NEW ZEALAND ARCHAEOLOGICAL ASSOCIATION

NEW ZEALAND JOURNAL OF ARCHAEOLOGY

The Riverton Site: An Archaic Adze Manufactory In Western Southland, New Zealand

H. M. Leach and B. F. Leach

Anthropology Department, University of Otago.

ABSTRACT

Analysis of stone material from a quarrying site and adze working floor near Riverton, Foveaux Strait (Site S176/1) required new methods of classification sensitive to unfinished and rejected adze preforms and new approaches to the waste flakes derived from different stages of adze production and core preparation. A variety of Archaic adze types were made at this site including large quadrangular-sectioned, triangular and reverse triangular, side-hafted adzes and many small trapezoidal and lenticular-sectioned adzes made from flakes. Adze making procedures were to some extent "formalised" and show regularities in order of flaking of butt and bevel, in orientation of flake blanks, and in bevel production. At the same time the artisans took advantage of shortcuts offered by the natural attributes of certain blocks, and reused broken preforms and fortuitously shaped waste flakes. "Jig-saw" reconstructions showed that secondary flakes derived from the trimming of adze faces all possessed scars on their dorsal surfaces left by the reduction of overhanging platform edges with special hammers. Analysis of food refuse indicated that the site was a specialist camp whose occupants lived on nearby coastal and forest resources while engaged in adze manufacture.

Keywords NEW ZEALAND, SOUTHLAND, ARCHAIC, ADZES, QUARRY, TECHNOLOGY, MIDDEN.

INTRODUCTION

The site S176/1 lies on the shores of Foveaux Strait in a small cove at the eastern end of Colac Bay, about five kilometres from the town of Riverton from which it takes its name (Fig. 1). It was selected for a joint excavation project to be undertaken by the Anthropology Department, University of Otago, and a Southland Adult Education class in 1964. The excavation director, L.M. Groube, saw it as a useful training excavation for both groups of students, as well as a chance to study the prehistory of an area in which limited fossicking had revealed many artefacts, and clear evidence of adze manufacture, using local 'argillite'.

After a preliminary visit to the site in 1963, which showed adze flakes and midden exposed on the edge of a small creek and on the surface about 40 m away, Les Groube planned an excavation (in which the senior author participated) which would link the two areas and obtain good samples of industrial debris and the food remains left by the adze-makers. Accordingly, he laid out a grid with 10 ft intervals over an area of 50 x 150 ft. Leaving baulks four feet wide between the excavation squares, he opened five squares, each 8 x 8 ft beside the creek edge (Area A), and three squares (two of them 8 x 8 ft, and the third 8 x 6 ft) at the other end of the beach (Area B). These were joined by a line of 8 x 2 ft test-pits (Fig. 2) referred to as the C line (Area C).

Excavations began on January 4, 1964 and continued until January 17. Rain fell on nine days and blustery south-westerly conditions were experienced on all but one day. Tarpaulins were erected on wooden lean-to frames over Areas A and B, but they reduced the light and working space over some squares to such an extent that the squares could not be fully excavated or photographed until the covers were removed on the last three days. Considering the difficult working conditions it is not surprising that some squares were left unfinished and that photographs took the place of

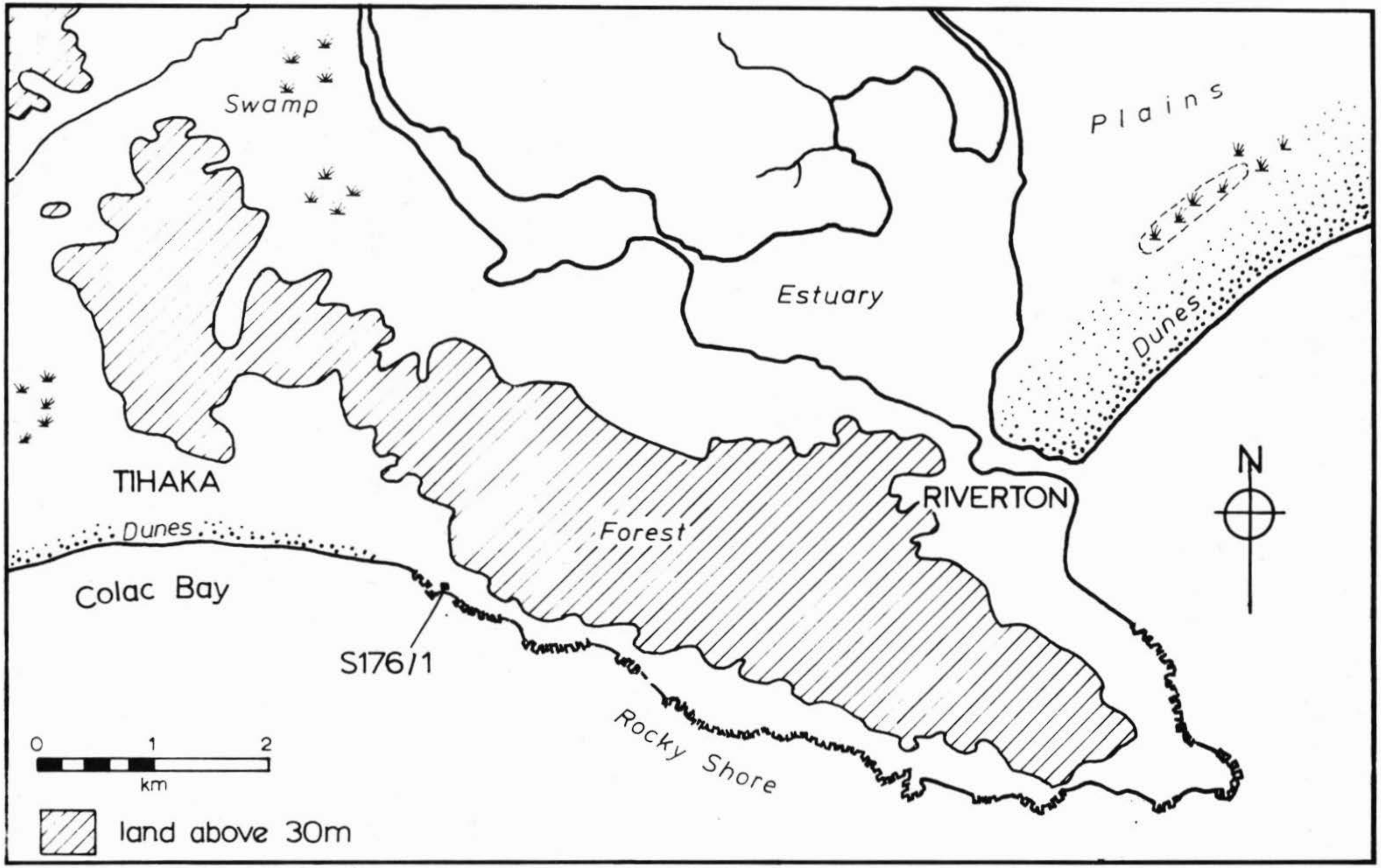

Figure 1: Location map showing the coastline near Riverton, Foveaux Strait, South Island, New Zealand.

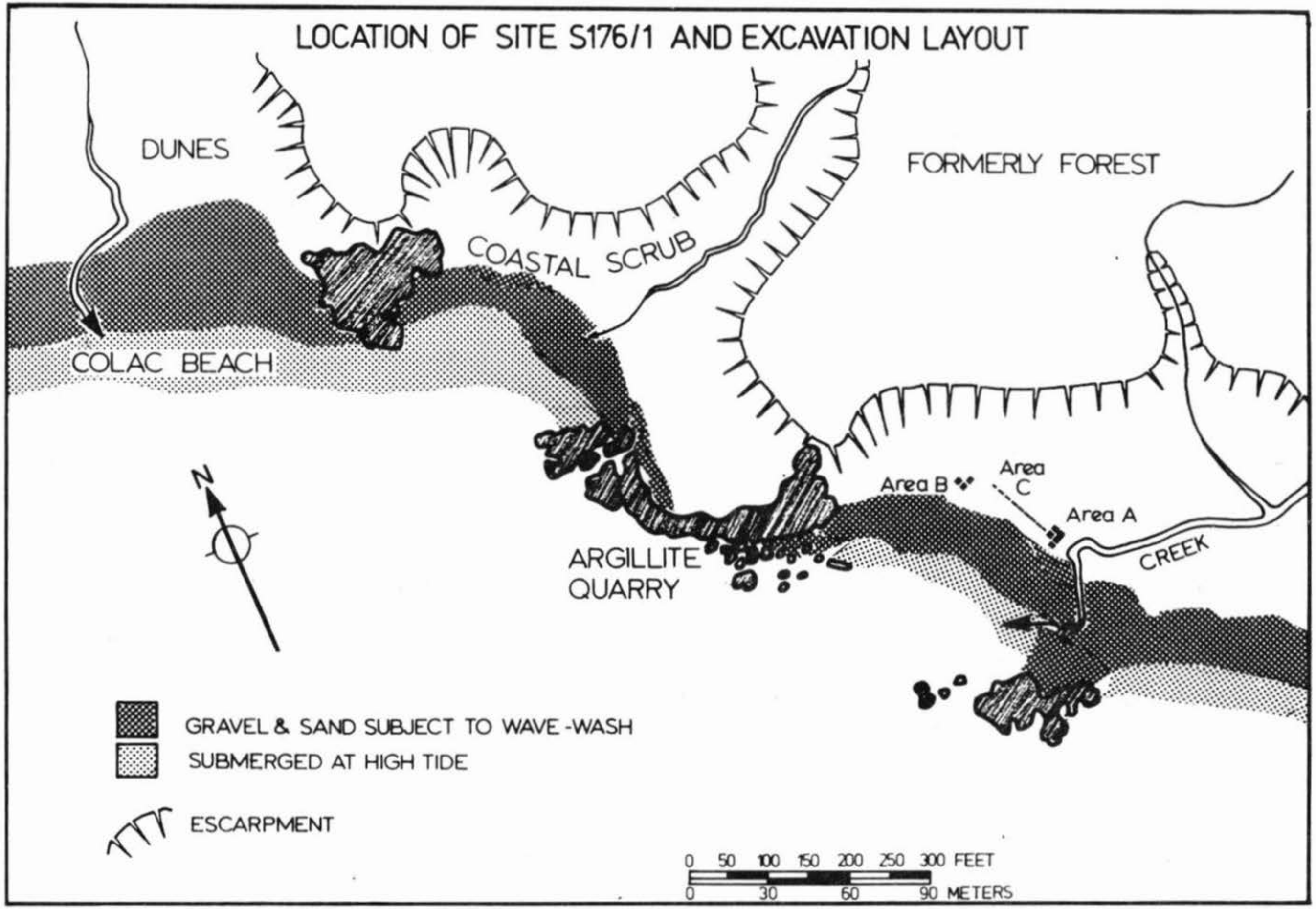

Figure 2: Location of Site S176/1 and excavation layout.

traditional square plans. Fortunately, section drawings were made, and these along with the excavation diary and photograph record book supply sufficient data for the present analysis of the site's history, contents and significance.

Excavation involved trowelling off layers and lenses in stratigraphic sequence, and bagging the material (picked out of the matrix by hand) according to quadrant and layer within each 8×8 ft square. Flake material was collected rigorously, as shown by the presence in the assemblage of nearly 3000 small flakes weighing on average about 2 g. Faunal remains were hand-selected for their diagnostic qualities and no sieving was undertaken.

A major problem is the lack of information on the proportions of each layer excavated within the large squares. It is clear from photographs and the site diary that although two of the three Area B squares were finished, the Area A squares were left with some quadrants untouched, others with only part of the lower cultural layer removed, and still others with only the midden layer excavated. It is not possible to say precisely which portions of which squares were affected. Thus when the site diary states that Layer 4 was partially removed in square D3, we cannot be sure how much was left and in which quadrant. This means that the plotting of flake or midden density or the distribution of the oven pits may present an impoverished picture of human activity in these squares.

On Groube's departure from Dunedin, the excavated material remained in the Anthropology Department where it was worked on sporadically by the authors and other senior students, including J. Kennedy and later D. G. Sutton. Initial midden sorting and some rebagging was carried out in 1964. In 1967 the stone material was transferred from bags to boxes to prevent loss of provenance if bags should burst. The stone material was steam-cleaned and labelled in 1969 and more thoroughly examined, together with the midden, in 1971-2. Carbon samples were extracted in 1969. H. Leach attempted to reconstruct some of the cores in 1977-8 and undertook the re-analysis of the stone assemblage in 1979.

The reasons why the material is now the subject of a detailed report are threefold: firstly New Zealand archaeologists have a long-term policy of completing reports on excavations which for various reasons could not be finished by the site directors; secondly this site was originally chosen for excavation as a specialist camp, a site category which is still not well documented, and analysis of midden and stone material from it confirms this interpretation; thirdly as an adze manufactory it offered the chance of documenting step by step the stages in the production of Archaic adzes.

STRATIGRAPHY, STRUCTURAL FEATURES AND DATING

In all three areas of the site, the activities of prehistoric man had taken place on a loose gravel deposit comparable to the modern beach. It may have carried some vegetation but this had obviously not been sufficient to build up the humus content of the gravel bank and stabilise its surface. Consequently prehistoric activity, especially the periodic digging and raking out of oven pits in Area A, modified the natural gravel layer by working charcoal, broken oven stones, and industrial debris into the top nine inches (23 cm), thereby creating the lower cultural layer (Layer 4).

In Area A, midden dumping occurred in some of the hollows where ovens had been built (Fig. 3). This gave rise to a shelly deposit referred to as Layer 3 in all parts where it was found. The site was then finally abandoned and vegetation (chiefly grasses) has become well established, no doubt enriched by the underlying ash, charcoal, and human rubbish. A topsoil has been built up under this vegetation to a depth of two to four inches (5-10 cm). This was subdivided into two layers (Layers 1 and 2) on the basis of root density.

There are several layer descriptions and section drawings covering the three areas. The section drawing (Fig. 4) of square D2 shows a complex series of ovens, covering the period when Layer 4 was created out of the natural beach sediments and food and industrial waste was dumped in the oven hollows. No descriptions of stratigraphy survive from the two squares C3 and B2, from which the bulk of stone material was recovered. However, photographs show clearly that in B2 shell midden overlay a darker, charcoal-stained layer into which two small oven pits had been cut. Both the shell layer and the charcoal-enriched layer contained numerous flakes. Stone material from both B2 and C3 is labelled either Layer 3A or 3B and it would appear that 3B is very close in composition, if not identical in origin, to Layer 4 recorded in C2, D2 and D3.

When charcoal samples were selected for radiocarbon dating four years after the excavation, the choice of charcoal blocks from three ovens in Area A was made to provide a secure provenance in an otherwise shallow, loose gravel deposit. The following results were obtained from Area A (for location of samples see Fig. 3).

Sample No.	Location	Years BP (old ½ life)	Years a.d.
NZ 924	Square B2, Layer 3B, Oven	548 ± 39	1402 ± 39
NZ 1032	Square D2, Layer 6, Oven	696 ± 49	1254 ± 49
NZ 1033	Square D3, Oven in SW Face	681 ± 36	1269 ± 36
	Pooled estimate (B.F. Leach, 1972):		1311 ± 47

The designation "Layer 6" originally referred to the natural gravel underlying the large oven shown in the section drawing of the north-west face of D2 (Fig. 4). Although stained by contact with charcoal, strictly speaking as a 'natural' layer it should not have contained charcoal. It seems likely then that this charcoal was derived from the base of the oven, now relabelled Layer 3C or Layer 4. The oven in the south-western face of square D3 is much less complicated. The charcoal for dating was almost certainly derived from a clearly marked lens within Layer 4.

Unfortunately nothing is known of the species of wood making up these radiocarbon samples. The inhabitants of the site would have had access to well-established forest above the site and a plentiful supply of driftwood on the beach. Unless it is suggested that large trees were being deliberately split for firewood, it is reasonable to assume that most wood used in heating oven stones would range from one year to perhaps 200 years in age. Thus the age estimate is unlikely to be more than two centuries too old. Taking all these factors into account, the formation of Layer 4 in Area A may have occurred on one or more occasions from the late 13th century to the early 15th century.

The question of how much later the midden layer was formed can be answered by an unusual technique potentially far more precise than radiocarbon dating. This technique, an offshoot of "jig-saw" analysis applied to problems of stone technology, involves the listing of layer accessions of all matching flakes and cores and the inspection of these for inconsistencies. Table 1 gives inter- and intra-layer inconsistencies for Area A. In squares such as D2 and D3 where Layer 3 is readily distinguishable from Layer 4, incorrect bagging as an explanation of matchings between layers seems less likely than the theory of contemporaneous and continual formation of both layers during each occupation period. Given the type of sediment making up the site and the patchy distribution of midden, chiefly in hollows, it is easy to imagine how the natural gravel would continue to be modified by traffic of feet and oven clearance (thereby forming Layer 4) at the same time as rubbish accumulated (as Layer 3) in disused ovens. Hence flakes detached in the making of an adze could become incorporated in either or both layers, depending on the location of the activity and where each flake fell.

This is not an argument for contemporaneity of Layers 3 and 4 *in toto*. As the sections

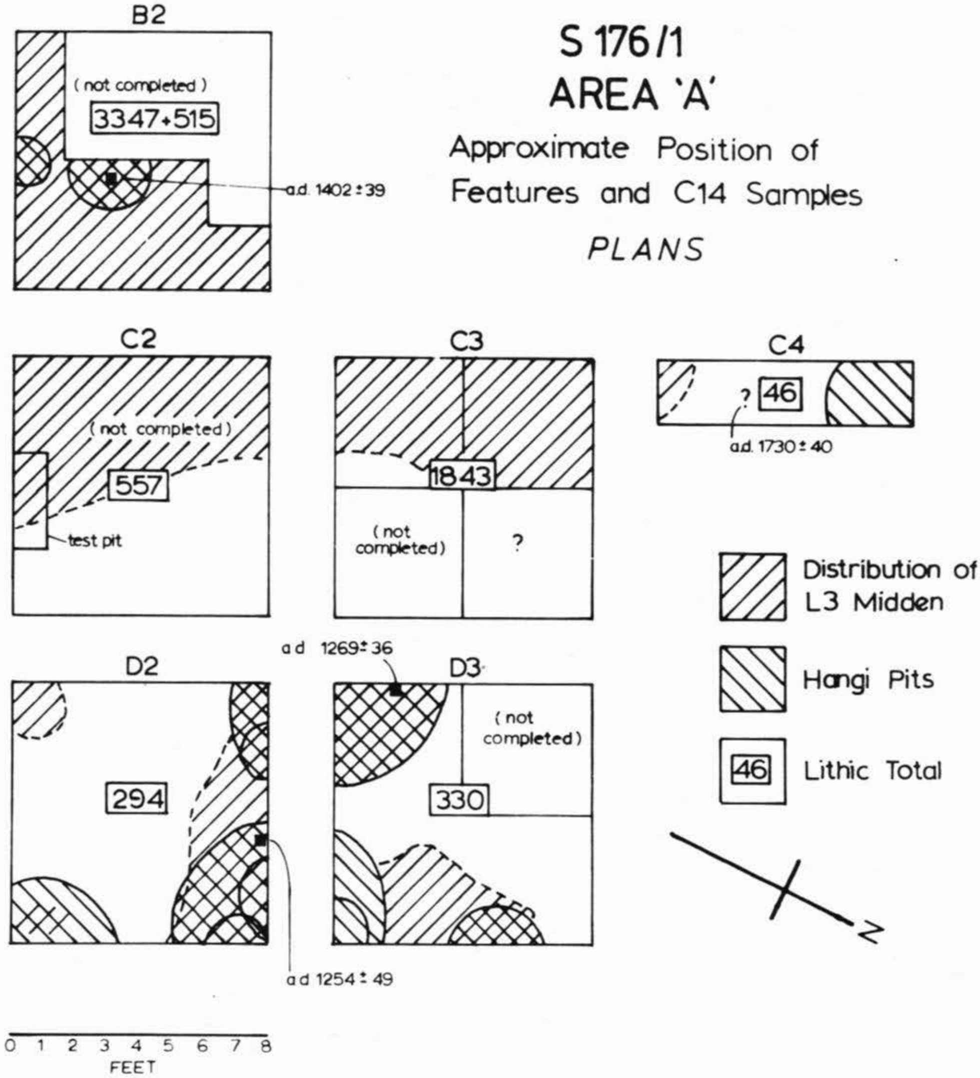

Figure 3: Plan of Area A. In some cases it was not possible to discover whether or not a quadrant had been completely excavated.

indicate, some of the modifications resulting in Layer 4 had to occur *before* Layer 3 was deposited on top. Strictly speaking, however, the time interval between the two activities need only have been a few hours, the amount of time involved in opening an oven, consuming its contents and throwing the refuse back into the pit. It is not argued either that Layers 3 and 4 were formed during a single period of occupation. The processes which built them up probably occurred on every visit to the site made by prehistoric groups. Thus a patch of Layer 3 midden deposited on one of the first visits to the site would pre-date Layer 4 oven rake-out in another location from a

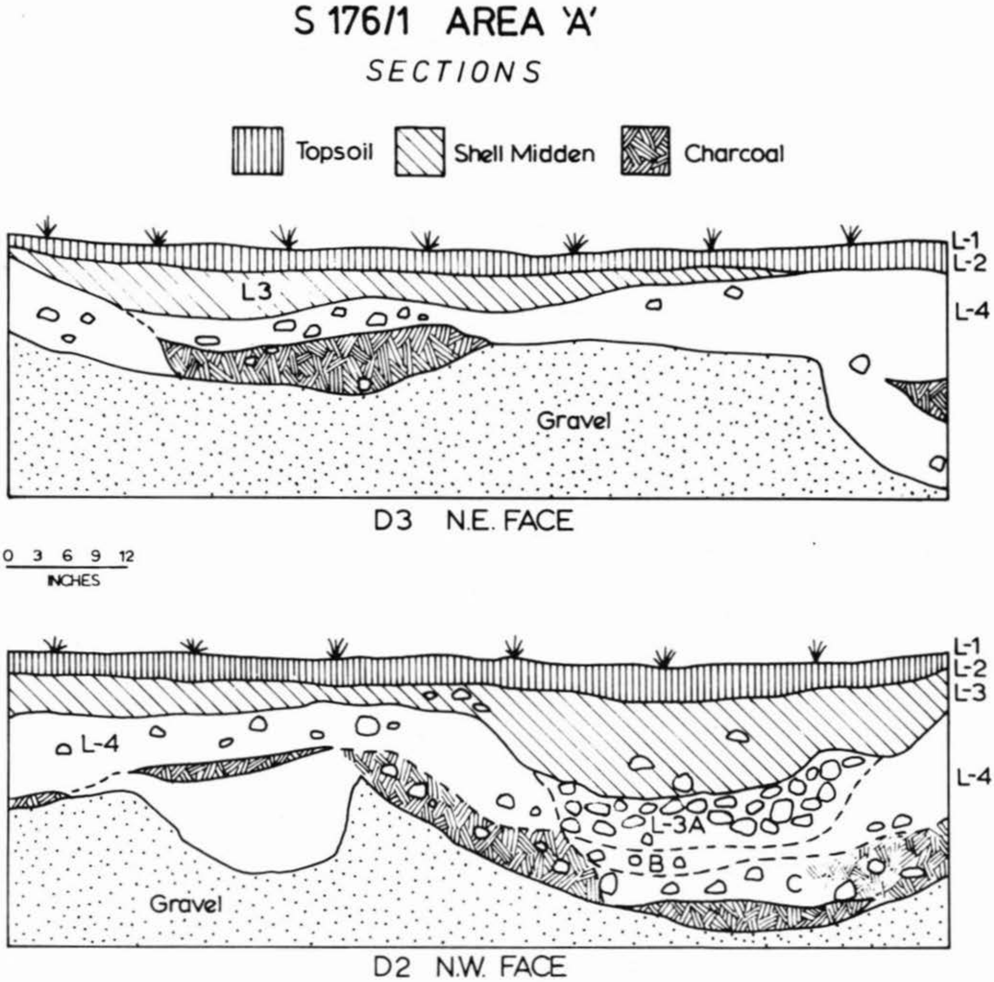

Figure 4: Area A: sections

later visit. The stratigraphy also demonstrates that occupation occurred sufficiently close in time to prevent the formation of a sterile sealing layer of sand between visits. Just how quickly such a layer could form on a wind-swept coast is not known. All that can be said is that two to four inches (5-10 cm) of topsoil have formed under vegetation since the last adze-makers camped on the site.

Stratigraphy on the long line of C squares joining Areas A and B can be partly reconstructed from section drawings made of squares C4 to C9 inclusive. In all these squares the turf and root zone was divided into two layers (L-1 and L-2). Layer 3 occurred in its shell midden guise in the corner of C4 closest to Area A, reappearing as a thin short lens 16 feet (4.9 m) away in C5. In C8 it re-occurred, increasing in thickness to a maximum of 6 inches (15 cm) in C9. It was also present in C10.

Layer 4 in this area consists of a dark band of mixed gravel and stones with occasional

TABLE 1

ARTEFACT MATCHINGS IN AREA A

D2	L3 + Layer below turf (?L2)	1 example
D2	L3 + L4	1 example
D3	L3 + L4	1 example
B2	Bottom L3 + L3	1 example
B2	L3A + L3	1 example
B2	L3B + L3	1 example

For stratigraphy, see Fig. 4
D2,D3,B2 = squares in Area A
L = Layer

charcoal, which merges into light-coloured, natural, beach gravels. Its depth appears greatest where oven stones and charcoal were encountered, again supporting the hypothesis that Layer 4 developed as a by-product of oven building.

Two radiocarbon dates were obtained from C line samples:

Sample No.	Location	Years BP (old ½ life)	Years a.d.
NZ 922	Square C4. Dark gravel layer beneath 2nd turf zone	220 ± 40	1730 ± 40
NZ 923	Square C10. Layer 4	450 ± 54	1500 ± 54

(Since the dates were so far apart, they were not pooled.)

Given the stratigraphy of C4, there can be no doubt that NZ 922 was derived from Layer 4. Unfortunately no indication was available of its depth in the layer. Considering the result, it is tempting to conclude that it came from immediately beneath the turf zone which elsewhere in Area A contained barbed wire. The sample consisted of fragments and larger blocks of charcoal, and if near the surface may have been exposed to heavy salt spray. Although more details of its provenance would be desirable there is insufficient reason to reject it out of hand as an indication of late prehistoric activity on the site.

The second sample is also from Layer 4 which in square C10 formed a narrow band beneath shell midden. If it is accepted that Layer 4 in this site formed over a long period and possibly during several occupations, the discrepancy between the two dates becomes unimportant. Indeed all five radiocarbon dates should be seen as demonstrating the modification of natural gravels by recurrent, sporadic, human activity on different or overlapping parts of the beach over four or five centuries. It must be concluded that at Riverton (and possibly many other large New Zealand beach sites composed of loose sediments) the layers reflect particular activities, often occurring together on each occupation rather than exclusive sequential periods.

The records of Area B consist of photographs and two section drawings without separate layer descriptions. The drawings show the two turf layers recognised elsewhere, lying on top of shell midden called Layer 3 (Fig. 5). No separate Layer 4 is shown on the sections although some artefacts from square Z16 are labelled Layer 4. It is possible that in this area Layer 4 was a thin interface between natural gravel and a midden dump. Layer 3 was subdivided into 3A and 3B in all three squares of Area B; so it is rather more likely that, as in B2, Layer 3B is equivalent to Layer 4.

Artefact matchings shown in Table 2 add very strong support to the theory that both cultural layers formed at the same time in this part of the site.

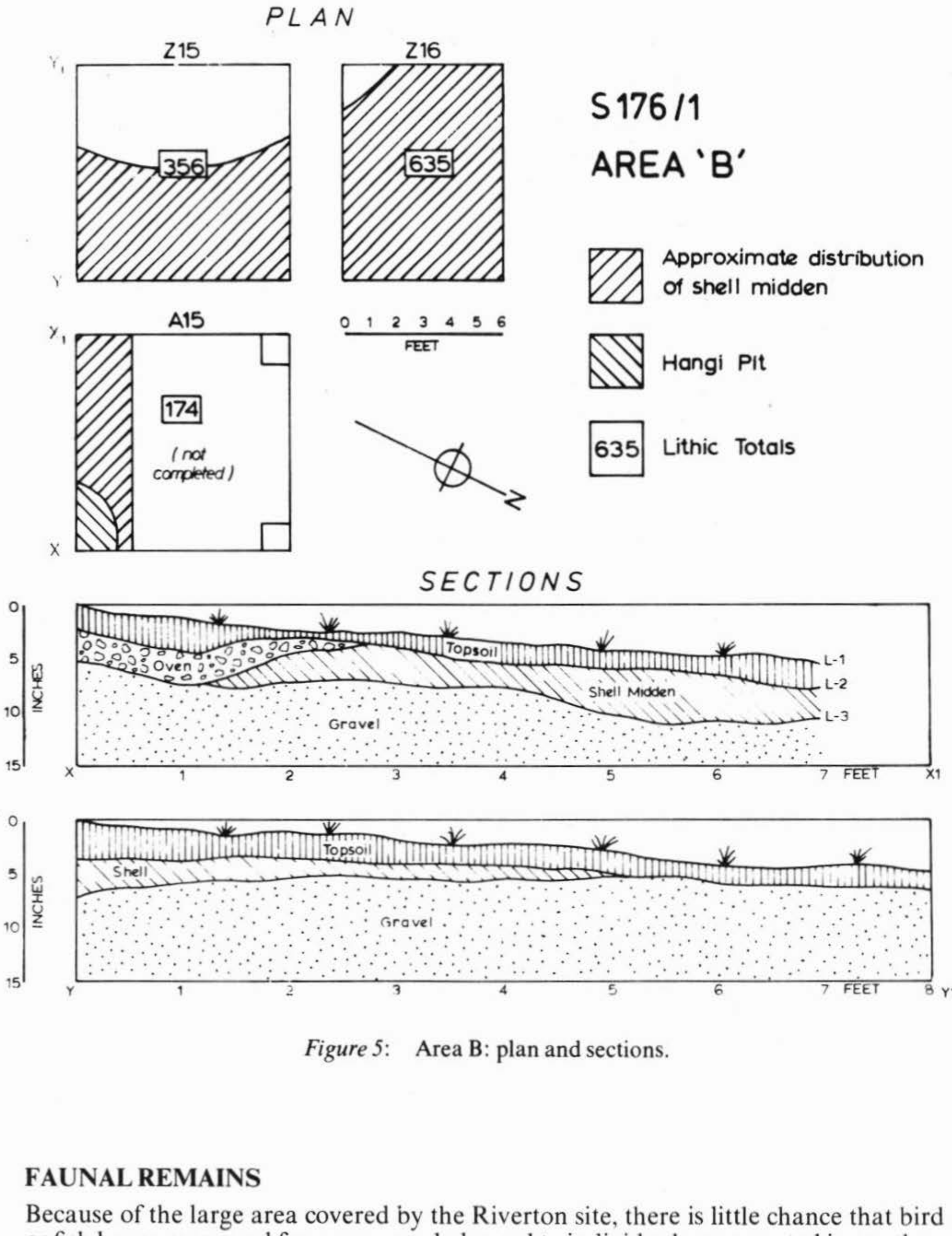

Figure 5: Area B: plan and sections.

FAUNAL REMAINS

Because of the large area covered by the Riverton site, there is little chance that bird or fish bones recovered from one area belonged to individuals represented in another. Thus minimum numbers were boosted by calculating them as though they are derived from three separate sites: Area A (including C4 and C5), Area B, and C8-12. In view of the conclusions relating to layer origin, material from all layers is considered together, within each sub-site.

Consideration of the habitats of the bird species in Table 3 suggests that they were obtained in several different localities. In Area A, 66% can be described as marine or shoreline species. Some of these would have been taken at their nesting sites in

TABLE 2
ARTEFACT MATCHINGS IN AREA B

A15	L3 + L3A/B from Z15	1 example
Z15	L3? + L4 from Z16	1 example
Z15	L3A/B NW + L3A from Z16	1 example
Z15	L3? + L3A/B + L2 from Z16	1 example
Z16	L3A + L2	1 example
Z16	L4 + L3A + L3? from Z15	1 example
Z16	L2 + L3? from Z15	1 example
Z16	L4 + L2	3 examples
Z16	L3A + L3? from Z15 + L3A Shell	1 example
Z16	L2 + L3A Shell	1 example
Z16	L2 + L3A	1 example
Z16	L4 + L3A + L4 + L3A	1 example
Z16	L2 + L3A + L3? from Z15	1 example
Z16	L3A Shell + L3A	1 example
Z16	L3A Shell + L4	1 example
Z16	L2 + L2 + L2 + L3A + L3A/B from Z15	1 example

For stratigraphy, see Fig. 5
A15, Z15, Z16 = squares in Area B
L = Layer
NW = NW quadrant of square.

autumn, judging by the immature specimens. Certainly the penguins and petrels are most vulnerable when on land. Although muttonbird burrows are not found in the area today, there is no reason why they could not have been present during the early prehistoric period. Ducks (7%) and the extinct coot were probably taken from more sheltered shores either around the Riverton estuary or from the swamps behind Colac Bay. The remaining birds in Area A are forest-dwellers such as the pigeons, kaka and saddlebacks, or possible fringe-occupants such as the now-extinct quail and small rail. These may have been obtained from or near the forest-clad slopes above the site.

In Areas B and C shoreline/marine birds made up 40% and 50% respectively of the birds present. The rest of the species in both areas came from wetlands and forests. The differences between the three areas are probably not significant and the overall impression is of deliberate visits to sea-bird colonies and into the forest. Considering the size of the site, bird numbers are not high although the range of species is comparable with that encountered in other coastal middens.

It is not easy to assess what effect the lack of sieving has had on the recovery of fish bones, but minimum numbers can be assumed to be too low (Table 4). With the exception of the freshwater eel, all of these fish could have been caught from a canoe or from the shore over or adjacent to rocky ground. The greenbone might have been taken in a fish-trap, while the others would have accepted a baited hook. The absence of the barracouta, the commonest fish in Murihiku sites, deserves some comment. An argument that Riverton is a winter-only site based on the unavailability of barracouta in winter is weakened by the fact that the greenbone also disappears during the winter months in these waters (R. Fyfe 1979: pers. comm.), and yet one is present in Area C. It seems more likely that the temporary occupants of the site were not equipped or had insufficient manpower available for barracouta trolling. The fact that no other trolled species are represented adds support to this interpretation.

Another unusual feature of this site is the lack of dog bone (Table 5). Although many rat bones may have been missed during the excavation, dog bones are readily seen and have a high survival rate. An explanation in terms of the specialist nature of the site must be considered. The sea mammals could have been obtained locally. There are no strong seasonal markers in the group, although under today's conditions sea lions are more common in winter (I. W. G. Smith 1979: pers. comm.).

Photographs of the site show considerable quantities of broken shell in the spoil heaps. It is reasonably certain that all whole shells were retained and so varying proportions in the minimum numbers list (Table 6) will reflect survival of the thickest rather than human preferences. Nevertheless each shell contributes information on the collecting behaviour of the site's occupants.

The shell species have been divided according to habitat: rocky shore which is the immediate environment of the site, sandy unprotected beach which occurs beyond a small headland just to the northwest, offshore beds well out into Foveaux Strait, and mud banks and channels of which the closest are in the Jacob's River estuary at Riverton. From records made on the composition of the layers it is apparent that mussels formed the bulk of the shell midden followed by paua and catseye. It can

TABLE 3
MINIMUM NUMBERS OF BIRD SPECIES
(immature examples are in brackets)

Species	Area A	Area B	Area C
Shoreline/marine			
Eudyptula minor Blue Penguin	9(1)	2(1)	1
Stictocarbo punctatus Spotted Shag	4(1)	1	–
Puffinus gavia Fluttering Shearwater	3	2	1
Puffinus griseus Muttonbird	2	1	2(1)
? sp. Small petrel	3(1)	–	–
Pachyptila ? sp. Prion	2	–	1
Larus dominicanus Black-backed Gull	2(1)	–	–
Puffinus tenuirostris Short-tailed Shearwater	2	–	–
Eudyptes pachyrhynchus Fiordland Crested Penguin	–	1	–
Pelecanoides urinatrix Southern Diving Petrel	1	–	–
Phalacrocorax carunculatus Stewart Island Shag	–	1	–
Sterna striata White-fronted Tern	1	–	–
Coot ?new sp. cf. *Fulica atra*	1	–	–
? sp. Small Tern or Gull	1	–	–
Wetland/estuary			
Anas ? sp.	1	1	1
Anas superciliosa Grey Duck	1	–	–
Anas ?gibberifrons Grey Teal	1	–	–
? sp. Wader	–	–	1
Forest/forest edge			
Hemiphaga novaeseelandiae Pigeon	2	6	–
Philesturnus carunculatus South Island Saddleback	2	3	–
Prosthemadera novaeseelandiae Tui	1	–	1
Nestor ?new sp. Small Kaka	1	–	1
Coenocorypha aucklandica cf. Sub-antarctic Snipe	2	–	–
Coturnix novaezealandiae Native Quail	1	–	–
Gallirallus minor Small Rail	1	–	–
Cyanoramphus auriceps Yellow-crowned Parakeet	1	–	–
Cyanoramphus novaezelandiae Red-crowned Parakeet	–	–	1
Nestor meridionalis South Island Kaka	–	1	–
Ninox novaeseelandiae Morepork	–	1	–
Total: 75	45	20	10

(Identifications by R.J. Scarlett 1971-2).

TABLE 4
MINIMUM NUMBERS OF FISH SPECIES

	Area A	Area B	Area C
Genypterus blacodes Ling	3	1	–
Pseudolabrus spp. Spotty	2	1	–
Parapercis colias Blue Cod	2	–	–
Notothenia microlepidota Black Cod	1	1	–
Physiculus bacchus Red Cod	1	–	–
Coridodax pullus Greenbone	–	–	1
Anguilla sp. Freshwater Eel	–	1	–
Total: 14	9	4	1

(Identifications by B.F. Leach, 1978)

TABLE 5
MINIMUM NUMBERS OF MAMMAL SPECIES

	Area A	Area B	Area C
Arctocephalus forsteri N.Z. Fur Seal	1 J	–	1 J
Phocarctus hookeri N.Z. Sea Lion	1 ?J	1 AM	1 AM
? Cetacean	–	1	–
Rattus exulans Polynesian Rat	1	–	–

(Seal mammal identifications by I.W.G. Smith 1978.)
Key:
J = Juvenile
AM = Adult Male

TABLE 6
MINIMUM NUMBERS OF SHELLFISH SPECIES

	Area A	Area B	Area C
Rocky Shore:			
Perna canaliculus Green Mussel	10	13	6
Haliotis iris Paua	–	23	1
Mytilus edulis Blue Mussel	6	6	2
Turbo smaragda Catseye	3	4	2
Haliotis ?sp. Paua	2	1	1
*Cellana strigilis redimiculum** Limpet	2	–	1
Lepsithais lacunosus Whelk	3	–	–
Scutus breviculus Sea Slug	–	1	1
*Buccinulum vittatum littorinoides**	1	–	–
Offshore Beds:			
Alcithoe swainsoni	2	10	1
Argobuccinum tumidum	1	2	8
Ostrea ? lutaria Oyster	1	15	4
*Glycymeris laticostata** Dog Cockle	–	1	2
Alcithoe ? fusus	1	1	–
Tawera spissa	1	–	–
Mud-banks and Channels:			
Amphibola crenata Mud Snail	–	–	4
Maoricolpus roseus	–	–	1
Sandy Beach:			
Struthiolaria papulosa Southern Ostrich Foot	1	1	3
Mactra discors	2	–	–
Umbonium (Zethalia) zelandicum	1	–	–
Paphies (Mesodesma) ventricosa Toheroa	–	–	1
Paphies ?sp.	–	–	1
Spisula aequilateralis	1	–	–
Protothaca crassicosta	1	–	–
Total: 148	39	69	40

(*Identifications by F. Climo 1972.)

be safely assumed that these were obtained along the rocks between the site and Howells Point, and were intended as food. The sea slugs and limpets were probably eaten, but the whelk and *Buccinulum* specimen are so small that they may not have been deliberately collected.

The food status of the sandy shore individuals is in even greater doubt. Except in the case of the medium-sized *Struthiolaria* which occurred in the three areas, the others are so few in number that they may have been picked up on the beach for industrial purposes. A deliberate trip to the long sandy beach of Colac Bay for toheroa or other large edible bivalves would surely have been rewarded with a greater quantity.

The presence of offshore shellfish in the midden, especially in Areas B and C, is equally puzzling. All the species are members of the shell-sand bottom communities now dredged for oysters. Their dead shells are regularly thrown up on these beaches, but in the case of *Alcithoe* the shell may still contain the fleshy part in edible condition (G. Hamel 1979:pers. comm.). Both oyster and dog cockle shells were sometimes used by Archaic groups as personal ornaments (cf. Higham 1968).

It is quite unlikely that either the four mud snails or the *Maoricolpus* could have been thrown up on the beach in front of the site and there collected by the prehistoric occupants. They must therefore constitute evidence of transportation, presumably by man from an estuary. Once again the question arises: why so few? They are small enough to have been missed by the excavators but this argument does not hold for the heavy-shelled southern toheroa, which is also a rare component. It is possible that the estuary shells were in the gizzards of ducks brought to the site.

In summary, food consumed by the occupants of the site seems to have been derived from the reefs, headlands and coastal forest close by, supplemented by fish caught over rocky ground and some waterfowl and eels from areas up to three kilometres distant. Although the proportions of food obtained from each zone cannot be calculated with any confidence, it is probably safe to say that in each area of the site sea mammals, sea birds, fish and shellfish contributed more to the diet than land resources.

LITHIC ASSEMBLAGE

INTRODUCTION

One feature of the Riverton site distinguishes it from the typical Archaic beach-front midden, and that is the presence of thousands of flakes, in places piled several layers deep. Unlike the lithic contents of many other middens in New Zealand these are not derived from a dozen or more sources anything from one to several thousand kilometres from the site. Almost without exception they are of a type of rock (loosely termed Riverton argillite) obtained from the headland at the north-western edge of the beach and possibly from other outcrops behind the beach.

Argillites occur in the Bluff Harbour-Tiwai Point area in three basic colours: green, grey, and black (Huffadine 1978). The Riverton variety lies within the green category, ranging from a pale grey green through mid-green to very dark green. Grain size is also variable; it is generally of mud or silt grade but may extend to medium sand grade. "Argillite" has been used as a descriptive field term for massive rocks that are well indurated (hardness greater than 4.5), often tough with a fracture usually subconchoidal to uneven and having no parallel cleavage. The best quality argillite, however, can be flaked in a finely controlled manner. The geology and petrology of these tuffaceous metasediments implies that they were water laid and later metamorphosed to pumpellyite-actinolite facies of Permian age. They have been ascribed to the Greenhills Group. Petrographically the rock is composed of altered albitised feldspar, minor quartz, small concentrations of epidote, rare prehnite, minor pumpellyite, chlorite and opaques (M. Watson: pers. comm.).

The volume of material from only one source places this site in the category 'quarry-working floor'. Even before excavation it was apparent that a prime purpose of the site was the manufacture of adzes, since broken, unfinished, and rejected examples were picked up in the eroded areas. Analysis of excavated material fully confirms this view because many more rejected adzes were recovered as well as several thousand waste flakes. The term 'waste' means that the flakes were not utilized after they were struck off the parent block and showed no sign of the edge modifications produced by the scraping, sawing or incising activities carried out at conventional fishing camps and coastal villages (cf. H. Leach 1979). The general appearance of the squares B2 and C3 with their dense carpet of waste flakes was comparable to the presumed adze manufacturing 'floors' on Nelson quarry sites (Skinner 1913, Duff 1946, Keyes 1975, Walls 1974) and at Tahanga on the Coromandel (Shaw 1963, Moore 1976, Best 1977). The Riverton site differs from these hill-side and ridge-top sites by having food wastes mixed with the industrial debris.

METHODS OF ANALYSIS

In the absence in 1969-71 of any previous comprehensive studies of the contents of adze-manufacturing sites, various approaches to the description and quantification of the assemblage were explored. Initially the assemblage was divided into 'flakes' and 'cores', with flakes being further subdivided into 'simple' or 'modified' depending on whether the flake was discarded after being struck from the parent core or was itself modified by the striking of further small flakes from its edges. Each category was further subdivided according to the presence or absence of cortex. Small flakes (less than 2 g) were counted and weighed by square but not classified. The classification was hampered by the difficulty of distinguishing true cores (what remains of a parent block after shaping flakes have been removed) from flakes which had been so modified after detachment from a parent block that the positive bulb (the usual criterion for categorizing a flake) had become obliterated.

A classification of adze 'blanks' or preforms, devised at the same time, also attempted to separate them into flake adzes (F) and core adzes (C). For further subdivision flake adzes were arranged with their bulbar surface face down and bevels oriented towards the observer. Depending on the position of the bulb these flake adzes were assigned to three classes: FP (bulb proximal to butt), FR (bulb on right side), FL (bulb on left side). Each of these classes was divided into massive (M), i.e. more than 2 cm thick, or thin (T). Core adzes were subdivided according to the number of lateral edges from which shaping flakes were detached: B (bilateral—two side edges), T (trilateral—two side edges and a front or back central apex), Q (quadrilateral—four side edges). Additional subdivisions depended on an assessment of the angle of flaking.

As with the classification of the total assemblage it was often difficult to distinguish cores from modified flakes, and since bevels had not always been formed at the time of rejection, many preforms could not be adequately classified. The most satisfactory aspect of the preform classification was the emphasis on technological attributes, especially the number of edges from which trimming flakes were struck, and the use of the large bulbar surface of the flake preform as a striking platform for further trimming. These aspects were retained and developed in the revised classification which is used below. At the same time the distinction between flake and core was given less weight and the absence of the bevel was no longer a bar to classification.

The latest examination of the full assemblage by H. Leach was stimulated by the question: what information concerning technological behaviour is potentially available from a quarry-workshop assemblage? The traditional approach of measuring a selection of continuous and discontinuous variables, e.g. length, width, weight, platform angle, cross section, was seen as a very time-consuming exercise in an assemblage of 9523 items. Such measurements had already been made on a sample of 168 flakes from Square B2, Layer 3B by B. F. Leach (1969) for comparison with samples from other sites. In addition it was felt that variables measured on waste flakes provided only one of several paths to understanding the intentions of the stone-workers. Two other approaches seemed worthwhile: firstly core-reconstruction as carried out on the Oturehua silcrete assemblage (B. F. Leach 1969) whereby waste flakes, blades and sometimes discarded cores were fitted back together; secondly, analysis of both positive and negative flake scars on discarded preforms to determine direction of blows, order of flaking of butt and bevel, and if possible the type of parent block, e.g., massive flake, waterworn cobble. It was hoped to determine a set of production sequences leading from various forms of parent block to the various adze types manufactured at this site.

As indicated earlier, not all squares at Riverton were completely excavated and baulks four feet wide were left between squares. This made 'jig-saw' analysis far more difficult than at Oturehua where all material was removed from contiguous baulk-less squares. In addition, at Riverton there is evidence for the inclusion of large flakes and even broken preforms in fires, possibly for use as oven stones. As a result they were discoloured, cracked and further fragmented. Only 143 matching pieces were found, as compared with 785 from Oturehua. Nevertheless they were extremely valuable because the reconstructed clusters fell into two distinct groups. Firstly, there were sets of adjoining flakes with a high proportion of cortex (water worn or air-weathered) on their dorsal surfaces (Fig. 6a). Sometimes they had been struck from a cortex-covered or natural fracture-plane platform, sometimes from the platform made by a single flake scar. They were highly variable in shape. The second group consisted of sets of adjoining flakes of characteristic recurring shapes (Fig.6b), sometimes struck from platforms on opposite sides, sometimes joining to make two or three sides of a rectangle. In a few examples these sets could be joined to an adze preform. When this was accomplished it was obvious that this second group was composed of trimming flakes produced in the final shaping of the preform. The first group of irregular flakes with a high proportion of cortex represented the primary stages of shaping the parent block.

One important difference was noted between flakes in the first and second groups: all secondary trimming flakes possessed an area of tiny negative flake scars immediately below the outer lip of the platform on the dorsal (non-bulbar) face. This feature was seldom present on the primary flakes, but it was present in the same position on all blades recovered at the Oturehua site. There it was interpreted as the result of reduction of the overhanging lip of the platform between each sequence of blade removal. Crabtree (1968:457,458,460,465) described how in blade making by pressure or percussion any overhang or lip left at the top of the core must be removed by striking on the ridge at right angles, before the next blade can be detached. This is particularly important in blade removal by direct percussion, where the blades display large bulbs of percussion. If it is not done the next blade may terminate in a hinge fracture a short distance down the core. In adze-making by direct percussion overhanging lips occur very commonly and it is therefore suggested that the operation which produced the multiple flake scars on all secondary flakes was the deliberate reduction of the overhanging portions of edge by striking directly on the edge of the platform. Each flake detached after edge reduction bears with it the typical scars on its dorsal surface.

Edge reduction damage was shown by 'jig-saw' reconstruction to occur at the secondary shaping and trimming stage of adze manufacture. Since the damage is visible on waste flakes, an important criterion for subdividing the waste flake assemblage on technologically significant grounds presented itself. It was proposed that Class A flakes should include flakes with a high proportion of cortex (including weathered fracture planes and waterworn areas) on their dorsal surfaces, and with minimal or no edge reduction damage. Class B flakes should invariably carry edge reduction scars. In practice any flake with more than half its dorsal surface covered in cortex and

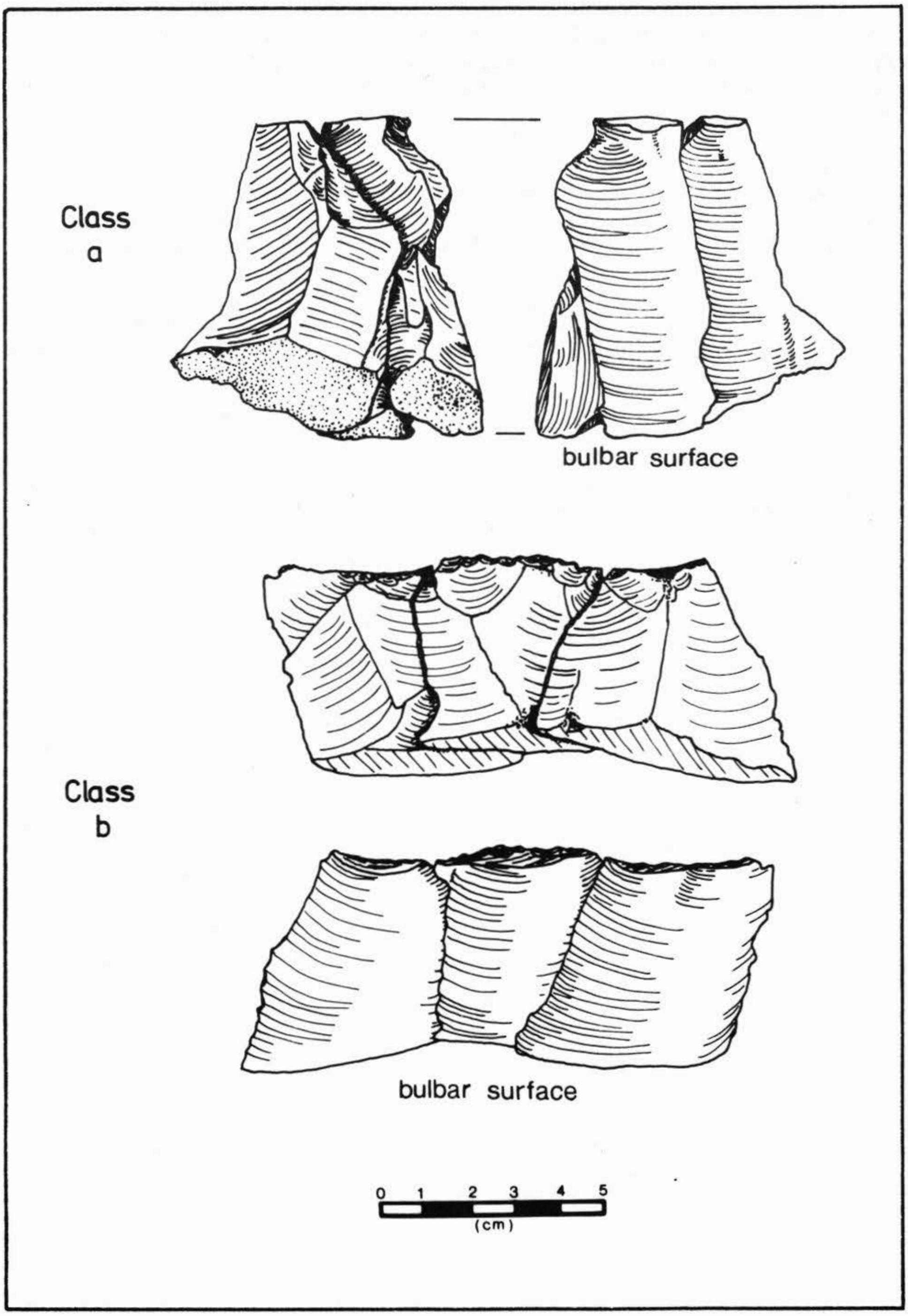

Figure 6: a. Matching Class A flakes (all three from B2 L-3), b. Matching Class B flakes showing edge reduction scars (all three from Z16 L-3A).

with only a few edge reduction scars would be assigned to Class A. A flake with many scars and only a small area of cortex would be placed in Class B. Since such potentially ambiguous cases were rare, it might be suggested that a definite transition took place in the technological procedure when the artisan reached a point where he could say to himself "I am now ready to shape the adze", having finished removing unwanted cortex and any other poor quality material from the parent block.

In the subdivision of the assemblage according to these criteria it was found convenient to set up another category (Class C) for broken flakes which had the area missing on which edge reduction damage might have been visible and for many tiny flakes which were unlabelled and had to be kept in the bags bearing their accession. Inspection of the contents of these bags in three squares showed that most of the small flakes were either Class B or broken, true Class C examples. The proportion of Class A flakes in the bags ranged from 40% down to 5%. It can therefore be seen that if the small flakes had been handled with the larger labelled ones, differences in the proportions of Class A and Class B flakes would have increased beyond their present level, rather than decreased. Table 7 gives the numbers of flakes in each category for each square; the numbers of preforms and other modified flake tools appear in the category 'special'.

The ratios between Class B and Class A flakes are a guide to determining whether particular areas were used more for primary or secondary flaking. For the whole site there were 11 Class B flakes for every 10 Class A. In some squares, especially B2, Z15 and A15, primary flakes become numerically dominant, while in C9 and C10, there are far more secondary flakes than primary ones. This supports the idea that deliberate carrying of material from one location to another sometimes took place between stages of production (a practice which has also been shown for Oturehua).

Following core-reconstruction and classification of waste flakes, analysis of the special items was undertaken. Each preform was sketched (front, back, and cross-section) and arrows were used on the sketches to indicate the directions from which final trimming flakes were struck. Non-flaked surfaces were shown, such as cortex,

TABLE 7
LITHIC CLASS TOTALS BY SQUARE

Area	Square	Class A	Class A/ Class A+B	Class B	Class C	Special	Total
A	D2	66	.37 ± .07	112	107	9	294
A	D3	111	.45 ± .06	135	75	9	330
A	C2	172	.45 ± .05	213	154	18	557
A	C3	601	.44 ± .03	763	375	104	1843
A	B2	1477	.64 ± .02	831	1493	61	3862
A	C4	13	.37 ± .17	22	5	6	46
C	C5	11	.35 ± .18	20	10	5	46
C	C6	18	.42 ± .16	25	60	4	107
C	C7	1	.14 ± .33	6	0	2	9
C	C8	5	.42 ± .32	7	0	1	13
C	C9	30	.09 ± .03	290	171	17	508
C	C10	49	.13 ± .04	324	320	14	707
C	C11	2	.29 ± .41	5	1	1	9
C	C12	1	.25 ± .55	3	4	0	8
B	A15	93	.68 ± .08	64	11	6	174
B	Z15	141	.53 ± .06	127	56	32	356
B	Z16	156	.35 ± .05	293	140	46	635
Unlocalised		3		10	2	4	19
Class Totals:		2950	.48 ± .01	3250	2984	339	9523

(Proportional error calculated to 95% confidence limits)

natural fracture planes, areas of hammer dressing and polish, and heat fractures. Later inspection of the sketches could therefore supply answers to such questions as how were the bevels formed, how many adzes were made from waterworn cobbles, by what techniques was the apex of the triangular adze formed, and from how many edges were trimming flakes struck (the basis of the preform classification). In adzes made from flakes every effort was made to identify the original bulbar surface and the direction from which the flake was struck relative to the adze. Using this information, specific techniques of core preparation prior to flake removal could be discovered. Other artefact types were drawn, usually showing the most diagnostic face, and comments made about their possible function.

ADZE MANUFACTURE

Before using the data accumulated by the above methods to outline the stages of adze manufacture at Riverton and the intentions of the artisans, it must be pointed out that there are dangers in using preforms alone to answer the question, 'What types of adzes were made on this site?' Basically, the preforms have all been rejected before completion, as having one or more qualities that will prevent completion and/or efficient use. In every case the archaeologist needs to seek out the reasons for rejection before using the preform as a guide to the appearance of a successful adze, 'frozen' at that particular stage of manufacture.

One of the most common causes of rejection is a transverse fracture (Fig. 7), often close to the middle of a preform. If this occurs in an adze with a broad cutting edge, two pieces almost as broad as they are long remain. Unless they can be reduced in width by at least a half they cannot be converted into smaller adzes. If the fracture occurs in a long narrow adze, two smaller adzes can be manufactured simply by forming a new bevel on one and reducing the butt on the other. Salvaging material was a common practice in this manufactory and may have differentially affected the survival and recognition of various types.

Another important cause of rejection was longitudinal asymmetry resulting from failure to straighten the sides of an asymmetrical flake or inability to reduce a lump of material on the side of an adze. The latter condition is usually associated with small flake scars showing hinge and step fractures, representing unsuccessful attempts to trim off the protruberance.

Accidental removal of thick flakes with prominent bulbs during the final trimming stage was also a reason for rejecting an adze, especially if the resultant hollow constituted a zone of structural weakness. Trimming could also proceed too far and there are several preforms which appear to have been considered too small to finish.

If preforms are studied in conjunction with trimming flakes, any bias in type proportions can be more readily recognised. In this site large, thin, Class B flakes with striking platform angles approaching 90° were detached during the final trimming of thick quadrangular-sectioned adzes, judging from core reconstruction (Fig. 8) and the appearance of the negative scars on the few quadrangular preforms. On the basis of preforms alone it might be claimed that this adze was only rarely made (less than 7% of the 269 preforms). However, the consistent appearance of these flakes in nearly all squares argues for the view that rather more were manufactured, and that a high success rate (coupled with deliberate reworking of broken examples) has meant that they are under-represented in the rejects. The same argument seems to apply to large triangular adzes. There are no large triangular preforms in the site but examples of Class B flakes with the appropriate surface features are present, as well as one highly diagnostic blade formed when the cutting edge of a 'hog-back' adze (Duff Type IV) is made. Struck from a narrow platform on the bevel side of the cutting edge, these blades effectively remove the beak formed by the front apex ridge in the vicinity of the cutting edge. Smaller triangular adzes made by the same trilateral flaking tech-

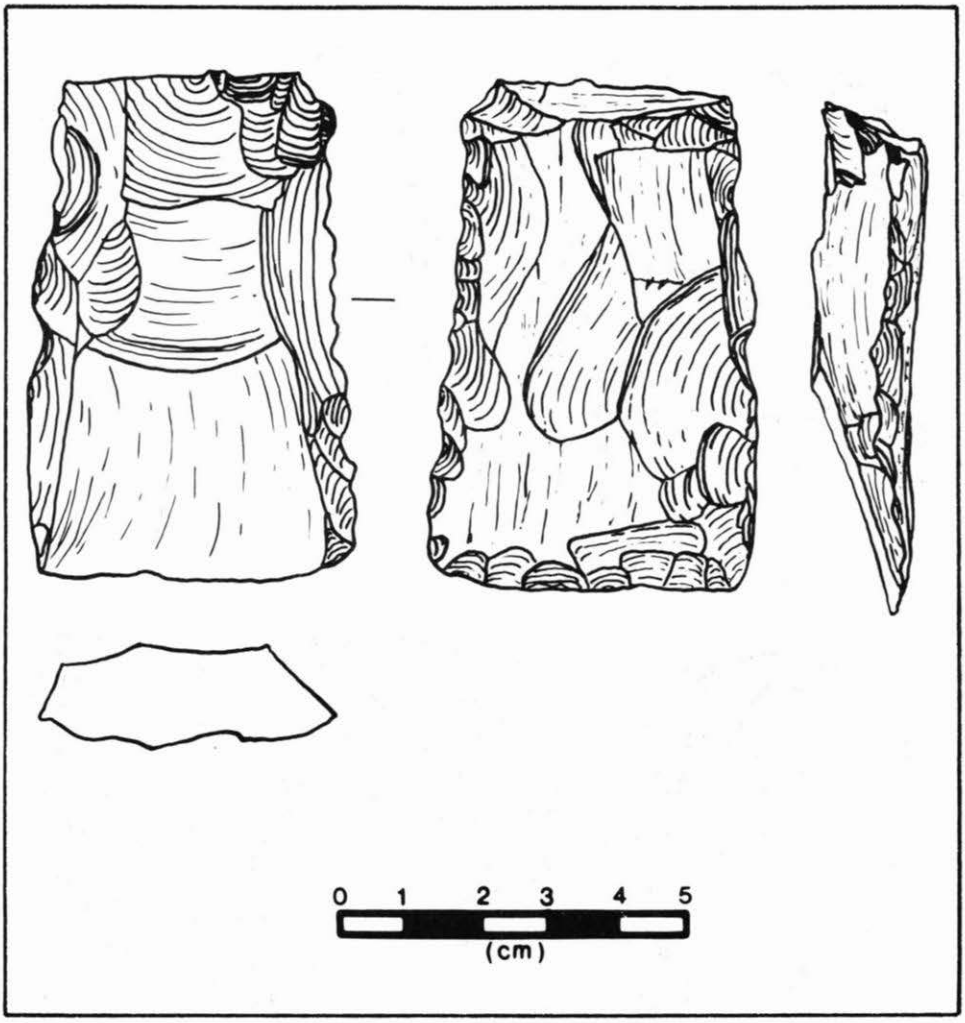

Figure 7: Example of transverse fracture on a preform with some subsequent reworking (B2 L-3b).

niques as the 'hog-back', (Fig. 9a, b) are represented by 20 preforms. Although the 'hog-back' adze is not recognisable among the preforms, this other evidence does point to its manufacture on the site.

The manufacturing process began with the quarrying of the raw material from the headland close to the site and the transportation of the parent blocks to the workshop areas. Inspection of Class A flakes showed that these blocks possessed three sorts of surface: a) waterworn, highly polished and rounded, obviously obtained from the intertidal zone, b) thick crusty cortex with deep weathering from exposure to the air, presumably obtained from higher up the headland, c) thin cortex showing discoloration, often planar. The latter surfaces often occurred on blocks also displaying thick cortex or water-polished areas. They represent natural fracture planes running through all the *in situ* faces and eroded boulders. The quarrying process obviously took advantage

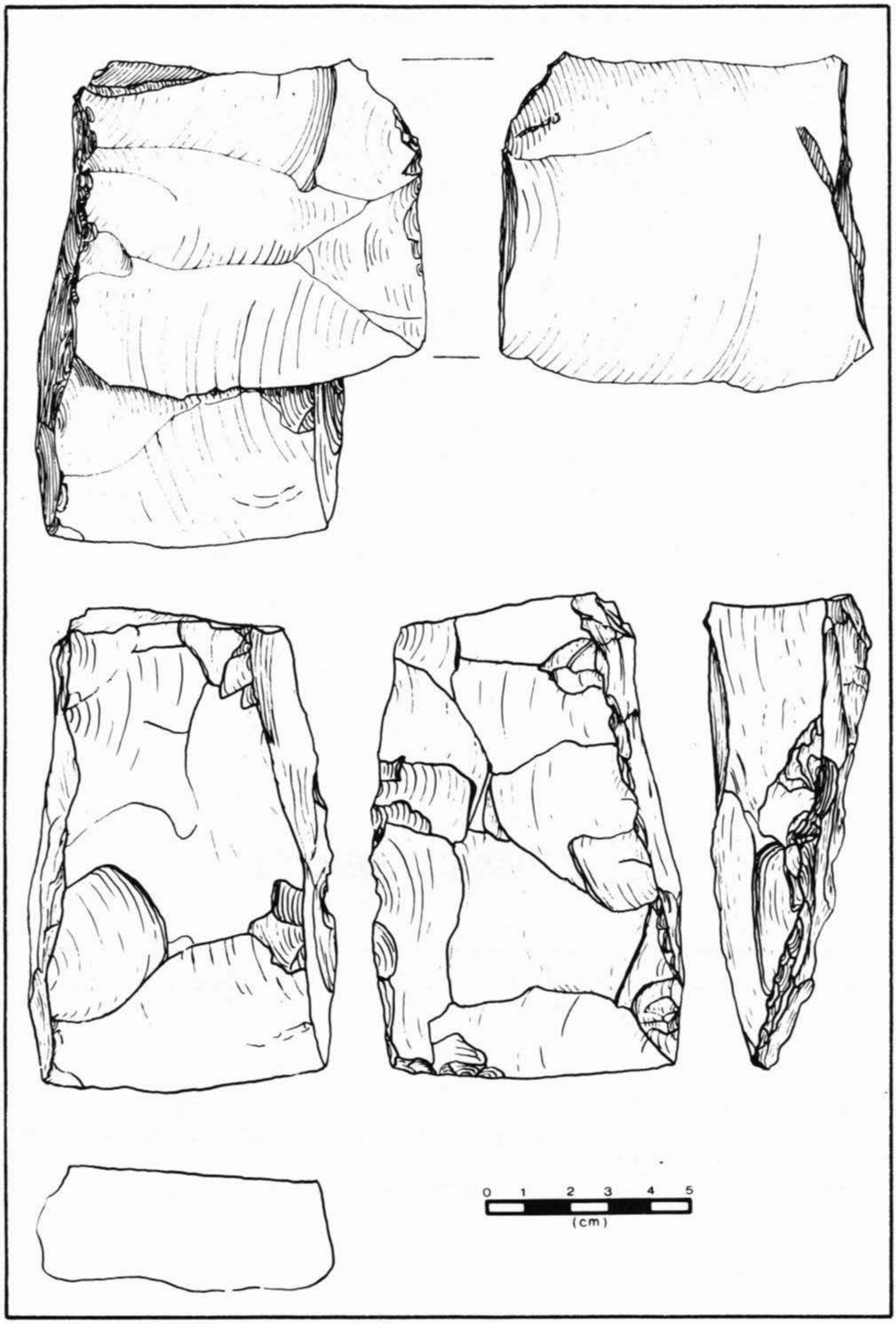

Figure 8: Reconstructed Class B flake (B2 L-3B) on quadrangular core preform discarded because of transverse fracture (B2 L-3).

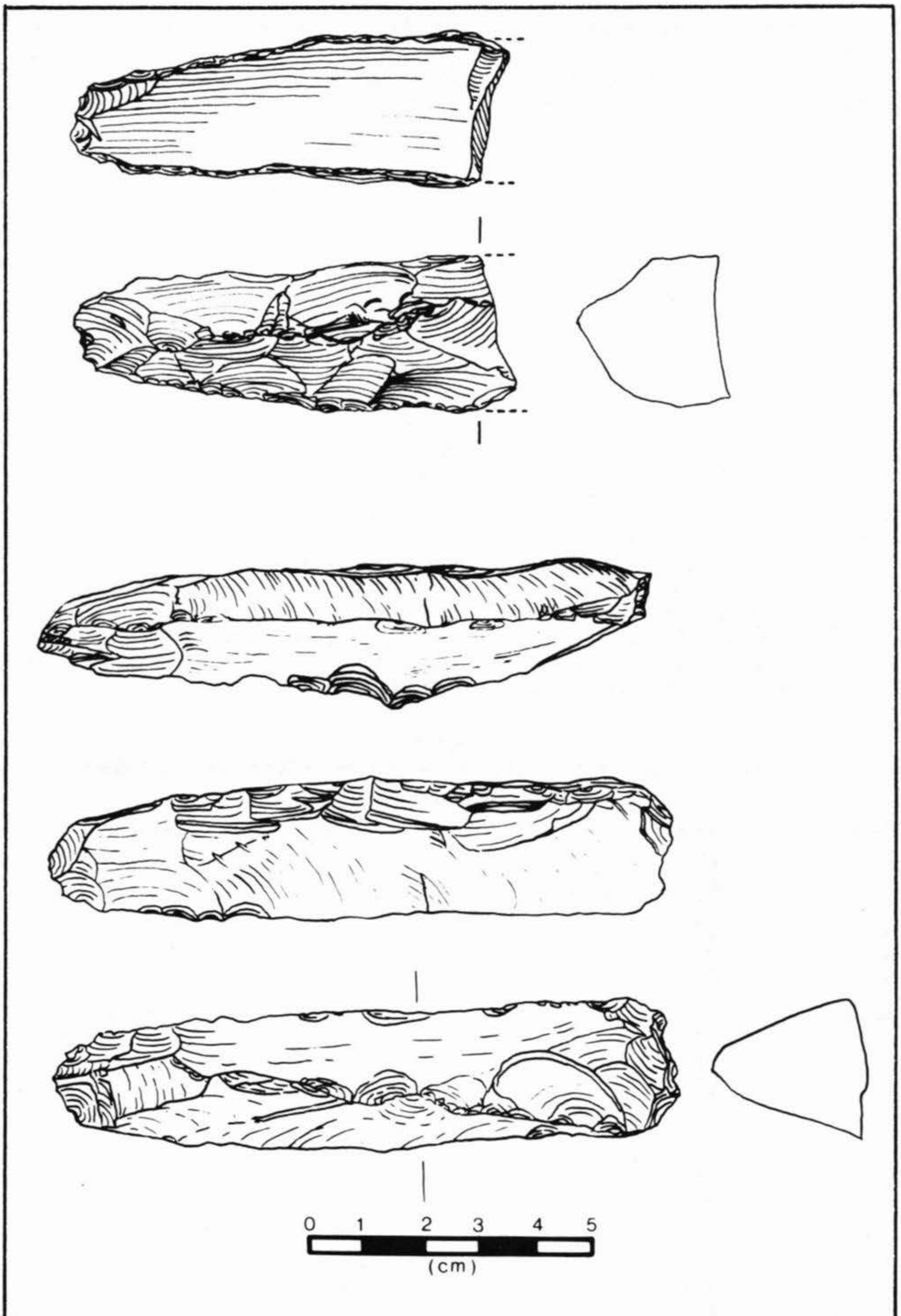

Figure 9: Small trilateral preforms, (a) No. AB27 (from B2), (b) from Z16 L-3B, butt end.

of these planes to break open the boulders and obtain suitable-sized blocks from the outcrops.

Of the total 269 preforms, 126 (47%) display traces of the original parent block surfaces. Since 10 of these have more than one type of surface, Table 8 is based on 136 occurrences of non-flake surfaces.

Table 8 suggests some differences in quarrying habits between the artisans who worked in Area A and those in Area B. In the former, there seems to have been a greater emphasis on blocks split off from outcrops above the reach of the sea. These would bear both thick cortex and fracture plane surfaces. In area B which is closer to the headland more attention was paid to broken beach boulders, also split open along their fracture planes. The incidence of adze preforms made from elongated beach cobbles (Figs 10-12) is probably not significantly different between the areas. Ten cobble preforms were present (Area A-2, Area C-3, Area B-5), representing opportunistic behaviour by groups who normally obtained the bulk of their raw material in much larger pieces. Although the cobbles imposed size and shape restrictions on the adzes, they were undoubtedly easy to work.

As every archaeologist who has handled adze preforms will know, a classification based on cross-section cannot place more than a few of the preforms with certainty. Although quadrangular and steep triangular forms (with apex angles 90° or less) are usually recognisable, the rest fall into a continuum of cross-section shapes from trapezoidal to sub-triangular, including variants with partially convex sides reminiscent of plano-convex and lenticular forms. Adzes undergo changes in cross-section throughout the manufacturing process and it is seldom possible to determine the final cross-section from a half-finished reject. The classification of preforms according to the number of lateral edges from which trimming blows were struck is far more appropriate, resulting in fewer ambiguous cases and having a direct relevance to studies of striking platform angle measurable on waste flakes.

TABLE 8

OCCURRENCES OF VARIOUS PARENT-BLOCK SURFACES ON PREFORMS

Area	Square	Water-Worn Surface	Fracture Plane	Thick Cortex
A	D2	–	2	1
A	D3	–	2	–
A	C2	2	2	1
A	C3	1	26	24
A	B2	2	6	9
A	C4	3	–	–
Subtotal:		8(10%)	38(47%)	35(43%)
C	C5	–	–	–
C	C6	3	–	–
C	C7	2	1	–
C	C8	–	–	1
C	C9	–	2	3
C	C10	2	1	–
C	C11	–	–	–
C	C12	–	–	–
Subtotal:		7(46%)	4(27%)	4(27%)
B	A15	2	1	–
B	Z15	10	4	1
B	Z16	8	9	4
Subtotal:		20(51%)	14(36%)	5(13%)
Unlocalised:		–	–	1
Class Totals: (136)		35(26%)	56(41%)	45(33%)

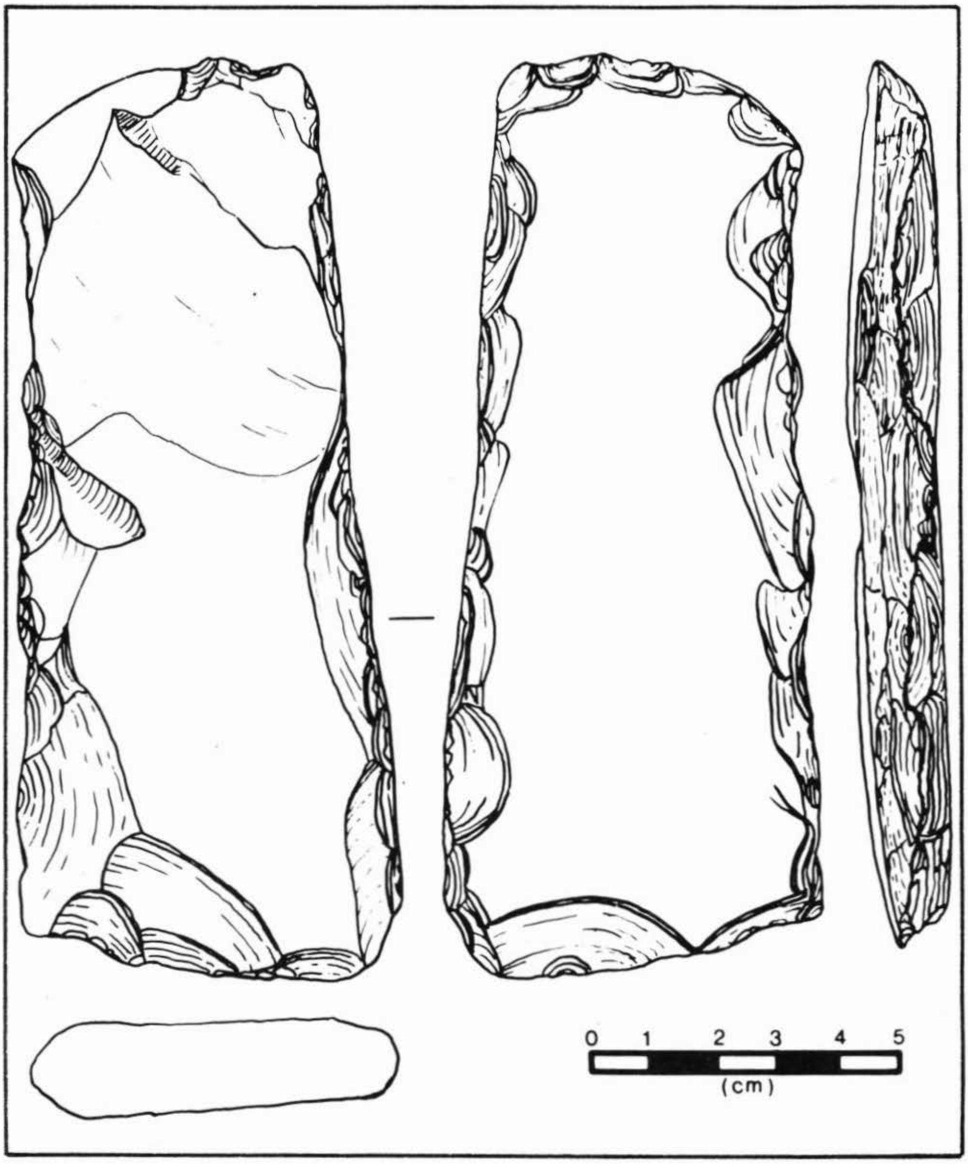

Figure 10: Preform made from beach cobble (C6).

Three classes were distinguished: bilateral, trilateral, and quadrilateral (Fig. 13). Strictly speaking a fourth class, unilateral, might be recognized, but comparison with bilateral examples strongly suggests that unilateral adzes are basically two-edged adzes which have been discarded after trimming flakes have been struck from only one edge. Some triangular adzes were rejected when trimming flakes had been detached from the apex and only one side. They are quite distinguishable from bilateral adzes of sub-triangular cross-section and are classified semi-trilateral. Similarly quadrangular-sectioned adzes with only three of their four edges worked are classified as semi-quadrilateral. Table 9 shows that there is little variation in the proportions of each class in the three areas.

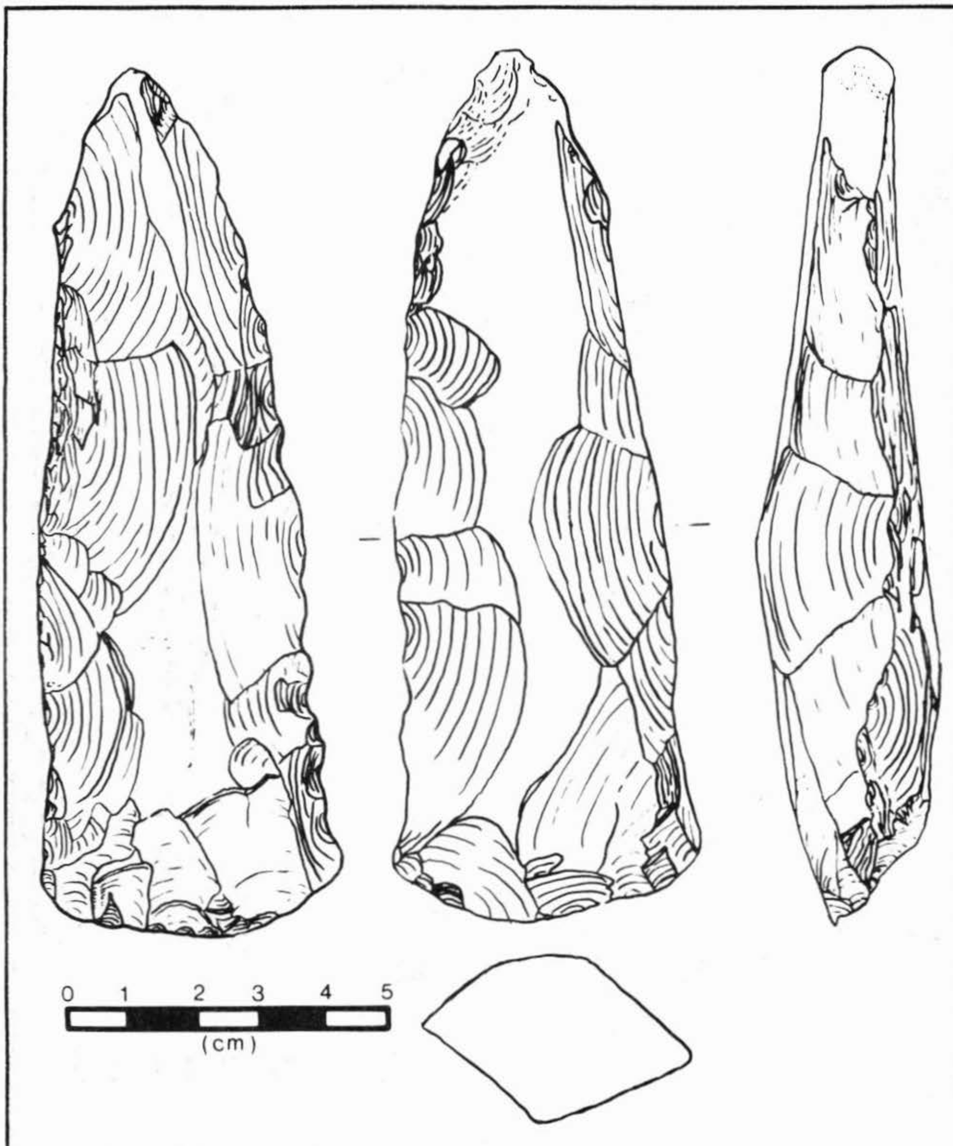

Figure 11: Preform made from beach cobble (Z15 L-3A/B).

It is important to realise that the three classes relate more closely to technological factors than to finished adze cross-section. Some of the quadrilateral preforms can be described as unfinished quadrangular adzes of Duff Type IA (Fig. 8), while others might have been completed as variants of Type I or II. A few trilateral forms may have been finished as gouges (Type VI), while others could be described as incomplete Type III or IV. Bilateral adzes could have given rise to any of Duff's types except the long, thick Type I and IV. There is even evidence for the rare side-hafted Type V adze (Fig. 14).

This classification has important implications for Polynesian adze studies, for it adds

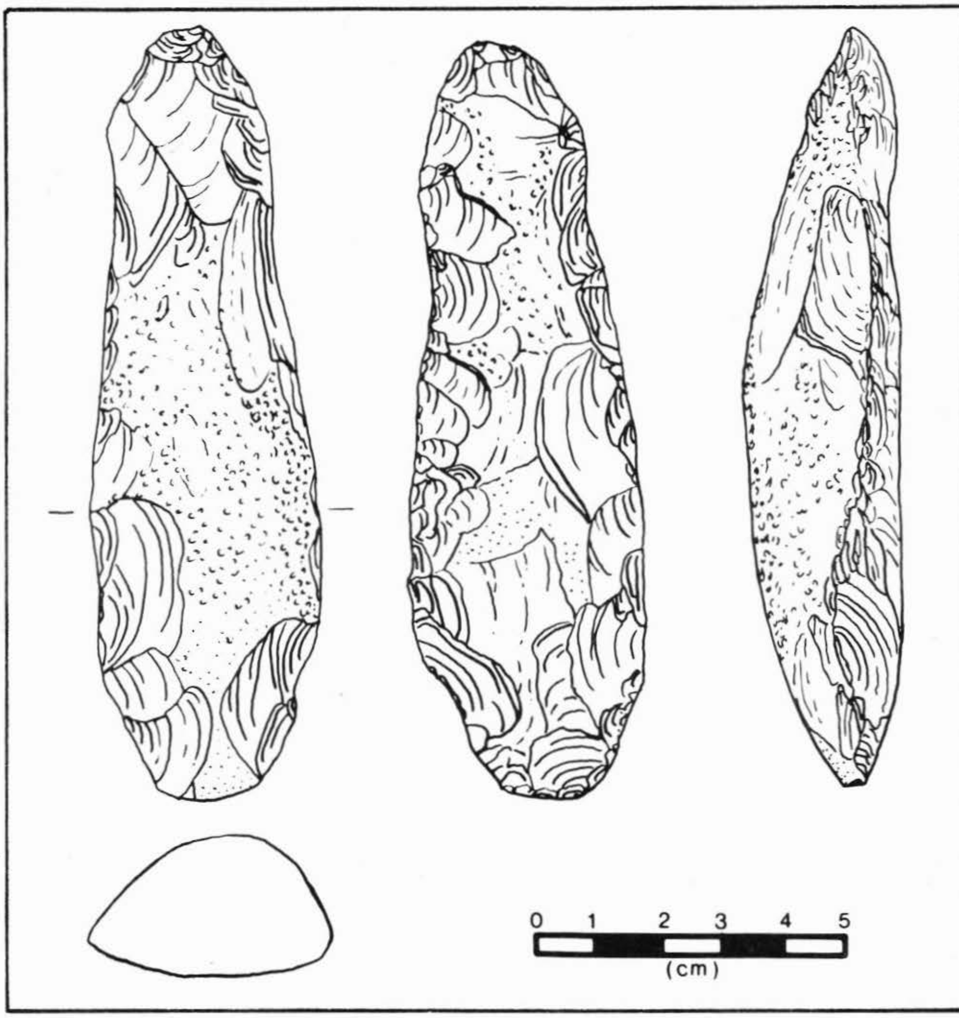

Figure 12: Preform made from beach cobble (C3 L-3A/B)

even more variables on which similarities and differences may be evaluated. Fully polished adzes of similar morphology may conceal potentially diagnostic differences in manufacture. Even the simple distinction between bilateral and trilateral trimming techniques in the Riverton preforms has shown that the triangular-sectioned adze was made by both styles of flaking.

Further opportunity for variation is evident in the stages between parent block and final trimming. Except in the manufacture of large quadrilateral and possibly large trilateral forms, many of the adze blanks are recognisably flakes (Fig. 15). There is evidence both for the opportunistic selection of suitably-shaped flakes struck while a larger core adze was being made and for deliberate preparation of the surfaces of the parent block so that a flake of a desired type can be detached. Core preparation of the latter type was of course the basis of successful blade making at Oturehua, so it is not altogether surprising to find it in another Archaic site in Murihiku.

In assessing the proportion of flake preforms in the Riverton assemblage it proved convenient to separate 'definite' examples from 'likely' ones. The remaining category

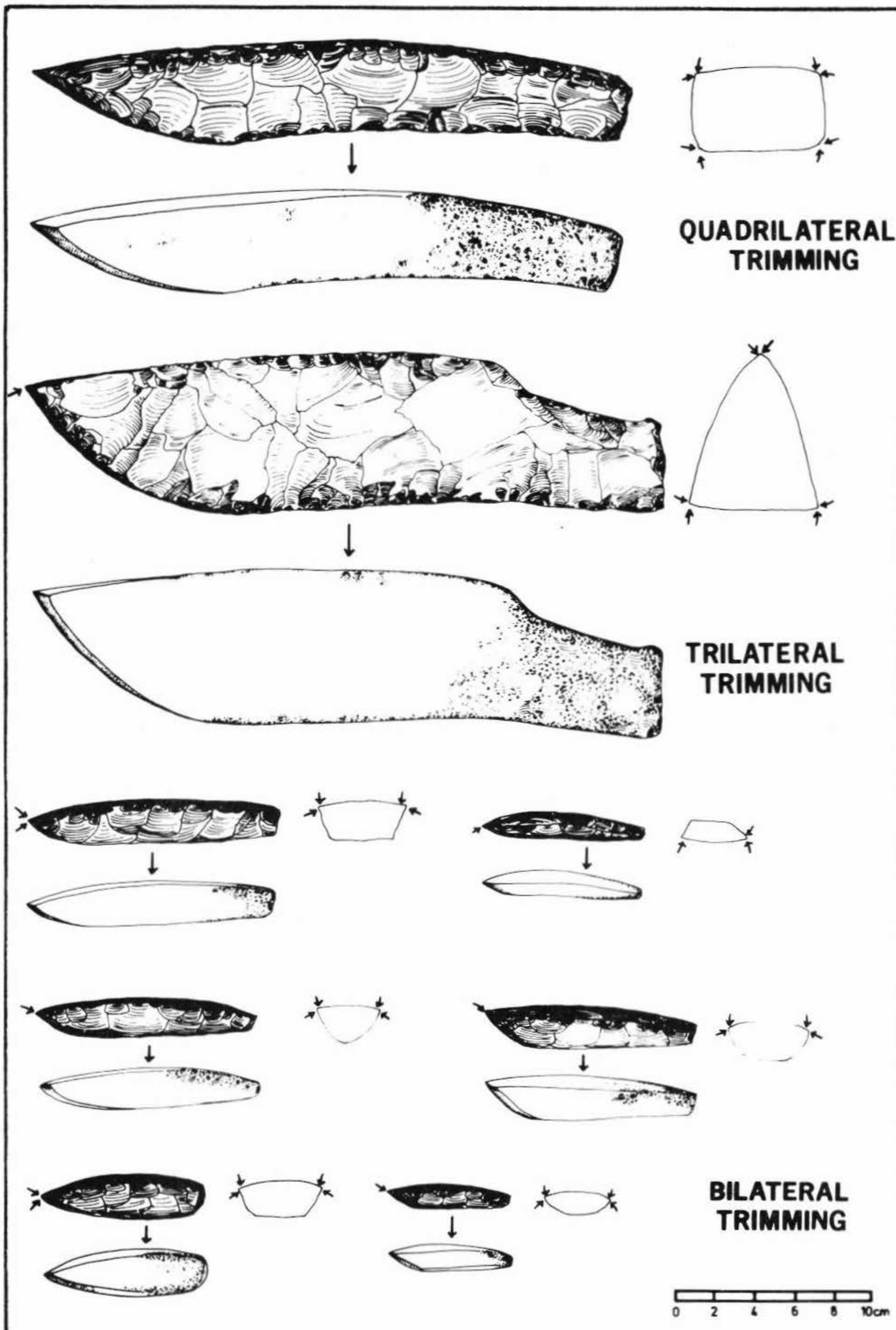

Figure 13: Bilateral, trilateral and quadrilateral trimming showing typical cross-sections and direction of trimming blows (based on argillite examples).

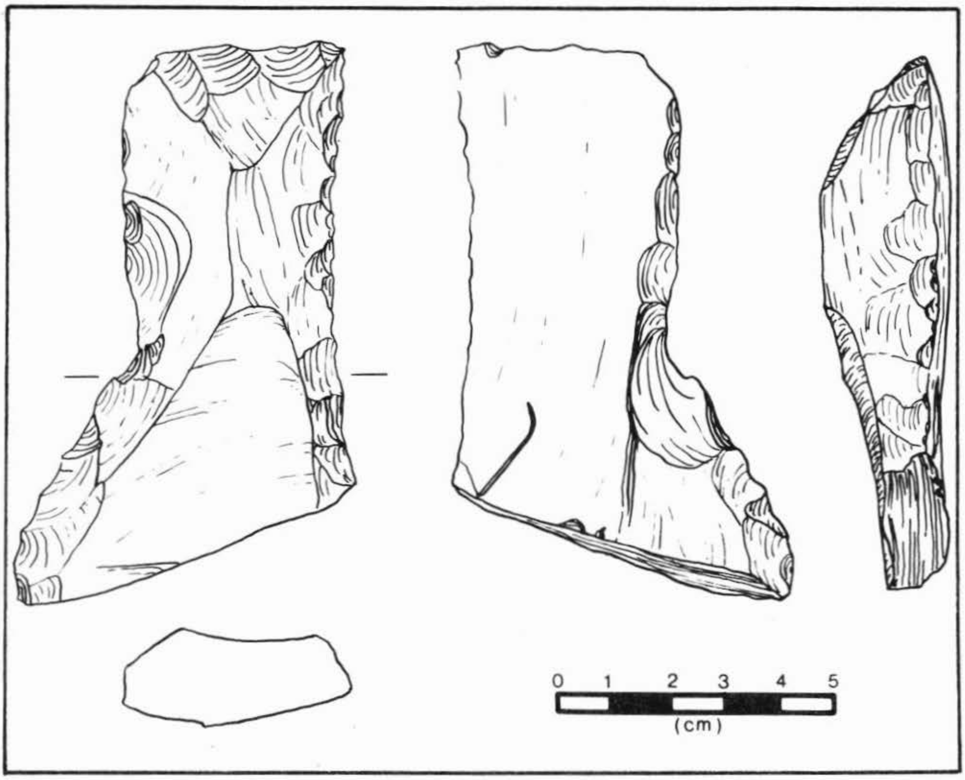

Figure 14: Preform of side-hafted adze with transverse fracture (C11).

includes both core adzes and flake adzes in which the bulbar surface is completely obliterated by later negative trimming scars. There is of course no way these can be distinguished. Considering the fact that the percentages in Table 10 are a minimum estimate, it is plain that most of the rejected preforms were originally flakes. What proportion of finished adzes were flake adzes cannot be discovered, because the larger triangular examples and almost all the large quadrangular types were more likely to have been made as core adzes by reducing a parent block. These figures do, however, suggest that the majority of small adzes taken from the site would have been flake adzes. Slight asymmetry in some small finished argillite adzes recovered elsewhere supports this view, for the asymmetry is clearly due to incomplete removal of the bulb of percussion. In a thin flake adze the total reduction of the bulbar swelling by hammer-dressing would carry with it a danger of fracturing the adze transversely.

Making an adze from a flake is a far more economical operation than reducing a large parent block down to the desired size. In the first case the waste consists of the outer decortication flakes and the small trimming flakes, plus any mis-shapen flakes unsuitable as adze blanks. In the second case everything is discarded except for the preform. The Riverton artisans seem to have blended both approaches for maximum economy, an indication perhaps of the scarcity of good quality material. They appear to have visualized large triangular and quadrangular adzes within the best parent blocks and to have reduced these with bold strokes that detached suitable flakes for smaller adzes at the same time. Less-regular parent blocks may have been broken down for flake adzes alone.

The prepared core technique represents a further refinement of flake adze manufacturing, since the artisan can pre-determine to a far greater extent the shape of the flake blanks and thus further reduce wastage. Assessing the degree to which flake adzes were pre-shaped *before* being struck from the parent block is very difficult because the diagnostic negative flake scars on the non-bulbar surfaces are usually obliterated by trimming scars which were struck from the direction of the bulbar face *after* the flake blank was detached. Only where minimal trimming occurred before rejection of the preform can evidence for core preparation be sought in the form of negative scars without the negative bulb (which is left behind on the core).

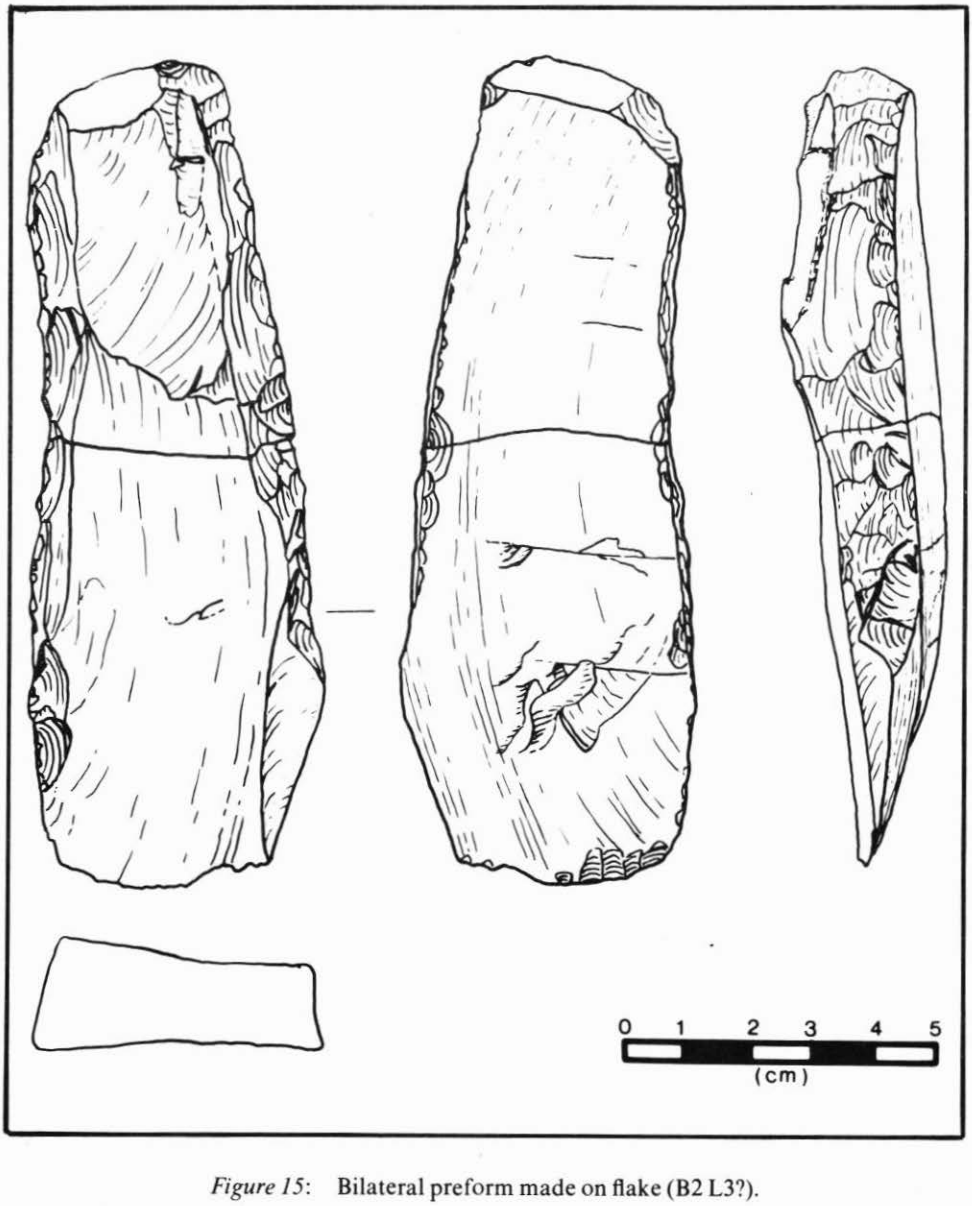

Figure 15: Bilateral preform made on flake (B2 L3?).

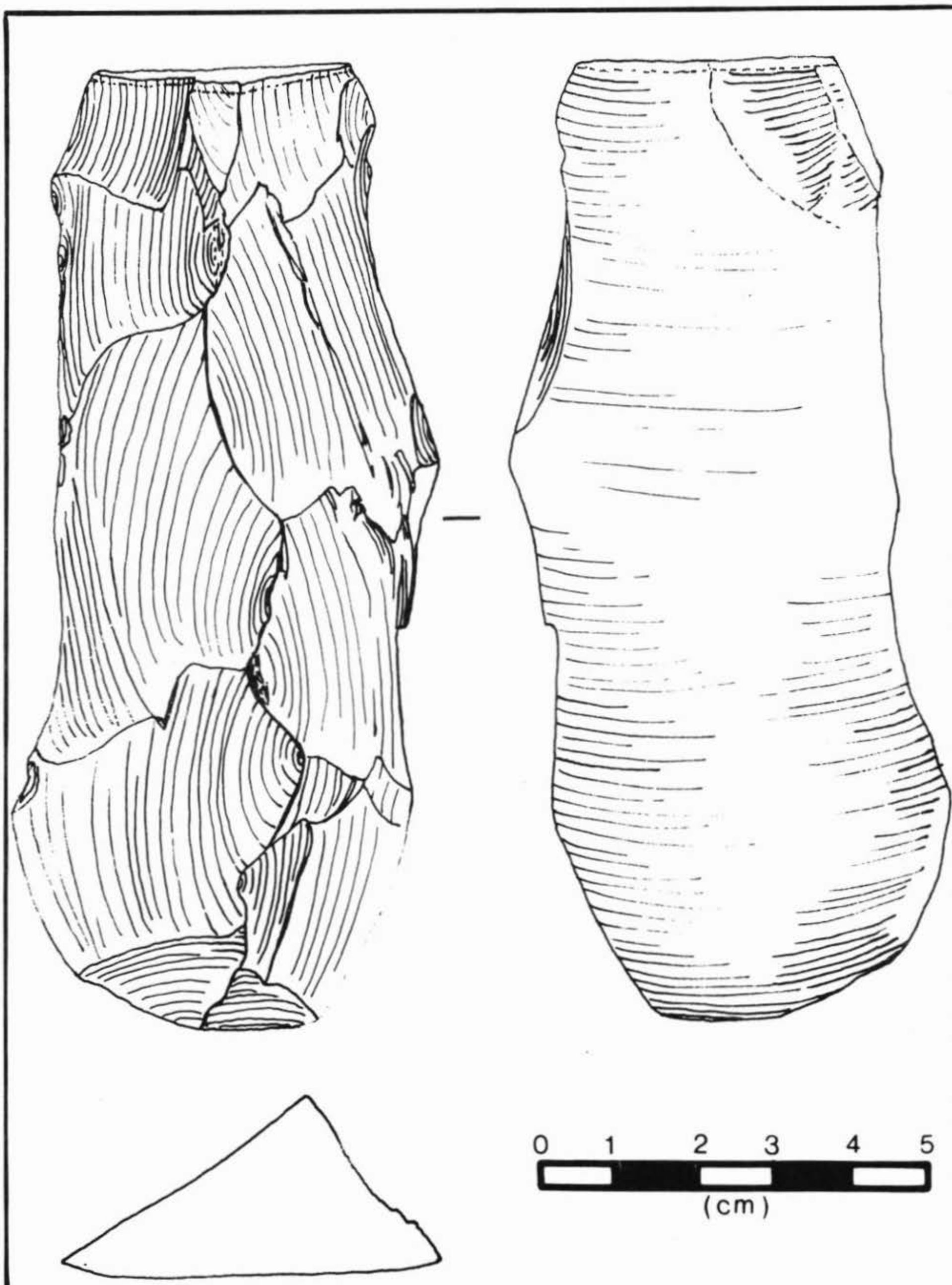

Figure 16: Blade detached by blow delivered on weathered fracture-plane platform. Sinuous apex ridge shows alternate flaking carried out before blade removal (C3 L-3B).

Such scars were recognised most clearly on some triangular preforms which displayed either alternate sinuous flaking of the apex (Fig. 16) carried out on the core, or a combination of flaking from one side of the apex and a single massive blow directed towards the apex from some unknown point on the core. At least five of these adze preforms were made from blades and another eight were possibly blades (with the bulb removed). Ridge preparation on the core is a well-known procedure for initiating blade production. The first blow following preparation detaches a triangular-sectioned blade in which the prepared ridge forms the apex. The next blade follows the slight ridges left on the core by the first (Crabtree 1968:455-6). Making small triangular adzes from corner blades would have allowed the artisan to produce a highly symmetrical adze which needed only a little final trimming. There is now evidence for this technique from the Nelson-D'Urville area and from Pitcairn Island and the Marquesas (H. Leach, n.d.) Larger numbers of preforms need to be examined in conjunction with core reconstruction for the procedure to be fully understood.

Following the trimming of the faces and, where present, the side surfaces of the preform, the bevel was shaped by detaching flakes from one or two surfaces, depending on the angle at which the two faces of the adze met. In many subtriangular and trapezoidal preforms it appears that the decision whether the adze should be hafted with 'front wider than back' or the reverse was dictated by the exigencies of bevel-making. Quite often the artisan had no choice at this stage of production. Flake adzes possessed several advantages in that the bulbar surface generally curves naturally

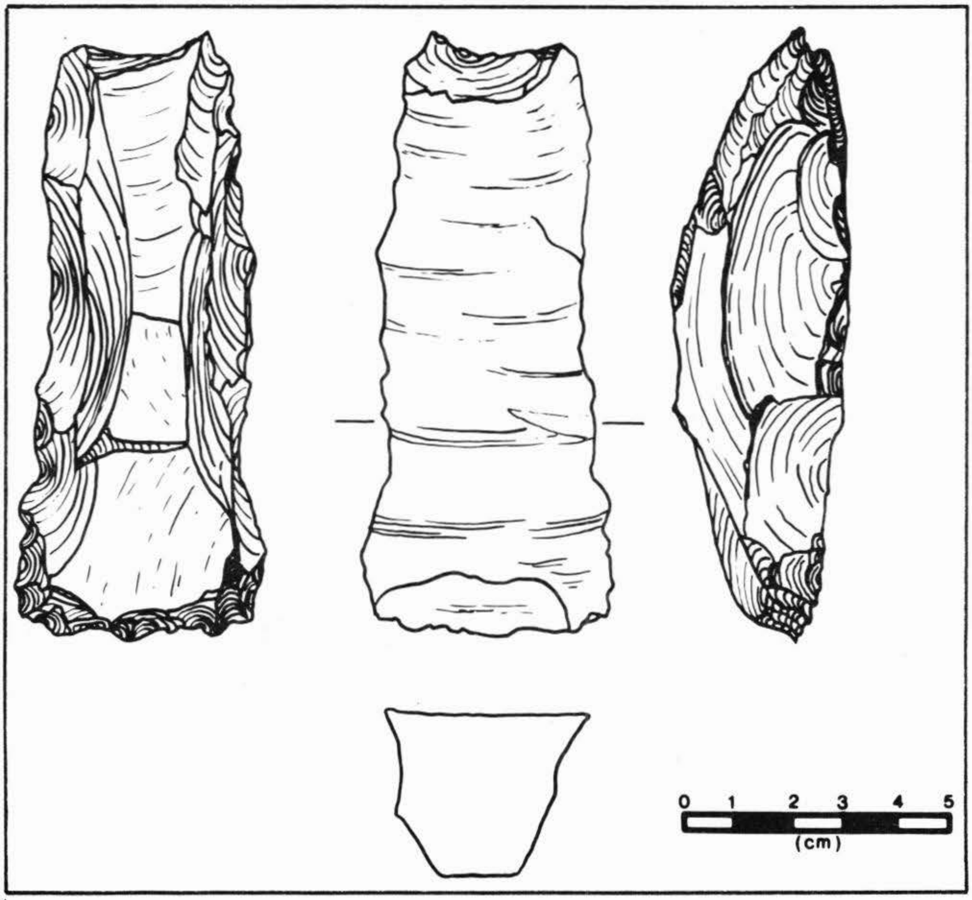

Figure 17: Bilateral preform made on flake with bevel trimmed from the bulbar face (C3 top L-3).

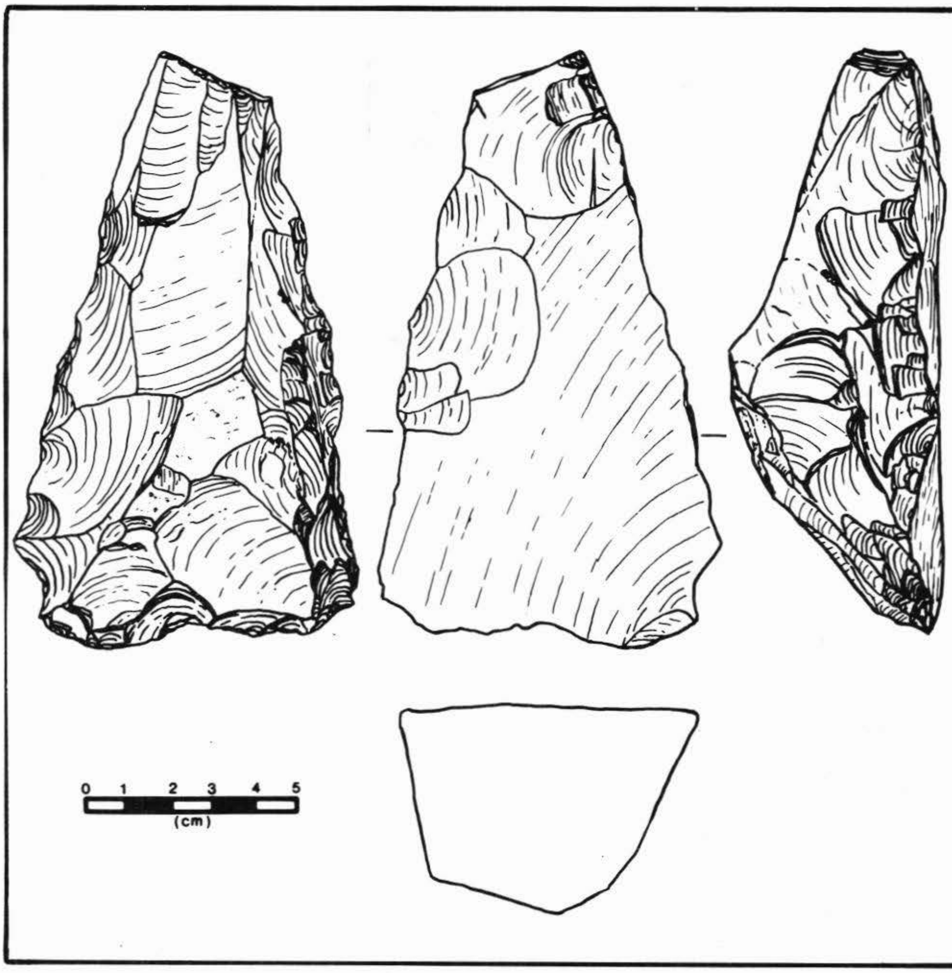

Figure 18: Bilateral preform made on flake with bevel trimmed from the bulbar face (C2 L-3).

to meet the non-bulbar surface (the front of the flake but not necessarily the front of the adze). The bulbar surface provides a suitable platform both for trimming the opposite face and for shaping the bevel. Of the 75 bilateral preforms whose sides had been trimmed from one face (Figs 17 and 18) the bulbar surface had served as the platform in 66. Of the 58 preforms where the bevel had been made by blows struck from one face, the bulbar surface had been the platform in 46. In such cases the typical cross-section of the finished adze would be described as sub-triangular or trapezoidal with front wider than back. New Zealand adze collections show a high proportion of 'front-wider-than-back' forms, which may indicate that flake adzes were the most numerous product of the workshops.

Inspection of the bevels of large quadrangular adzes from this and other sites shows that the convergence of the faces is achieved by striking off flakes from the sides, not from the cutting edge end as in thinner flake adzes (Fig. 8). Only a few, small, final flake scars originate from the cutting edge. In the 'hog-back' (Type IV) the true back bevel was shaped from the sides while the frontal ridge was reduced by striking from one to four small blades from the cutting edge area (Fig. 19).

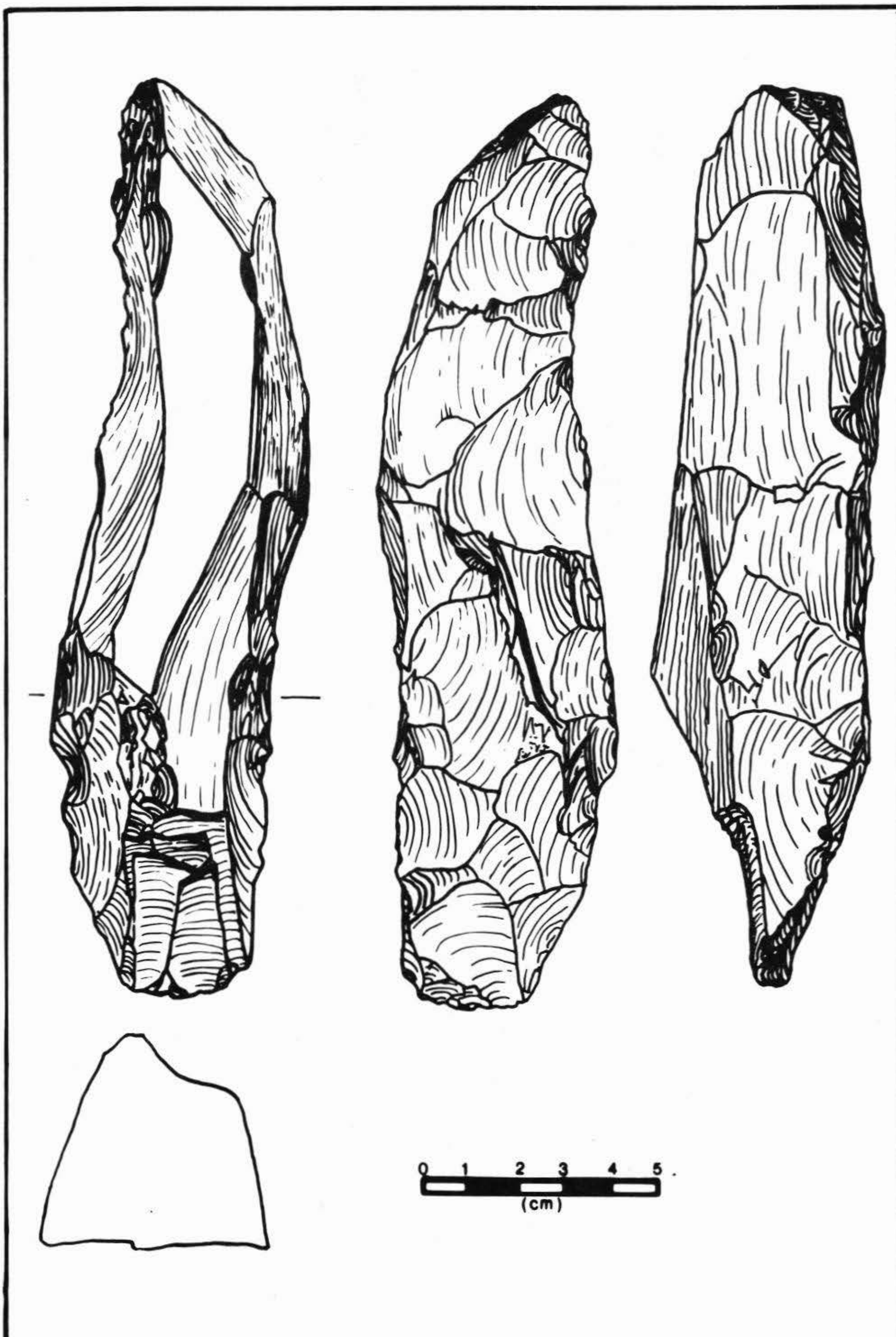

Figure 19: Bilateral, sub-triangular-sectioned preform with front bevel formed from small blade scars, as in a hog-back adze (D3 L-4).

The final shaping of the adze butt took place after the bevel was made. Up to this point the butt is simply the slightly tapered, narrower end of the adze, marked by a small platform instead of convergent faces. The platform quite frequently shows traces of cortex or a weathered fracture plane and is often offset relative to the long axis of the adze. This feature is also common on Nelson-D'Urville preforms and it may be an important clue to a specific technique of core preparation. At present it is strong evidence that the artisan had a preferred orientation in the way that he held the blank.

Very few of the Riverton preforms show deliberate reduction of sides, back or front to form a definite tang. Those that do invariably carry the distinctive scars of hammer-dressing. This does not mean that butt reduction was carried out entirely by hammer-dressing, but the final trimming of the butt by flaking seems to have been done just before and along with the hammer-dressing. The fact that few preforms possess a tang suggests that after the bevel had been made the 'mortality' rate in adzes declined steeply and that few had to be discarded as a result of fractures occurring when the butt was reduced or the high points pulverised in the hammer-dressing process. It is interesting to note that at the Mauna Kea quarry on Hawaii very few preforms were found to be tanged (McCoy 1977:241). Table 11 shows the number of preforms and flakes with signs of hammer-dressing or polish.

TABLE 9
NUMBERS OF PREFORMS IN TECHNOLOGICAL CLASSES

	Area A %	Area C %	Area B %	Unlocalised	Total
Bilateral	117) 91%	18) 66%	57) 84%	1	230(86%)
Unilateral	30)	3)	4)	–	
Trilateral	8) 7%	5) 19%	2) 3%	1	20(7%)
Semi-trilateral	3)	1)	–)	–	
Quadrilateral	4) 2%	2) 15%	3) 13%	–	19(7%)
Semi-quadrilateral	–)	3)	7)	–	
Totals:	162	32	73	2	269

TABLE 10
PROPORTION OF PREFORMS ORIGINATING AS FLAKES

	Definite %	Definite plus likely %	Total
Bilateral	153 67%	177 77%	230
Trilateral (small)	9) 60%	– 60%	20
Semi-trilateral	3)		
Quadrilateral	0) 16%	1) 26%	19
Semi-quadrilateral	3)	4)	
Total:			269

TABLE 11
THE INCIDENCE OF HAMMER DRESSING AND POLISH ON PREFORMS AND FLAKES

	Hammer Dressing		Polish
Area	Flakes	Preforms & Fragments	Preforms & Fragments
A	66	8	2
B	23	6	1(+ 1 ? ulu)
C	89	7	0
Totals	178	21	4
%	1.9 of flakes	7.8 of preforms	1.5 of preforms

The number of flakes with hammer-dressing is highest in Area C where Class B flakes also predominated, indicative of more adze trimming than preparation of parent blocks. These two lines of evidence point to some spatial differentiation in activities. A mundane explanation might be that large sharp primary flakes would make an uncomfortable and even dangerous seat for a person engaged in adze finishing. There is sufficient evidence of hammer-dressing to argue that the process began at this adze manufactory. Whether it was completed here is doubtful for very few of the flakes and fragments have more than their most prominent ridges bruised. A shoulder fragment from a quadrangular adze found in C3, a partly-polished butt fragment from Z15, and two portions of a Type III adze from C9 (Fig. 20) are the only pieces with extensive bruising.

Polishing was rarely carried out at this site. The two preforms with polish from Area A could both be described as atypical: one is a cobble adze which required little modification to attain an adze shape; the other is a slender blade with light trimming and a polished bevel (Fig. 21). The only other polished adze fragment is a fully finished butt from Area B (Fig. 22), which may have been derived from an adze brought to

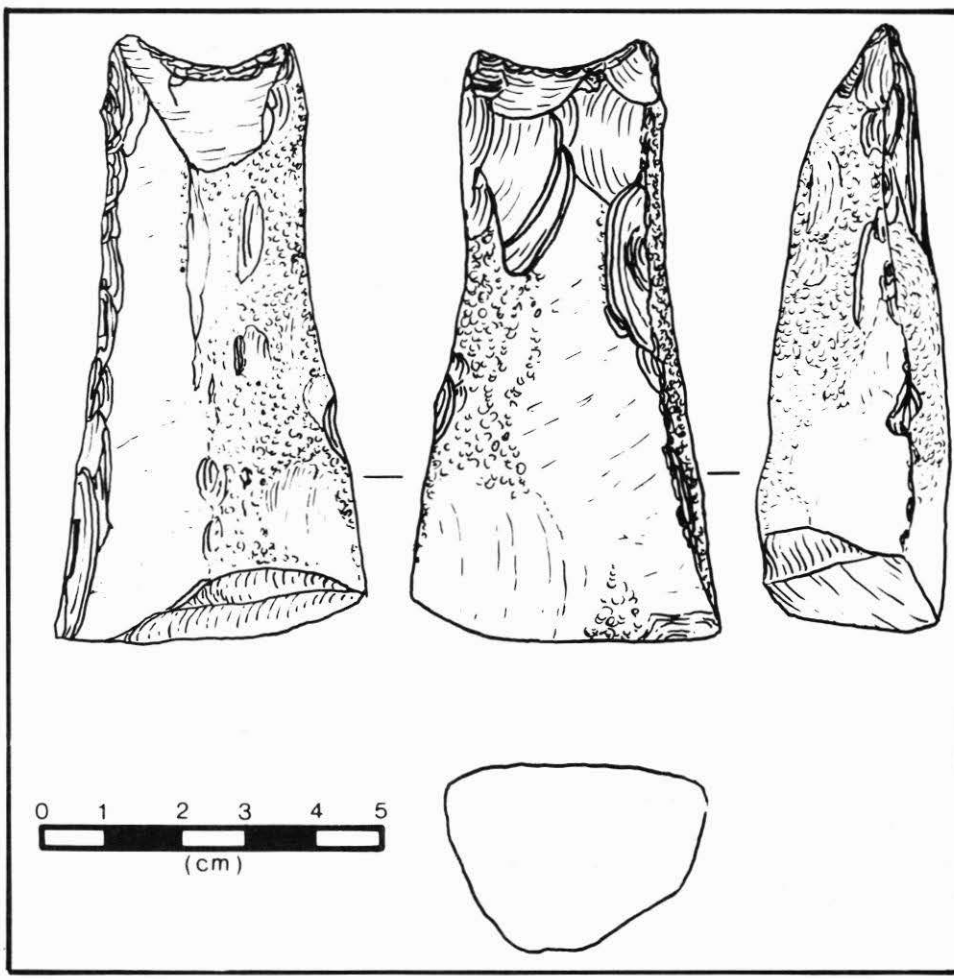

Figure 20: Butt of possible Duff Type III adze showing pecking (C9 L-3).

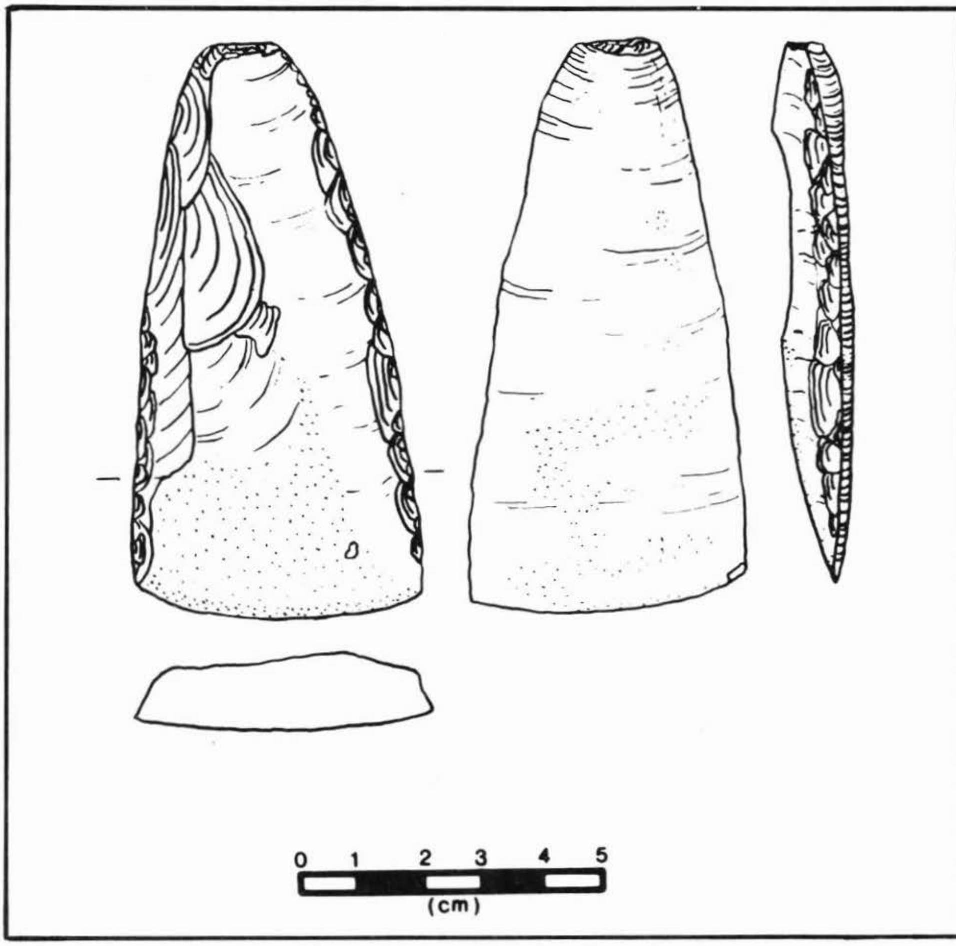

Figure 21: Thin adze made from blade with polish near cutting edge (D3 L-4).

the site. An even stronger argument against polishing is the lack of grindstones. Only one 'possible' grindstone was found.

OTHER ARTEFACTS

Hammer-stones are generally recognised from the heavily battered areas on their surfaces which exhibit a much greater degree of crushing than is seen on hammer-dressed adzes. Several types of artefact in the Riverton site show this extreme wear. In the first category are three rounded, waterworn, granite stones with roughened edges (Fig. 23a, b, c). They weigh 313 g, 141 g and 92 g. These weights are comparable to that of the lighter hammer (230 g) used in preparing platforms in experimental hand-axe manufacture in England (Newcomer 1971:85). For roughing-out, Newcomer used a hammer weighing 555 g. Some greywacke spalls and possibly some burnt granite fragments in Area A may represent other hammers of this type.

The second category consists of argillite pieces (flakes, cores and preform fragments) with heavily battered straight or convex edges. Five examples were recovered of which three were from Area A and two from B. Two of these edge-battered hammers had 'hand-grips' created by hammer-dressing (Fig. 23d) and a third was water-rolled (Fig. 23e).

In the third category are argillite flakes and preforms with from one to five deep battered notches on their edges (Fig. 23f, g). Fourteen clear examples of this type of wear have been recognized, and a further 12 examples show notches with less wear. The notches range from 1-3 cm across and from 4-7 mm deep.

Matching the hammer types with the various operations performed on the argillite cores and preforms must remain tentative until controlled replicative experiments can be performed. Hammers were needed for flaking (both primary and secondary), reduction of edge overhang, and hammer-dressing. Modern knappers undertaking direct percussion flaking generally use rounded hammer-stones, and it is tempting to attribute this function to the waterworn granite hammers from Riverton. Preliminary experiments with reduction of overhang showed that battered notches form on the edge of the argillite flake used as the hammer. From this the notched edge hammers found on this site may be tentatively described as edge-reduction hammers. The straight and convex-edged hammers bear no resemblance to the hammer-dressing tools described by Skinner (1974a), and the shape appears quite unsuitable. They may be edge-reduction hammers in which the wear has been spread along the hammer edge rather than concentrated in one or two notches. Another possibility is that they served as 'specialist' hammers for bevel-making or retouch.

Besides the hammers, there are 19 artefacts which cannot be described as preforms or broken preforms because of unsuitable shape. Seven of these are massive flakes with from one to three roughly flaked edges. The unifacial flaking has left deep bites along the edges with sharp points between. There has been no attempt to reduce the overhang. Seven smaller flakes show much finer unifacial retouch on one edge. Neither the larger nor the smaller retouched flakes show obvious use damage and their function remains obscure. The same is true of a small disk-like core with steep-angle retouch around its circumference.

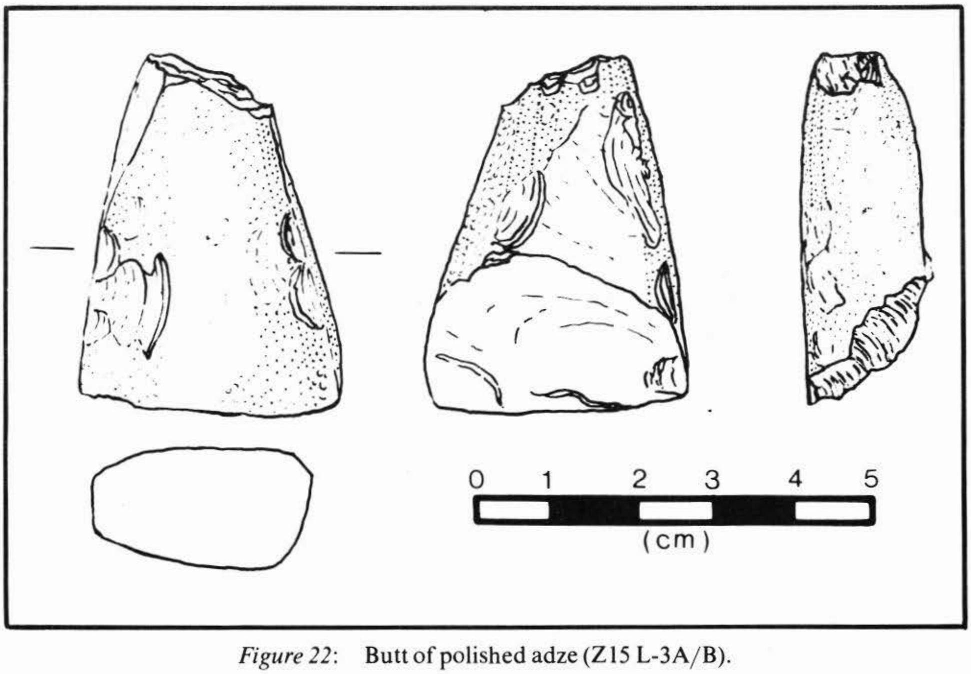

Figure 22: Butt of polished adze (Z15 L-3A/B).

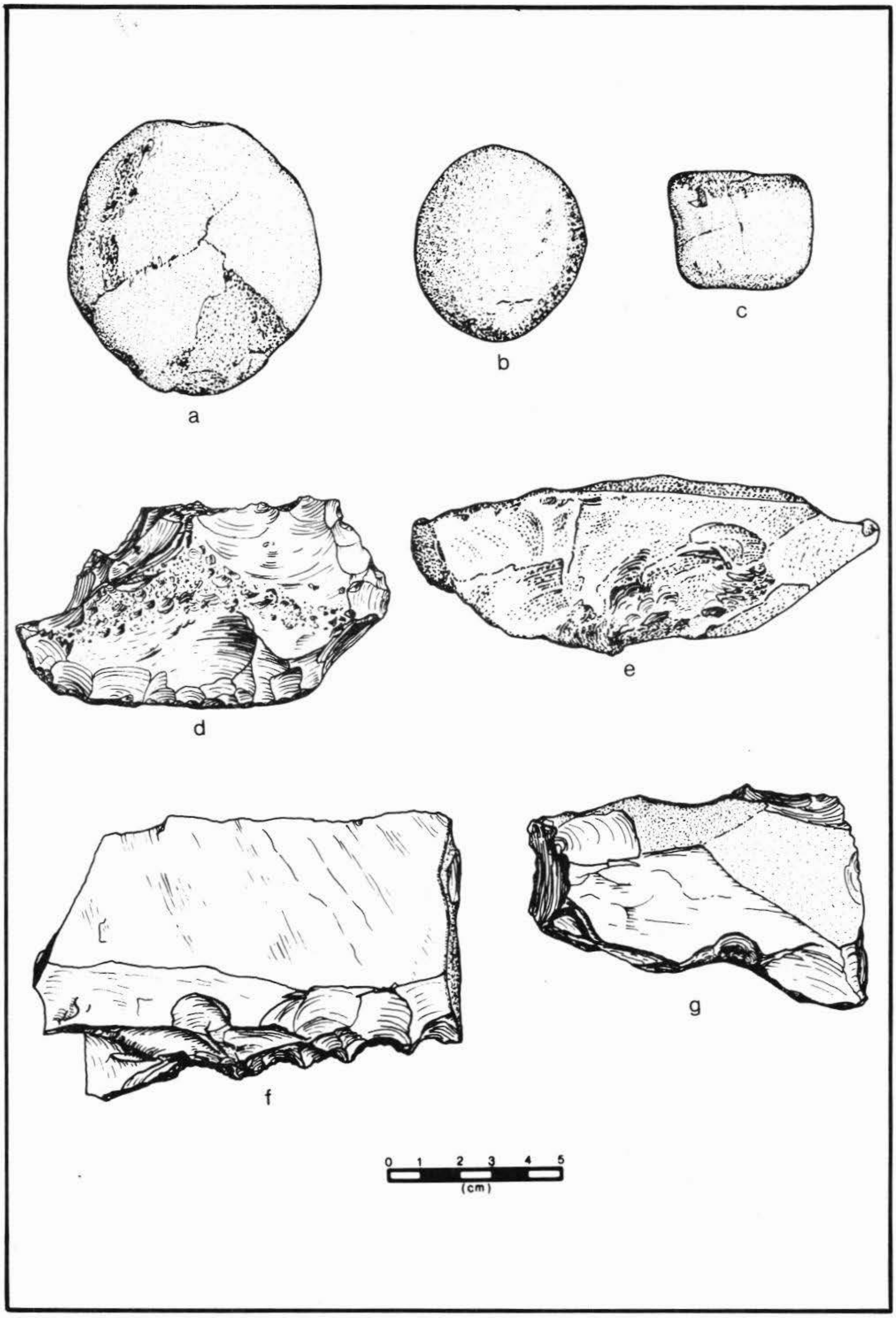

Figure 23: Hammers. Top row: C9 L-?, Z15 L-3A/B, Z15 L-3A/B. Middle row: C2 L-3, B2 L-3. Bottom row: C3 L-3B, B2 top L-3.

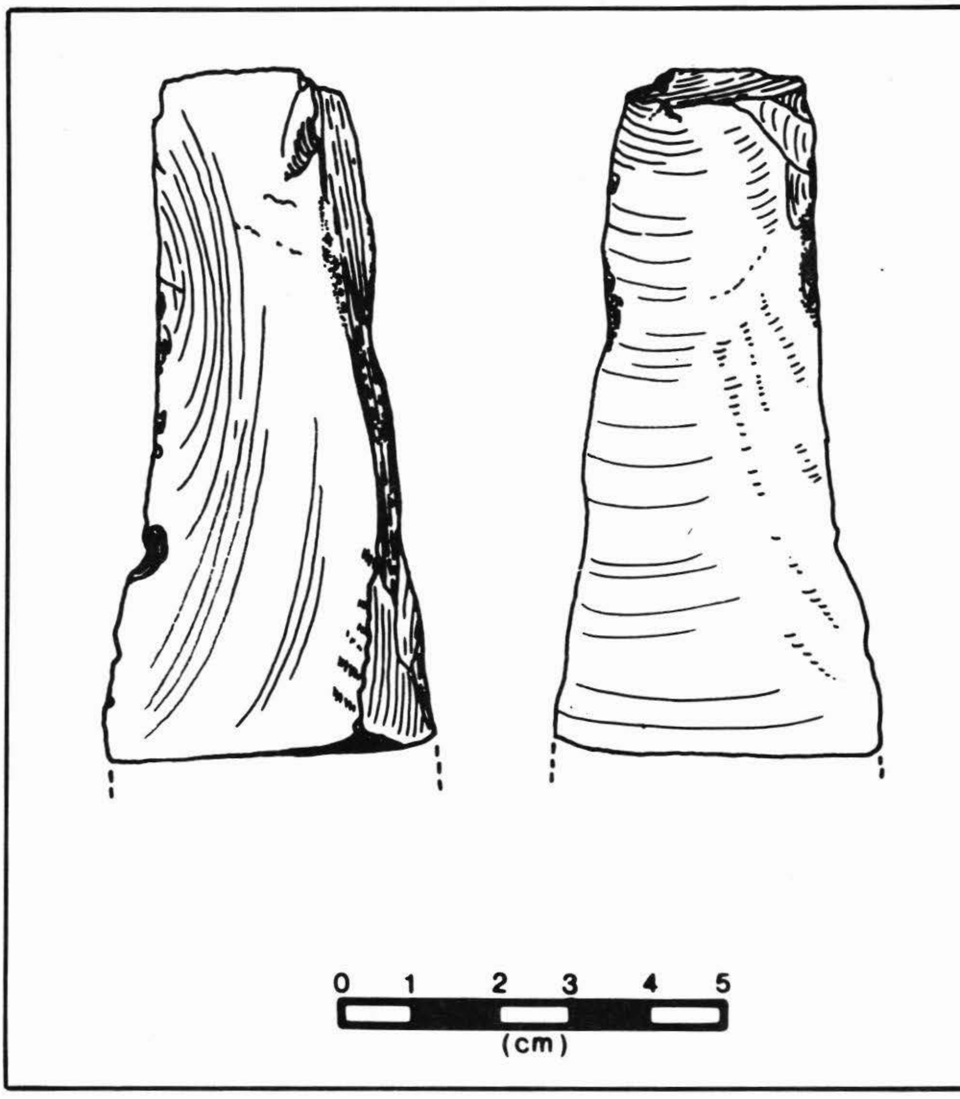

Figure 24: Broken blade butt with traces of hafting (C10).

A more unusual artefact was a broken triangular blade (Fig. 24) which shows some signs of hafting–fine flaking of the ridges in the haft area and traces of haft polish. A possible anvil was recovered from Area A. The hollow formed by a negative flake scar on this large flake shows coarse pitting and bruising, quite unlike hammer-dressing. A weathered argillite slab with roughened edges may have served as a grindstone.

An important find from Area B was an unfinished argillite 'ulu' (Skinner 1974b). This had been made on a flake by grinding the long edge opposite the platform, together with one side (Fig. 25). Slight polish is evident on adjacent ridges. The unground side is thick and irregular and was probably the reason why the artisan did not complete the grinding. Instead most of the long ground edge was subject to rough chipping and/or use wear before the tool was finally discarded.

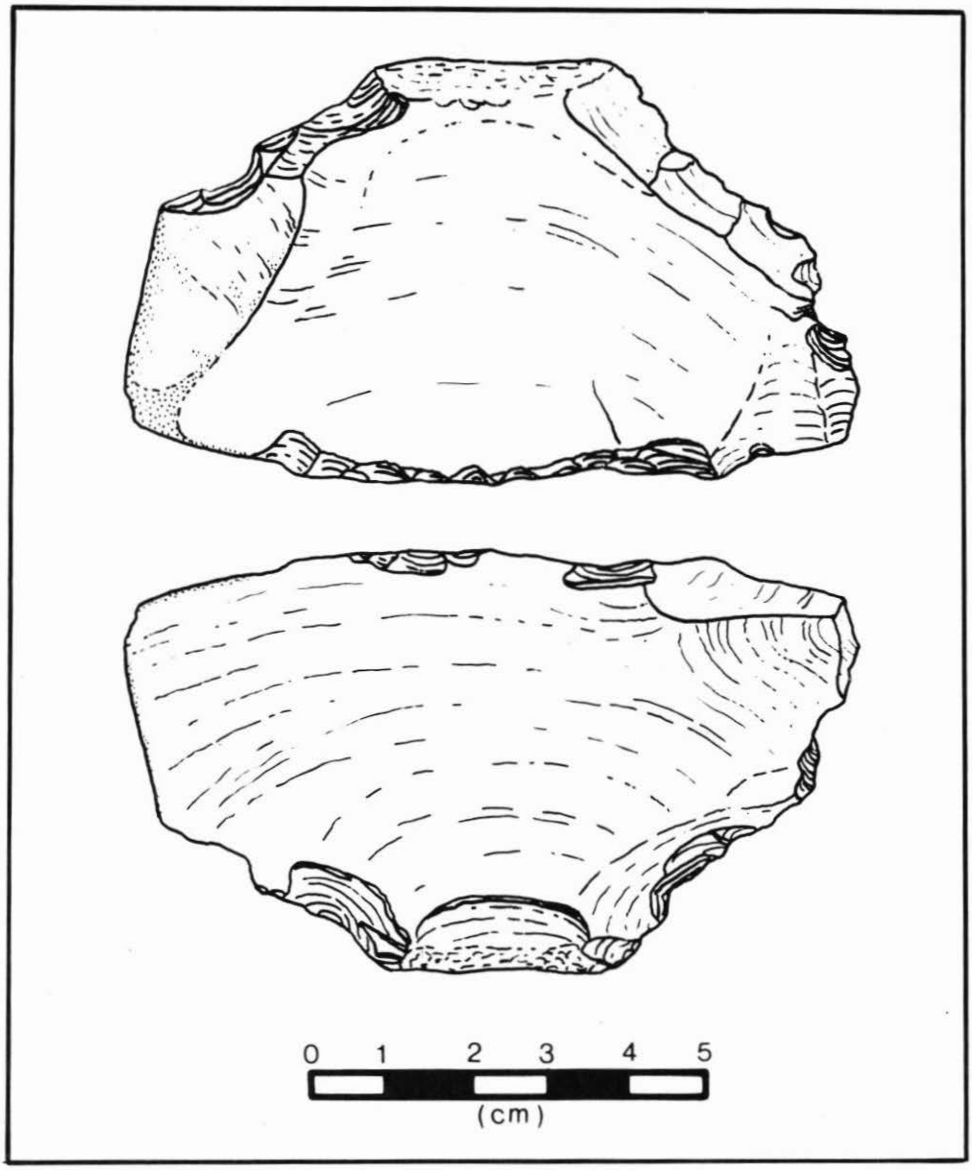

Figure 25: ?Ulu, unfinished and later reworked (Z15).

Only one bone artefact was recovered. This was a spatulate tool, made from a whale jaw bone and usually described as a paua priser (Fig. 26). It was found when test-pits were dug following the setting out of the grid of C squares. Its exact provenance along this line is not known. Stratigraphically, it lay at the interface of the "second turf zone and cultural layer".

CONCLUSIONS

The Riverton site has proved unusual in several respects. Its lithic assemblage is almost wholly derived from the argillite outcrops around the site and granite water-worn

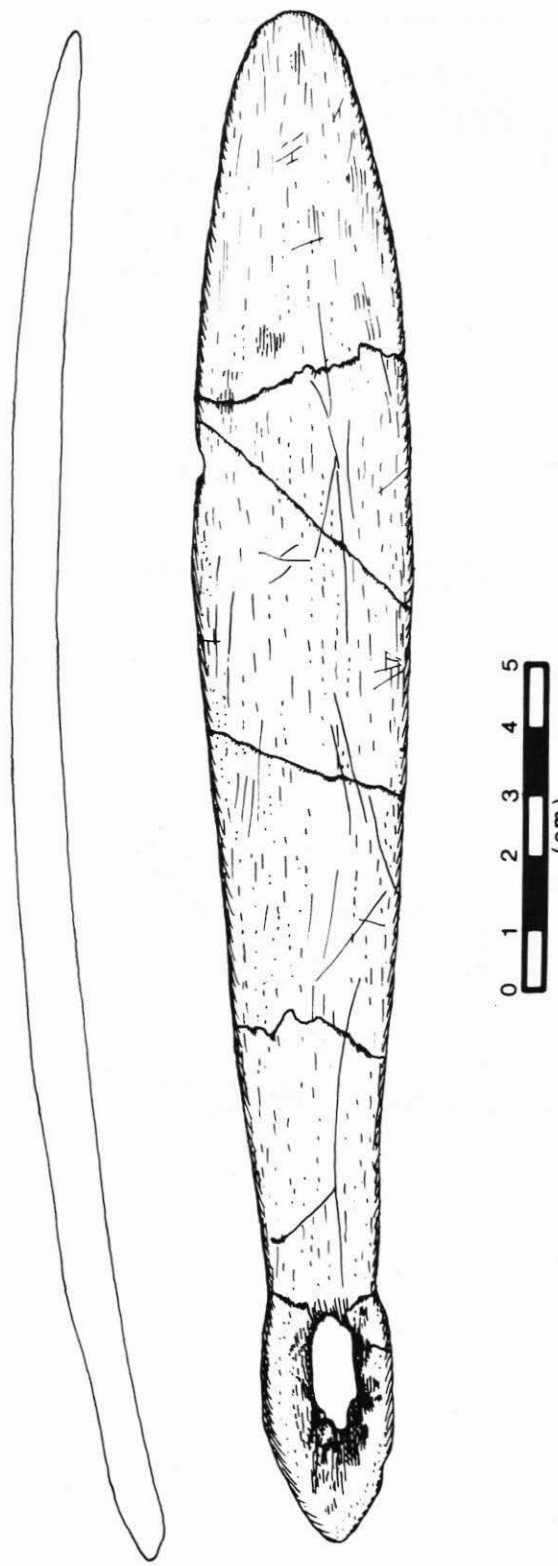

Figure 26: Paua priser from C line square. B70.204, Southland Museum.

stones available directly in front of it. Not a single flake of silcrete or porcellanite was recovered. These are usually very common in Murihiku sites. Only one bone artefact, the paua priser, was found. Some fish-hook fragments or broken bird spears might have been expected on the basis of the midden contents but they were not encountered in the 640 square feet ($60m^2$) opened up. The lack of files, awls, grindstones, and worn flake scrapers suggests that bone and wood-working were uncommon activities at this site. This is further indicated by the absence of chips from polished adzes.

Some anomalies are apparent in the food refuse. The absence of trolled fish species, especially barracouta, has already been noted, along with the absence of dog. Dogs and barracouta have been recovered from every coastal site of comparable size excavated in Murihiku. They were present at the Wakapatu site in adjacent Kawakaputa Bay (Higham 1968) which was the destination of many of the adzes made at Riverton. Moa bones were found in association with ovens dated to A.D. 1270 ± 40 at Tihaka at the head of Colac Bay (B. F. Leach and Higham 1971), but were not recovered at the Riverton site which was occupied at the same period.

It must be concluded that very little artefactual material was brought to this site from elsewhere and that the food-gathering activities of its occupants were restricted to the surrounding coastal zone and adjacent forest. The site belongs in fact to a category rarely excavated by New Zealand archaeologists, that of the specialist camp primarily used as a base for extracting and preparing a raw material for export to multi-activity habitation sites. It may not have been occupied for more than a few days at a time, and it is possible that the occupants were adult and adolescent males, who arrived by canoe unaccompanied by women and small children. It might be expected that the adzes were transported by canoe because of their weight. Because of the exposed nature of the site, the visits probably took place during periods of fine settled weather, in summer and autumn.

The occupants' prime objective was the manufacture of a wide range of Archaic adzes from the local argillite. They displayed considerable skill in this activity as well as parsimonious and opportunistic attitudes to their raw material. A range of flaking techniques were employed and it is obvious, from the recurring patterns of flake scars and the characteristic shapes of most secondary trimming flakes, that adze-making procedures were to some extent 'formalized', set by custom, and thus transmitted between generations. Our understanding of these procedures is at present limited to the quarrying, decortication, and final trimming stages. Much more needs to be known about core preparation prior to the manufacture of flake adzes, about the order of flaking of the faces and sides of large preforms, and the types of hammers employed at each stage.

Both replication experiments and 'jig-saw' reconstructions will be needed to fill these gaps. For the reconstructions to be successful, total removal of material from contiguous, undisturbed squares is essential. The common practice of collecting preforms from surface exposures without plotting their precise position greatly jeopardizes this type of analysis for future archaeologists. Although the Riverton assemblage was obtained under difficult excavation conditions and inappropriate recording methods, the type of analysis devised (and revised) over a period of 15 years since the excavation, has provided new details of adze-manufacturing techniques, and set the scene for comparative studies elsewhere in Polynesia.

ACKNOWLEDGEMENTS

The authors wish to thank Les Groube for making all the site records available for study and for his permission to analyse the material. For assistance with identifications grateful thanks are due to Ron Scarlett, Frank Climo and Ian Smith. To former students and friends of the Anthropology Department at Otago who assisted with the sorting, analysis, and re-analysis we wish to express our gratitude, especially Jean Kennedy, Susan Manton, and Doug Sutton.

REFERENCES

Best, S. B. 1977. The Maori adze: an explanation for change. *Journal of the Polynesian Society* 86(3):307–37.

Crabtree, D. E. 1968. Mesoamerican polyhedral cores and prismatic blades. *American Antiquity* 33(4):446–78.

Duff, R. S. 1946. Native quarries of baked argillite. *Records of the Canterbury Museum* 5:115–24.

Higham, C. F. W. 1968. Prehistoric research in Western Southland. *New Zealand Archaeological Association Newsletter* 11(4):155–164.

Huffadine, M. S. 1978. To leave no stone unturned: an examination of a lithic assemblage from Tiwai Point, Southland. Unpublished research essay, Anthropology Department, University of Otago.

Keyes, I. W. 1975. The D'Urville Island–Nelson metasomatised rocks and their significance in New Zealand prehistory. *Whakatane and District Historical Society Historical Review* 23(1):1–17.

Leach, B. F. 1969. The concept of similarity in prehistoric studies: a test case using New Zealand stone flake assemblages. *Studies in Prehistoric Anthropology* Vol.1, Anthropology Department, University of Otago.

Leach, B. F. 1972. Multi-sampling and absolute dating methods: a problem of statistical combination for archaeologists. *New Zealand Archaeological Association Newsletter* 15(3):113–116.

Leach, B. F. and Higham, C. F. W. 1971. Radiocarbon dates for Southland. *New Zealand Archaeological Association Newsletter* 14(4):202–3.

Leach, H. M. 1979. An analysis of an open-air workshop in Palliser Bay. *New Zealand Journal of Archaeology* 1:139–151.

Leach, H. M. n.d. Technological changes in the development of Polynesian adzes. Paper presented to XIV Pacific Science Congress, Khabarovsk, Russia, 1979.

McCoy, P. C. 1977. The Mauna Kea adze quarry project: a summary of the 1975 field investigations. *Journal of the Polynesian Society* 86(2):223–244.

Moore, P. R. 1976. The Tahanga basalt: an important stone resource in North Island prehistory. *Records of the Auckland Institute and Museum.* 13:77–93.

Newcomer, M. H. 1971. Some quantitative experiments in handaxe manufacture. *World Archaeology* 3(1):85–94.

Shaw, E. 1963. Maori quarry, Tahanga Hill, Opito. *New Zealand Archaeological Association Newsletter* 6:34–6.

Skinner, H. D. 1913. An ancient Maori stone-quarry. *Transactions of the New Zealand Institute* 46:324–9.

Skinner, H. D. 1974a. Murihiku hammers. *In* Gathercole, P., Leach B. F. and Leach, H. M. (Eds), *Comparatively Speaking: studies in Pacific material culture 1921–1972*: 123–131. University of Otago Press, Dunedin.

Skinner, H. D. 1974b. Ulu in the Pacific (with D.R. Simmons). *In* Gathercole, P., Leach, B. F. and Leach, H. M. (Eds), *Comparatively Speaking: studies in Pacific material culture 1921–1972*: 115–122. University of Otago Press, Dunedin.

Walls, J. Y. 1974. Argillite quarries of the Nelson Mineral Belt. *New Zealand Archaeological Association Newsletter* 17(1):37–43.

Received 5 October 1979