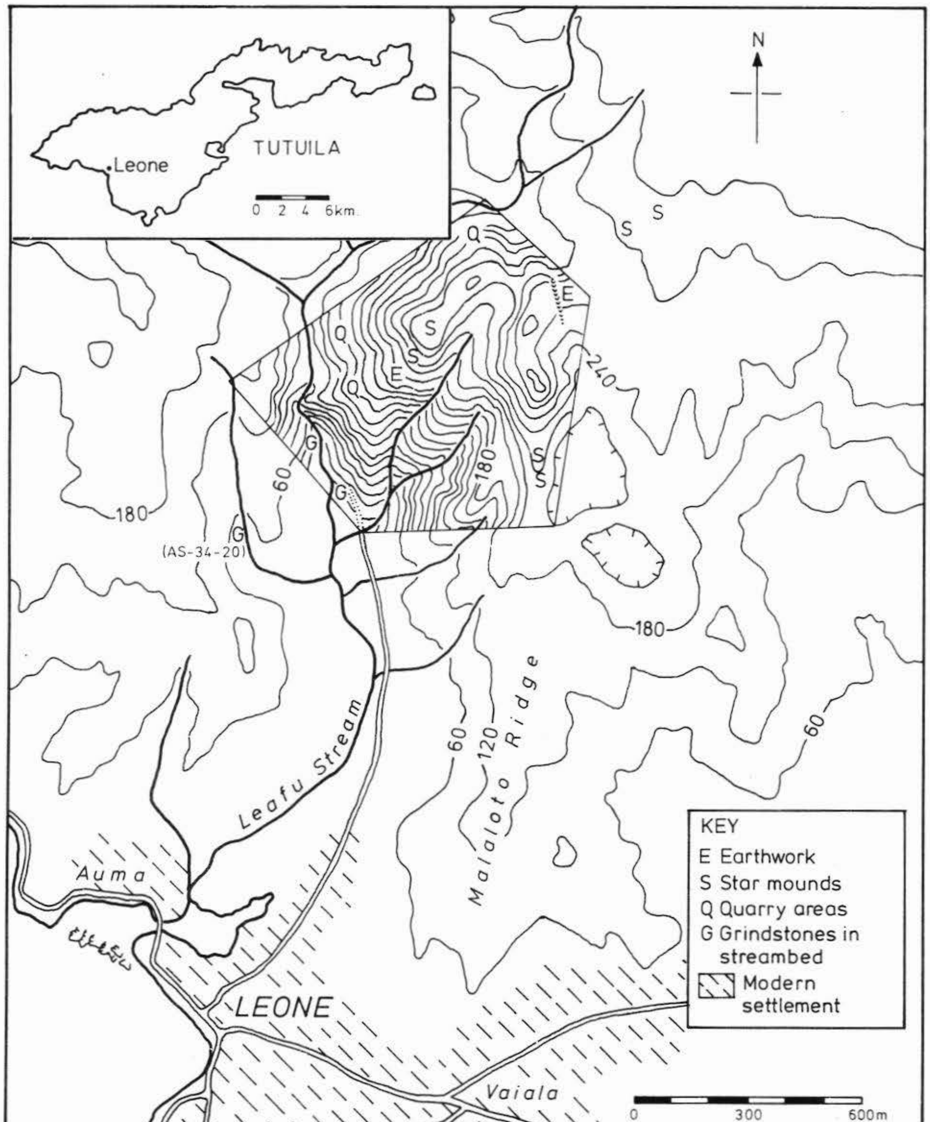

Figure 1: Location map (revised from Leach and Witter 1985).

AIMS OF THE 1988 PROGRAMME

The recent phase of research at Tataga-matau had four major objectives. The first was to extend the survey on to the heavily forested ridges and slopes above the site in search of other quarry exposures, terraces and platforms. The second was to establish by excavation to what extent the defensive features and the adjacent quarry were contemporary, and to date some of the different activities that had taken place at Tataga-matau. The third was to obtain more detailed information on the range of adze types manufactured on the workshop terraces, while the fourth was to investigate the technology of quarrying.

The published site report (Best, Leach and Witter 1989) provides a detailed discussion of the extended survey, and of each of the excavations conducted on the site. This paper will summarise the results obtained under the first two objectives, before concentrating on the issues of adze making and quarrying technology.

THE 1988 SURVEY (Figs 1 and 2)

With the clearance of undergrowth from the terraces previously located above the pit and trench feature, the characteristic stone-faced lobes of a star mound were revealed. This was to be the location of Simon Best's excavations (referred to as the Star Mound Terrace). One hundred metres further up the ridge was a second star mound, occupying a high point and separated from the first by a set of terraces. At this point the ridge divided, with a spur dropping off towards the west. This spur was cut by several terraces and had been the site of extensive basalt extraction and preform manufacturing operations (Quarry Area 3 on Fig. 2). A stone row ran across the lower portion of this quarry area in a comparable position to a row of similar construction found at the first quarry. Opinion was divided as to whether these should be interpreted as defences or boundary markers. In the context of the fortifications of the Lau group, Fiji, such stone rows serve a tactical purpose (Best 1984: 56–7, 108–9, Plate 2.16B), while in Western Samoa stone rows frequently function as boundaries (Davidson 1974: 238–9). Stone rows were encountered by Clark and Herdrich in their survey of Eastern Tutuila. In two cases they were interpreted as walkways (Clark 1989: 20, 25), which is a possible explanation for the two on Tataga-matau, especially as they tend to follow the contour of the hillside.

Beyond the second star mound the ridge top narrowed and only a few, mostly narrow, terraces had been cut out of the slopes on each side. A shallow ditch was recorded running across the ridge just south of a levelled high point and its associated terraces. A second ditch was noted to the north of another cluster of platforms and terraces, 160 m from the first. In the site map (Best, Leach and Witter 1989: 8), Best describes these as shallow depressions, but an interpretation of them as defensive ditches is possible given their position on the ridge top.

Just below the terrace cluster where the second of these cuts was observed, the survey team found a large scree of debris from basalt extraction and flaking (Quarry Area 2 on Fig. 2). With the discovery of these additional quarries, it became clear that the named quarry visited by Buck was only one of several within the catchment and that others may yet be found. In view of the dispersed nature of these, it now seems much less likely that the high quality basalt occurs as separate dykes than as a single flow (cf. Leach and Witter 1987: 39).

The narrowest part of the ridge was just to the east of Quarry Area 2. A short section had stone buttressing which may have acted as a retaining wall, preserving access along the ridge which at this point had one near-vertical side. Just past this point is the junction with the broad flanks of Malaloto Ridge. The site was found to continue as an impressive series of terraces cut into a narrow spur lying parallel to the main bulk of Malaloto Ridge. The

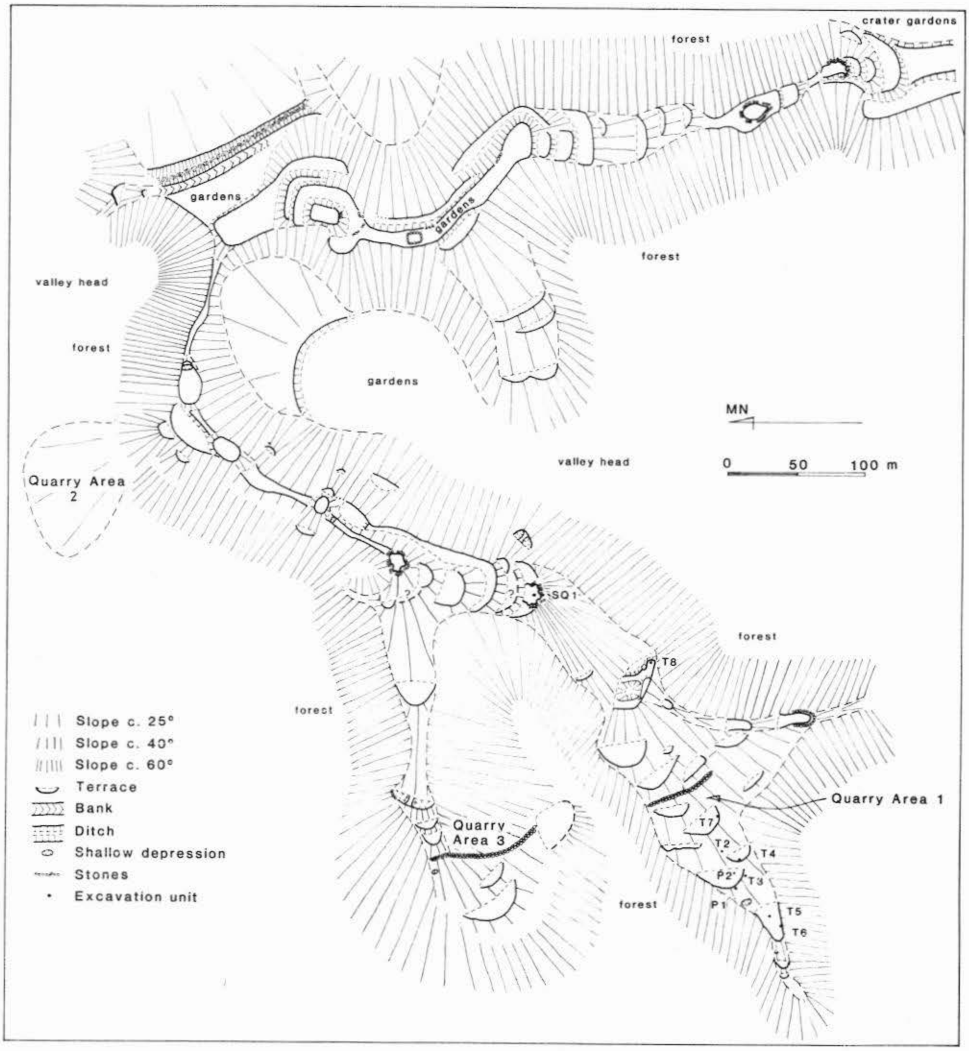

Figure 2: Map of Tataga-matau fort and quarry complex. (SQ 1 indicates the star mound excavated by Best. Other star mounds are marked with a star symbol.)

spur is cut off at the top end by a massive ditch and bank, up to 6 m deep and over 100 m long. Because there was no clear break in the cultural features, the survey continued down the spur until it reached the Ololua Crater gardens which Clark (1980) had recorded as the site of the Tataga-matau quarry. Just above the crater, two more star mounds were located on the lower terraces. This spur is referred to as the southeast arm of the site, while the ridge and spurs on which the quarries occur is the southwest arm.

The discovery of more quarries, extensive ridge-top levelling, terraces and mounds, together with the extremely large defensive ditch at the top of the site required a re-appraisal of Leach and Witter's earlier view (1987) that the discontinuous ditch and bank just above Quarry area 1 had been cut to protect this quarry. It may more plausibly be interpreted as a defence for the platforms, star mounds and terraces above it on the southwest arm of the ridge. In turn these may have been defended from downhill incursions by the two possible transverse ditches and the marked narrowing of the ridge where it bends round towards the southeast arm. Of course, groups occupying the southwest arm would have been in a powerful position to control access to all three quarry areas.

In the site report it was conceded that there is as yet insufficient evidence to determine whether the southwest arm was a separate fortified complex from the southeast arm (Best, Leach and Witter 1989: 9). The large upper ditch is probably the strongest argument for viewing the site as a single fort complex, since it protects both arms. If the site is interpreted in this way, Best believes that the central living area would have been that part of the ridge just south of the large upper ditch. It consists of a flat-topped ridge containing probable house mounds, one of which has three tiers, and as the highest point on the site, dominates the surrounding area. The southeast arm on which it stands would have been protected by the ditch and its outworks, and by the high scarps of the terraces where the ridge joins the crater.

The 1988 survey increased the known area of the site threefold, but at the same time revealed a level of complexity of features which made Leach and Witter's (1987) notion of a fortified quarry at the end of the southwest arm far too simplistic. But until excavations are undertaken at the upper ditch and on the southeast arm it is probably unwise to assume that the enlarged complex is a single fortification, rather than two constructed on different arms at different periods. Malaloto Ridge itself may have a similar density of features to Tataga-matau (Best, Leach and Witter 1989: 69). Two star mounds on terraces only 250 m above the main ditch (Fig. 1), and the artefactual evidence found in the crater gardens suggest that the present site boundaries should not be regarded as final.

In the meantime, the label 'fort and quarry complex' reflects the existence of important defensive features, and of stone extraction and tool manufacturing areas. As for the name 'Tataga-matau' (literally, the striking of preforms), it can legitimately be applied to the area of the southwest arm that Buck visited, and to the spurs where the quarries occur, but in future it may not prove appropriate to use it to refer to the southeast arm.

THE 1988 EXCAVATIONS

Excavations were undertaken at three locations on the southwest arm of the site. Best opened a series of squares at the lower of the two star mounds. Leach examined the relationship of tool manufacturing and earthworks at the lower ditch feature, and Witter studied terrace formation and quarrying technology on several terraces on the spur above the waterfall.

THE STAR MOUND TERRACE

At the site of the star mound (SQ 1 on Fig. 2), Best established that after a period of stone extraction and flaking on the ridge itself, a terrace had been cut into the spur and occupied by people who had used some of the weathered basalt blocks in the soil matrix to make preforms. This occupation was dated by charcoal sample (NZ7598) as follows : conventional radiocarbon age 602 ± 50 years B.P.($\delta^{13}C = -27.2$), corrected age[1] range at 1σ is Cal A.D. 1308–1358 (42%) and 1381–1411 (25%). At a later stage, the terrace level appears to have been raised, perhaps using material derived from the construction of a higher terrace. The last activity was the building up of the star mound. A charcoal lens at the same level as the terrace surface beyond the star mound provided a sample (NZ7597) which was dated to less than 250 years B.P. ($\delta^{13}C = -28.2$) (conventional radiocarbon age), with a corrected age later than Cal A.D. 1710. Best believes that this sample may date the construction of the star mound.

The presence of three thin-walled potsherds and a small obsidian core, which had become incorporated in the fill layers, suggests that this portion of the ridge had been visited or occupied before about A.D. 200–300, if this estimate for the disappearance of pottery and obsidian from Upolu in Western Samoa is widely applicable. However, recent charcoal dates from excavations at 'Aoa (Locality 2) have raised the possibility that pottery may have persisted on Tutuila much later than on Upolu (Clark 1989: 92). It must be stressed that the 'Aoa dates (which are fifteenth century A.D. and younger) are not derived from the main pottery-bearing layers, though they are in close proximity.

Full details of Best's excavations have been published in the site report (Best, Leach and Witter 1989: 19–35).

THE LOWER DITCH

Leach's excavation at the lower ditch was designed to establish the chronological relationship between stone working and the construction of defensive features. Ideally, both ditch complexes should have been studied, but present land use and uncertainties about ownership ruled out an investigation of the large upper ditch. Contiguous squares were laid out on a small terrace on the southwest edge of the lower ditch (T8 A and B on Fig. 3). It was established that the terrace had been built up of a mixed deposit of clay, soil, and natural highly weathered cobbles, probably derived from the cutting of the adjacent ditch (Fig. 4). A few medium to large flakes had been included in the fill, indicating that stone working had taken place in the vicinity before this phase of ditch cutting. Before soil had time to form on the terrace, the surface became a working floor, acquiring a cover of flake debris, preforms, fine shatter and charcoal.

A charcoal sample taken from the base of the flake layer (NZ7592) gave a conventional radiocarbon age of less than 250 years B.P. ($\delta^{13}C = -27.8$). It directly dates the last phase of tool making (adzes and 'graters'(see below)) on this part of the site. If, as suspected, this workshop activity followed closely the cutting (or possibly recutting) of the ditch, the sample also indirectly dates the last defensive activity. It was concluded that in this location at least, stone working bracketed and was probably also contemporary with the construction of defences (Best, Leach and Witter 1989: 12–17). Its continuation up to the era of European contact may explain why knowledge of the quarry's location and its name survived into the twentieth century.

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[1]Radiocarbon dates reported in this paper were obtained from the Institute of Nuclear Sciences, DSIR, Lower Hutt, New Zealand. Ages reported as having been corrected for secular effects were calculated by this laboratory.

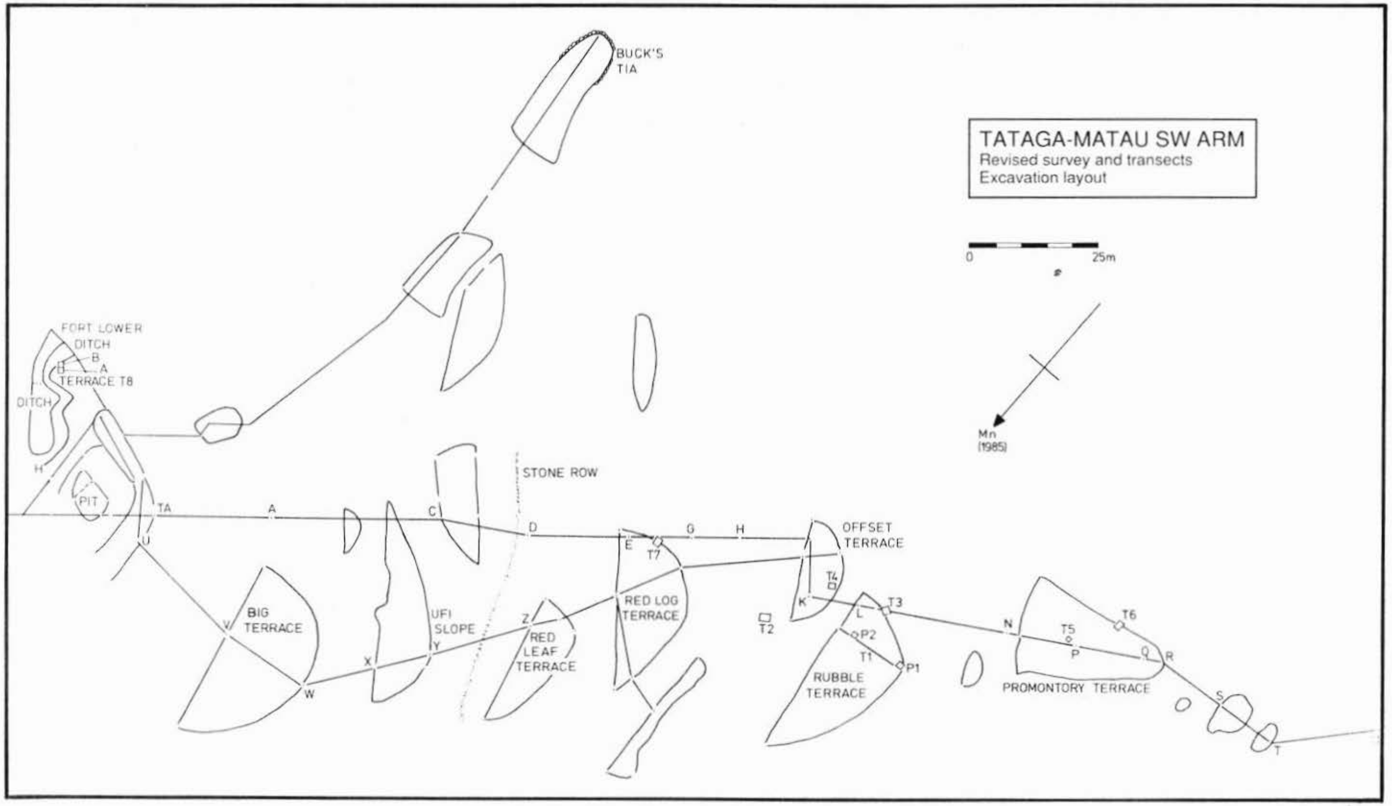

Figure 3: Map of SW arm of Tataga-matau. (T1 to T7 refer to excavation trenches, P1 and P2 refer to test pits on Trench 1.)

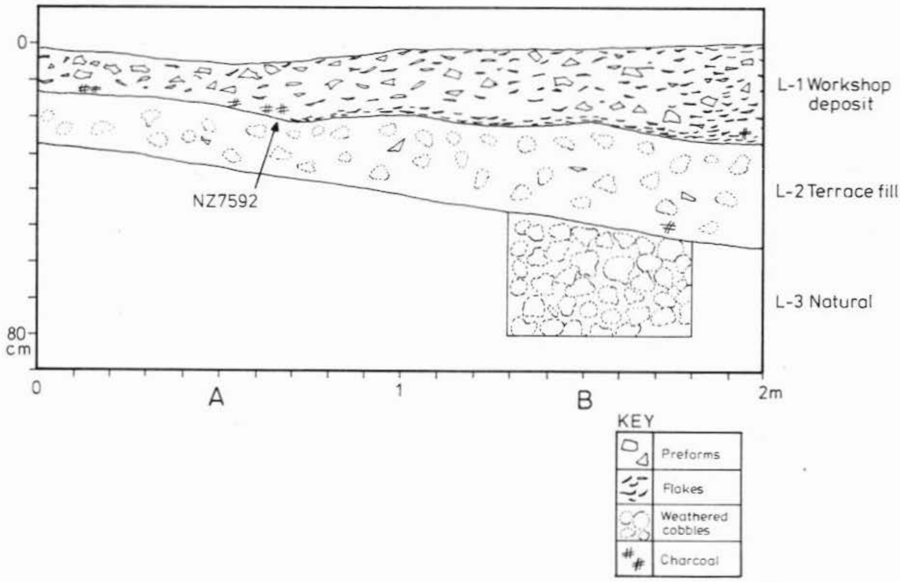

Figure 4: Lower Ditch terrace, NE section.

THE RUBBLE TERRACE COMPLEX

In this part of the site, the 1985 survey had located a series of terraces and slopes with variable exposures of worked stone debris ranging from dense, matrix-free deposits to sparse scatters. This variability suggested differences in function and possibly of terrace construction techniques that could be investigated archaeologically. The focus of the 1988 excavations was the Rubble Terrace. This name was assigned to the large terrace shown as L by Leach and Witter (1987: Fig. 2), but renamed in the revised survey of 1988. This revision followed extensive clearing of undergrowth and the discovery of some additional features. The Rubble Terrace was named for its concentration of worked basalt rubble and flakes, over its entire 32 x 15 m surface. The adjoining terraces, both uphill and downhill, were examined for comparison (Fig. 3). In the former group were the Off-set Terrace (formerly Terrace I), and the Red Log Terrace (formerly Terrace F). Further down the spur Witter also tested the Promontory Terrace (formerly Terrace P).

At the Rubble Terrace the first objective was to determine the stratigraphy of the terrace. The working model formed during the 1985 visit was that the slope had been cut into in order to extract suitable basalt (possibly from fractured bedrock), and the spoil and flake debris had been dumped behind the work face, thereby building out the front of the terrace in the classic cut-and-fill fashion. To test this hypothesis, three units were excavated to depths of from 1.3 to 2 m: one at the front (Pit 1, Trench 1), one at the rear (Pit 2, Trench 1), and one at the side (Trench 3). Although there was insufficient time to join the trenches, the layers are so similar that correlation can be undertaken with some confidence (Figs 5–7). In each of these excavations, the two uppermost layers (1 and 2) consisted mainly of flakes and preforms, increasing in size with depth. Charcoal lying between some exceptionally large flakes in Layer 2 of Trench 3 provided two samples for dating: NZ7594 gave a conventional radiocarbon age of 580 ± 63 years B.P. ($\delta^{13}C = -27.2$) and a corrected age

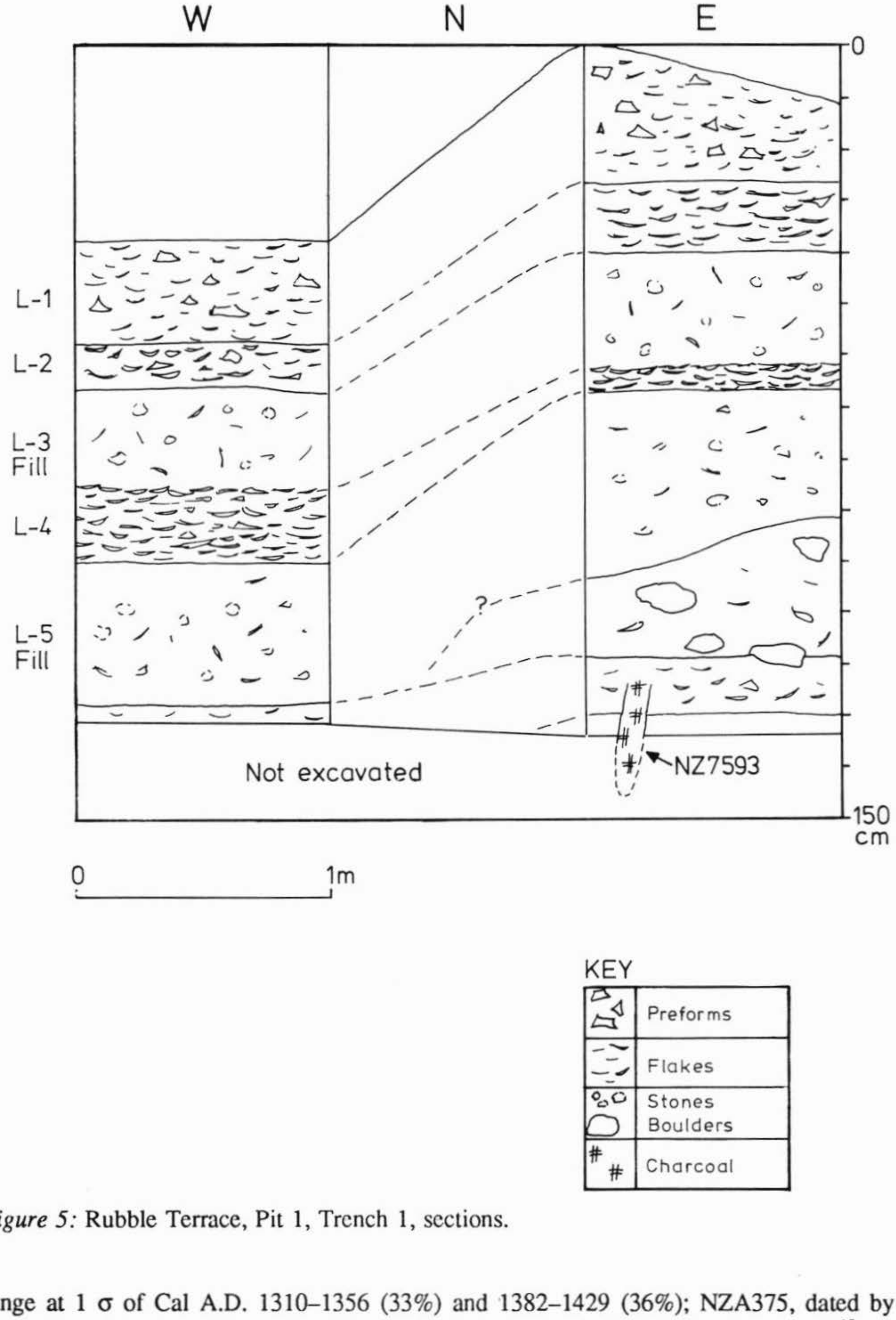

Figure 5: Rubble Terrace, Pit 1, Trench 1, sections.

range at 1 σ of Cal A.D. 1310–1356 (33%) and 1382–1429 (36%); NZA375, dated by tandem accelerator, gave a conventional radiocarbon age of 580 ± 110 years B.P. ($\delta^{13}C$ = −28.1) and a corrected age at 1 σ of Cal A.D. 1294–1438.

The flakes in these layers had been deposited on red-brown clay fill which contained unworked stones and flakes sometimes lying on edge, indicating secondary deposition.

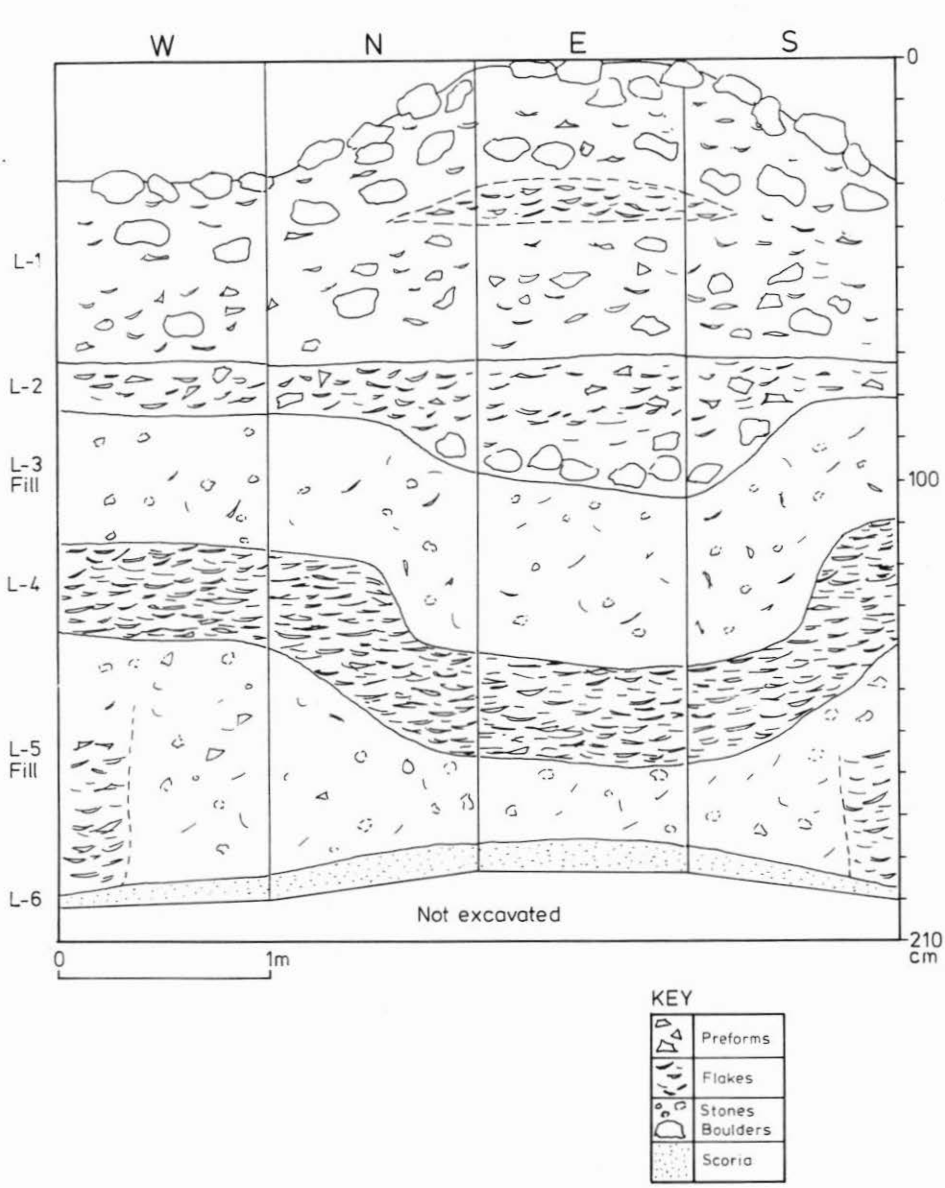

Figure 6: Rubble Terrace, Pit 2, Trench 1, schematic sections.

Charcoal from this fill layer in Trench 3 gave a conventional radiocarbon age (NZ7595) of 448 ± 70 years B.P. ($\delta^{13}C = -27.1$), and corrected age ranges at 1 σ of Cal A.D. 1421–1519 (56%) and 1591–1622 (12%). In the Trench 1 squares, the fill had been built up in at least two phases, with a bed of large flakes and preforms sandwiched between, the result of a single major flaking episode. At the base of the lower fill layers in the front and side units, much larger boulders were recorded.

Along the front of the Rubble Terrace the fill had covered a brown loam, formed originally under forest but containing abundant flakes. In turn this overlay a natural brown soil into which a 10-cm-diameter posthole had penetrated a short distance. A sample of charcoal from this posthole (NZ7593) produced a conventional radiocarbon age of 906 ± 157 years B.P. ($\delta^{13}C = -26.8$), corrected to Cal A.D. 1017–1269 (68% confidence interval). Judging from the posthole, the diameter of the post could not have been larger than 10 cm. If a small tree or sapling had been used, there would be little inbuilt age in the resulting date; however, the charcoal was too fragmented to judge whether it came from a complete pole or had been split out of a larger and older tree. At the back of the terrace the fill had been dumped directly on to a freshly cut scoria surface. Yet very little scoria had been used to build up the front of the terrace. Instead the fill layers consisted of red-brown clay, boulders, stones and redeposited flakes. Clearly the Rubble Terrace was not of the expected cut-and-fill type. Examination of the adjacent terraces and hillside was required before an alternative model could be developed.

Although the constructional details of the Rubble Terrace were difficult to unravel, there was little doubt about its function within the quarry complex. Even before the terrace was formed, the ridge had been the scene of preform manufacture, probably from basalt boulders

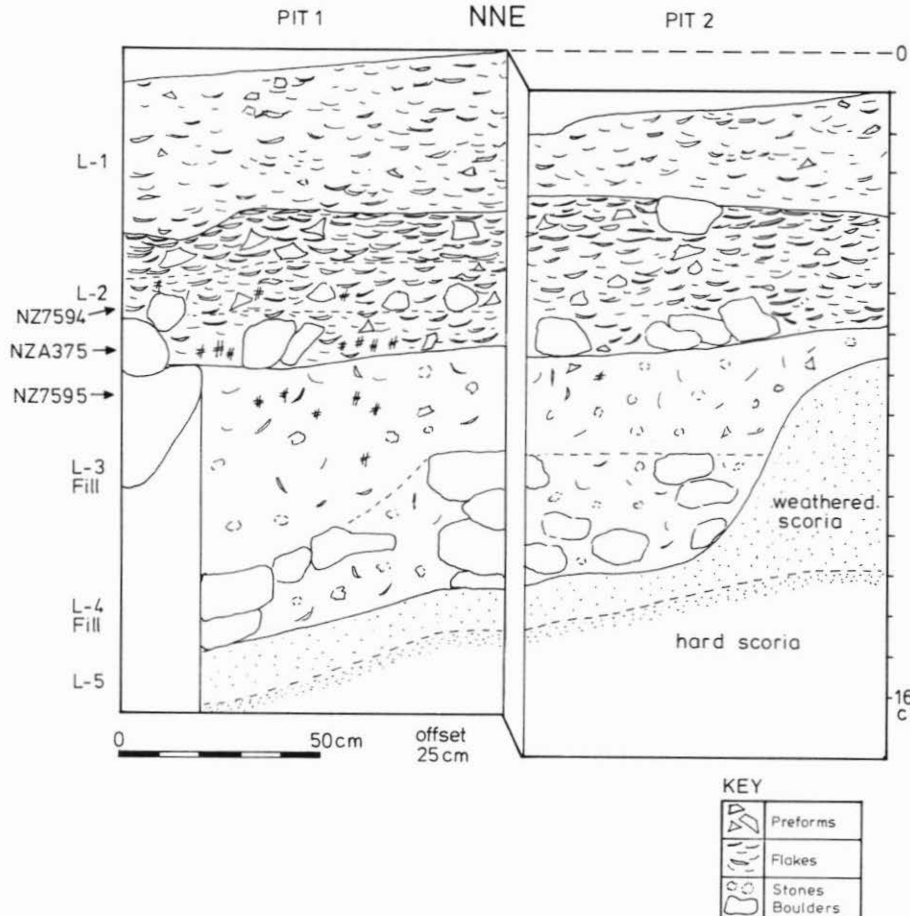

Figure 7: Rubble Terrace, Trench 3, Pits 1 and 2, NNE sections.

naturally exposed on the surface. The date for a post (or structure) erected at this time places this activity in the eleventh to thirteenth centuries A.D. The next stage involved the cutting of the terrace and the removal of the freshly exposed scoria to another location. Boulders were piled on the floor of the cut, some used to produce adze blanks, others left unworked.

Clay fill was then dumped on top, probably derived from the weathered scoria clays which occur on the hillside above. This fill contained preforms (e.g., Fig. 8), waste flakes and small stones, but no boulders. Once in place it provided a near level surface for a major stone working operation which involved the two stages of blank, then preform production. For the former, suitable boulders were completely reduced, providing huge flakes to serve as blank cores. The preform stage is represented by a range of exceptionally large reject preforms of triangular and trapezoidal cross-sections (Fig. 9). Both stages gave rise to quantities of large waste flakes which accumulated into a bed up to 40 cm thick. By overlapping and interlocking horizontally, these massive flakes effectively prevented the clay from the next layer of fill from penetrating the gaps between them. If the layer correlation is correct, this production event occurred between the fourteenth and seventeenth centuries A.D.

The cycle was repeated with the new layer of fill serving as a working floor for more episodes of flaking, though not at the same scale as the earlier ones. Selected artefacts from these later flaking activities appear in Figures 10 and 11.

In contrast to the Rubble Terrace above it, the Promontory Terrace has no stone-working debris visible on its broad clay surface (40 m long and 20 m wide). Nor does the small scarp cut at the rear of the terrace seem to be of sufficient size to have provided the fill needed to build it up. The two excavation units dug on the Promontory Terrace revealed that

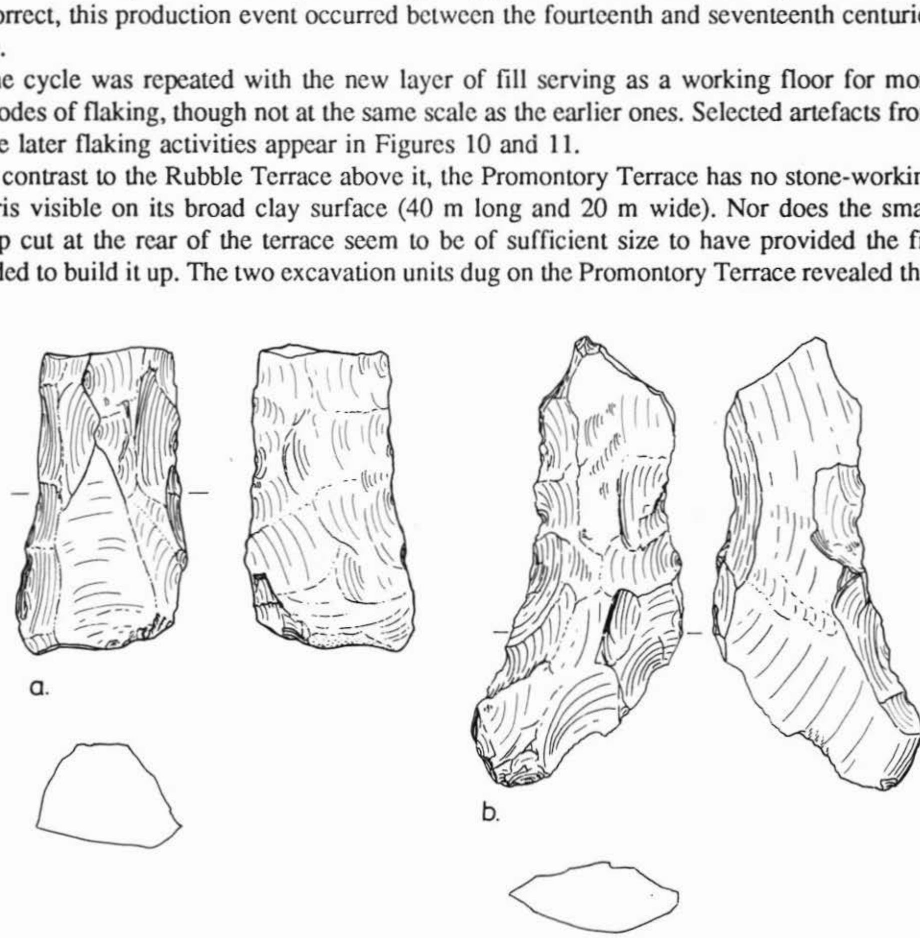

Figure 8: Rubble Terrace Trench 3, Pit 2, preforms from clay fill Layer 3.

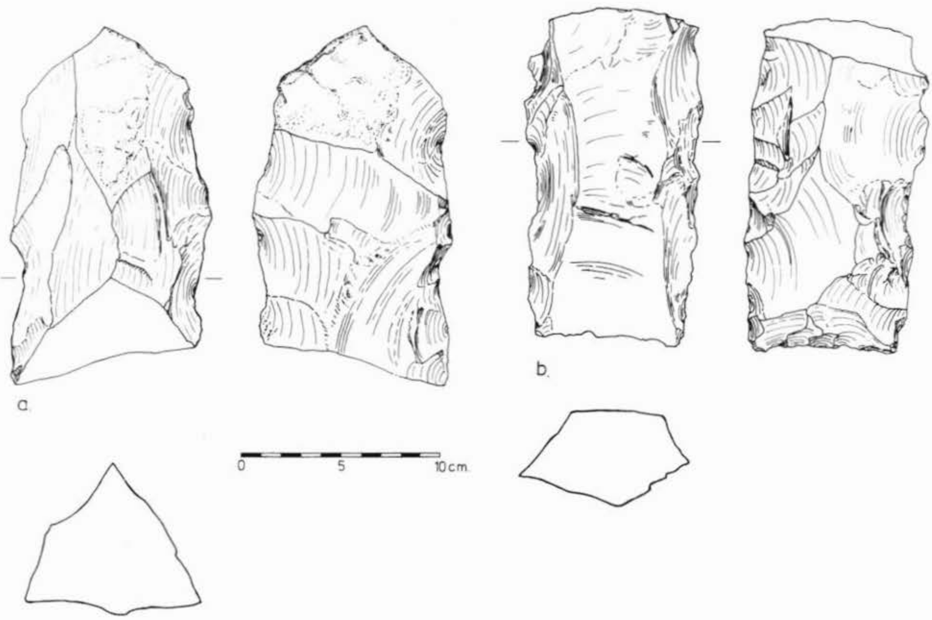

Figure 9: Rubble Terrace Trench 3, Pit 1, preforms from Layer 2.

this compact red-brown clay fill was over 90 cm thick in the centre (Trench 5) and up to 70 cm thick at the terrace edge (Trench 6) (Fig. 12). A few flakes occurred within it. It had been dumped on a natural brown topsoil formed under forest, which in turn overlay a brown subsoil and basalt bedrock. The reddish colour of the fill and the scatter of flakes within it suggests that it was derived from the cutting of the Rubble Terrace, the nearest major earthwork feature uphill.

The small Off-set Terrace, lying above and to the southeast of the Rubble Terrace, seems to have been formed in a similar way to the Promontory Terrace, by using fill transported from an external location rather than cut from its own rear scarp. Witter positioned one excavation unit (Trench 4) towards the front of the Off-set Terrace, and another (Trench 2) on the steep face beside it. The Off-set Terrace had been built up by dumping red-brown clay fill (containing only a few flakes and stones) on to the natural dark-brown stony clay of the hillside. This may have occurred progressively, since a fire feature marked by a lens of charcoal and some large boulders (some fire-reddened) was incorporated in the upper zone of the fill (Fig. 13). A charcoal sample from this possible oven (NZ7596) gave a conventional radiocarbon age of 521 ± 55 years B.P. ($\delta^{13}C = -28.0$), with a corrected age range at 1 σ of Cal A.D. 1396–1458. This result falls within the period of large preform production on the Rubble Terrace. Although a broken hammerstone (Fig. 10f) was found in Layer 2 of the Off-set Terrace, the clay fill forming this terrace had not become the foundation of a flaking floor. The presence of a possible oven may suggest that it functioned as a temporary resting area or shelter. Certainly the rock and flake-strewn surface of the adjacent Rubble Terrace would not have provided anywhere to lie down or sit in comfort.

Witter positioned Trench 2 on the slope above the Rubble Terrace to determine if this area had been the site of a basalt outcrop quarry face subsequently obscured by slumping. Under a brown clay topsoil, he encountered not a rock face but a deep, homogeneous red-brown clay containing large basalt boulders (up to 30 cm across) as well as numerous smaller stones (Fig. 14). The clay surrounding the boulders was very similar to that which had provided the fill for the Rubble Terrace and the Off-set Terrace, while the boulders were comparable to those at the base of the earliest fill layer on the Rubble Terrace. The obvious conclusion was that the adze-makers had mined a clay solifluction mantle which has been working its way downslope for thousands of years, carrying large blocks of fine-grained basalt.

The clay from which the boulders were extracted was used in the formation of the two adjacent terraces. In the case of the Off-set Terrace it was dumped directly on to the slope and levelled out, while on the Rubble Terrace it was deposited on an existing cut terrace after the surface had already had some use as a working floor. The practice of covering flake debris with clay fill was repeated there on at least one other occasion. As for the original scoria and clay out of which the Rubble Terrace had been cut, it appears to have been used to build up the surface of the Promontory Terrace.

QUARRYING TECHNOLOGY AND TERRACE FORMATION

In this set of terraces only one, the Red Log Terrace, lying above the Off-set Terrace, proved to fit the simple model of cut-and-fill terrace formation (Fig. 15). Although some

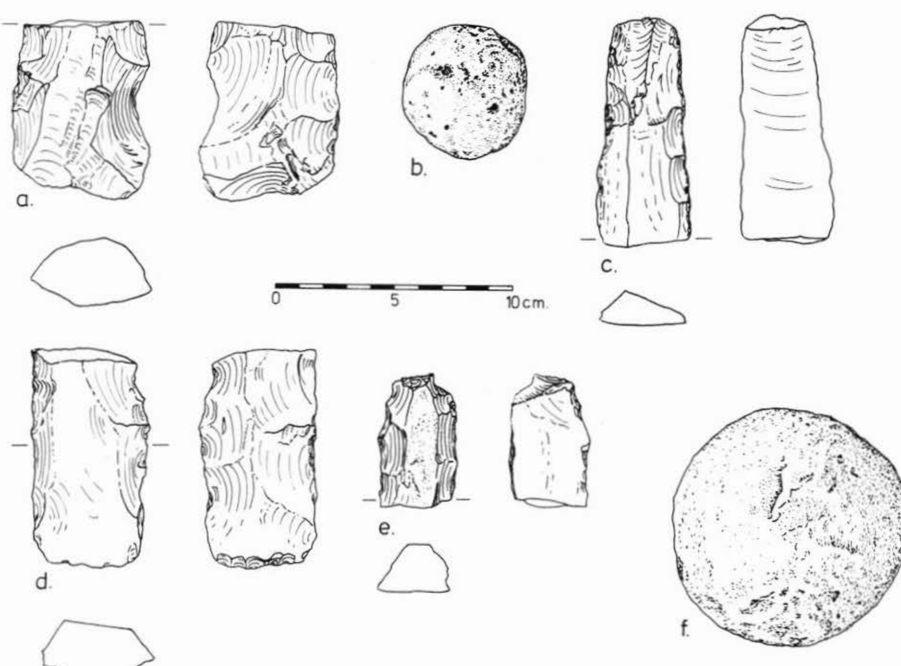

Figure 10: Artefacts from Rubble Terrace (a, c, e, L2; b, surface; d, L3) and Off-set Terrace (f, L2).

preform finishing had occurred there, it seems to have been built for purposes unrelated to either quarrying or preform manufacture. Of the other terraces in the complex, two were 'fill only', while the third, the Rubble Terrace, had provided fill for a lower terrace and then been built up itself with fill from the quarry slope (Fig. 16). While the primary function of the two 'fill only' terraces is uncertain (possibly living areas), there is no doubt that the Rubble Terrace was designed for industrial use as a series of superimposed working floors.

A crucial part of the extraction process would have been the technique by which the basalt boulders were separated from the clay and smaller stones. The land owner, Mr Tony Willis, provided a possible clue to this technique. He told Witter that

> in road building in Samoa it was common practice to set up a post and rail fence along the slope. This allowed the clay (which was always wet) to pass through the rails, while the boulders were retained as in a giant sieve. (Best, Leach and Witter 1989: 57)

A similar device could have been erected on the hillside above the Rubble Terrace, with the clay and small stones being forced through the rails and then spread on the terrace, and the boulders to serve as blank cores piled up behind the screen. At a certain point the stock-piled boulders would be released on to the terrace surface for sorting and flaking. Even if this method does not represent prehistoric practice, some type of boulder retaining device would have been necessary, since the slope is too steep for safe stacking of boulders as they were dug out of the wet clay mantle.

These earth moving and boulder extraction operations were associated with the reduction of basalt blocks firstly to blanks and then to large preforms. In the final stages of preform production, activity was concentrated on the outer edge of this and other terraces, perhaps to facilitate the disposal of the thousands of small, sharp flakes. It is possible that small parties of stone workers undertook each task consecutively, in such a way that each member shared in boulder extraction, the spreading of clay fill, and blank and preform production. However, this would not have utilised the skills of the best knappers in the most economical way. As in several craft activities recorded by Buck in the 1920s, Samoans in prehistory probably organised quarry labour to reserve the most highly skilled tasks for experts, while untitled young men provided unskilled labour under their direction.

RE-EXAMINATION OF TOOL PRODUCTION AT TATAGA-MATAU

Following the 1985 field work, which involved inspection of preforms found on the site and in public and private collections, together with informal replication trials, a classification of blank types was developed. It was found that "the preferred technique was to strike off large flakes to be used as blanks, rather than to reduce the block itself into a preform" (Leach and Witter 1987: 41). Reduction sequences based on the three main blank types were then outlined (Leach and Witter 1987: 45–50). The extensive clearance of undergrowth from large areas of Quarry Area 1 during the 1988 field work and, more importantly, the excavation of blanks and preforms from deposits up to 2 m deep, provided not only some time depth but an opportunity to observe a much larger sample from both quarry and working floor locations. Witter also continued his replication trials using fresh basalt from the base of the waterfall.

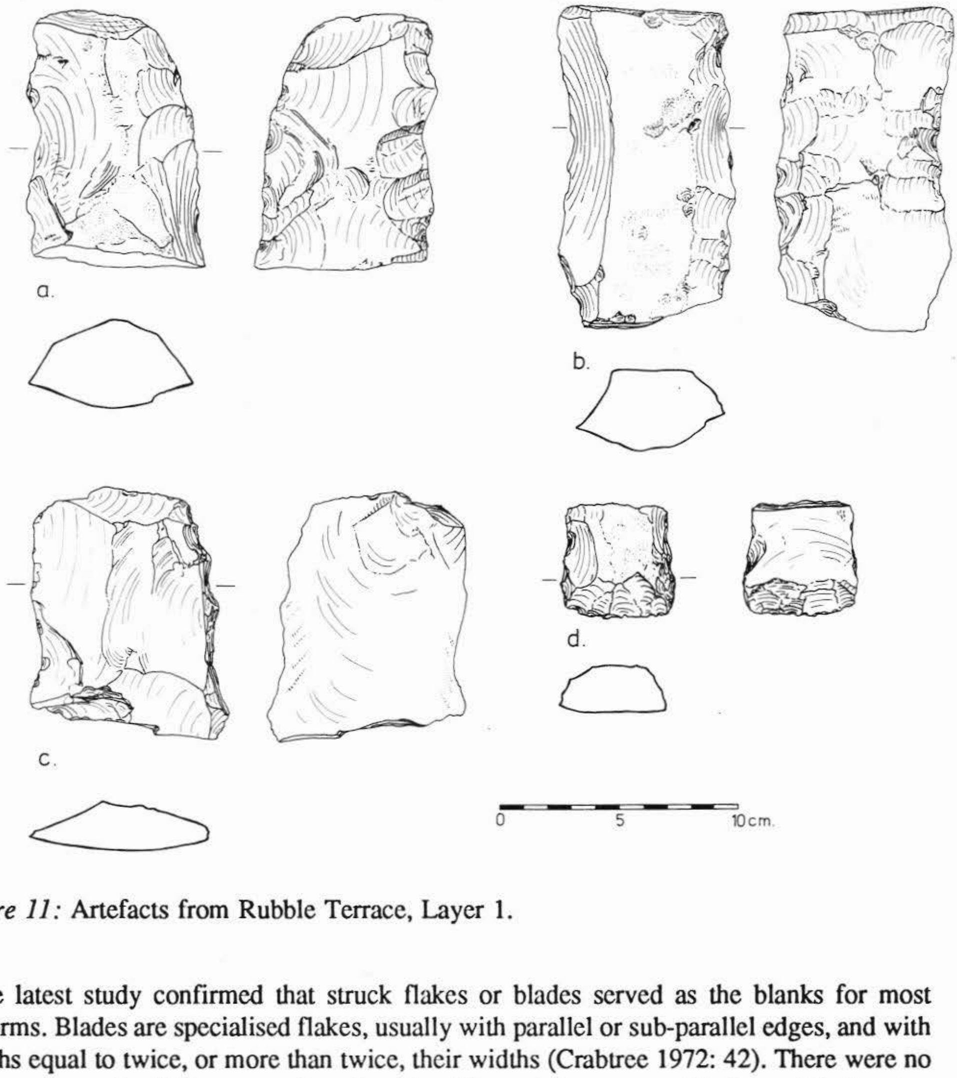

Figure 11: Artefacts from Rubble Terrace, Layer 1.

The latest study confirmed that struck flakes or blades served as the blanks for most preforms. Blades are specialised flakes, usually with parallel or sub-parallel edges, and with lengths equal to twice, or more than twice, their widths (Crabtree 1972: 42). There were no obvious cases of cobbles or weathered-out boulders serving as core blanks, and in keeping with this finding was the low proportion of waste flakes with cortex on their dorsal surfaces. Some opportunistic selection of suitably shaped blocks was evident, but the blanks concerned had fractured along zones of weakness, probably during flaking attempts. Technologically these pieces were therefore more akin to flake than to core blanks. Flake blanks have also been found to predominate in many Hawaiian adze quarries (Weisler 1990).

The flake or blade blanks underwent three main manufacturing stages to become preforms:

1. Bimarginal reduction—this involved narrowing, usually of the sides, and the loss of the greatest amount of mass;

2. Bidirectional reduction—this involved thinning, shaping and trimming to achieve maximum cross-sectional symmetry;

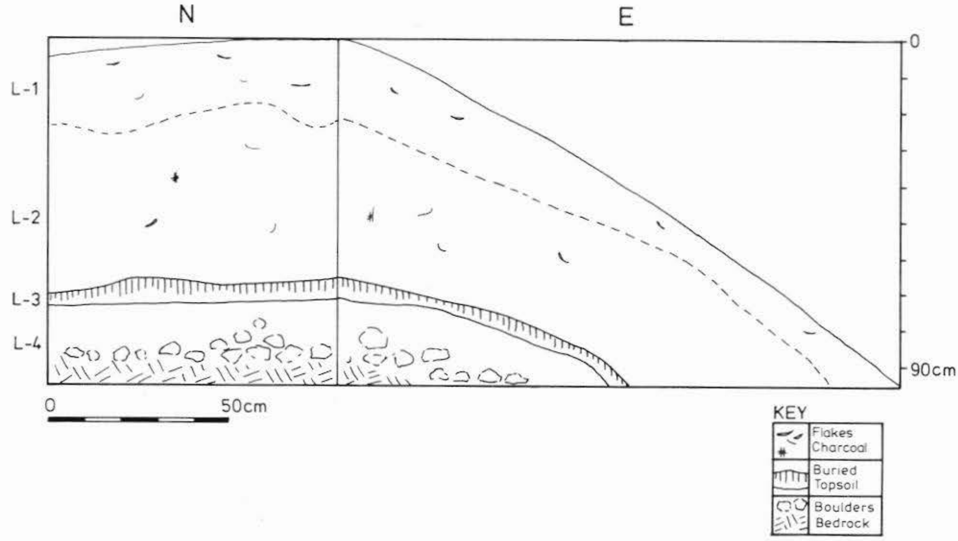

Figure 12: Promontory Terrace, Trench 6, sections.

3. Bevel flaking—the bevel was usually made on the same side as the surface used as the platform for the first stage of reduction.

With the discovery in the excavations of distinctive variations of blanks not often found on the surface, it was considered necessary to expand the classification to recognize these sub-types. In the terms used in their description below, axial length refers to the length of the flake from the proximal (platform) end to the distal end. The axial width is the greatest measure at right angles to this, even though it may exceed axial length. In relation to a flake, the ventral surface is the side where the fracture occurred as the flake was struck from its core—it usually displays a positive bulb of percussion. The dorsal surface lies on the opposite side. In the first stage of reduction, either the dorsal or the ventral surface served as the platform for the narrowing process, depending on its curvature relative to the other side of the flake. Generally, the flatter side was chosen as the platform for this bimarginal reduction. When referring to adze preforms, once the bevel has been made (or it is obvious where it would have been made) the terms front and back can be employed, as in conventional adze terminology. The surface with the bevel is referred to as the back. Although most adzes are presumed to have been hafted with the back and bevel facing towards the user, this hafting convention may not have been rigorously applied to all adzes. Exceptions have been noted by Buck (1930: 362–3) and Firth (1959: 151). In using the term 'back', therefore, we are referring simply to the side with the bevel and not to the hafting orientation.

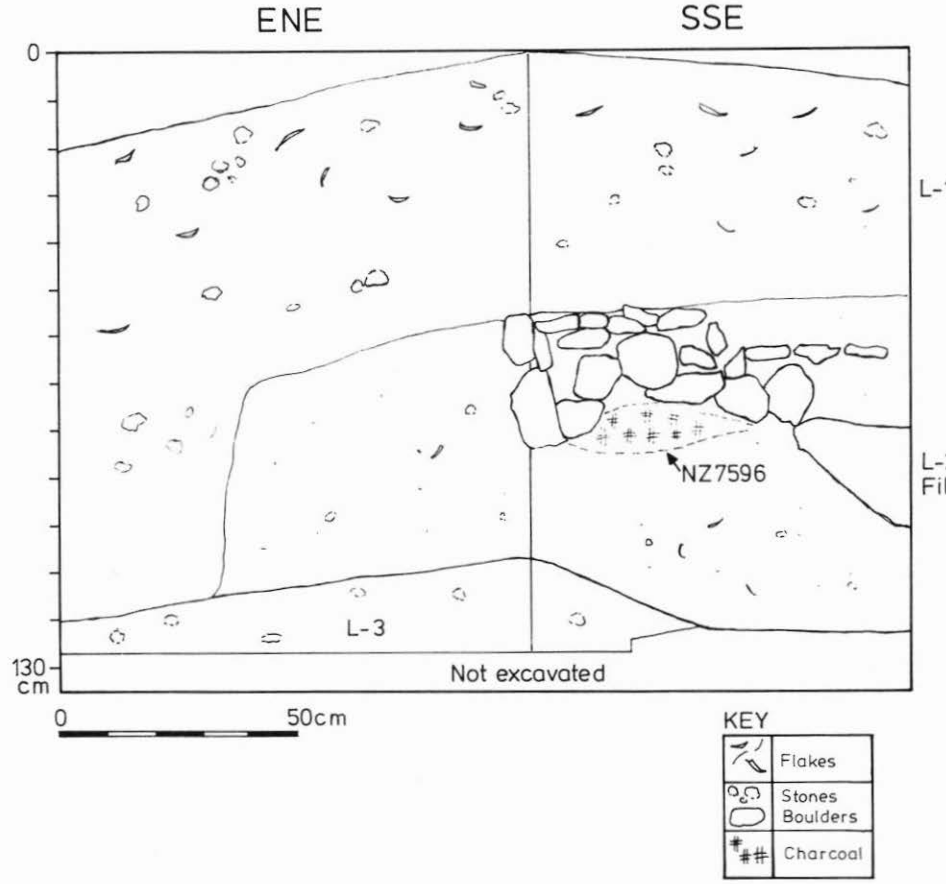

Figure 13: Off-set Terrace, Trench 4, sections.

Blank Type A (Fig. 17): Small flat blanks with a weak percussion bulb and no prominent dorsal ridging. Axial length may be greater than axial width. The main stage of reduction, usually steep anvil-backing, used the dorsal surface as striking platform, but not invariably. The bevel was usually formed on the dorsal surface. Finished adze, cf. Type III in Green and Davidson's classification (1969, 1974). This type is distinctively thin in profile. For an example, see Fig. 11c.

Blank Type B1 (Fig. 17): Pronounced bulb of percussion, hence ventral surface very curved, no dorsal ridge, axial width much greater than axial length. First stage of reduction is on ventral surface from a dorsal platform. Preform cross-section roughly trapezoidal or may have a keel-like ridge down the back. Bevel formed on dorsal surface. Finished adze, cf. Types I, II. Type I has a trapezoidal cross-section with front narrower than back. Type II is similar, but with an irregular ridge running along the centre of the back which may result from trimming flakes falling short of the centre line. For an example of Blank Type B1, see Fig. 8b.

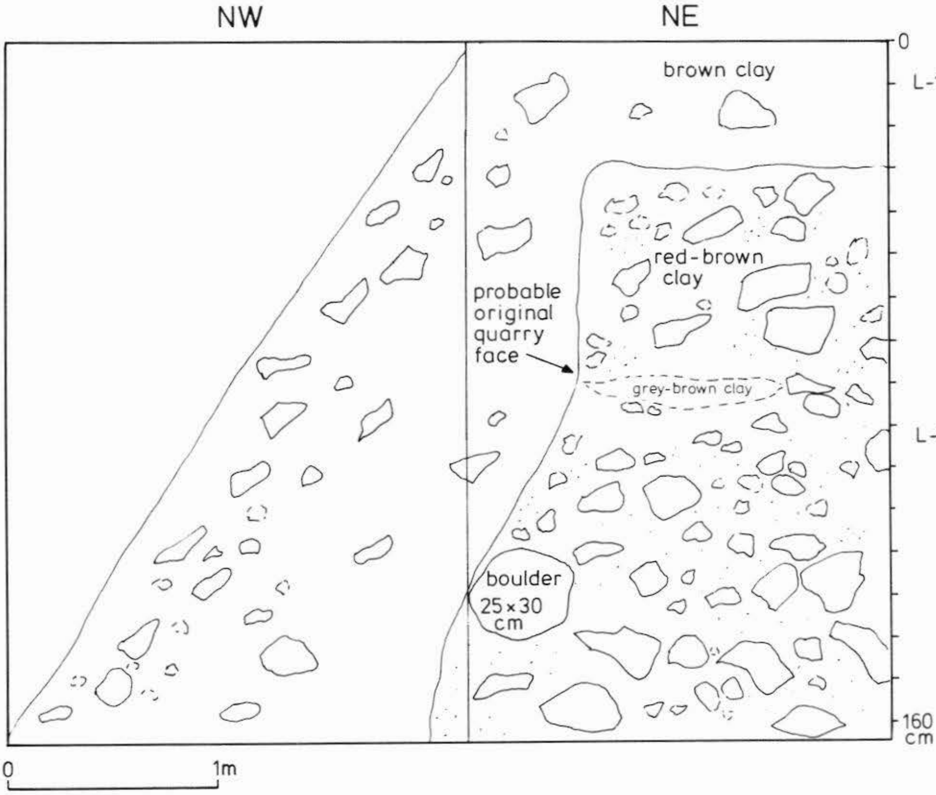

Figure 14: Near Off-set Terrace, Trench 2, sections.

Blank Type B2 (Fig. 17): Weak bulb of percussion, hence ventral surface relatively flat, and dorsal surface protruding and massive. Axial width greater than axial length. First stage of reduction is from a ventral platform. If bevel is formed on the ventral surface, preform cross-section is trapezoidal or rounded. Finished adze, cf. Types I, IX. (The Samoan Type I merges into the Type IX as the front becomes increasingly narrow.) If bevel is formed on the dorsal surface, preform cross-section is reversed sub-triangular or reversed triangular. Finished adze, cf. Type IV, a type which commonly has a reverse sub-triangular cross-section. For examples of Blank Type B2, see Fig. 18.

Blank Type C1 (Fig. 19): Blade blank with pronounced dorsal ridge, and axial length more than twice the axial width. First stage of reduction is from ventral surface. Bevel made on ventral surface. Preform cross-section is triangular. Finished adze, cf. Types VI, VII. Type VI is an important Samoan form of triangular cross-section, apex up. In cases where the adze thickness exceeds the width, this triangular form is classified as Type VII. If bevel is made on dorsal surface of the blank, the rare Buck Type VIII would result. (Green and Davidson include several adzes in Type VIII which we would classify as Type IV, reverse triangular or subtriangular with thickness much less than width. In our view, Type VIII should be reserved for the true trilaterally-flaked, reverse triangular adze with thickness greater than or equal to width.) For examples of Type C1 see Figs 8a and 20.

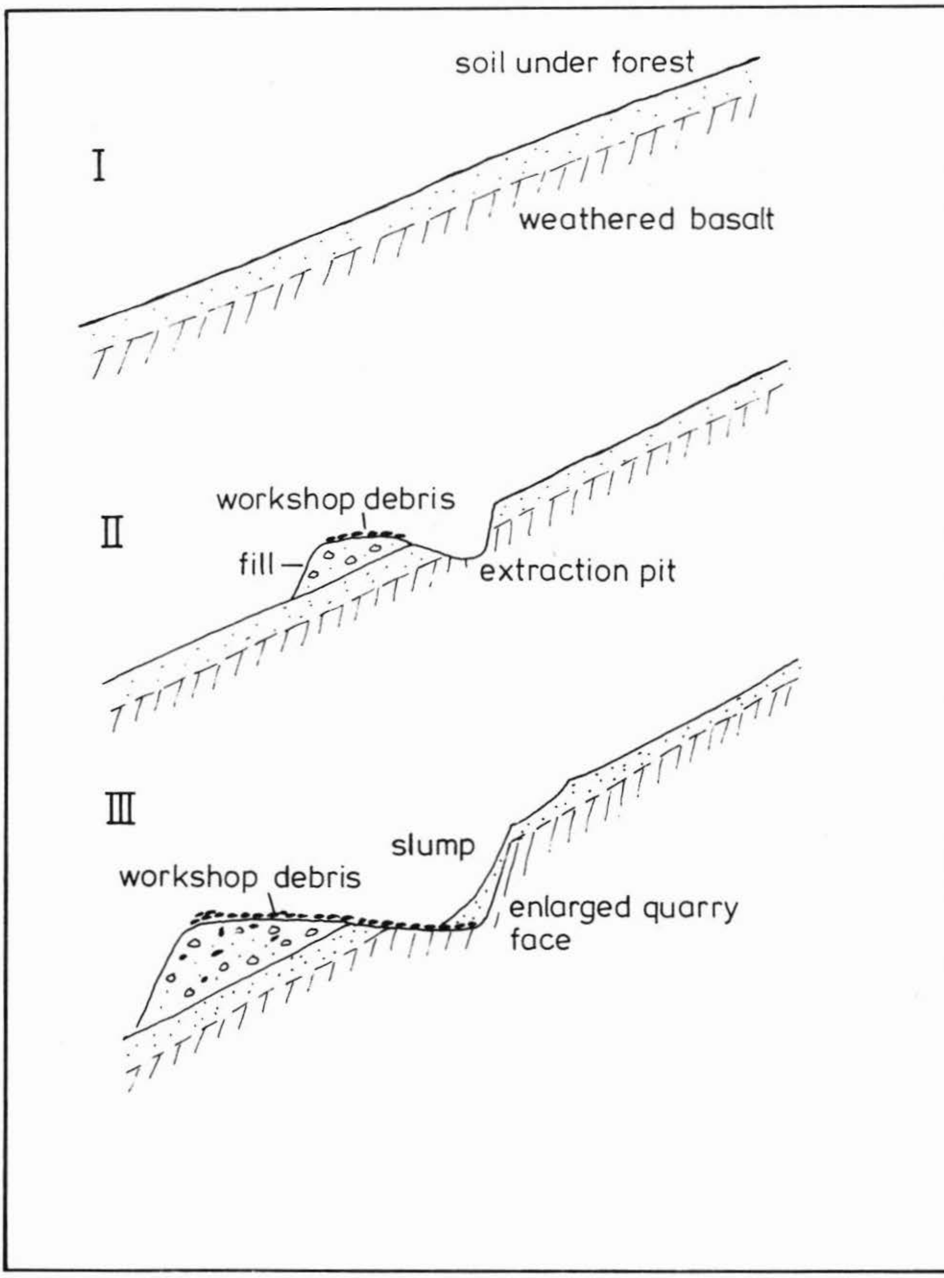

Figure 15: Original cut-and-fill model of formation of Rubble Terrace.

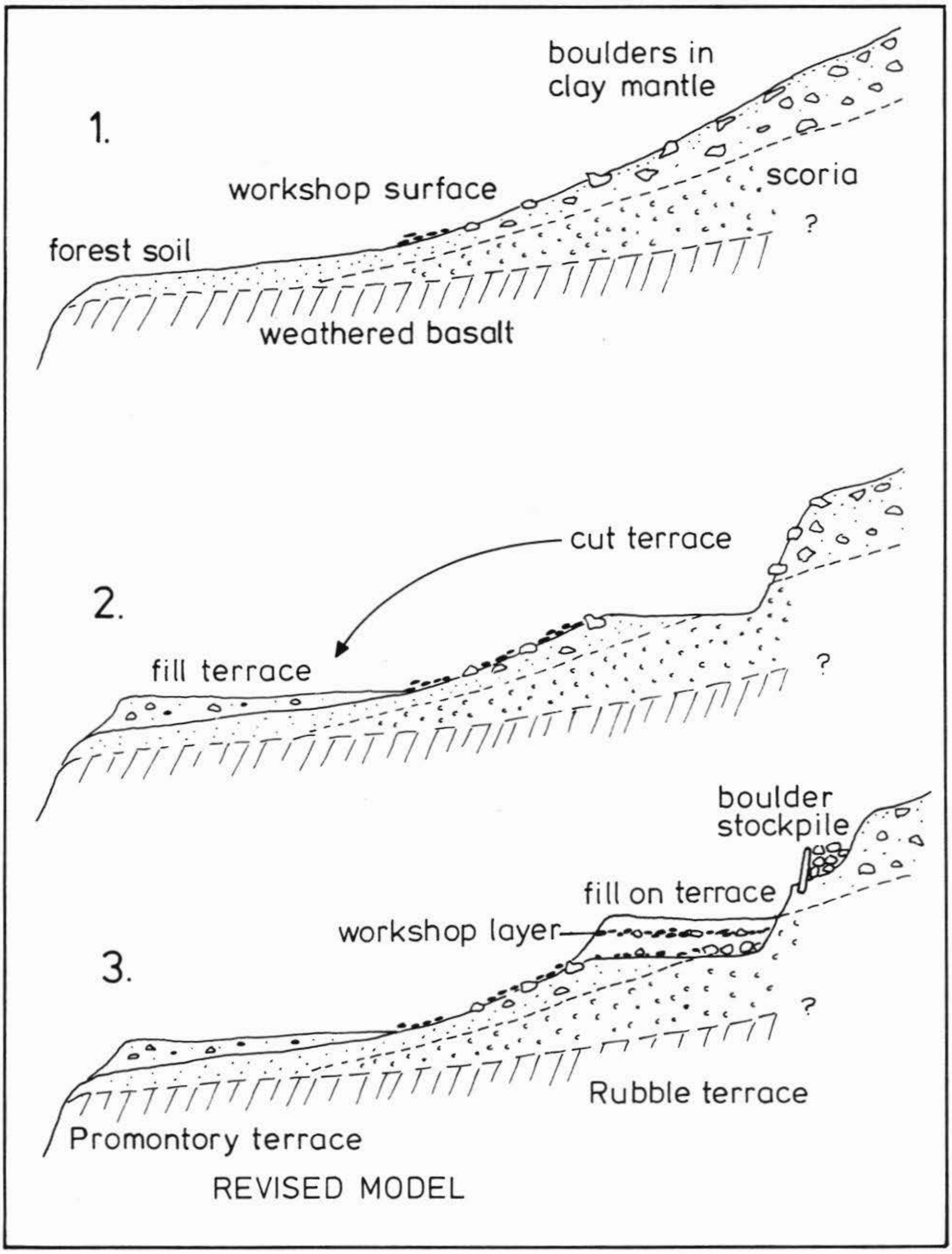

Figure 16: Revised model of formation of Rubble and Promontory Terraces.

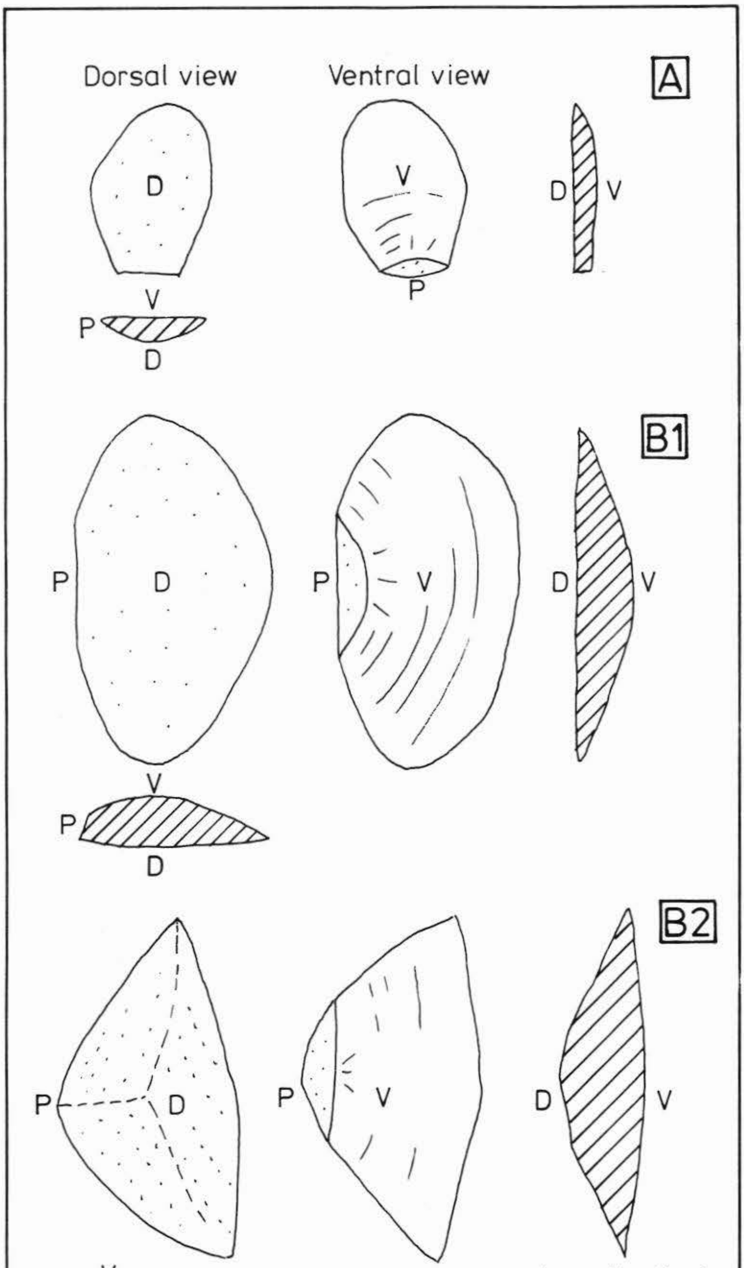

Figure 17: Blank Types A, B1 and B2.

Blank Type C2 (Fig. 19): Blade blank with a blade scar or natural surface down the dorsal ridge producing a trapezoidal cross-section, and axial length over twice the axial width. First stage of reduction is from ventral surface. Bevel also made on ventral surface. Preform cross-sections can range from sub-triangular to trapezoidal. Finished adze, cf. Types I, VI, IX. For examples, see Figs 10c and 21.

Blank Type D1 (Fig. 22): Elongated flake blank with a strong dorsal ridge, axial length greater than axial width but not twice as great. First stage of reduction is from the ventral surface. Bevel made on ventral surface. Preform cross-sections usually trapezoidal. Finished adze, cf. Types I, IX.

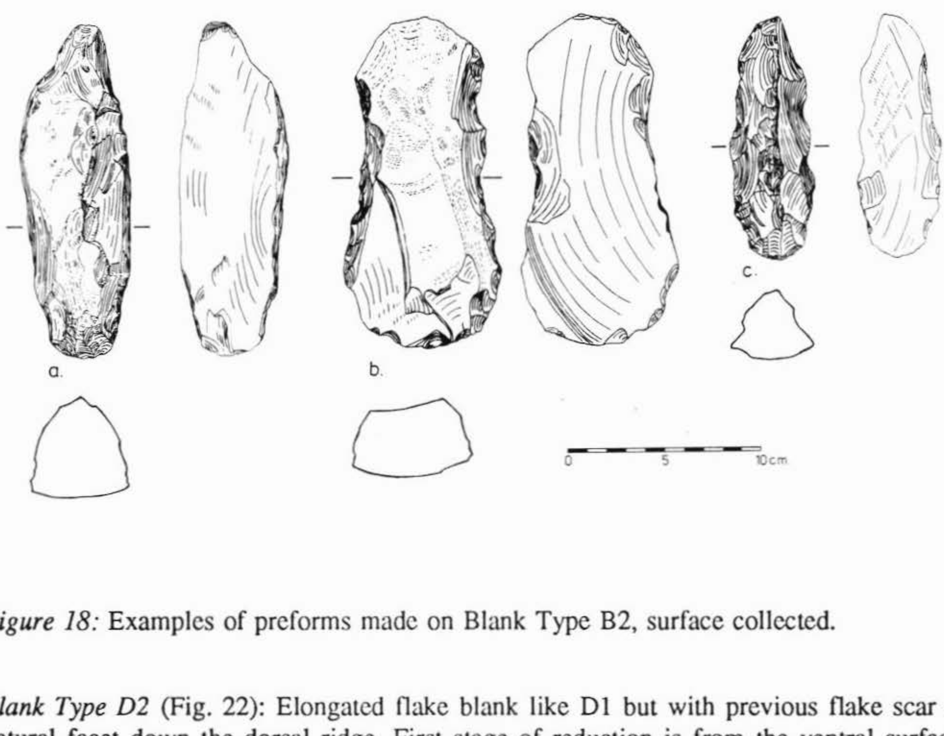

Figure 18: Examples of preforms made on Blank Type B2, surface collected.

Blank Type D2 (Fig. 22): Elongated flake blank like D1 but with previous flake scar or natural facet down the dorsal ridge. First stage of reduction is from the ventral surface. Bevel made on the ventral surface. Preform cross-sections usually trapezoidal. Finished adze, cf. Type I. For an example, see Fig. 11b.

Blank Type D3 (Fig. 22): Elongated flake blank with rounded dorsal surface. First stage of reduction from ventral platform. If bevel is made on ventral surface, preform cross-sections are trapezoidal (cf. Types I and IX) or possibly plano-convex (cf. Type V). If bevel is made on dorsal surface, cross-section is reversed, cf. Type IV. For a possible example, see Fig. 11a.

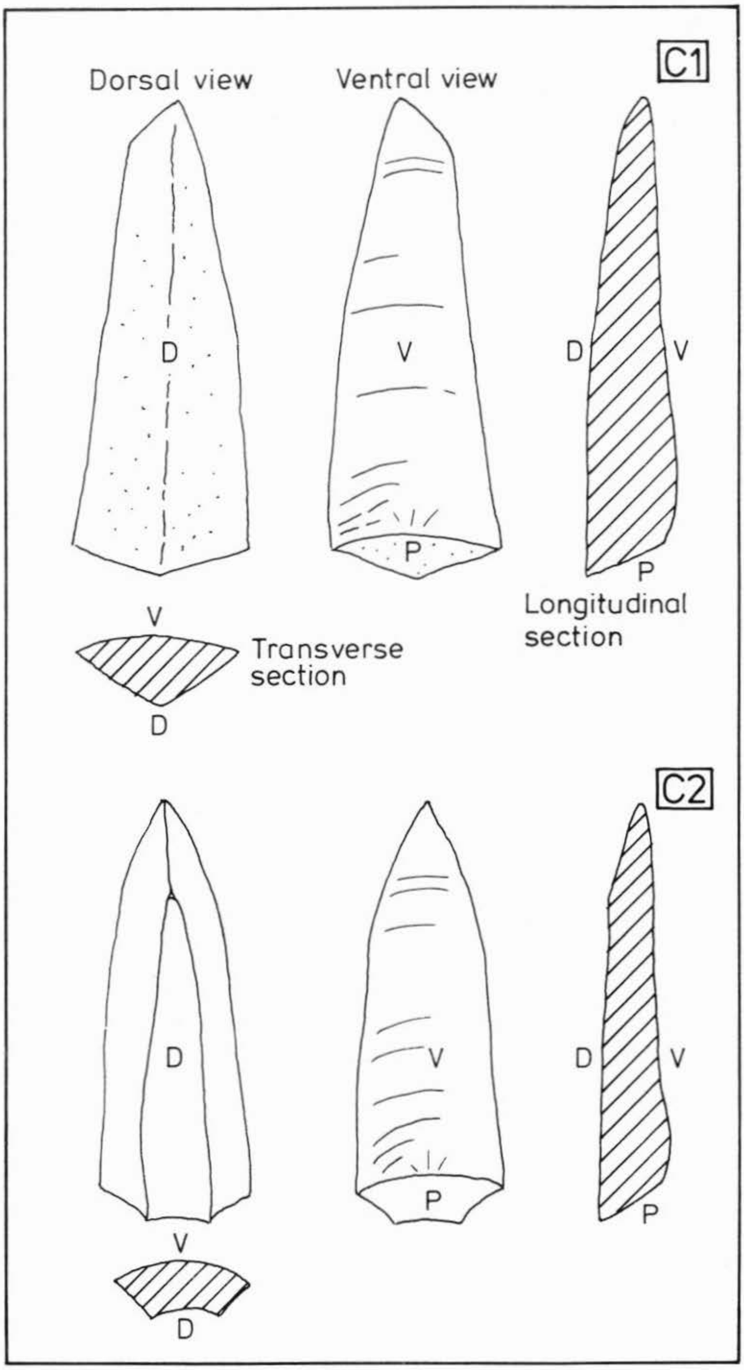

Figure 19: Blank Types C1 and C2.

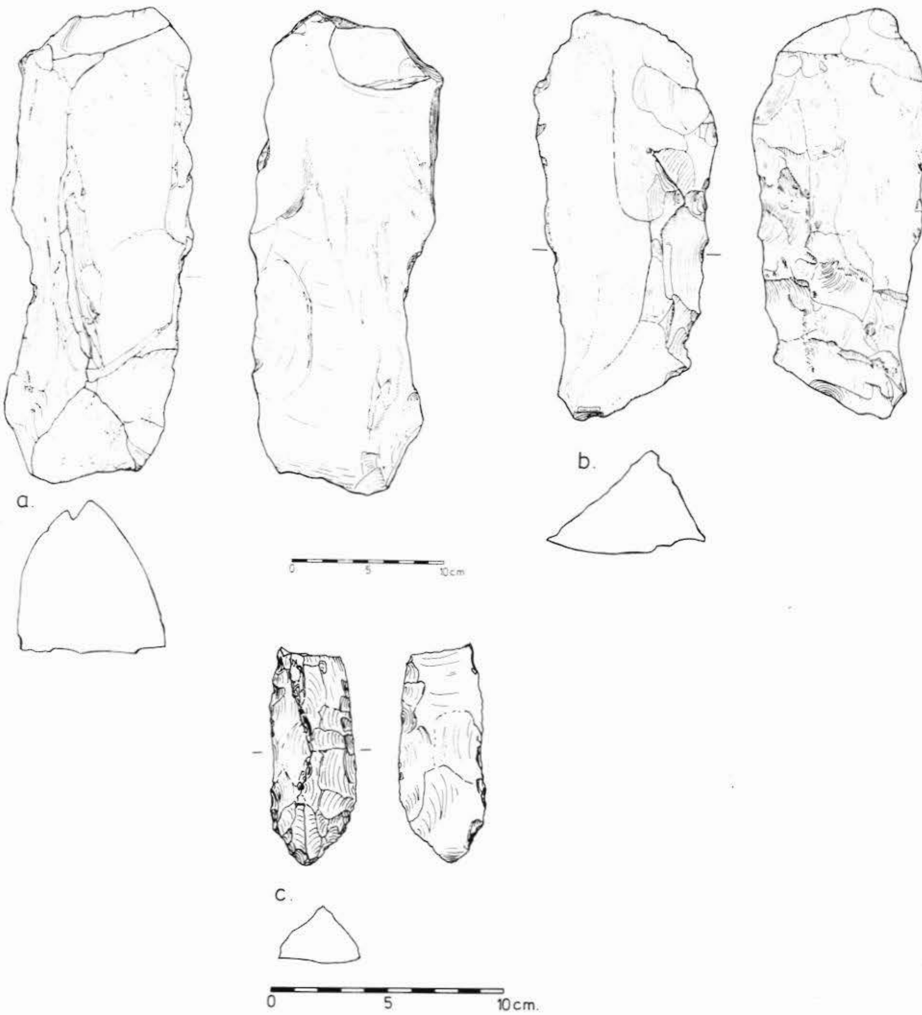

Figure 20: Examples of preforms made on Blank Type C1, surface collected.

Blank from a tabular fragment fractured along natural cleavage planes rather than a conchoidal flake, or else from a large block fragment or quarry splinter, without a flake orientation. Preform cross-section usually rectangular or trapezoidal. For examples, see Fig. 23.

Blank from a stream cobble or weathered out stone, with no flake orientation. This type was not encountered at Tataga-matau.

Judging from the material excavated from Layer 2 in the Rubble Terrace squares, the large-scale operation undertaken there in the fourteenth to fifteenth century was intended to produce Type D blanks. The cores from which these blanks were struck were systematically reduced in such a way that the flake scars left dorsal ridges. Where block dimensions were suitable, corner blades (C1) and subsequently C2 blades also resulted from this reduction process. Although the lengths of the large elongated flake blanks are unknown because of transverse fractures on the discards (none in this early stage of manufacture were found complete), some reached 100 mm in width. Judging by the measurements of some completed Samoan adzes, the blanks may well have exceeded 320 mm in length. The adzes made from such blanks would have been of Types I, VI and IX. Interestingly, adzes made by percussion flaking at the Tuman quarries in the Papua New Guinea Highlands are believed to have been limited to a maximum achievable length of 33 cm (Burton 1989: 268). As in the Tuman case, it is possible that the adze production operation represented on the Rubble Terrace was primarily organised for the manufacture of large preforms for exchange.

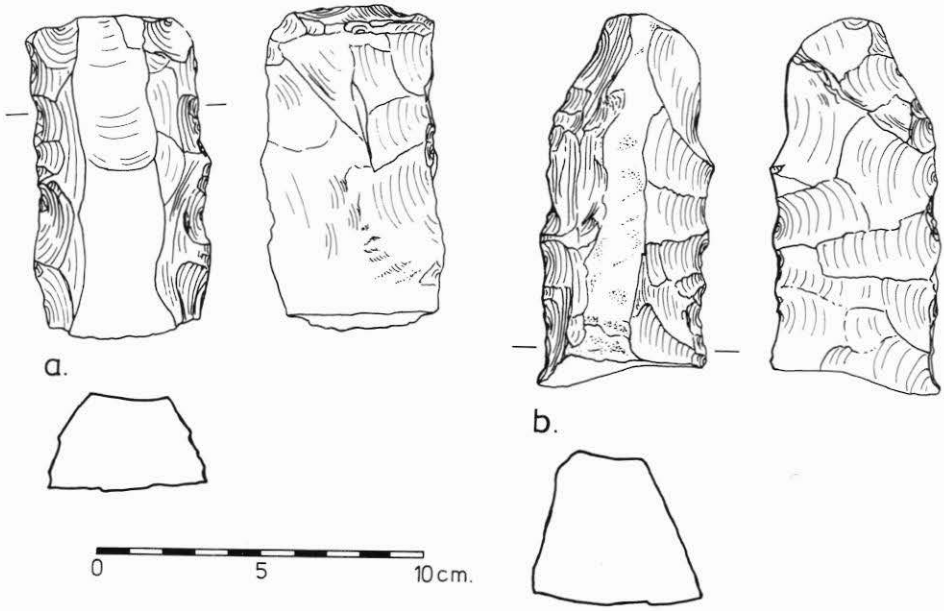

Figure 21: Examples of preforms made on Blank Type C2, surface collected.

This situation contrasts with that frequently observed on the surface and in the upper layers of the working floors. Here the boulders used as blank cores show only a few flake scars, mostly for the blank Types A, B1, and the small C1. Production of these blanks has been replicated experimentally and does not require the same expertise and manpower as the large Type C or D forms which Witter was unable to match in his trials. The existence of small preforms made from Type D blanks in the workshop debris at the Lower Ditch and Star Mound Terrace, as well as in the top layer of the Rubble Terrace, may suggest some gleaning of Type D blanks rejected during earlier phases of stone working. When these short blanks are flaked experimentally, they take on a hump-backed appearance, which matches discards found on the workshop surfaces and some adzes from local collections.

Adzes were not the only tools manufactured at Tataga-matau. During the analysis of 29 preforms and blanks found in the late phase workshop adjacent to the Lower Ditch, it was found that seven stood out from the rest by their possession of steeply flaked, curved

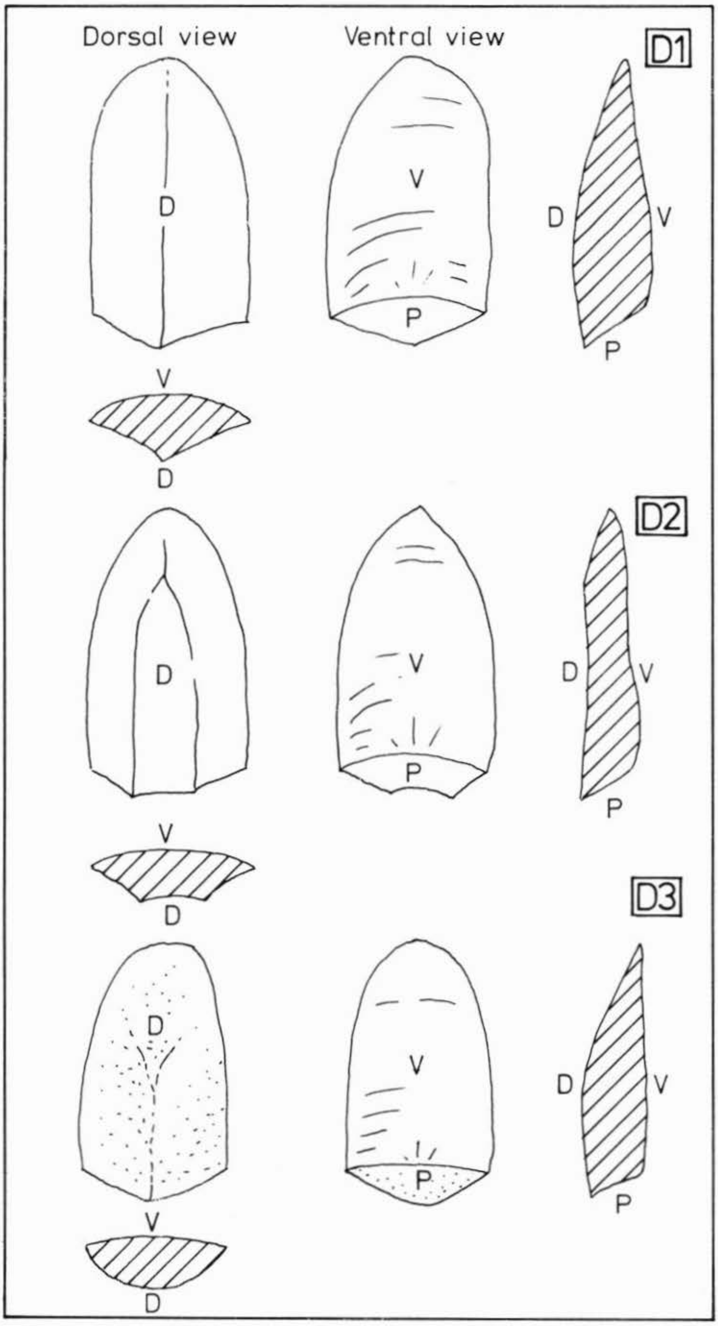

Figure 22: Blank Types D1, D2 and D3.

working edges (Figs 24a and b). They were significantly shorter (p = .01) and thinner (p = .05) than the adze preforms. In five cases the blanks selected for these tools were elongated flakes (Type D) or true blades (Type C), though of small dimensions. A similar artefact (Fig. 24c) was recovered by Best on the Star Mound Terrace (Best, Leach and Witter 1989: 34). Instead of preparing the cutting edge from a platform on the flake's dorsal surface (as in the majority of adzes), the stone workers had chipped the steep, curved edge from the ventral surface of the elongated flake or blade. The resulting tool could not have functioned as an adze, nor can it be classified within either Buck's (1930) or Green and Davidson's (1969, 1974) system. However, Buck did recognise this form as a distinctive class of tool. His Samoan informants identified it as a *tuai ma'a* or stone coconut grater head (Buck 1930: 111, 367–8, Fig. 217). More commonly made of coconut shell, or today of metal (hinges or bent reinforcing rods), the *tuai* was lashed flat side uppermost to the wooden arm of the grater stool. Buck also noted that old stone adzes were sometimes retouched as graters.

On the basis of this identification, Davidson (1969a: 199, Fig. 85b; 1969b: 246, Fig. 102e) and Ishizuki (1974: 54, Fig. 33c) described three similar artefacts from Upolu as coconut graters. Clark and Herdrich (1988: 101–2) felt that the original attribution made by Buck's informants was conjectural. They prefer to include this form as Class I within a classification of non-adze formal flake tools. Attention was drawn to the rarity of this tool on Upolu, and its prevalence in the vicinity of adze manufacturing areas on Tutuila (Clark and Herdrich 1988: 105). The discovery of these tools in a preform state at Tataga-matau now establishes that some were made at this adze quarry during the later stages of its use. A distinctive technique was employed, involving a reversal of the blank orientation used for adzes. This, coupled with their characteristic shape, support the notion of a special function such as that of the *tuai*, a tool which is as vital to Samoan cuisine as the adze was to Samoan wood working. In pre-European times the *tuai ma'a* would have lasted longer than the grater head made of coconut shell. Transformation into a grater head would have extended the usefulness of adze heads which had become too short or misshapen for use in wood working. The close relationship between the distribution of these flake tools and adze quarry sites may be explained by the fact that symmetrical elongated flakes were the preferred blank for both the grater and certain types of adze, and that the production of such blanks required high quality material and skilled stone workers.

In the earlier report (Leach and Witter 1987: 45), it was argued that blank type is an important determinant of preform shape, and that the source of the stone and the form in which the parent block occurs are determinants of blank shape. The 1988 field work re-affirmed the significance of these factors. It also drew attention to three more factors which appear to have influenced production at Tataga-matau : the organisation of labour for extracting the material, the levels of skill available, and the special demands put on the craftsmen such as for large, 'export' quality adzes.

DISCUSSION

In 1985, Tataga-matau was the only adze quarry known from Tutuila. Nevertheless, Frost's (1976: 33) comments concerning the abundance of basalt flakes in the Tulauta (Tulotu) site in Eastern Tutuila suggested the presence of another quarry at that end of the island. The area was re-investigated by Gould, Honor and Reinhardt (later Brophy) in 1985. Clark and Herdrich (1988: 26–31) and Clark (1989: 36–7, 50–1) later convincingly argued that Brophy's (1986) 'lithic manufacturing center of Samoa' based on a supposed quarry at

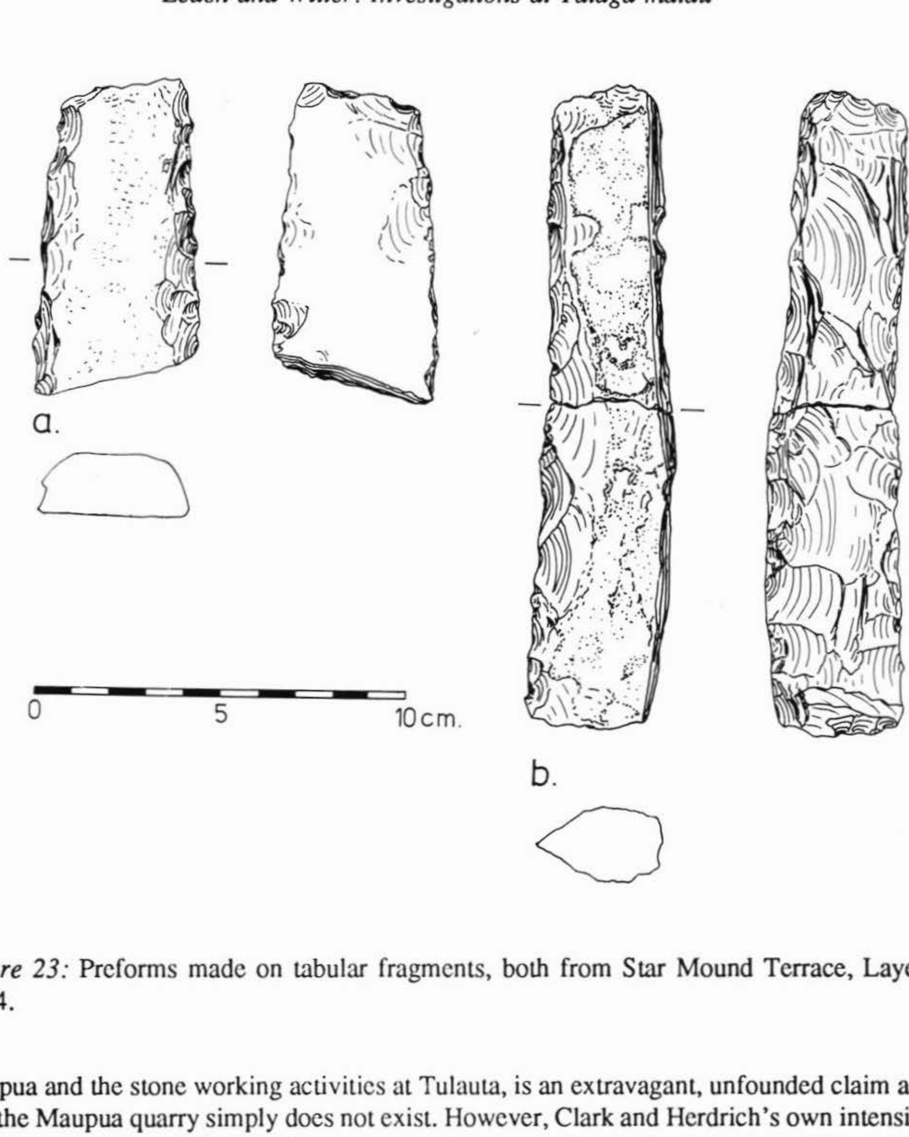

Figure 23: Preforms made on tabular fragments, both from Star Mound Terrace, Layers B3–4.

Maupua and the stone working activities at Tulauta, is an extravagant, unfounded claim and that the Maupua quarry simply does not exist. However, Clark and Herdrich's own intensive surveys have revealed five basalt quarry-workshop areas, four behind 'Aoa Bay (Clark 1989: 21, 69, 78, 79), and one close to Tula, which may have supplied the basalt for the Tulauta site (Clark 1989: 48). None of the flake concentrations at these sites exceeds 240 square metres, whereas at Tataga-matau the Rubble Terrace alone has an area of 480 square metres. The accumulating evidence, therefore, supports the view adopted after the 1985 season that

> future studies will demonstrate that many separate sources supplied the small adzes used on a routine basis by ancient Samoans, but that only one or two quarries offered the fine-grained relatively homogeneous material in a form suited to the manufacture of the large...forms required by specialist canoe and house builders. (Leach and Witter 1987: 51)

What was not appreciated after the 1985 survey was the extent of the quarries at Tataga-matau. The 1988 field work programme not only identified three major quarry areas within the complex, but also extended the site area to more than twice its original size, to include a massive defensive ditch, four star mounds (in addition to Buck's *tia*) and numerous terraces. The complexity of the features, and the evidence of human activity from a period before pottery and obsidian fell into disuse right through to the eighteenth century, mean that it can no longer be viewed as a single fortified quarry, nor perhaps as a single site.

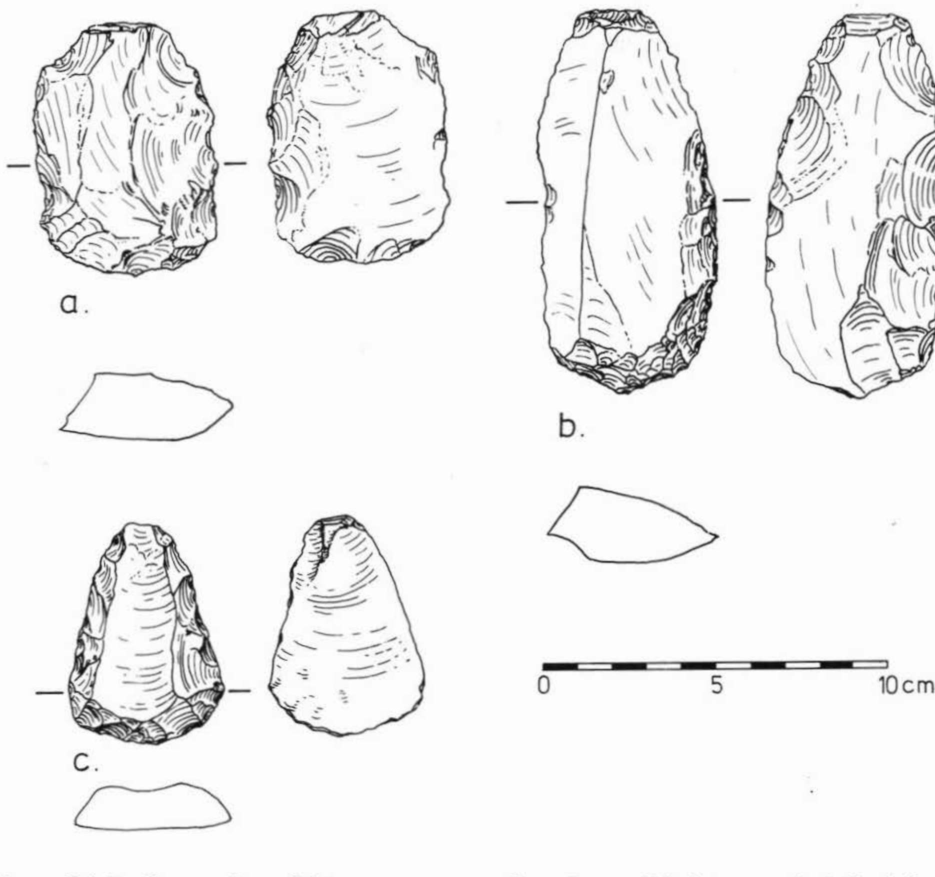

Figure 24: Preforms of possible coconut graters from Lower Ditch terrace (a, b, both Layer 1) and Star Mound Terrace (c, Layer A6).

However, in strategic terms, the defensive features could have been used to control access to the three main quarry areas, and the excavations at the Lower Ditch confirmed that stone working occurred both before and after earthwork construction. At one phase of the complex's long history, therefore, the quarries were closely associated with the fortifications, though it must be made clear that the ditches and scarps also protected what were probably living areas. On present evidence, the lower ditch was cut towards the end of the prehistoric sequence, and there is nothing to suggest that other components of the fortifications pre-date the formation of the Star Mound Terrace about the fourteenth century or the organised boulder extraction and earth moving operations occurring at the same period within the Rubble Terrace complex.

Tool manufacture took place on the Tataga-matau ridges both before and after what might be called the major industrial phase of the fourteenth to sixteenth centuries. This phase was characterised by the systematic mining of the stony clay mantle for basalt boulders of suitable shapes from which massive flake and blade blanks could be struck. It also involved the moving of possibly several thousand cubic metres of clay and topsoil—the Promontory Terrace alone is estimated to be covered by 800 cubic metres of clay fill. As Burton found in the New Guinea Highlands case (Burton 1989: 262, 268), the satisfaction of local demand for adzes can hardly account for this investment of labour and skill. This inferred large-scale labour organisation seems to have ended before European contact. By this time, preform manufacture seems to have been individualised and opportunistic, including the re-cycling of previously rejected waste.

Kirch and Green (1987: 442) have recently commented that many islands

> in the southwestern Pacific have been part of extensive long-distance exchange systems for hundreds or even thousands of years. The teasing out of these prehistoric networks from archaeological data is a major task facing Oceanic prehistory today.

There is now sound technological evidence for the important position of Tataga-matau during the last millennium of Samoan adze manufacture. Although we still need geological confirmation of the full distribution of Tataga-matau adzes, this site remains the most promising candidate in Samoa for the role of an export centre.

Although Tataga-matau has not revealed evidence of the period when Samoans were transforming their adze kit from the ancestral Lapita forms to the classic Samoan types, it has allowed us to understand for the first time just how those classic adzes relate to the form of the raw material available in the quarry, and the intervening stages of blank and preform production. The clarification of these sequences and relationships is essential for any future attempt to understand the significance of the adze types (especially the plano-convex forms) found in Samoan sites dating to the first millennium B.C.

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